

Storing Water Correctly

The Water & Food chapter covers how much water to store and roughly what to store it in. This guide covers what's easy to get wrong: what the standard 1 gallon/person/day figure actually assumes and doesn't, how to prepare a container before you fill it, whether the water needs treating first, and how to keep a stored supply safe to drink months or years later. For treating water that's already questionable, see Water Purification; this guide is about water you're storing while it's still known-good.

How much should you actually store

The manual's own 1 gallon/person/day figure comes from FEMA and CDC guidance, and it's built the way most people have heard it described: roughly half a gallon for drinking, and the rest for food preparation and minimal hygiene. That's a real, defensible number, but it's a **survival floor**, not a comfort target, and it's worth knowing exactly what it does and doesn't cover before you treat it as the whole plan.

What it assumes: rationed drinking, no laundry, and no toilet flushing at all, which is exactly why this site's own sanitation approach uses a no-flush bucket system instead of trying to keep a flush toilet running. A single flush of an older toilet is 3.5–7 gallons; even a modern EPA WaterSense low-flow toilet is 1.28–1.6 gallons. Flushing more than once or twice would consume the entire household's daily ration by itself.

The fuller number: WHO / Sphere humanitarian standards

Humanitarian relief agencies plan water supply using the Sphere Handbook, the standard reference for disaster response and refugee camps, which breaks the same problem into three categories:

Use	Amount per person, per day
Drinking (survival minimum)	2.5–3 liters (~0.7–0.8 gal)
Basic hygiene	2–6 liters (~0.5–1.6 gal)
Basic cooking	3–6 liters (~0.8–1.6 gal)
Total	7.5–15 liters (~2–4 gal)

Sphere is explicit that 7.5 liters is only the acute-emergency floor, the number used in the first days of a crisis response, and that 15 liters (about 4 gallons) is the real target once things stabilize even slightly, and

even that "is never a maximum." That's up to **four times** FEMA's 1-gallon figure.

What this means for a 14-day supply

The manual's Tier 1 target of 14 gallons/person over 14 days is internally consistent with the FEMA floor, and it works specifically because the household's sanitation plan avoids flush water and doesn't assume laundry. At the WHO/Sphere comfort target, the same 14 days works out to roughly **56 gallons/person**, not 14. Neither number is "wrong"; they're answering different questions; treat 14 gallons as the minimum floor and build toward the higher figure with any storage capacity you have beyond it.

What neither number includes

- **Laundry.** The single biggest line item people forget. Hand-washing one load costs roughly **2 gallons for the wash alone**, and **15–20+ gallons once you add rinse water** using the three-basin method in the hygiene guide above. One load of laundry can cost more water than one person's entire daily ration.
- **Dishwashing.** Smaller per instance, but it happens multiple times a day and adds up over weeks.
- **Illness.** Fever, vomiting, and diarrhea all increase water needs, and anyone you're isolating needs a higher personal ration than the household average, not the same one.
- **Hot weather.** CDC guidance states plainly that water needs can double in high heat.
- **Pregnancy and breastfeeding.** Baseline drinking-water needs run roughly 2.4 liters/day (~0.6 gal) pregnant and 3.1 liters/day (~0.8 gal) breastfeeding, independent of and on top of the hygiene/cooking share above.
- **Physical exertion.** Hauling water, clearing debris, or walking out on foot meaningfully raises the drinking-water floor above what a sedentary household member needs.
- **Children.** CDC specifically flags children as needing more water relative to the standard figure, not less, contrary to the instinct to scale down for smaller people.
- **Wound irrigation.** Proper wound care calls for irrigating thoroughly with clean water; real, if occasional, consumption.
- **Pets.** Already factored into this site's shopping list: roughly 0.5–1 gallon/day combined for a dog and two cats, on top of the household's own figure.

None of this means the manual's 14-gallon Tier 1 target is wrong, it's the floor, and it's a reasonable one for the first two weeks of nearly any disruption. But if your household includes anyone pregnant, nursing, sick, doing hard physical work, or if you're planning past the first couple of weeks, plan your Tier 2 bulk storage toward the WHO figure rather than just multiplying the Tier 1 number by more days, and treat laundry as its own explicit planning line rather than something the daily ration is supposed to quietly absorb.

Calculate your own numbers

Enter your household and however much water you actually have stored, or are considering storing, and see how many days it covers at both the FEMA survival floor and the fuller WHO/Sphere comfort level above.

People in the household	Dogs
e.g. 4	0
Cats	Gallons of water stored
0	e.g. 56
Count every food-grade container you'd actually use, barrels, jugs, sealed commercial bottles, not water you're relying on a tap or well to keep providing.	
Calculate	

Why pets get one flat number instead of a range

A dog's or cat's water need doesn't have a "survival minimum" separate from a comfortable one the way a person's does, it's just what keeps them healthy, so this calculator adds one estimate per animal rather than scaling it with the rest of the range: about 0.3 gal/day for an average ~40 lb dog and 0.1 gal/day for an average ~12 lb cat, based on the standard veterinary guideline of roughly 1 ounce of water per pound of body weight per day for dogs and slightly less for cats. A much larger or smaller pet, hot weather, or an all-wet-food diet will shift this in either direction, treat it as a planning estimate, not a precise figure.

Choosing a container

Use **food-grade containers only**. These carry a recycling number 1 (PETE), 2 (HDPE), or 4 (LDPE), or are explicitly labeled food-grade, and won't leach chemicals into water over long storage. 55-gallon food-grade barrels work well for whole-household bulk storage; stackable 5–7 gallon jugs are easier to move and better for a portable, grab-and-go subset.

Never reuse a container that held a toxic chemical

A container that previously held bleach, pesticides, motor oil, or any other chemical is never safe to reuse for water storage, even after washing. Residue and absorbed chemicals in the plastic itself can leach into the water. This includes most household chemical jugs, don't repurpose them no matter how thoroughly they're rinsed.

Cleaning and sanitizing a new container before its first fill

A brand-new food-grade container still needs this step; dust, manufacturing residue, and open-air storage before purchase are all reasons to sanitize before the first fill, not just reused containers.

- 1. Wash the container with dish soap and rinse it completely with clean water.
- 2. Make a sanitizing solution: **1 teaspoon of unscented household bleach** (5–9% sodium hypochlorite, no added scent or dye) per **1 quart (4 cups) of water**.
- 3. Pour the solution into the container, cap it tightly, and shake well so it touches every interior surface.
- 4. Let it stand for at least **30 seconds**, then pour the sanitizing solution out.
- 5. Let the container air-dry completely before filling it with water for storage.

Does the water need to be treated before storing it?

Water source	Treat before storing?
Municipal tap water (already treated by your water utility)	No, store as-is
Private well water, tested and known safe	No, store as-is
Any untested, questionable, or outdoor source	Yes, treat first using the same bleach dosing in the Water Purification guide before storing it
Commercially bottled water	No, use the manufacturer's own sealed container and printed date; don't decant it into another container

Filling and protecting the container

- **Leave headspace.** Water expands roughly 9% when it freezes. Leave about 10% empty space at the top of a rigid container, or store it somewhere that stays above freezing, to keep it from cracking.
- **Store out of direct sunlight,** in as cool a location as practical. Heat and light both accelerate plastic degradation and make algae growth in the container more likely if any light reaches the water.
- **Label every container with the fill date,** the same FIFO habit the rest of this site uses for food storage. A container without a date is a container you can't trust without re-testing it.
- **Store away from gasoline, pesticides, solvents, and other chemicals.** Some plastics can absorb vapors from nearby chemical storage over time, even through a sealed cap.

Rotation: how long stored water actually stays good

Properly sanitized and sealed water has a very long practical shelf life, but taste and confidence both degrade over time. **Replace stored tap water every 6 months** for best taste and peace of mind; some guidance extends that to 12 months for water that's been correctly sanitized and sealed. Tie the swap to a date you'll actually remember, the same daylight-saving-time habit the rest of the site uses for food rotation, so it doesn't quietly slip past a year unnoticed.

When you rotate, dump the old water (it's still fine to use for non-drinking purposes like plants or cleaning) and repeat the full clean-and-sanitize process before refilling, don't just top off an old container.

TIP

Fix flat-tasting stored water by pouring it back and forth

Water that's sat sealed for months loses dissolved oxygen and can taste flat even though it's perfectly safe. Pour it back and forth between two clean containers a few times right before drinking, or shake a partly-full bottle, to reintroduce air and restore a normal taste. It's a taste fix, not a safety step; it doesn't replace treating water you actually suspect is contaminated.

Dispensing without contaminating the supply

Draw water off with a barrel spigot or a siphon pump rather than dipping a cup directly into bulk storage. Every hand or cup that touches the stored water introduces new contamination risk to the entire container, not just the portion removed.

Northern Utah note: unheated storage

Garages and sheds along the Wasatch Front regularly drop below freezing in winter. If your bulk storage lives in an unheated space, either move it somewhere conditioned for the winter months or make sure every rigid container has the full 10% headspace described above; a cracked barrel loses its entire contents at once, right when you're least likely to have a backup.

Sources

- CDC, "How to Create and Store an Emergency Water Supply" (container type, cleaning and sanitizing steps, bleach dosing, rotation interval): CDC
- Utah State University Extension, "Storing Water for an Emergency": USU Extension
- University of Florida IFAS Extension, preparing and storing an emergency safe drinking water supply: UF/IFAS
- FEMA / Ready.gov, the 1 gallon/person/day drinking-and-hygiene guidance: Ready.gov
- Sphere Association, minimum water quantity standards in humanitarian response (drinking, hygiene, cooking breakdown): Sphere; WHO, "How Much Water is Needed in Emergencies": WHO
- CDC, increased water needs for illness and hot weather: Ready.gov
- Institute of Medicine drinking-water guidance for pregnancy and breastfeeding: WebMD
- EPA WaterSense, toilet water use by age/generation (older vs. low-flow fixtures): EPA
- Flat taste from lost dissolved oxygen in long-stored water, and pouring/aerating to restore it: Oxygen SuperCharger; Backdoor Survival

Auditing Your Food Supply

The Ready, Set, Ready assessment asks a simple-sounding question: do you know, as an actual count and not a guess, how many days of food you currently have? Most people don't, and there's no shame in that, almost nobody has ever actually counted. This guide is the counting method itself: no kitchen scale required, no nutrition background assumed, just a worksheet, a worked example to copy, and a calculator. It's the reverse of Calorie Planning for Your Food Supply, that guide tells you how much to buy to hit a target from zero; this one tells you how far what's already in the house actually gets you.

You don't need to be exact, you need to be honest

Two things make this feel harder than it is. First, most food packaging doesn't advertise itself in a form that's easy to add up, a box of pasta says nothing about "days," it says "16 oz." Second, nobody's pantry is a clean, full set of sealed packages, it's half a bag of rice, three cans of something, a jar that's mostly empty. Both problems have the same fix: round down when unsure, and use the label that's already on the package instead of trying to estimate from scratch.

- **Most bags and boxes already tell you the weight.** Look on the front or side panel for a number in pounds (lb) or ounces (oz). 16 oz is 1 lb. If a bag of rice says "20 lb" and looks about half full, count it as 10 lb, not 20.
- **Cans and jars are counted, not weighed.** You don't need a scale for these, just count how many you have. The worksheet below tells you exactly what to count.
- **When in doubt, guess low.** A pantry that turns out to cover a little more than you counted is a pleasant surprise. A pantry you overcounted is a real gap you didn't know you had. This whole exercise is about removing a blind spot, not passing a test, so err toward the number that keeps you honest about what's actually missing.
- **"Kcal" is just "Calories."** The Calories number on a nutrition label and "kcal" are the same unit, food-energy content. This guide uses kcal because that's what the USDA's own reference data uses, but every number below means exactly what the Nutrition Facts panel on a can already means.

Two ways to count, pick based on how much time you have

Neither method below is the "wrong" one. Use whichever actually gets done.

The fast version: count meals, not calories

Walk your kitchen and count how many complete meals you could actually put together right now, a protein plus a starch plus something to go with it. Ten cans of vegetables alone isn't ten meals, it's a side dish with nothing to pair it with; be honest about what's actually assemble-able. Divide the total meal count by 3 meals per person per day to get a rough day estimate. This takes about five minutes and misses some nuance (it won't catch a pantry that's calorie-heavy but nutritionally thin, or the reverse), but a rough number today is worth more than a perfect one you never get around to.

The worksheet and calculator below are the precise version: an actual calorie count, using the same per-pound and per-item figures already published in *Calorie Planning for Your Food Supply*, so nothing here contradicts that guide. It takes closer to fifteen or twenty minutes the first time, and gives a real number instead of an estimate.

The worksheet: what to actually count, and how

Walk the pantry, freezer, and any other food storage area once, and write down what you find for each row below. Use the unit shown, pounds for bagged staples, a simple count for cans and packaged meals, and check the specific product's label if you want more precision than the average figure gives you.

Category	What to count	Unit to use	Assumed calories
Dry staples (rice, oats, pasta)	Total weight, check the bag's label; estimate a partially-used bag by how full it looks	Pounds	~1,700 kcal/lb
Dried beans (not canned)	Total weight, check the bag's label	Pounds	~1,575 kcal/lb
Cooking oil	Total weight; a standard 48 oz bottle is about 3 lb	Pounds	~4,000 kcal/lb
Peanut or nut butter	Total weight; a standard 16 oz jar is about 1 lb	Pounds	~2,650 kcal/lb
Nonfat dry milk (powder)	Total weight, check the container's label	Pounds	~1,600 kcal/lb
Granulated sugar	Total weight, check the bag's label	Pounds	~1,800 kcal/lb
Canned goods (any kind)	Number of standard 14-16 oz cans	Count	~350 kcal/can (average; a meat-based can often runs higher, check the label for a precise number)
MREs	Number of complete MRE meals	Count	~1,250 kcal/MRE
Freeze-dried entrees (#10 can)	Number of #10 cans	Count	~5,000 kcal/can (varies by product; check the label for a precise number)

What if something isn't on this list

Fresh produce, refrigerated food, and freezer food all count toward what you have today, but they don't count toward a multi-day emergency total the same way shelf-stable food does, they depend on power staying on or being eaten within days. Leave them off this worksheet entirely; see Food Safety After a Power Outage for how long refrigerated and frozen food actually stays safe once the power goes out. If you have a shelf-stable item that isn't listed above (crackers, granola bars, dried fruit), a close-enough substitute is fine: dried fruit and granola bars behave like a smaller version of the dry-staples row, crackers behave like a low-density version of the same row. Getting within a reasonable range matters more here than perfect categorization.

A worked example, copy this process with your own numbers

Here's what the whole method looks like for one real household: 2 adults, 1 child, moderately active (some hauling water and physical cleanup, not sedentary). Their pantry, after an honest walk-through:

What they found	Counted as	Calories
A 20 lb bag of rice, about half used	10 lb dry staples	$10 \times 1,700 = 17,000$ kcal
A 4 lb bag of dried pinto beans, unopened	4 lb dried beans	$4 \times 1,575 = 6,300$ kcal
One 48 oz bottle of vegetable oil, about a third used	1 lb cooking oil	$1 \times 4,000 = 4,000$ kcal
One 16 oz jar of peanut butter, unopened	1 lb peanut butter	$1 \times 2,650 = 2,650$ kcal
9 cans of mixed vegetables, soup, and beans	9 cans	$9 \times 350 = 3,150$ kcal
No MREs or freeze-dried food	0	0 kcal

Total calories on hand: $17,000 + 6,300 + 4,000 + 2,650 + 3,150 = 33,100$ kcal.

Their daily need, 2 adults at 2,200 kcal each (moderately active) plus 1 child at 80% of that (1,760 kcal):
 $2,200 + 2,200 + 1,760 = 6,160$ kcal/day.

Days covered: $33,100 \div 6,160 \approx 5.4$ days. Against a 14-day target, that's a real, specific gap of about 8.6 days, not a vague sense that "we should probably get more food." That's the number this whole exercise exists to produce, and it's exactly the kind of gap the calculator below will also show for a target day count.

The calculator

Enter your household once, then your own worksheet numbers from above. It shows how many days your current supply actually covers, and if you enter a target, what's left to close the gap.

Step 1: Your household

Adults

0

Children (roughly ages 4–13)

0

Household activity level

Some physical work (moderately active) ▼

Target days (optional)

e.g. 14

Step 2: What you counted on the worksheet

Dry staples (lb)

0

Dried beans (lb)

0

Cooking oil (lb)

0

Peanut butter (lb)

0

Dry milk powder (lb)

0

Sugar (lb)

0

Canned goods (count)

0

MREs (count)

0

Freeze-dried #10 cans (count)

0

Calculate

Closing the gap

Once you have a real number, two guides pick up from here. Calorie Planning for Your Food Supply covers what to actually buy to close the gap well, not just cheaply: macro balance, the vitamin C and B12 gap in an all-shelf-stable diet, and why the same three meals on repeat undermines a plan that looks fine on paper. The Shopping List and Readiness Ledger are where the actual purchasing happens once you know what to buy.

Redo this periodically, not just once

A pantry changes: food gets eaten, rotated, or quietly expires. Treat this audit as something to redo every few months, not a one-time task to check off, the same way Storing Water Correctly recommends rotating stored water on a schedule rather than assuming a fill date holds forever.

Sources

- USDA FoodData Central, calorie density per 100g for dry rice, rolled oats, dry pinto beans, peanut butter, soybean/vegetable oil, and nonfat dry milk, converted to calories per pound, the same figures used in Calorie Planning for Your Food Supply: USDA FoodData Central
- U.S. Dietary Guidelines for Americans 2020–2025, Appendix 2, "Estimated Calorie Needs per Day, by Age, Sex, and Physical Activity Level": reproduced table (APA)
- MRE Info, MRE per-meal calorie design targets: MRE Info

- Augason Farms Freeze Dried Chicken Fettuccine Alfredo Kit, #10 can total calories (5,040 kcal), used as a representative freeze-dried entree figure, same source as Calorie Planning for Your Food Supply: Walmart

Calorie Planning for Your Food Supply

The Water & Food chapter and this site's shopping list both call for a 14-day, non-perishable food supply per person, no-cook options included. Neither says how to actually hit a calorie target with real food, and that's the part that's easy to get wrong: canned goods feel like "real" food storage but are mostly water by weight, while the cheap, calorie-dense staples that actually cover a 14-day gap, rice, oats, dried beans, oil, are the ones people under-buy. This guide covers calorie density, how much you actually need, macro balance, the micronutrient gap a shelf-stable diet creates, and why eating the same food for two weeks straight undermines the whole plan even when the math checks out on paper. Already have some food stored and want to know how far it actually goes before buying more? See [Auditing Your Food Supply](#) for the reverse calculation, a worksheet and calculator that turn what's already in the pantry into a real day count.

How many calories does your household actually need

The "2,000 calories a day" figure most people know comes from the FDA's Nutrition Facts label, where it's used as a fixed reference point for calculating %Daily Value on packaging, a general nutrition-education baseline, not a personalized target for any specific person. The USDA's Dietary Guidelines for Americans use a wider, more honest range: adult women typically need roughly **1,600–2,400 calories/day** and adult men roughly **2,200–3,000 calories/day**, with the spread inside each range driven by age, body size, and activity level, not a single "right" number.

Activity level	USDA definition	What it looks like in an emergency
Sedentary	Only the light activity of typical day-to-day living	Sheltering in place with power and mobility intact
Moderately active	Walking roughly 1.5–3 miles/day at 3–4 mph, beyond normal daily activity	Hauling water, carrying supplies, light cleanup
Active	Walking more than 3 miles/day at 3–4 mph, beyond normal daily activity	Debris clearing, extended physical labor, walking out on foot

That's not a minor adjustment. The gap between the sedentary and active end of the range is roughly **600–800 calories/day per adult**, and real emergency conditions push people toward the active end more often than the sedentary one: hauling water, clearing debris, or walking somewhere because a vehicle isn't an

option. Plan a working household's food supply closer to the moderately active or active end of its members' ranges, not the sedentary one, especially past the first day or two.

Calorie density: what actually fills the gap

Pound for pound, dry staples beat canned goods by a wide margin, because canned food's weight is mostly the water and brine it's packed in. This is the single most common mismatch between what a "food storage" shopping cart looks like and what it actually delivers.

Food	Calories per pound	Note
Cooking oil	~4,000 kcal/lb	The single densest calorie source that stores well; pure fat
Peanut butter	~2,650 kcal/lb	Fat and protein together; also a no-cook item
Freeze-dried entrees (#10 can)	~1,900–2,000 kcal/lb	Genuinely dense like dry staples, since freeze-drying removes the water canned food carries; varies by product, a pasta- or rice-based entree runs denser than a meat-heavy one, so check the label; needs hot water to rehydrate, and costs about as much per calorie as an MRE, not as little as rice
Granulated sugar	~1,800 kcal/lb	Nearly as dense as rice or oats; already part of this site's Tier 2 bulk food line alongside salt, which carries no calories but still belongs in the pantry for preservation and flavor
Rolled oats, white rice (dry)	~1,650–1,700 kcal/lb	Cheapest calories per dollar in most markets
Nonfat dry milk (powder)	~1,600 kcal/lb	Also the household's main shelf-stable calcium and B12 source
Dried beans (pinto, black, etc.)	~1,575 kcal/lb	Protein-dense; needs the longest cook time of this group
Canned beans, with liquid	~350–400 kcal/lb	A pull-tab, no-cook version of the line above, at roughly a quarter the density
MRE (Meal, Ready-to-Eat)	~370 kcal/lb	A full meal at roughly 1,200–1,300 kcal per 3.4 lb ration; density-wise, it's a canned good, not a dry staple
Canned soup or stew, chunky/meat-based	~300–500 kcal/lb	Varies a lot by product; check the label
Canned vegetables (green beans, etc.)	~100–200 kcal/lb	Valuable for vitamins and minerals, not for hitting a calorie target

What this means for the shopping list's 'non-perishable food' line

A 14-day supply built mostly from canned vegetables and soup can look full in a pantry and still fall far short of the household's actual calorie need, since so much of that weight is water. Build the bulk of the calorie target from the top of the table, dry staples, peanut butter, cooking oil, and use canned goods for variety, vitamins, and the no-cook days, not as the main calorie source. See Sealing Bulk Food for Long-Term Storage for how to actually store dry staples for years rather than months.

Where MREs actually fit

MREs have a reputation as dense survival food, but by weight they land in the same tier as canned beans, not anywhere near dry staples, and a case runs roughly **8–18x** the cost per calorie of rice or beans. Their real value isn't calorie density, it's that they need no water, no cooking, and no power, with a 3–7 year shelf life and some including a self-heater. That makes them a genuinely good fit for a go-bag or the no-cook days in a home supply, not the bulk of a 14-day calorie target.

Where freeze-dried meals fit

Freeze-drying removes the water canned food carries, so a #10 can of a freeze-dried entree lands close to dry staples for density, genuinely dense, unlike an MRE. What it doesn't remove is the price: at roughly **\$6–7 per 1,000 kcal** for a typical entree can, it costs about as much per calorie as an MRE, sometimes more, since you're paying for the drying process and packaging, not just the food. The real advantages are shelf life, often 25–30 years, and needing only hot water rather than a full stove-and-pot cook. Budget the water and fuel to rehydrate it the same way you would for rice or beans; it's a dense, long-lived food, not a no-cook one.

Calculate a rough target

Enter your household and a realistic activity assumption for the days you're planning around, sheltering in place looks different from a household doing real physical labor, to get a total calorie target for the period and a rough sense of how many pounds of dry staples alone that would take.

Adults

Children (roughly ages 4–13)

Household activity level

Days

Calculate

Children's calories scale with the same activity tier at roughly 80% of the adult figure, a rough midpoint of the USDA's much wider 1,000–3,200 cal/day child and adolescent range, not a substitute for an age-specific number if you want to plan more precisely.

Macro balance: protein and fat aren't optional

Hitting a calorie number with carbohydrate alone, rice and oats and nothing else, technically closes the energy gap but leaves out what actually makes a diet livable for two weeks: protein and fat drive satiety (feeling full) and support basic physical function in a way carbohydrate alone doesn't. The National Academies' Dietary Reference Intakes set a broad, healthy range for adults: **45–65% of calories from carbohydrate, 10–35% from protein, and 20–35% from fat.**

For a food-storage plan specifically, aim for the higher end of the protein and fat ranges rather than the minimum, since a shelf-stable pantry skews toward cheap carbohydrate (rice, oats, pasta) by default unless beans, peanut butter, dry milk, and oil are deliberately built in. A reasonable working split for a 2,000-calorie day: roughly **50% carbohydrate (250g), 20% protein (100g), 30% fat (67g)**, comfortably inside the DRI range while leaning on the foods that keep people actually eating the plan.

Where MREs land on this split

A standard MRE runs roughly **51% carbohydrate, 36% fat, and 13% protein**, per its own military design spec, built for the extreme physical exertion of active-duty use, not the more moderate activity levels this guide is scoped to. That 13% protein clears the DRI floor of 10% but falls well short of the 20% working target above, and 36% fat runs slightly past the DRI's own 35% ceiling. A household leaning on MREs for calories is quietly running lower-protein and higher-fat than the rest of this section recommends; balance it out with peanut butter, canned meat or fish, and dry milk from the dry-staple side of the supply.

The micronutrient gap: vitamin C and B12

An all-shelf-stable diet built from the staples above runs short on two nutrients in particular. **Vitamin C** is heat- and processing-sensitive, and the dry staples that carry most of the calorie load, rice, oats, beans, oil, powdered milk, contain essentially none of it; canning further degrades what little vitamin C fresh produce started with. **Vitamin B12** occurs naturally only in animal products, so a pantry leaning on grains, beans, and oil rather than meat, eggs, or dairy can fall short of it too, even though nonfat dry milk does supply some.

- **Shelf-stable vitamin C sources:** fortified drink mix powders (check the label for added ascorbic acid), freeze-dried fruit, and canned citrus or tomato products, which hold onto more vitamin C through processing than most other canned vegetables.
- **Storage caveat:** ascorbic acid (vitamin C) itself degrades slowly over long storage even sealed, so treat a fortified product's vitamin C content as declining over years, not fixed.
- **The household multivitamin closes both gaps at once.** This site's own shopping list already includes household multivitamins as a Tier 2 item for exactly this reason, a daily multivitamin is the simplest way to cover vitamin C and B12 without relying on any single shelf-stable food to carry it.
- **MREs already cover part of this, by design.** Military MREs include a fortified beverage powder with added vitamin C, a deliberate design choice with roots in historical scurvy prevention on extended field rations, and most entrees are meat-based, covering some B12. That's a real partial answer if MREs are part of the plan, not a substitute for the multivitamin above: not every MRE menu includes the fortified beverage, and freeze-dried entrees don't carry the same built-in fortification.

For the deeper fix, growing or storing real produce, see *What to Grow: Crop Selection & Seed Saving*, which covers which crops actually close the nutrition gap that stored grains and beans leave behind.

Food fatigue: why the same menu on paper doesn't survive two weeks in practice

Menu monotony, the loss of appetite from eating the same limited set of foods repeatedly, is a well-documented problem in military ration research, not a soft or anecdotal concern. In one field trial, soldiers eating a single ration as their sole food source for 34 consecutive days averaged only **2,189 calories/day**, well under the ration's roughly 3,600-calorie design target, and lost **4.8% of their body weight**, despite rating the food itself as acceptable on surveys. The shortfall wasn't about the food being bad; it was about eating the same thing repeatedly. That's also the reason the modern MRE ration is only approved as a sole source of nutrition for **21 days or less**, and why the military's own field-testing standard calls for trials of at least **14 days**, preferably 21–30, specifically because that's the window where monotony's effect on how much people actually eat becomes measurable.

What this means for a household plan

A calorie-adequate plan on paper can still fail in practice if it's the same three meals on repeat for two weeks. Build in real variety, different grains, different bean types, different seasonings and sauces, not just different brands of the same thing, and treat the 14-day mark as exactly when appetite fatigue tends to start biting, not a milestone you've safely cleared. If MREs are part of the plan, that 21-day sole-source ceiling isn't a theoretical limit, it's the same monotony effect the field trial above measured, so mix them with dry-staple meals rather than treating a case of MREs as a complete 14-day supply on its own. The same logic applies to freeze-dried entrees: a #10 can typically holds one flavor, and rotating through only two or three flavors for two weeks straight risks the identical drop in how much people actually eat, buy enough variety across flavors and brands, not just enough total cans.

No-cook vs. cook-required

This site's shopping list already calls for "no-cook options included" in the Tier 1 food line, since a stove and fuel aren't guaranteed in the first hours or days. Split the supply deliberately rather than defaulting entirely to either category.

No-cook (ready as-is)	Cook-required	Note
Peanut/nut butter, crackers	Rice, oats, dried beans (not canned)	Cook-required staples are the calorie-dense backbone; budget fuel accordingly
Canned meat, fish, and beans (pull-tab)	Pasta	Canned protein is the no-cook equivalent of dry beans, at lower calorie density
Dried fruit, nuts, granola/protein bars	Powdered milk (reconstituted)	Can be eaten dry in a pinch, though reconstituted is far more palatable over time
Shelf-stable tortillas, honey	Cooking oil-based meals	Oil itself needs no cooking, but most of its calories arrive cooked into food
MREs (self-contained meal)	No direct counterpart, a complete meal rather than an ingredient	Some include a flameless heater pouch; the most complete no-cook option here, at the cost and density tradeoff noted above
No direct counterpart, needs only hot water rather than full cooking	Freeze-dried entrees (#10 can)	Draws from the same water and fuel budget as a full cook-required meal, just less of it, at the cost and density tradeoff noted above

Cook-required staples also spend your water budget

This site's own Storing Water Correctly guide splits the 14 gal/person target roughly half for drinking, half for food preparation and hygiene combined. Leaning heavily on cook-required staples, rice, oats, dried beans, pasta, or a freeze-dried meal that needs hot water, spends more of that food-prep half than a fully no-cook plan would. It's not just a fuel cost, it's a water cost too, worth weighing alongside calorie density and price when deciding how much of the supply to build from each category.

Household variation

- **Children.** Don't simply scale a child's ration down from an adult's by body weight; growth has its own calorie and protein demands. USDA guidance puts the full child and adolescent range at roughly 1,000–3,200 calories/day depending on age, sex, and activity level, a wider spread than most people expect, and shortchanging it risks growth and energy, not just comfort. MREs are a poor fit for this household member specifically: they're built around a soldier's combat-level physical exertion, and a child sheltering in place gets the same high sodium, carbohydrate, and fat load noted above without the activity level that's supposed to offset it. Favor dry staples, canned goods, or freeze-dried meals for a child's share of the supply where there's a choice.
- **Pregnant and nursing household members.** Pregnancy adds roughly **340 calories/day in the second trimester and about 450/day in the third**; breastfeeding adds roughly **330–400 calories/day** depending on the infant's age, on top of baseline need, not instead of it. Folate, iron, and iodine needs rise too, another reason a prenatal-specific multivitamin matters more here than the household's general one.
- **Diabetic household members.** A shelf-stable pantry skews heavily toward carbohydrate by default (rice, oats, pasta), which cuts against steady blood sugar management. **Skip sugar as a calorie source:** despite being dense and cheap in the table above, it's pure simple carbohydrate with none of the fiber that at least slows rice or oats down; keep it as a cooking and morale staple, not something to plan real calories around. **Check the sodium on MREs and freeze-dried meals before stocking either:** a single MRE typically runs **1,600–2,300mg**, close to or over the CDC's full daily limit on its own, and freeze-dried entrees vary widely by product, roughly **600–1,600mg per serving**, with a chicken fried rice or teriyaki-style entree running closer to MRE territory than a plainer one, so read the label rather than assuming freeze-dried is automatically gentler. **Lean into protein and fat instead:** peanut butter, canned meat and fish, and oil-cooked meals from the table above, and keep the household's own diabetes management plan and fast-acting glucose source stocked and current; this guide isn't a substitute for that plan.

- **Food allergies.** Build the substitution in ahead of time rather than mid-emergency: sunflower seed butter in place of peanut butter, oat or soy milk powder in place of dairy powder, rice-based staples in place of wheat-based ones for a gluten allergy. The calorie-density figures above still apply to most substitutes; check the specific product's label rather than assuming a 1:1 swap. MREs and freeze-dried entrees are both harder to manage this way, since each is a pre-assembled meal with several components rather than a single labeled ingredient you can swap out; read every component's label individually before stocking either for a household with a real allergy, or skip them for that household member's supply entirely.

Sources

- USDA FoodData Central, calorie density per 100g for dry rice, rolled oats, dry pinto beans, peanut butter, soybean/vegetable oil, and nonfat dry milk, converted to calories per pound: USDA FoodData Central
- USDA FoodData Central, canned green beans (drained), canned kidney beans, canned chunky chicken noodle soup, and granulated sugar calorie density: USDA FoodData Central
- Augason Farms Freeze Dried Chicken Fettuccine Alfredo Kit, #10 can total calories (5,040 kcal) and net weight (2 lb 10 oz), and Walmart Business, current price (\$34.23), used as a representative freeze-dried entree for calorie density and cost per calorie: Walmart
- Bureau of Labor Statistics / FRED, average U.S. retail price per pound for white long-grain rice (APU0000701312) and dried beans (APU0000714233), used for the cost-per-calorie comparisons above: FRED, rice; FRED, dried beans
- U.S. Dietary Guidelines for Americans 2020–2025, Appendix 2, "Estimated Calorie Needs per Day, by Age, Sex, and Physical Activity Level": reproduced table (APA)
- FDA, the 2,000-calorie reference value on the Nutrition Facts label: FDA
- National Academies of Sciences, Engineering, and Medicine, Dietary Reference Intakes, Acceptable Macronutrient Distribution Ranges for carbohydrate, protein, and fat: NCBI Bookshelf
- Office of Disease Prevention and Health Promotion (health.gov), additional calorie needs during pregnancy and breastfeeding: ODPHP
- Institute of Medicine, "Not Eating Enough: Overcoming Underconsumption of Military Rations in the Field," the 34-day sole-ration field trial (calorie intake and body-weight loss) and ration menu-monotony findings: NCBI Bookshelf
- MRE Info, MRE per-meal calorie design targets and civilian case weight/pricing: MRE Info; civilian MRE comparison
- Human Performance Resource Center (HPRC), MRE macronutrient design percentages (carbohydrate, fat, protein) and the operational rationale behind them: HPRC
- ArmyNavyOutdoors, MREs designed for a soldier's combat-level exertion and the resulting mismatch for a less-active civilian, including children: ArmyNavyOutdoors; CDC, avoiding higher-sodium foods in a child's emergency

food supply where possible: CDC

- Emergency Essentials / Be Prepared, MRE shelf life by storage temperature: Be Prepared
- Military Medicine (Oxford Academic), MRE sodium content per meal and civilian health considerations: Military Medicine; CDC, daily sodium intake recommendation: CDC
- Mountain House and Augason Farms product nutrition labels, freeze-dried entree sodium content per serving, used for the diabetic household caution above: Emergency Gear Lab; Trail Cooking
- Defense Logistics Agency, MRE component specifications listing the fortified beverage base (added ascorbic acid) as a standard accessory item: DLA
- Journal of the Academy of Nutrition and Dietetics, 21-consecutive-day randomized ration trial (micronutrient intake, including vitamin C, and the 21-day sole-source limit): PubMed
- Institute of Medicine, vitamin C stability and fortification in stored food products: NCBI Bookshelf

Sourcing & Hauling Water

Storing Water Correctly covers water you already have, and Water Purification covers making questionable water safe to drink. Neither covers the step in between: what to actually do once the stored supply is running low and you need to find, and physically move, more.

Where to actually find more water

- **Official emergency distribution.** After a declared disaster, FEMA runs Disaster Recovery Centers that can point you to water access; find the nearest one with FEMA's own DRC locator. Local 211 (dial 211, or 211.org) is a second, often faster route to the same information, since it covers local and county-level services a national locator won't always have yet. Know both exist before you need them, look-up time matters when you're already low.
- **A private well, if you have one.** Most residential wells need electricity to run the pump, so a well without backup power is only as useful as your generator or battery setup; see Fire-Starting & Generator Safety for running one safely. Check now, not during an emergency, whether your specific well has any manual or bucket-accessible option.
- **Open sources: streams, lakes, reservoirs.** Usable, but always treat before drinking or storing, see Water Purification above. In Northern Utah specifically, check the Utah DEQ's harmful algal bloom advisories before drawing from Utah Lake or the Jordan River; a bloom can make water dangerous even after normal disinfection. How you actually collect it matters too: draw from moving, flowing water rather than a still or stagnant edge, dip from a straight, uniform stretch of the channel rather than a backwater or eddy, and scan the area upstream first, a beaver dam, grazing livestock, or a heavily used campsite upstream all raise contamination risk. Dip the container slowly and lift it out without letting it touch the streambed; microorganisms concentrate in bottom sediment, and stirring it up puts more of them in your container, not less. Avoid collecting for a day or two after heavy rain if you can wait, runoff washes surface contamination into the water and raises the bacterial load right when it's hardest to see.
- **Neighbors and your local network.** Someone nearby may have a well, a cistern, or stored water to share, especially once a real local network exists before you need it, not improvised after.
- **Rainwater, where it's legal.** See Legal Rainwater Harvesting in Utah for the actual rule and a basic collection setup, set up in advance, this isn't something you can build mid-emergency.
- **No source at all nearby.** See Collecting Water From Snow, Dew & Condensation for melting snow correctly, dew collection, transpiration bags, and an honest look at solar stills as a genuine last resort, rated for how much they actually produce rather than survival-show hype.

Hauling it home

Water is heavy, and that fact alone shapes every decision here: how much you bring back per trip, whether you carry it or wheel it, and how many trips a day are actually realistic.

Container (full)	Approximate weight	How to move it
1 gallon	~8.3 lb	Carry by hand, no problem
5-gallon jug	~43–44 lb	Carry short distances; use a dolly or cart for longer ones
8-gallon wheeled container	~70 lb	Built for wheeling, not carrying
15-gallon container	~125 lb	Near the limit of what one person should move alone; use a cart or two people

A working rule of thumb

Use a dolly or wheeled cart for anything over 5 gallons, and keep any load you're actually carrying by hand under about 50 lb. A garden cart, a hand truck, or even a sled in snow all beat repeated trips carrying a heavy jug, especially once hauling becomes a standing weekly task rather than a one-time trip.

If hauling by hand is genuinely the only option, a shoulder yoke, a wood or bamboo bar carried across the shoulders with a bucket balanced on each end, is the real historical answer to why hand-carried water is traditionally split into two containers rather than one big one. It shifts the load off your hands and forearms onto your shoulders and torso, which handle sustained weight far better, and a balanced load on both ends stops water from sloshing out with every step the way a single unbalanced bucket does. Two 5-gallon buckets on a yoke is a genuinely easier carry over distance than the same 10 gallons split one-handed.

For repeat trips rather than a single big haul, collapsible containers, water bladders, or fold-flat jugs pack smaller on the way out and are easier to fill from an awkward source (a shallow stream, a distribution point's own spigot) than a rigid barrel. Keep at least one rigid container too, a collapsible one is easy to puncture and harder to move once it's damaged.

Treat it before you drink it, treat it again before you store it

Water from any source outside your own sealed, known-good storage is untreated by default, regardless of how clear or clean it looks. Treat it using the methods in Water Purification before anyone drinks it. If you're bringing it home to add to your bulk storage rather than drinking it immediately, follow Storing Water Correctly's container-cleaning and treatment steps too, don't just top off a storage container with untreated water because it's going to sit for a while first.

This is also the task the Act of Surviving's Tier 2 weekly rhythm means by "water sourcing": a standing, planned trip, not a scramble the day the stored supply finally runs out.

Sources

- FEMA, finding water and other assistance after a disaster (Disaster Recovery Center locator): FEMA; FEMA DRC Locator
- 211, local emergency and community service referrals: 211.org
- Utah Division of Water Quality, harmful algal bloom advisories for Utah Lake and the Jordan River: Utah DEQ
- Water weight and container capacity figures: CrystalQuest; manufacturer specifications, 8-gallon wheeled container
- Safe stream-water collection site selection, sediment disturbance, and post-rain contamination risk: USGS; Battlbox
- Shoulder yoke mechanics and balanced two-bucket carrying: Digging in the Driftless; Lehman's

Sealing Bulk Food for Long-Term Storage

The Water & Food chapter's Tier 2 goal is bulk staples stored in Mylar with oxygen absorbers, in one line, with no actual technique behind it. Buying the bags and the food is the easy part; sealing them correctly is what determines whether that stockpile is still good in five years or has gone stale, buggy, or rancid in one.

How long will it actually last your household

Before sealing anything, it's worth checking whether what you've bought actually covers your household. The manual's own Tier 1 target is a flat **2,000 kcal per person per day**, the same baseline both general nutrition and disaster-response guidance use, adjusted up for children, larger adults, or anyone doing hard physical labor rather than down. Add up the calories in what you've stored, nutrition labels list servings per container and calories per serving, and check it below.

People in the household

Calories per person, per day

2,000 is the manual's own baseline. Raise it for children, larger adults, pregnancy, or hard physical labor; the manual doesn't treat this as a fixed rule.

Total calories stored

Servings per container × calories per serving, added up across everything you're counting toward this supply.

Calculate

Pet food isn't counted here

There's no sourced daily-calorie figure for pets on this site the way there is for people, feeding needs vary too much by species, size, and the specific food. Pet food is sized differently in practice anyway: check the feeding guidelines printed on the bag for your pet's weight, multiply by however many days you're planning for, and store that separately from the household's own calorie count above.

What this method is for

Mylar-and-oxygen-absorber storage works by blocking light, moisture, and oxygen, the three things that degrade stored food fastest. It's built for **dry, low-moisture, low-fat staples**: white rice, dry beans and lentils, oats, pasta, wheat berries, dry corn, sugar, and some dehydrated vegetables. Done correctly, these can stay good for well over a decade.

This isn't the right method for everything

Fats and oils go rancid from oxidation and heat regardless of how well you seal them, an oxygen absorber slows that but doesn't stop it, so treat high-fat foods (nuts, whole-grain flour, anything with real oil content) as a shorter-rotation item, not a decade-plus stockpile, no matter how they're packaged.

Materials

Item	Spec	Notes
Mylar bags	5–7 mil thick, food-grade, sized to your storage plan	Thickness is what actually blocks oxygen over years, not just at sealing time; 5 mil balances flexibility and durability for most staples, 7 mil for sharp-edged foods like pasta or hard beans. Gallon bags for smaller portions, 5-gallon bags to match a matching bucket
Oxygen absorbers	300cc per gallon of bag volume as a baseline	Round up rather than down; an absorber slightly too large does no harm, one too small won't fully displace the oxygen
Heat source	A dedicated impulse bag sealer, or a clothes iron/hair straightener set to a cotton or wool setting (roughly 380°F) with steam turned off	An impulse sealer applies heat in a thin, consistent line in 2–3 seconds and is the more forgiving choice for a first attempt; an iron or straightener spreads heat over a wider area and has to be dragged evenly by hand, which is where most beginner seal failures happen
A flat board or ruler	Anything rigid, a foot or so long	Slides inside the bag under the fold to give the heat source a firm, flat surface to press against; sealing without this backing is a common cause of wrinkled, leaky seams
Outer container (optional)	A food-grade 5-gallon bucket	Protects the Mylar bag itself from punctures and pests once sealed. One 5-gallon Mylar bag holds roughly 30–40 lbs of dry rice, wheat, or beans; four 1-gallon bags fit inside one 5-gallon bucket instead if smaller portions are the goal

Sizing the oxygen absorber

Bag size	Oxygen absorber
1 quart / small bag	About 100–300cc
1 gallon	300–500cc
5 gallon	2,000–3,000cc

When in doubt, size up rather than down. An oversized absorber just finishes its job faster; an undersized one leaves residual oxygen in the bag, which defeats the point.

Step by step

1. Have everything ready before you open a single oxygen absorber packet: bags filled and staged, sealing tool warmed up if needed. This matters because of the next step.
2. **Work fast once an absorber packet is open.** Oxygen absorbers start reacting with air the moment they're exposed to it, not just the air trapped in your bag. Get each one sealed into its bag within about **15–20 minutes** of opening the packet, or its capacity is wasted absorbing room air instead of the air in your food.
3. Fill the bag with food, leaving about 3 to 4 inches of empty bag above the contents, enough to fold and work with but not so much that you're sealing mostly air.
4. Drop the oxygen absorber in on top of the food, don't set it aside "for a minute", every minute it sits in open air is capacity lost.
5. Press out as much air as you reasonably can by hand. A true vacuum isn't necessary, the absorber handles what's left.
6. Fold the top of the bag over on itself two or three times to create a flat sealing surface, then slide a flat board or ruler inside the fold as a firm backing and smooth the Mylar taut with both hands to work out wrinkles before sealing; wrinkles left in the fold are the most common path a slow leak takes.
7. Run your heat source across the fold with firm, even pressure for about **3–4 seconds**, in one smooth pass across the full width of the bag.
8. Check the seal immediately by gently trying to pull the fold apart. If it separates at all, reseal that section.

Confirming it actually worked

Check every bag again within **24 hours** of sealing. A properly sealed bag with a correctly sized oxygen absorber will be noticeably vacuum-tight, the Mylar pulled snug against the food inside, since the absorber has consumed the oxygen that was left in the bag. Keep in mind oxygen is only about 21% of air, so even a perfect seal won't pull down to a hard vacuum, snug and wrinkle-free against the food is the real target, not rigid. Look closely along the seal line itself for any wrinkle or gap, that's the specific spot a slow leak comes from even when the rest of the bag looks fine. If a bag still looks puffy or loose after 24 hours, the seal likely failed somewhere; open it, replace the oxygen absorber with a fresh one, and reseal.

Storage and rotation

- Label every bag with the contents and the seal date, the same FIFO habit used everywhere else on this site.

- Keep sealed bags somewhere in the 50–65°F range with humidity under 60%, a basement or interior closet rather than a garage or attic that swings with the outdoor temperature. Every 10°F cooler roughly doubles expected shelf life, so where a sealed bag sits matters almost as much as how it was sealed.
- Store sealed bags inside a food-grade bucket where practical; the bucket protects the Mylar itself from punctures, rodents, and crushing.
- Check seals seasonally, and watch for small holes or frass (insect droppings) in grain and bean stores, exactly the inspection routine already called for in the Water & Food chapter's Tier 2 rotation guidance.
- Once a bag is opened, its long-term protection is gone; move the remaining contents to a shorter-rotation container rather than resealing the original bag and expecting the same shelf life.

Sources

- Utah State University Extension, food storage guidance for Mylar-packaged staples: [USU Extension](#)
- Oxygen absorber sizing per bag volume, activation timing, and seal verification technique: [Oxygen Absorbers; Discount Mylar Bags](#)
- Mylar bag mil thickness for long-term storage: [Brand My Dispo](#)
- Heat sealer temperature settings and iron/straightener technique: [TruePrepper](#)
- Fold-backing and wrinkle-free sealing technique: [BNPack](#)
- Seal troubleshooting and common leak points: [Cubit Packaging](#)
- Bucket-and-bag food quantity yields: [PailHQ](#)
- Storage temperature and humidity effect on shelf life: [Mother Earth News](#)

Legal Rainwater Harvesting in Utah

Rainwater harvesting in Utah isn't illegal, the way the old rumor goes, but it is regulated, and the rule itself is simple enough to just know. This is a Stage 3 self-sufficiency skill from the Water & Food chapter and its addendum, and unlike most of what's in that stage, the "how" here is a bureaucratic process, not a hands-on course, so it's genuinely teachable on one page.

The two tiers of Utah's rule

Storage amount	What's required
Up to 200 gallons (2 covered containers, 100 gallons each, max)	Nothing. No registration, no paperwork, completely legal on its own.
Up to 2,500 gallons total, on one parcel	Free registration with the Utah Division of Water Rights
More than 2,500 gallons, or water for other parcels	A full water right, a genuinely different and more involved process

Read these as two separate options, not additive tiers: two 100-gallon covered containers requires nothing at all, while a setup you register can hold up to 2,500 gallons total on its own. Almost every household system fits inside the 2,500-gallon registered tier without ever needing an actual water right.

How to register

1. Go to waterrights.utah.gov/forms/rainwater.asp.
2. Fill out the form: your name, phone number, property address, and email. That's the whole information requirement.
3. Submit it. Registration is free, and you'll get a certificate to print and keep with your other household documents.
4. Register again if you significantly increase your total storage capacity later; the registration covers the capacity you declared, not an open-ended allowance.

Where you can use it

Collection and use are limited to the same parcel of land where the water is captured and stored. You can't collect rainwater at one property and truck or pipe it to use on another, registered or not.

Building a system that doesn't create a mosquito problem

The legal part is the easy part; a poorly built system creates a real, separate problem: standing water breeds mosquitoes within days. A few basic components prevent that instead of causing it.

- **A gutter screen** at the inlet catches leaves, sticks, and roofing debris before they reach the container.
- **A first-flush diverter** routes the initial, dirtiest runoff (dust, pollen, bird droppings that accumulated on the roof since the last rain) away from your storage, before clean water starts filling it. The standard design is a vertical standpipe mounted on the downspout: it fills with the dirty first flush, a floating ball inside then rises and seals off the pipe once full, and subsequent clean water diverts past it into the tank. A small bleed hole, roughly 3–5mm, drilled at the base of the standpipe slowly drains it between storms so it resets on its own before the next rain. A rough sizing rule: divert at least 12.5 gallons for every 1,000 square feet of roof area being collected from.
- **Screened openings and vents**, 1/16-inch mesh or finer, on every point where the container is open to the outside. Bond rigid mesh to vent caps and openings with PVC cement or an adhesive sealant rather than just laying it over the opening, and caulk any remaining gaps around lids, vents, or pipe penetrations. This is the single most important anti-mosquito measure; an unscreened or loosely-fitted opening is an invitation.
- **A "dry" system**, meaning no standing water left sitting in exposed pipes or fittings between rains. Stagnant water anywhere in the system, not just in the main container, is a potential breeding site.
- **Overflow routed away from your foundation**, with a real minimum size: at least 1½ inch in diameter, since anything narrower clogs easily, positioned 2 to 4 inches below the container's rim, sloped at least ¼ inch per foot, and routed at least 10 feet from the foundation.

Connecting the gutter to the container itself usually means a mid-downspout diverter kit: drill a hole in the downspout (the front face for a 2x3 inch downspout, the side face for a 3x4 inch one), fasten the diverter fitting in place with the self-tapping screws it comes with, and run the included fill hose down to the container's inlet, positioned level with the intake so the diverter's own overflow works correctly once the container is full.

Use an opaque, UV-stabilized, food-grade HDPE container (often sold in the industry-standard blue for exactly this reason) rather than an unrated plastic drum, even for water you don't plan to drink without treatment first: food-grade plastic won't leach chemicals into stored water over time, and opacity blocks the sunlight that would otherwise grow algae inside the tank.

Where to find it: first-flush diverters, gutter screens, and mesh screening are sold at hardware stores, home improvement retailers, and specialty rain-barrel suppliers online; a basic setup for a single rain barrel costs well under \$100 in parts.

Watch it: Utah State University Extension, "How to Install a Rain Barrel Diverter".

This water isn't automatically safe to drink

Registering and collecting rainwater legally doesn't make it potable on its own; roof runoff picks up whatever was sitting on your roof. Treat it with one of the methods in the water purification guide before drinking it, the same as any other questionable source. It's genuinely useful untreated for irrigation, flushing, or other non-drinking uses without that extra step.

Sources

- Utah Division of Water Rights, rainwater harvesting registration rules and process: waterrights.utah.gov
- Unregistered vs. registered storage thresholds: ABC4; USU Extension
- First-flush diverter sizing and rainwater system design: Oklahoma State University Extension
- Mosquito-prevention design for rainwater harvesting systems: NC State Extension
- First-flush diverter floating-ball/standpipe mechanism and bleed-hole sizing: Rain Tanks; Clean and Native
- Why food-grade rain barrels are blue (UV resistance and algae prevention): BlueBarrel Rainwater; BlueBarrel Rainwater

Food Preservation: Canning, Dehydrating & Smoking

The Water & Food chapter's Tier 3 names canning, dehydrating, smoking, and root cellaring in one line each. This guide is the real how-to, and just as important, the real safety line. Most of the skills on this site fail loudly: a bad water filter tastes off, a weak knot slips. Food preservation is different. Done wrong, it can produce food that looks, smells, and tastes completely normal while containing a toxin that's fatal in a taste. That's why this guide leads with what actually destroys the risk, not just what tradition says worked.

The core rule: acid decides the method

Clostridium botulinum, the bacteria behind botulism, forms hardy spores that survive ordinary boiling. In an acidic environment, pH below 4.6, those spores can't germinate or produce toxin, so a boiling-water bath (212°F) is genuinely sufficient. In a low-acid environment, pH above 4.6, boiling isn't enough: the spores survive, then germinate and produce toxin inside the sealed, oxygen-free jar while it sits on your shelf, with no visible sign anything is wrong.

Food category	Examples	Safe method
High-acid (pH below 4.6)	Most fruit, jam, jelly, and anything properly acidified with vinegar (pickles, salsa made to a tested recipe)	Water-bath canning (boiling water, 212°F) is sufficient
Low-acid (pH above 4.6)	Vegetables, meat, poultry, seafood, beans, soups and stews, and any mixed dish containing them	Pressure canning only (240°F+); a water-bath canner cannot reach a safe temperature for these

WARNING

This isn't a theoretical risk: a real outbreak from exactly this mistake

At a 2015 Ohio church potluck, potato salad made with home-canned potatoes, a low-acid food processed in a water-bath canner rather than a pressure canner, sickened 29 of the 77 attendees with botulism; one person died. The jars looked, smelled, and tasted normal. This is the specific, documented failure mode the acid/method table above exists to prevent, not a hypothetical.

Altitude changes the numbers

Water boils below 212°F above 1,000 feet of elevation, which means both canning methods need adjusting the higher you are, not just a mountain-specific concern. Most of the Wasatch Front sits well above that threshold.

Altitude	Water-bath: add to processing time	Pressure canning: increase pressure by
1,001–3,000 ft	+5 minutes	+2 lbs (dial gauge) or use 10 lb weight (weighted gauge)
3,001–6,000 ft	+10 minutes	+3 lbs (dial gauge) or use 15 lb weight (weighted gauge)
6,001–8,000 ft	+15 minutes	+4 lbs (dial gauge) or use 15 lb weight (weighted gauge)
8,001–10,000 ft	+20 minutes	+5 lbs (dial gauge) or use 15 lb weight (weighted gauge)

Pressure canning compensates with more pressure rather than more time, since a pressure canner can reach a higher temperature than boiling water can. A dial-gauge canner adjusts in small pound increments; a weighted-gauge canner jumps between fixed weights, so round up to the next available weight rather than under-adjusting. Look up your specific elevation, not just a rough guess, before your first canning session; a NOAA or county extension elevation lookup takes a minute.

The equipment itself, plainly identified

Equipment	What it actually is
Water-bath canner	A large pot, deep enough to submerge filled jars under at least 1–2 inches of boiling water, with a rack in the bottom so jars don't sit directly on the hot metal
Pressure canner	A heavy pot with a locking lid and a pressure gauge, built to reach higher-than-boiling temperatures under pressure. Not the same as a stovetop pressure cooker unless it's specifically rated large enough and approved for home canning
Dial gauge	A numbered pressure dial on the canner's lid; needs to be tested for accuracy once a year (free at most county extension offices, including USU county offices), and replaced if it reads more than 2 lbs off
Weighted gauge	A small weight that sits on a vent pipe and rocks or jiggles at set pressures (usually 5, 10, and 15 lbs); self-verifying by the way it moves, so it never needs separate accuracy testing
Food dehydrator	An electric appliance with stacked trays and a fan that circulates warm air; a home oven set to its lowest temperature with the door propped open is a real, if less efficient, substitute

Filling and processing a jar: the physical steps the tables above assume

Knowing the right acid category, time, and pressure doesn't help if the jar itself isn't filled correctly first.

- **Leave the headspace a tested recipe specifies**, typically ¼ inch for jams and jellies, ½ inch for most fruits and tomatoes, and 1 inch for low-acid vegetables and meats. Too little headspace can force food out and break the seal during processing; too much can leave too little vacuum to seal at all.
- **Remove trapped air bubbles** by sliding a non-metallic spatula or bubble-remover tool down between the food and the jar wall, working it around the full circumference. Trapped air that isn't released can cause liquid loss and a false or weak seal.
- **Wipe the jar rim clean** with a damp paper towel or cloth before adding the lid. A single bit of food residue, even one you can't easily see, on the sealing surface is enough to prevent a real seal from forming.
- **Center the lid and apply the band fingertip-tight**, not cranked down as hard as possible. Air needs a path to escape the jar during processing; a band tightened too hard traps it and can also prevent a proper seal.

Pressure canning: don't skip the venting step

Before starting the timer on a pressure-canning load, vent steam continuously for a full **10 minutes**, letting a steady column of steam escape before closing the petcock or adding the weight. This purges the air that's still trapped inside the canner alongside the steam. Skipping it is one of the most common, least visible mistakes in home pressure canning: a canner with trapped air can still show full pressure on the gauge, but the actual temperature inside runs lower than that pressure reading implies, which means low-acid food can come out under-processed with no way to tell just by looking at it.

Cooling and checking the seal

Once processing time is up, let a pressure canner depressurize and cool on its own; don't run water over it or force the vent open early; either one can cause liquid loss from the jars or damage the canner. Once jars come out (water-bath or pressure), set them undisturbed on a towel or cooling rack for 12 to 24 hours before touching the lids.

After that wait, check each seal: press the center of the lid. A sealed lid stays down and doesn't flex. A lid that pops back up when pressed, or a jar that sounds dull rather than ringing clearly when tapped with a spoon, didn't seal. An unsealed jar isn't a failure to panic over, just refrigerate it and eat the contents within a few days, or reprocess it within 24 hours using a new lid and the full original processing time.

A worked example, so you know what a real tested recipe looks like

Pressure-canned green beans process for 20 minutes (pints) or 25 minutes (quarts) at 10 lbs of pressure on a weighted gauge, before any altitude adjustment. A real, tested recipe always gives you a specific time *and* a specific pressure or method together, like that; if a recipe only gives you one of the two, or neither, it isn't a tested recipe and shouldn't be trusted for a low-acid food.

Safe dehydrating: the preheat step most instructions skip

Jerky is dehydrated meat, not a separate process: the same moisture-removal mechanism that preserves dried fruit or vegetables applies here, historically with salt or a marinade and sometimes light smoking added for flavor and shelf life. What's genuinely different is the risk profile, which is exactly why it gets its own callout below rather than folding silently into the general dehydrating steps.

A food dehydrator's typical drying temperature, 130–140°F, is fast enough to dry meat before it spoils but not hot enough on its own to reliably kill bacteria like *Salmonella* and *E. coli* O157:H7, the actual cause of most homemade-jerky illness outbreaks. The USDA's fix is a step most dehydrator manuals never mention: heat meat to **160°F** and poultry to **165°F** with moist heat (simmering the meat, or steaming/roasting it) before it goes into the dehydrator. That single step kills what the drying temperature alone won't, and the rest of the process, drying at 130–140°F until fully dry, proceeds the same way afterward.

Vegetables carry a lower risk profile but still benefit from a quick blanch (a brief boil or steam) before drying: it stops enzyme activity that would otherwise continue degrading flavor, color, and nutrients in storage, not primarily a pathogen-kill step the way meat preheating is.

"Dried enough" is a real endpoint, not a guess: fruit should be leathery and pliable with no pocket of moisture when torn open, most vegetables should be brittle enough to shatter rather than bend, and jerky should bend and crack without fully snapping in half. Once a batch looks done, condition it before final packaging: pack it loosely into a jar for 7 to 10 days, shaking it once a day. If condensation shows up on the inside of the glass, moisture is still redistributing from wetter to drier pieces, and the batch needs more drying time before it goes into long-term storage. Package fully conditioned, dried food out of light and air, canning jars or this site's own Mylar-and-oxygen-absorber method, not a loose bag that lets moisture back in.

Smoking and curing: real technique, real dose

Hot smoking, cooking meat through at a safe internal temperature while adding smoke flavor, carries roughly the same risk profile as any other cooking method: get the internal temperature right and it's safe.

That means checking with a calibrated digital probe thermometer inserted into the thickest part of the meat itself, not trusting a smoker's built-in lid gauge, which reads chamber air temperature, not the meat's. The real targets: poultry to 165°F, ground meats to 160°F, and whole-muscle cuts (a roast, steaks, a whole chicken breast) to at least 145°F held for a 3-minute rest before cutting or serving. Cold smoking is different and genuinely riskier: it holds meat in the 40–100°F range for extended periods, exactly the conditions *C. botulinum* favors, without ever cooking it through.

Curing salt (often labeled Cure #1, containing sodium nitrite) is what actually makes cold-smoked and cured meat safe, not the smoke itself: at roughly **0.25% of the meat's weight**, it doesn't kill spores, but it disables their ability to germinate and produce toxin for about 30 days under refrigeration-range cold-smoking conditions. This is a real dose, not a pinch-to-taste ingredient; measure it by weight against a tested recipe, never estimate it, since both too little (spores survive) and too much (nitrite toxicity) are real failure modes in the wrong direction.

What Works, What's Questionable, What Doesn't (Avoid)

Home food preservation carries more folklore than almost any other skill in this book, plenty of it from people who did it that way for years without incident. Surviving isn't the same as safe: *C. botulinum* contamination is rare per jar, which is exactly why an unsafe method can seem to "work" for years before it doesn't. Here's what the actual research and regulatory guidance (USDA, the National Center for Home Food Preservation, and state extension services) supports.

Works: methods backed by real research and testing

- **Water-bath canning** for genuinely high-acid foods, following a tested recipe's exact processing time, adjusted for your altitude.
- **Pressure canning** for low-acid foods, following a tested recipe's exact time and pressure, adjusted for your altitude, with a canner whose gauge has been checked for accuracy (most county extension offices test dial gauges for free).
- **Dehydrating**, meat and poultry preheated to 160–165°F before drying, vegetables blanched first, everything dried to a low enough moisture content to actually stop microbial growth.
- **Cold-smoking and curing with a properly measured nitrite cure**, following a tested recipe's exact dose and time, not a family tradition without a known dose.
- **Root cellaring** and **freezing**, both well-understood, low-risk methods when held at correct temperature and humidity for the specific food.

Questionable: real techniques, but with real caveats

- **Home freeze-drying.** A real, effective method, but the "25-year shelf life" claim you'll see marketed is validated for commercial, industrially packaged freeze-dried food, not necessarily a home unit's output. Realistic figures for home freeze-dried food in typical home packaging run closer to 1–15 years depending heavily on the packaging quality and storage conditions; treat the 25-year number as a commercial-product claim, not a guarantee for your own batches.
- **Cold smoking without a precisely measured cure.** The technique itself is real and long-established, but it's genuinely more dangerous than hot smoking or straightforward canning, and it's not the place to estimate rather than measure. If you're not confident in the exact dose and timing, hot-smoke instead, or cure first using a tested recipe before cold-smoking.

WARNING

Doesn't work / avoid entirely

- **Open-kettle canning** (cooking food in an open pot, then filling and sealing jars without a separate processing step). Filling the jar reintroduces spores from the air and equipment; only an actual timed processing step reliably kills them.
- **Oven canning.** Dry oven heat never reliably reaches the food's interior fast enough, doesn't destroy *C. botulinum* spores in either high- or low-acid foods, and can shatter jars not designed for dry heat.
- **"Dry canning"** of dry goods, flour, rice, sugar, dried beans, heated in jars in an oven. This isn't canning at all: residual moisture in the dry food migrates and condenses inside the jar, creating exactly the conditions mold and bacteria need, while the jar never achieves a genuine vacuum seal. For long-term dry storage, use this site's own Mylar-and-oxygen-absorber method instead.
- **Inversion (upside-down) cooling** as a substitute for real processing. Flipping a hot-filled jar upside down to cool can make the lid pop the way a real seal does, but the contents were never actually processed at a safe temperature; the seal is cosmetic, not sterilizing.
- **Paraffin (wax) sealing** for jams and jellies, once standard, discontinued for a real reason: wax develops microcracks as it cools, and testing found significantly higher mold contamination compared to a proper vacuum-sealed jar.
- **Reusing single-use canning lids.** The sealing compound is designed to compress once; a used lid's compound is already indented and won't reliably form an airtight seal a second time, and boiling a used lid doesn't restore it.
- **An untested family recipe, or a tested recipe with unlisted substitutions.** Processing times are calculated for a specific density, acidity, and jar size. Adding extra low-acid ingredients (onion, garlic, extra vegetables) to a recipe that wasn't tested with them, using a bigger jar than specified, or skipping a step "because Grandma always did" can silently invalidate a safe

processing time. Follow a current NCHFP or extension-tested recipe exactly, or don't assume the result is safe.

Sources

- National Center for Home Food Preservation (NCHFP), equipment and methods not recommended: NCHFP
- CDC, home-canned food and botulism prevention: CDC
- 2015 Ohio church potluck botulism outbreak from water-bath-canned potato salad: Food Safety News
- Altitude adjustments for water-bath and pressure canning: SDSU Extension; Colorado State University
- USDA jerky preheating guidance (160°F meat / 165°F poultry before dehydrating): USDA FSIS
- Jar headspace, air-bubble removal, and rim-wiping technique: NCHFP
- Pressure canner venting/exhausting requirement: Iowa State Extension
- Cooling jars and testing jar seals: NCHFP
- Pressure canner dial-gauge testing, free at county extension offices: USU Extension
- Hot smoking safe internal temperatures by meat type: USDA FSIS
- Worked example processing time (pressure-canned green beans): SDSU Extension
- Conditioning and packaging dried food: NCHFP
- Cold smoking, botulism risk, and nitrite (Cure #1) dosing and function: AmazingRibs
- Dry canning of dried goods, why it's unsafe: UC Master Food Preservers; Penn State Extension
- Inversion canning, paraffin sealing, and reused-lid safety: Pick Your Own; NDSU Extension
- Home freeze-drying realistic shelf life versus commercial claims: Valley Food Storage

Building a Biosand Water Filter

A commercial gravity filter (Berkey-, Sawyer-style) is a stored, finite resource: the cartridge eventually wears out and needs replacing. A properly built biosand filter is the renewable alternative the Water & Food chapter's Tier 3 has in mind, sand and gravel don't run out, but it only works if it's built to the real specification, not the popular internet shortcut.

The real design, and the one that isn't

Two very different things get called a "sand and charcoal water filter." The one with decades of field deployment and published pathogen-removal data behind it is the **biosand filter (BSF)**, a design standardized by CAWST (the Centre for Affordable Water and Sanitation Technology) and used by aid organizations worldwide. The one that shows up in most online tutorials, a bucket layered with sand, gravel, and charcoal that drains at a normal gravity-fed pace, is a different device. It's a reasonable sediment pre-filter. It is **not** a tested purification method, and no credible source has published pathogen-removal data for it. The difference between the two isn't the materials; it's the flow rate, and that's the entire subject of this guide.

What the biosand filter actually is

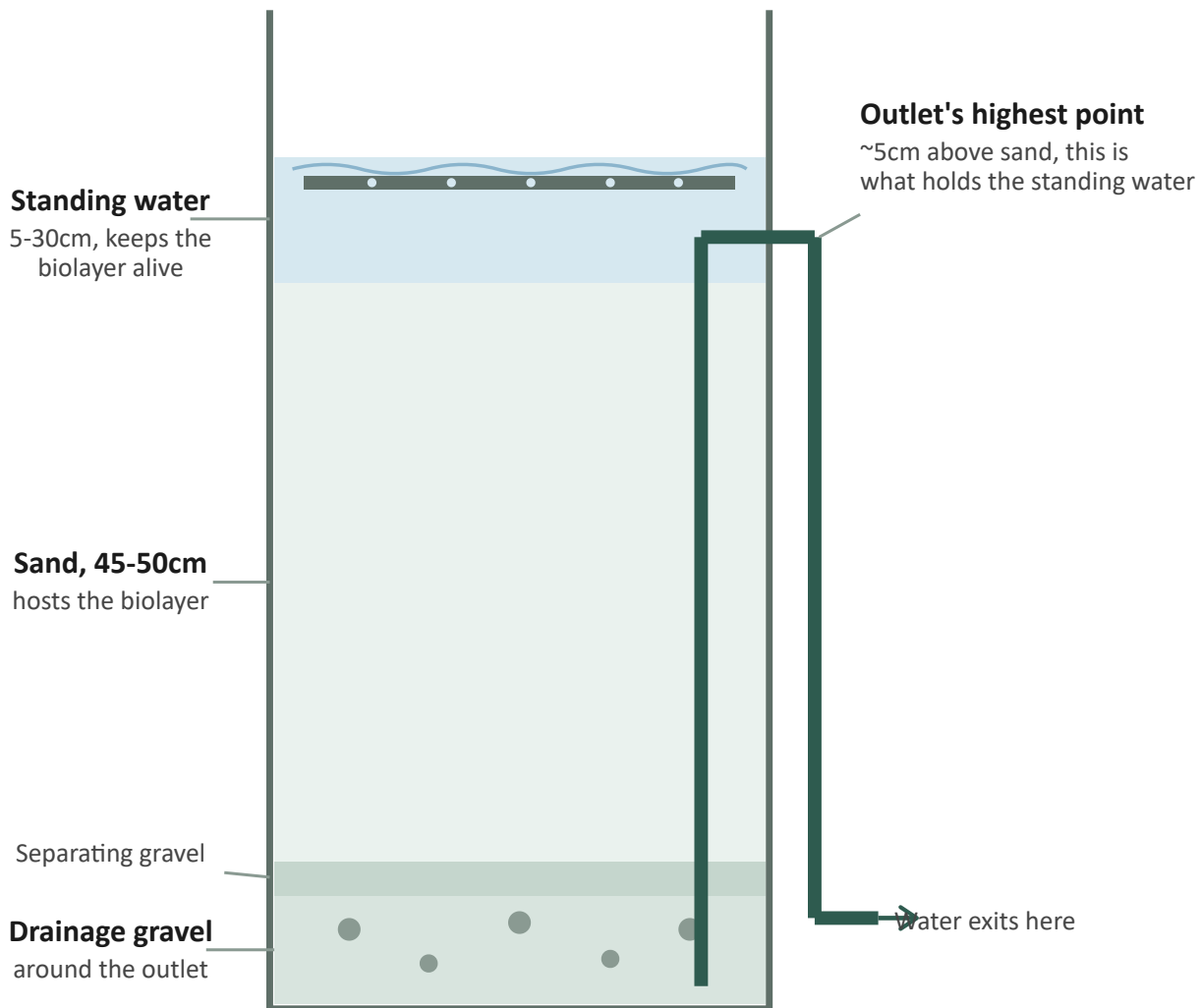
A biosand filter is a container of sand and gravel that water passes through slowly enough for a living biological layer, the **schmutzdecke** (German for "dirt layer"), to establish on top of the sand and do most of the actual pathogen removal. It's the same principle municipal water utilities have used since London's Chelsea Waterworks first installed slow sand filtration in 1829, scaled down to a household container.

Component	Specification
Housing	A tall, narrow container, roughly 0.3m square or in diameter and 0.9m tall: food-grade plastic buckets, a 55-gallon food-grade drum, or CAWST's standard concrete or high-density plastic housing all work, as long as the proportions hold
Sand layer	Effective size 0.15-0.30mm, uniformity coefficient 1.5-3.0, at least 45-50cm deep. This is the layer that hosts the biolayer; it is not just a strainer
Separating gravel	0.7-6mm, a thin layer between the sand and the drainage gravel so sand doesn't wash down into it
Drainage gravel	6-12mm, at the base, surrounding the outlet pipe
Diffuser	A flat plate drilled with a uniform pattern of small holes, mounted roughly 70mm (2.8in) above the sand surface, so incoming water spreads out and drips instead of jetting straight down and cratering the sand
Standing water	5cm of water always sitting above the sand at rest, refilled to 20-30cm when you add water; this layer keeps the biolayer organisms alive between uses

Building it

1. Screen your sand and gravel to the sizes above. This is the step people skip, and it's the one that determines whether the finished filter actually works: a controlled comparison found 99% *Cryptosporidium* removal with well-graded sand versus just 48% removal with coarser, poorly-graded sand of otherwise the same design. You can check your own screened sand against the CAWST specification with a home sieve analysis: run a weighed sample through a graduated stack of sieves, then find the sieve size that let through the smallest 10% of the sample by weight, that opening size is your **effective size (ES)**. Do the same for the size that let through the smallest 60%, that's your **d60**. Divide d60 by ES to get your **uniformity coefficient (UC)**. If ES falls outside 0.15-0.30mm or UC falls outside 1.5-3.0, re-screen before building.
2. Wash all media thoroughly before loading it, sand and gravel straight from a source carries fine silt that will cloud your first several batches of water and can clog the bed prematurely.
3. Layer from the bottom up: drainage gravel around the outlet, separating gravel above it, then the full sand depth on top.
4. Mount the diffuser plate roughly 70mm above the finished sand surface, not resting directly on it, so poured water sprays through its holes and lands as a spread-out drip rather than a jet that digs a crater in the sand and disturbs the biolayer underneath.

5. Build the outlet as a tube whose highest point sits inside the container roughly 5cm above the sand surface: from the drainage gravel at the base, the tube rises up inside the housing to that height, bends over, and runs back down and out through the wall or base. That rise is what physically holds 5cm of standing water above the sand at rest, water can't drain below the height of the tube's highest point, which is what keeps the biolayer wet and alive between uses. There is no flow-control valve to buy or install; the slow flow rate itself comes from the resistance of the sand bed plus the height of water pushing down on it (the head), not from anything restricting the outlet pipe.

**WARNING****Flow rate is not a limitation, it's the mechanism**

A properly built biosand filter runs at roughly **0.4 liters per minute or slower** (CAWST's own maximum for its standard unit), regardless of how large the container is. That slowness is what gives

the biolayer enough contact time to actually remove pathogens; a filter built the same way but allowed to run faster is not a faster biosand filter, it's a device with no biological treatment happening at all. If your build drains in a few minutes instead of tens of minutes, it is functioning as a sediment filter, not a purifier, no matter what media you loaded into it. If flow ever drops below about 0.1 liters per minute, the surface has clogged and needs maintenance (see below), not a redesign to make it flow faster.

What size actually gets you what flow rate

CAWST's maximum safe loading rate works out to roughly **400 liters per hour per square meter** of sand cross-section, a physical constraint tied to contact time, not to container size. That means output scales with the footprint of your sand bed, not with how big or dramatic the container looks. Before building, it's worth knowing what you're actually going to get:

Container	Approx. sand cross-section	Physics-derived maximum output
5-gallon bucket	~0.066 m ²	~26 L/hour (~6.9 gal/hour)
55-gallon drum	~0.26 m ²	~102 L/hour (~27 gal/hour)
CAWST standard unit (concrete/plastic housing)	n/a	0.4 L/minute (~24 L/hour), CAWST's own directly published maximum, the reference figure the estimates above are derived from

Those are ceilings, not targets, running at the maximum starves the biolayer of contact time the same way an oversized outlet does. Claims online of a single household filter producing over a thousand liters a day are not consistent with this physics and shouldn't be relied on; a single 5-gallon-bucket-scale unit is realistically a slow, steady household supplement, not a whole-family primary water source on its own. Multiple units run in parallel, not one unit run faster, is the correct way to scale up output.

Ripening the biolayer

A freshly built filter does not work yet. The schmutzdecke takes roughly **2 to 4 weeks** to establish, and pathogen removal during that window is meaningfully worse than once it's mature: one study found bacteria removal rising from about 63% in an unripe filter to 98-99% once fully matured. Build and start ripening a filter well before you need to depend on it, not during an actual emergency.

Between uses, let the standing water sit for **6 to 12 hours** (minimum 1 hour, maximum 48 hours) before drawing the next batch. This pause is when the biolayer organisms actually feed; too short a pause doesn't give them time to work, and too long a pause in a hot, dry climate risks the standing water evaporating away and the biolayer drying out and dying.

What it actually removes, and what it doesn't

A mature, correctly built biosand filter is genuinely effective against bacteria and, especially, protozoa like *Giardia* and *Cryptosporidium*, often exceeding 99% removal once ripened. Virus removal is the real weak point, and it's worth being honest about rather than repeating a confident-sounding percentage: published results vary enormously by virus type and filter maturity, with at least one peer-reviewed bench study finding reductions as low as 50% for some virus surrogates, well short of the World Health Organization's own minimum performance target for household water treatment.

WARNING

Never rely on filtration alone if you suspect viral contamination

This is the same rule this site's Water Purification guide already gives for commercial filters, and it applies here without exception: no filter, biosand or commercial, should be trusted alone against a water source that might carry human sewage (a flooded municipal line, a compromised septic system). Pair this filter with a disinfection step, boiling, bleach, or chlorine dioxide tablets, on the same schedule you'd use for any other filtered water. Treat the biosand filter as the sediment and bacteria/protozoa stage of a two-stage system, not a complete one by itself.

Charcoal's real role: taste and odor, not purification

Some biosand builds add a charcoal layer, and it's worth understanding exactly what that layer is doing, because it isn't purification. Raw charcoal from a wood fire has a surface area of roughly 2 to 5 square meters per gram; commercially activated carbon, steam- or chemically-treated specifically to open up its pore structure, reaches 500 to 1,500 square meters per gram, a hundred to a thousand times more adsorption surface. Homemade charcoal will noticeably improve taste and odor and adsorb some organic compounds. It will not reliably remove bacteria, viruses, or protozoa, and it does nothing for dissolved minerals, nitrates, or most chemical contamination.

If you're pairing a charcoal stage with chlorination, order matters

Activated carbon and raw charcoal both adsorb free chlorine. If a charcoal layer sits after your disinfection step, it will strip the chlorine residual you just added, the exact thing meant to keep the water safe through storage. Put any charcoal stage before disinfection, never after.

Maintenance: swirl and dump first, scrape only as a last resort

When flow slows to a crawl, the sand surface has clogged, not failed, and the fix that actually preserves the biolayer is "swirl and dump," not scraping. Pour about a gallon of water into the empty filter, use a clean hand to gently swirl just the top layer of sand so the trapped dirt suspends in the water, then pour that dirty water off the top before it settles back down. Smooth the sand surface flat again and repeat two or three times until flow noticeably improves. This works because it resuspends and removes the clogging sediment without stripping away the living schmutzdecke itself, the way scraping does.

Reach for scraping only when repeated swirl-and-dump no longer restores flow. Drain the standing water, then scrape off the top 1 to 3 centimeters of sand, the clogged schmutzdecke layer, and remove it. Refill with water and let it sit and recirculate for several hours before returning to normal use, giving a new biolayer time to begin establishing. Municipal slow sand filtration plants run this same scrape-and-rest cycle on a rotation of multiple beds so treatment never fully stops; a household filter just goes offline for a few hours instead. Once repeated scrapings have thinned the sand bed down to within about 10cm of the minimum 45-50cm depth, stop scraping and add fresh, properly screened sand back on top instead, continuing to scrape a bed that's gotten too shallow starves the biolayer of the depth it needs to work.

Before you need it

The Water & Food addendum's own goal is owning at least two independent water treatment methods so a single point of failure doesn't leave a household without safe water. A biosand filter is a strong second method precisely because it doesn't depend on a replaceable cartridge, but only if it's already built, already ripened, and already tested with your own water before an emergency is the first time you need it working. Build it now, run water through it for the several weeks the biolayer needs, and confirm your own flow rate matches what you'd expect from the table above before counting on it.

Sources

- CAWST biosand filter design specifications, grain size, flow rate, and maintenance guidance: biosandfilter.org; emergency-wash.org; Wikipedia, citing CAWST
- Slow sand filtration hydraulic loading, biolayer maturity, and grain-size/removal-efficacy comparison: "Slow Sand Filters for the 21st Century: A Review," PMC
- Bench-scale biosand filter bacteria and virus reduction study: PMC
- WHO International Scheme to Evaluate Household Water Treatment Technologies, performance targets: WHO
- CAWST, the multi-barrier approach to safe drinking water: CAWST
- CDC, household water treatment options including slow sand filtration: CDC; CDC, slow sand filtration
- Activated carbon adsorption capacity and limitations versus raw charcoal: Wikipedia; University of Kentucky Cooperative Extension
- Household-scale drum biosand filter design: biosandfilter.org
- History of slow sand filtration, Chelsea Waterworks and the Metropolis Water Act 1852: Wikipedia; Wikipedia
- Diffuser plate placement and dimensions: Clean Water for Laymen
- Swirl-and-dump maintenance technique: biosandfilter.org
- Home sieve analysis method for effective size and uniformity coefficient: Clean Water for Laymen
- Standing-water outlet-tube mechanism and current CAWST grain-size standard: CAWST

What to Grow: Crop Selection & Seed Saving

The Water & Food chapter's Tier 3 names Agriculture and Seed Saving in one line each. This guide is the actual how-to: which crops are worth the garden space, why open-pollinated seed is the one choice that actually matters for going indefinitely without resupply, real isolation distances for saving seed that grows true, how long saved seed actually stays viable, and what a legitimate starter seed collection looks like versus a marketing pitch.

Why this is a health question, not just a calorie one

A Tier 1–2 food storage plan built around grains, dry beans, and canned goods, the standard advice this site's own Water & Food chapter gives, covers calories well and vitamin C and vitamin A barely at all. Neither vitamin is present in any meaningful amount in basic grain-and-bean storage, and a deficiency in either doesn't show up quickly, it shows up months in, which is exactly the timeframe Tier 3 is built for. A garden isn't a backup calorie source in that scenario, stored staples already cover calories, it's what actually prevents a real, documented, easily-avoided deficiency disease over a long enough horizon.

Scurvy, vitamin C deficiency, is the textbook example: real, well-documented, and entirely preventable with a small, steady amount of the right food. Potatoes are the historically important case here, not because they're vitamin-C-dense per bite, but because they're one of the only real vitamin C sources that also stores for months; potatoes contributed roughly 20% of dietary vitamin C intake across Europe historically for exactly that reason. Cabbage carries the same advantage: genuinely storable, genuinely a real vitamin C source, unlike most vitamin-C-rich produce (citrus, berries) which doesn't keep.

What to actually plant

Split garden space roughly 70–80% toward calorie-dense staples and 20–30% toward the vitamin-completeness crops storage alone doesn't cover. Most fresh vegetables are mostly water and fiber, real nutrition, but not a meaningful calorie source; beans, grains, and potatoes are what actually get a household through a shortage calorie-wise.

Role	Crop	Why this one
Calorie staple	Potatoes	A well-tended patch realistically produces 20–50 lbs per 100 sq ft, roughly 7,000–18,000 calories; also the vitamin C crop above
Calorie staple	Dry beans	Store for years as dry seed, fix their own nitrogen in the soil, and are a real protein source stored grains alone don't fully cover
Calorie staple	Dent or flint corn (not sweet corn)	Grown for dry kernels, not fresh eating; stores as a grain, but see the seed-viability table below before counting on it as a static seed bank
Calorie staple	Winter squash	Long-storing varieties (butternut, hubbard) hold for months without any processing at all
Vitamin completeness	Cabbage and other brassicas	Stores for months in a root cellar and is a real, storable vitamin C source

Northern Utah note: pick varieties for the season you actually have

The Wasatch Front runs roughly 120–140 frost-free days, average last frost mid-to-late May, first frost late September to early October. Most seed catalogs are written for a national audience with a much longer season by default; check "days to maturity" on every variety against your own frost dates before buying, not just the crop name. USU Extension publishes region-specific planting calendars built for exactly this.

Potatoes are the one exception here: save tubers, not seed

Every other crop on this page is saved and replanted as true botanical seed. Potatoes aren't grown that way in practice, they're propagated from "seed potatoes," pieces of the tuber itself with an eye intact, because true potato seed produces genetically variable, unpredictable offspring rather than a copy of the parent plant. Set aside healthy, disease-free tubers from your own harvest for next year's planting instead of looking for potato seed packets.

Secondary crops: closing the rest of the nutritional gap

The five crops above cover calories and vitamin C. A few real gaps remain even with those solid, and a garden can close most of them, though not all.

Gap	Crop	Why this one
Vitamin A	Carrots	A real, storable vitamin A source; stores for months in a root cellar the same as the crops above
Vitamin A, calcium, iron	Kale and chard	Cold-hardy leafy greens that cover ground the cabbage above doesn't, and the same crops already worth knowing for a walipini's extended season
Storage variety, minor nutrition	Onions and garlic	Real storage crops in their own right, and the flavor variety that keeps a long-term diet from becoming the "menu monotony" problem that undermines an otherwise sound plan
Dietary fat	Sunflowers	The one real gap none of the crops above touch at all: a roughly 400-ft row presses into a few gallons of oil, enough for a household for a year
Fresh vitamin C, variety	Tomatoes and peppers	Don't store anywhere near as well as cabbage, but add real variety and are worth the space once the calorie staples above are solid
Variety, medicine	Culinary and medicinal herbs	Flavor variety for the same monotony problem, plus a direct line into Herbal Medicine & the Home Apothecary for the medicinal side

WARNING**The one gap a garden genuinely can't close: vitamin B12**

No plant crop, none, provides a reliable source of vitamin B12. This isn't a matter of picking the right vegetable; B12 is produced by microorganisms, not plants, and the handful of plant foods sometimes claimed as sources (mushrooms, fermented foods like sauerkraut) have inconsistent, unreliable amounts that don't hold up as a real dietary plan. This gap closes through animal products (eggs, meat, dairy) or a stored, shelf-stable B12 supplement, not through anything grown in a garden. See Backyard Poultry & Small Livestock Basics for the real, sourced case for keeping laying hens specifically for this gap.

Heirloom, open-pollinated, and hybrid: why the difference matters here

Open-pollinated seed comes from plants pollinated naturally, by wind, insects, or gravity, between the same or a genetically similar variety; a seed saved from an open-pollinated plant grows true to type next season.

Heirloom seed is a subset of open-pollinated with a documented history, generally in circulation before

1945 or at least 50 years, but the meaningful distinction for this guide is open-pollinated versus hybrid, not heirloom versus modern.

Hybrid (F1) seed is the deliberate first-generation cross of two specific parent lines, bred for a specific trait: disease resistance, uniformity, size, shelf life. Seed saved from a hybrid plant won't grow true next year, it reverts toward the traits of one or both grandparent lines, is less vigorous, and is far more variable. That's a real tradeoff for a normal garden, where you can just buy fresh hybrid seed every year. For a Tier 3 plan built specifically around *not* depending on outside resupply, it's disqualifying: hybrid seed is a dead end after one generation. Open-pollinated is the only choice that actually closes the loop this tier is built around.

Saving seed that actually grows true next year

How hard this is depends entirely on how the crop pollinates, not on the crop itself.

Pollination	Examples	Realistic isolation to keep varieties pure
Self-pollinating (easiest)	Beans, peas, tomatoes, lettuce	10–20 ft between different varieties of the same crop is enough; the flower pollinates itself before it even opens
Wind-pollinating	Corn, spinach, beets	Pollen travels far on wind; grow only one variety per season, or separate varieties by a few hundred feet to a mile depending on how strict you need to be
Insect-pollinating	Squash, cucumbers, melons	Bees carry pollen long distances; full commercial isolation runs up to roughly 1,500 meters (~0.9 mile). Hand-pollinating a flower yourself and bagging it before bees reach it is the realistic home-garden alternative to that much land

This is exactly why beans, peas, and tomatoes are the standard starting point for anyone new to seed saving, and why corn and squash are usually the last crops a household adds to its own seed-saving practice, not the first.

Harvesting seed: wet-processing versus dry-processing

Harvesting is a separate, physical step from the isolation work above: actually getting clean seed out of the plant once that variety is confirmed pure. Which method applies depends on whether the seed sits in wet flesh or dries down on the plant itself.

Tomatoes need fermentation, not just scooping

A tomato seed carries a gel coating with a built-in germination inhibitor, the same mechanism that stops seed from sprouting inside a still-attached, still-ripening fruit. Scoop the seeds and gel into a jar, cover with about an inch of water, and leave it loosely covered (not sealed) for 2 to 4 days at room temperature. A frothy, slightly sour-smelling film forming across the surface means fermentation has done its job, breaking down the gel and destroying the inhibitor; rinse the seeds clean in a strainer once it covers the whole surface. Spread the rinsed seeds in a single, non-touching layer on a coffee filter, paper plate, or fine mesh screen, not a paper towel, which the seeds stick to tenaciously once dry and are hard to remove from, and let them air-dry somewhere shaded with good airflow for 5 to 7 days, stirring gently once a day so the layer doesn't clump. They're ready for storage once they no longer feel tacky and snap rather than bend. Skipping this step doesn't ruin the seed outright, but germination rates come in lower and less even.

Beans, corn, and grains are dry-processed instead: leave pods or ears on the plant until they're fully dry and brittle, past the point most people think to harvest, then thresh and winnow to separate the seed from the hull and plant debris.

Step	Home method	What it's doing
Threshing	Put dried pods or ears in a sturdy bag and beat it against a hard surface, or stomp them inside a shallow box	Physically breaks the seed free of the pod, hull, or cob it's attached to
Winnowing	Pour the threshed mix between two containers in a light breeze or in front of a fan	The heavier seed falls straight down; the lighter chaff blows aside, separating the two
Screening	Pass the mix through a screen with holes just larger than the seed, then a second screen with holes just smaller	Removes debris too big or too small to be seed, a useful second pass after winnowing rather than a replacement for it

None of this requires special equipment: a bag, a fan, and a kitchen sieve or two cover most home-scale needs. The real mistake is harvesting too early, pods and ears that still have any give or green color haven't finished transferring the plant's stored energy into the seed, and seed pulled then stores and germinates worse than seed left to fully dry down first.

Storing seed so it's still viable when you need it

Store seed dry, cool, and dark: a sealed jar or bag with a silica gel packet, kept in a refrigerator or freezer, meaningfully extends viability beyond room-temperature storage in a drawer. Moisture and temperature are the two variables that actually matter, drier and colder both extend shelf life, and the two effects stack.

Typical viable storage life	Crops
1–2 years	Onions, corn
2–4 years	Peppers
3 years	Beans, carrots
4–5+ years	Lettuce, squash, tomatoes

This is the real reason this site's own "5+ year seed bank" framing needs a caveat: wheat and beans genuinely hold up that long under good storage, but corn and onion seed don't, no matter how well they're stored, and need to be regrown and re-saved on a shorter cycle to keep a viable stock on hand. A seed bank someone doesn't rotate is a seed bank that quietly stops working for exactly the crops it was counted on for.

Test old seed before you need it, not during planting season

Wrap 10 seeds in a damp paper towel, seal it in a plastic bag, and keep it somewhere warm (on top of a refrigerator works). Check germination after the timeframe listed on the seed packet, typically 5–10 days for most vegetables. If 7 or more of 10 sprout, plant normally; if 4–6 sprout, plant more thickly than usual to compensate; below that, the seed lot isn't reliable enough to depend on and should be replaced or replanted for fresh seed as soon as possible, not stored longer.

WARNING

What to avoid: the commercial 'survival seed vault' pattern

A real, honest starter seed collection exists, sold by companies that name their actual varieties, source real open-pollinated or heirloom seed, and package it appropriately for storage. What to watch for in the ones that aren't: inflated total seed counts padded with cheap, small, largely decorative seeds rather than useful food-producing varieties; vague marketing claims like "grow \$2,000 of food" with no real basis; and documented cases of mislabeled packets, tomato seed that's actually sunflower, radish that's actually fennel. Buy from a source that names specific varieties and sources real seed, not a count and a dollar figure.

Keeping the soil productive indefinitely

None of the above stays true if the same soil is planted with the same heavy-feeding crop year after year; yields decline as specific nutrients deplete. A simple rotation, legumes one year to fix nitrogen, then a heavy feeder like corn or brassicas, then a lighter root crop, then back to legumes, keeps soil productive across seasons without external fertilizer. Beans and peas are doing double duty here: a calorie crop and a soil-fertility crop at the same time. The full practice, composting, cover cropping, and closed-loop nutrient cycling at a scale meant to last decades, is covered in The Act of Thriving's Long-Run Sustainability chapter rather than repeated here; for how much land a household or community actually needs to feed itself this way, see Physical Foundation. A perennial food forest sidesteps annual rotation entirely, at the cost of years to establish instead of one growing season.

Sources

- Vitamin A sources and the beta-carotene gap, carrots and dark leafy greens: Leslie Beck Nutrition; Food and Agriculture Organization
- Calcium and iron sources among leafy greens: Leslie Beck Nutrition; National Library of Medicine
- Sunflower seed fat content and home oil-pressing yield: Wikipedia; Homesteading Family
- No reliable plant source of vitamin B12, and the real deficiency risk on an unsupplemented plant-based diet: National Library of Medicine; VeganHealth.org
- Open-pollinated, heirloom, and hybrid seed definitions and seed-saving implications: UC ANR; Gardening Channel
- Self-pollinating vs. cross-pollinating crops and real isolation distances: Old Farmer's Almanac; Seed Savers Exchange
- Tomato seed fermentation, the germination inhibitor, and wet-processing method: Garden Betty; Garden Myths
- Tomato seed drying surface and duration after fermentation: HowStuffWorks; Cultivating Flora
- Dry-processing: threshing and winnowing method for beans, corn, and grain: Hobby Farms; BC Farms & Food; Annapolis Seeds
- Calorie yield of potatoes, dry beans, corn, and winter squash per growing area: The Survival Mom; Mother Earth News
- Potatoes and cabbage as storable vitamin C sources, and the vitamin gap in basic grain/bean storage: American Journal of Potato Research; Deseret News
- Seed viability by crop and storage conditions: Illinois Extension; Iowa State University Extension
- Germination testing method: Illinois Extension
- Commercial survival seed vault marketing issues, inflated counts and mislabeling: Humbly Rooted Home

- Seed Savers Exchange, a real nonprofit seed-preservation organization (founded 1975, ~20,000 varieties):
Wikipedia; Seed Savers Exchange
- Crop rotation and nitrogen-fixing legumes for long-term soil fertility: SARE
- Wasatch Front frost dates and growing season: USU Extension regional planting calendars (this site)

Food Safety After a Power Outage

The Water & Food chapter mentions the 40°F safety line in one sentence. This guide is the actual decision-making: exactly how long refrigerated and frozen food stays safe, what order to eat it in so less of it goes to waste, when it's safe to refreeze, and how to buy extra time with ice or dry ice if the outage runs long.

The core rule

Bacteria that cause foodborne illness grow fastest between 40°F and 140°F, the "danger zone." The question that matters isn't how the food looks, smells, or tastes, it's how long it sat above 40°F and for how long. **Never taste food to decide whether it's safe;** many of the bacteria that make food dangerous don't change its appearance, smell, or flavor at all.

Use an appliance or food thermometer, not a guess, to check the actual temperature of anything you're unsure about after an outage.

How long you actually have

Appliance	Door kept closed	Action
Refrigerator	Safe up to 4 hours	After 4 hours without power, discard perishables: meat, poultry, fish, eggs, dairy, and leftovers
Freezer, full	Holds a safe temperature about 48 hours	Keep the door closed; don't open it to check unless necessary
Freezer, half full	Holds a safe temperature about 24 hours	Same rule, less buffer, since there's less frozen mass to hold the cold

Keep the door closed as much as possible in every case, opening it to look resets the clock on how fast the interior warms.

Buying more time

- **Before an outage:** keep the freezer as full as practical; a full freezer holds cold twice as long as a half-empty one. Freezer packs, bags of ice, or even frozen bottles of water tucked into empty space all add thermal mass that extends how long everything stays cold.
- **During a longer outage:** block ice or dry ice can extend a freezer's safe window substantially. As a rough guide, **50 pounds of dry ice can hold an 18-cubic-foot freezer for about 2 days.**

Dry ice safety

Dry ice is solid carbon dioxide at about -109°F. Never touch it with bare skin, it causes frostbite-like burns instantly; handle it with gloves or a thick towel. It sublimates directly into CO₂ gas, which displaces oxygen in a small, sealed space, so keep the room ventilated and never store it in a fully airtight cooler or a small closed room where someone might be overcome without warning. Keep it away from children and pets.

What to eat first

This is the part that's easy to overlook while you're focused on what's safe: the *order* you eat things in determines how much of your food survives the outage at all. FEMA and the Red Cross both give the same sequence:

1. **Fresh, perishable food first.** Refrigerated meat, dairy, produce, and leftovers have the shortest safe window (4 hours per the table above), so they're either eaten now or lost regardless of what else happens. Cooking perishable meat fully, even without a clear plan to eat all of it immediately, keeps the option to safely refrigerate or eat the cooked leftovers a bit longer than the raw ingredients would have lasted.
2. **Then the freezer.** A full freezer holds a safe temperature for about 48 hours, giving genuinely more runway than the refrigerator, but it's still a countdown, not a stockpile. Work through freezer contents next, prioritizing anything that's started to thaw over anything still solid.
3. **Shelf-stable food last.** Canned goods, dry staples, and other non-perishables aren't racing a clock the way refrigerated and frozen food are, so they're the correct thing to hold in reserve while the time-sensitive food gets used first.

Following this order does two things at once: it minimizes actual food waste, and it naturally preserves your longest-lasting supply (the shelf-stable Tier 1 stock) for whatever comes after the refrigerator and freezer contents are gone, exactly when you'll need it most if the outage runs long.

When the power comes back

Condition	Safe to refreeze or keep?
Still has ice crystals, or reads 40°F / 4°C or below	Yes, safe to refreeze or refrigerate. Quality (texture, taste) may suffer, but it's safe.
Above 40°F but you're not sure how long	If it's been more than 2 hours above 40°F, discard it. When in doubt, throw it out.
Refrigerator perishables after 4+ hours without power	Discard: meat, poultry, fish, eggs, dairy, leftovers, cut produce
Shelf-stable pantry items (canned goods, dry goods) that weren't submerged or heat-damaged	Safe to keep; the danger zone rule applies to perishables, not sealed shelf-stable food

When in doubt, throw it out

This isn't overcaution for its own sake. The cost of throwing out food that might have still been fine is inconvenience; the cost of eating food that wasn't is a foodborne illness on top of whatever emergency is already underway, at exactly the moment medical care may be hardest to reach. Treat any real uncertainty as a "discard," not a coin flip.

Before the next outage

Two cheap habits do most of the work: keep an appliance thermometer in both the refrigerator (40°F or below) and freezer (0°F or below) year-round so you're reading an actual number instead of guessing, and keep the freezer stocked with ice packs or water bottles in any empty space. Both are already on the site's own Shopping List under Water & Food.

Sources

- USDA FoodSafety.gov, "Food Safety During Power Outage" (4-hour refrigerator rule, 48/24-hour freezer rule, refreezing guidance): FoodSafety.gov
- USDA Food Safety and Inspection Service, keeping food safe during emergencies: USDA FSIS
- CDC, "Keep Food Safe After a Disaster or Emergency": CDC
- FDA, food and water safety during power outages and floods: FDA

- Dry ice quantity guidance (50 lbs / 18 cu ft freezer / 2 days) and handling safety: USDA
- Eating order during a power outage (fresh, then freezer, then non-perishable): Ready.gov; American Red Cross

Solar Cooking: Box, Panel & Parabolic

The Water & Food chapter's Backup Cooking Fuel item is about not letting one fuel type be a single point of failure for every meal. A solar cooker goes a step further: it needs no fuel at all, just direct sun, making it the one backup cooking method that keeps working even if every stored fuel runs out.

Three real types, a real tradeoff

Type	How it works	Typical temperature	Tradeoff
Box cooker	An insulated box with a clear lid and reflective flaps directing extra sunlight in; a dark pot inside absorbs the trapped heat	200-300°F	Cheapest and most forgiving; slow, more like an oven than a stovetop
Panel cooker	Several flat reflective panels focus sunlight onto a pot sealed in a clear oven bag or under a glass cover	200-250°F	Very cheap and simple to build, but the least effective of the three
Parabolic cooker	A curved dish reflector concentrates sunlight to a single focal point under the pot	Up to about 400°F	Fastest and hottest, closest to real stovetop cooking, but carries a genuine safety hazard, see below

For most households, a box cooker is the right default: cheap, safe, and good enough for slow-cooking grains, beans, and one-pot meals over a few hours of good sun.

Building a box cooker

The classic design nests two cardboard boxes with an air gap between them for insulation: an outer box roughly 28x24x10 inches around an inner box roughly 23x19x9 inches (or as small as 15x15 inches inside, if that's what you have on hand). Line the inside of the inner box, and a separate reflective lid flap, with aluminum foil, smoothed as flat as you can get it rather than wrinkled, since wrinkles scatter light instead of directing it at the pot. Paint the inner box's bottom and a metal or dark tray to hold the pot with flat, non-toxic black paint, flat outperforms gloss because gloss reflects more light away instead of absorbing it. Glaze the top opening with glass, acrylic, or clear polycarbonate sheeting sized about 1.6 to 3.2 inches larger than the box opening so it seats on a lip. Seal the gap between the two boxes with crumpled newspaper or

another insulating filler, and hold the whole thing together with white glue or wheat paste. Finally, put the actual cooking pot inside a clear, oven-safe roasting bag before it goes in the box: the bag traps humidity around the food (which speeds cooking) and keeps condensation off the glazing.

Building a panel cooker (CookKit-style)

A panel cooker is the cheapest and fastest to build of the three: a single sheet of cardboard roughly 4 feet by 3 feet, cut and folded into a pattern of about 11 flat panels that fold around the pot from multiple angles, all reflecting toward one center point rather than one flat surface reflecting in one direction. Join adjoining panels with strips of cloth about 2 inches wide, glued across the fold line as a hinge so the panels fold flat for storage and pop back into shape for use. Glue aluminum foil to the side of the cardboard that faces the pot, smoothed flat the same way as the box cooker's lining. As with the box design, put the pot itself inside a clear oven bag or under a glass cover set on a dark surface. Free, pre-cut CookKit patterns are published by Solar Cookers International if you'd rather trace a proven layout than design your own fold pattern.

How long it actually takes

Solar cooking is slow by design, plan the day around it rather than starting it like a stovetop meal. In good sun, rice takes roughly an hour; dried beans or chickpeas that have been pre-soaked take 3 to 4 hours; most one-pot meals fall somewhere in a 2 to 4 hour range. A parabolic cooker cuts this down meaningfully since it runs hotter, but even it is not a fast-food appliance. Start earlier in the day than feels necessary, and don't count on a solar-cooked meal being ready by a fixed clock time the way a stove lets you plan.

Keeping sun-cooked food out of the danger zone

Slow cooking creates a real food-safety question that a fast stovetop mostly avoids: food sitting between 40°F and 140°F, the bacterial "danger zone," lets bacteria populations double roughly every 20 minutes, and that risk climbs faster on a hot day. Food should pass through that zone in under 2 hours (under 1 hour if the ambient air is already above about 86°F), and should ultimately reach an internal temperature of 165-180°F or higher to actually be safe to eat, not just warm. Because a box or panel cooker can stall on partial cloud cover, check that the food has actually reached that internal temperature with a thermometer before eating, rather than assuming enough time in the sun means it's done.

Keeping the cooker actually facing the sun

None of these designs track the sun on their own, and output drops quickly once the reflector or panel is aimed even a little off-axis. Reposition a box or panel cooker every 30 to 60 minutes to keep it square to the sun. A parabolic cooker's narrow focal point is far more angle-sensitive and needs repositioning every 15 to 30 minutes, sometimes more often near solar noon when the sun moves faster relative to a fixed reflector angle.

A real limitation, stated plainly

A solar cooker only works in direct sun. It doesn't work at night, and it doesn't work well through heavy cloud cover. Treat it as a genuine fuel-free supplement to your stored cooking fuel, not a full replacement for it.

Water pasteurization: a faster, more certain alternative to SODIS

The Water Purification guide's solar disinfection (SODIS) method works by leaving clear water in direct sun in a covered container for a full day, relying on UV exposure and mild heat together. A solar cooker can pasteurize water faster and more certainly, since it can reach and hold the water at an actual measured pasteurization temperature (149°F for a few minutes kills the pathogens that matter) rather than relying on a full day of ambient UV exposure. A WAPI (Water Pasteurization Indicator), a small wax-filled tube that visibly melts once the water has held pasteurization temperature, makes this simple to confirm without a thermometer.

WARNING

Parabolic cookers concentrate sunlight enough to cause real eye and burn injury

A parabolic reflector can redirect over 90% of the sunlight striking it toward a single focal point, concentrating it 50 to 300 times normal intensity and reaching temperatures around 500°F there, meaning a glance at the wrong angle exposes your eye to nearly as much intensity as looking directly at the sun, with a real risk of permanent retina damage. Ordinary sunglasses are not enough protection near the focal point: use dark, UV- and IR-rated glacier-style sunglasses at minimum, and welding-grade eye protection for higher-concentration setups. When you need to reach in near the focal point, position your own body between the sun and the reflector so your shadow falls on the work area, rather than reaching in from an angle that's still exposed to the reflected beam. Solar Cookers International's own safety guidance is direct: never look at the reflector when it's aimed at the sun, and keep children away from the focal point entirely, since it can cause a serious burn

instantly. Box and panel cookers don't concentrate light nearly as intensely and don't carry the same risk; if eye and burn safety around a household with children is a real concern, that alone is a good reason to default to a box cooker.

Sources

- Cooker types, mechanism, and temperature comparisons: [HowStuffWorks](#); [SolarCooker.org](#)
- Parabolic cooker eye and burn safety: [Solar Cookers International](#); [The AMSI Project](#)
- WAPI and solar water pasteurization: [Solar Cookers International](#); [World Health Organization / SODIS Reference Centre solar water disinfection protocol](#)
- Box cooker and CookIt panel cooker construction dimensions and materials: [Solar Cooking Wiki](#); [Solar Cooking Wiki](#)
- Realistic solar cooking times by food type: [American Solar Energy Society](#)
- Food-safety danger zone for solar-cooked food: [Solar Cooking Wiki](#)
- Sun-tracking and repositioning intervals by cooker type: [Solar Cooking Wiki](#)

Collecting Water From Snow, Dew & Condensation

The Sourcing & Hauling Water guide covers finding more water from a well, an open source, rain, or a neighbor. This guide covers what's left when none of those exist nearby: pulling water from snow, dew, and the air itself, rated honestly for how much they actually produce.

Melting snow: the real technique

In a Utah winter, snow is often the most abundant water source on the property, but doing it wrong costs you more than it gives.

WARNING

Don't eat unmelted snow as a water source

Snow is mostly trapped air; melting it yourself gets back only roughly a quarter to a fifth of its volume as water, and your body has to supply the heat to melt it. Eating snow directly, or relying on it in any real quantity, uses body heat and calories fast enough to work against you, a real, documented contributor to hypothermia and net dehydration, not just an old wives' tale.

1. Melt snow with an external heat source, a camp stove, fire, or any other heat source not coming from your own body, whenever one is available at all.
2. Start with a small amount of water or already-melted snow in the pot before adding more snow; melting straight from dry snow with nothing already liquid in the pot risks scorching the pot and wasting fuel.
3. Treat the resulting water the same as any other untreated source, see Water Purification, before drinking it; snow isn't sterile just because it's frozen.
4. If no heat source exists at all, packing snow into a bottle and holding it inside a jacket against your body is a genuine last-resort trickle, not a real strategy, plan to have a stove or fire available rather than relying on this.

Dew collection

On a clear night with a real temperature drop, moisture in the air condenses on any surface that cools faster than the air around it. A large plastic sheet or tarp, laid flat and propped slightly off the ground on sticks or

rocks so air can move underneath, collects that condensation; angle it gently toward one low corner with a container underneath to gather what forms.

Realistic yield is roughly 0.1 to 2 liters per square meter of sheet per night, depending on humidity and how much the temperature actually drops overnight; a clear sky and a big day-to-night temperature swing produce more than an overcast or unusually mild night. Treat this as a genuine, repeatable supplement rather than a primary source, scale it by using more sheet area, not by expecting a small tarp to produce a household's daily needs.

Without a sheet or tarp on hand, an absorbent cloth (a t-shirt, a bandana, a chamois) dragged or dabbed over dew-soaked grass at first light works as a real backup: wring the collected moisture into a container and repeat across a wider patch of grass than you'd think necessary, since each pass picks up relatively little. Avoid dew collected near roads or from lawns that may have been chemically treated.

Dew and any water condensed this way is not automatically safe to drink: it forms on whatever surface it touches, which can carry dust, pollen, or animal droppings. Filter or boil it the same as any other untreated source before drinking, see Water Purification.

Transpiration bags

A clear plastic bag sealed tightly around a healthy, leafy, non-toxic branch, with a low corner weighted down to form a collection point, captures the water vapor the plant naturally releases through its leaves as it condenses on the inside of the bag. Gather the open end of the bag around the branch and tie it off snugly with any cordage on hand, paracord, string, a twist tie, even a rubber band, so vapor can't escape around the seal.

Detail	What to know
Bag choice	Clear, not colored or opaque; sunlight needs to reach the leaves for the plant to keep transpiring at a useful rate
Branch choice	Stick to easily identified, non-toxic broadleaf trees like oak, maple, or birch; avoid poison oak, poison ivy, and sumac entirely, a bag sealed around one of those still concentrates their irritant oils in the vapor and on the bag's outside
Realistic yield	Up to roughly 900mL per bag over a full day in good sun; a few hundred mL is a more typical result
Foliage amount	More leaves generally means more water, but packing in so much that the bag shades itself cuts yield
Plant care	Move to a different branch after about 48 hours; leaving one branch bagged longer risks real damage to the plant

Transpiration water is generally lower-risk than dew since it's been filtered through the plant's own tissue, but treat it as questionable rather than automatically safe, particularly if any leaf or bark debris ends up in the bag; filtering or boiling before drinking is still the safer default.

Solar stills: a real last resort, not a real strategy

A pit still, a hole lined with plastic sheeting over a container, with a clear sheet stretched over the top and weighted in the center so condensation drips down into the container, pulls moisture out of the ground itself using the sun's heat. It's a genuinely well-known survival technique, and it's also genuinely overrated.

1. Dig a bowl-shaped hole roughly 3 feet across and 2 feet deep in a sunny spot, ideally somewhere the soil is visibly damp.
2. Set a clean container in the center of the hole's bottom.
3. Line the inside of the hole with non-toxic green vegetation, kept clear of the container itself, to add extra moisture through its own transpiration as it heats up.
4. Stretch a clear plastic sheet across the top of the hole and seal its outer edges by piling excavated soil or sand over them, so the humid air trapped inside can't escape around the perimeter.
5. Place a small weight (a rock) at the center of the sheet, directly over the container, so condensation running down the underside drips into it instead of back onto the ground.
6. If a length of tubing is available, run one end into the container and out under the sealed edge, so the still can be sipped from a straw without breaking the seal and losing the built-up heat and humidity each time it's opened.

The honest yield, and the real criticism

A well-built pit still commonly produces only about 0.25 to 1 liter of water per day, and output drops further in cold, cloudy, or windy conditions. A real, widely-discussed criticism among experienced survival instructors is that the sweat spent digging the pit itself, especially in hot conditions, can cost more water than the still eventually produces. Treat this as a technique to know for a genuine survival emergency, not a household water strategy to plan around. Water condensed in a still is effectively distilled and safe to drink without further treatment, which is also what makes urinating directly into the pit itself, never into the collection container, a legitimate way to add moisture to the system in a genuine survival emergency: the still purifies it on the way to the container.

Two you may have heard of, rated honestly

"Atmospheric water tower" designs like Warka Water have gotten real press attention for a bamboo-and-mesh tower claimed to pull over 25 gallons a day from fog and humidity. Those numbers come from the project's own field reports; independent, third-party verification of that output is thin. Treat the claim as unproven rather than either confirmed or debunked, and don't plan around it as a real household solution.

Fog nets, large mesh panels that comb water droplets out of fog as it blows through, are a real, deployed technology with genuine success in places like coastal Chile and Morocco. They depend entirely on a climate with regular, reliable fog, which the Wasatch Front generally doesn't have; this is a real technique worth knowing about, just not one that fits Northern Utah's climate.

Sources

- Snow hydration physics, hypothermia risk, and correct melting technique: Cleveland Clinic; Adventure
- Dew collection method and realistic yield: Wikiversity, Dew harvesting; IWA Publishing, condensing surface analysis
- Transpiration bag method and yield: RECOIL OFFGRID; Off Grid World
- Solar still realistic yield and field-use criticism: DesertUSA; World Water Reserve
- Warka Water field claims: Warka Water FAQ; Smithsonian Magazine
- Fog net technology and deployed examples: Wikipedia, Fog collection
- Dew cloth-drag collection method: BattlBox
- Solar still field construction steps (soil-sealed edges, vegetation lining, sipping tube): DesertUSA; World Water Reserve

- Transpiration bag toxic-branch avoidance and sealing method: RECOIL OFFGRID

Water Testing: Strips, Labs & Field Methods

The Water & Food chapter's Water Testing Kits item names test strips for pH, chlorine, and bacteria in one breath, but they don't work the same way. This guide separates the three real tiers, strips, a mail-in lab, and field-expedient bacteria testing, and covers what each one honestly can and can't tell you.

Three tiers, not one test

Tier	What it tells you	Turnaround	Best for
Color-match strips	pH, chlorine residual, hardness, lead, nitrate, present/not-present rather than a precise value	Seconds to minutes	A fast field screen, or confirming a treatment step (like chlorination) actually worked
Mail-in lab panel	Precise, quantified results across a full contaminant panel, the most accurate option that exists	Days, and requires a working postal or courier system	An annual private-well test, or any time real precision matters and normal shipping is running
Field-expedient bacteria test	Presence/absence (or a quantified estimate) of fecal-indicator bacteria, with no lab or mail required	24-48 hours, incubated at a warm temperature	Exactly the situation this manual plans around: mail-in isn't an option, but you still need to know if a source is fecally contaminated

Reading a strip correctly, not just dipping it

A strip's own reagent pads are sensitive enough that sloppy technique gives a genuinely wrong answer, not just an imprecise one. Handle the strip by its non-reactive end, dip the pads in the water for about one second, don't leave it soaking, and shake off the excess without blotting it on anything. Wait the exact time printed on the bottle, typically 15 seconds to a minute depending on the product, before comparing colors, reading too early or too late both distort the result. Hold the strip flat and level rather than tilted, since colors from adjacent pads can bleed into each other at an angle, and compare against the chart in natural daylight rather than under artificial light, which shifts how colors read. Never touch the pads themselves with your fingers, oils transfer easily and throw off the reaction.

Your annual baseline: what to actually test for on a private well

Test annually for total coliform bacteria, nitrate, total dissolved solids, and pH, the EPA's standing recommendation for any household on a private well, not just a Tier 3/4 household. Test the full chemical panel every 3-5 years, and retest immediately after a flood, a well repair, a new baby in the house, or any change in taste, smell, or appearance. This baseline matters regardless of whether an emergency ever happens; most private wells are never tested at all otherwise.

Find a certified lab through your state health department's environmental lab directory or a national mail-in service like Tap Score or National Testing Laboratories, both ship a sterile sample kit to you first. Collect a bacteria sample with real sterile technique: use only the sterile bottle the lab sent (discard it if the seal was already broken), remove any aerator screen from the faucet, run the water for 2-3 minutes to clear the line, and fill the bottle without letting the faucet touch the bottle or your fingers touch the inside of the bottle or cap. Ship it back the same day if possible; most labs want a bacteria sample analyzed within 24-30 hours of collection.

Field-expedient bacteria testing: no lab, no mail, real methods

Two real, well-documented methods exist for exactly the situation where a mail-in lab isn't reachable. Both only detect fecal-indicator bacteria, see the warning below, but both are genuine, not improvised.

Method	How it works	Where to get it
H2S test	A WHO/UNICEF-recommended paper-strip or bottle method built specifically for low-resource and disaster settings with no institutional lab access. The sample culture turns black within 24-48 hours if hydrogen-sulfide-producing (fecal indicator) bacteria are present. Costs roughly \$1-1.50 per test to produce.	Sold pre-made in the U.S. as part of Aquagenx's CBT product line, available on Amazon and directly from Aquagenx, explicitly marketed for disaster and emergency use
Coliscan Easygel / compartment bag tests	A self-contained culture medium; add the water sample directly, no filtration or transfer step, and incubate 24-48 hours at a warm temperature. Coliform colonies turn pink, E. coli colonies turn purple.	Micrology Labs sells Coliscan Easygel directly; Aquagenx's Define/CBT II kits do the same job and are sold on Amazon, both explicitly designed for on-site field use with no lab required

You don't need a real incubator

Both methods need a warm, stable temperature (roughly 90-98°F) for 24-48 hours, not a lab incubator specifically. A warm windowsill in summer, a spot near a wood stove, or even body heat (carried in an inner jacket pocket) can hold a sample at an adequate temperature in a real off-grid situation.

WARNING

A clean result is not the same as safe water

Both the H2S test and Coliscan-style tests detect fecal-indicator bacteria only. Neither detects viruses, protozoa like Giardia or Cryptosporidium, heavy metals, or chemical contamination. A clean result means the water isn't fecally contaminated by this test's sensitivity, not that it's safe to drink untreated. Use these tests to screen a source or catch a clear red flag, and still run any questionable water through the Water Purification guide's treatment steps rather than treating a clean bacteria test as a green light to skip treatment.

Sources

- Strip test types and what each contaminant test covers: Fresh Water Systems; Water Filter Guru
- EPA private well testing recommendations: EPA; CDC
- H2S test method, WHO/UNICEF recommendation, and field use: World Health Organization; post-earthquake Haiti field study, PMC
- Coliscan Easygel mechanism and incubation: Micrology Labs; King Conservation District
- Aquagenx CBT/Define kits, U.S. retail availability and disaster/field-use design: Aquagenx
- Test strip dip time, reading window, and technique: Outdoor Fixes; ScienceInsights
- Sterile bacteria sample collection procedure: Missouri Department of Natural Resources; RMBEL

Building a Walipini: The Underground Greenhouse

The Water & Food chapter's Tier 3 Greenhouse / Season Extension item names a greenhouse as a way to extend Utah's short growing season. A walipini is a specific, real design for that: a sunken pit greenhouse that uses the earth's own stable temperature to hold cold-hardy crops through winter without burning any fuel. See Building a Jean Pain Compost Heat Mound for actual supplemental heat on top of this, since a walipini holds temperature, it doesn't generate it.

Where this comes from

In the 1990s, the Benson Institute, a humanitarian arm affiliated with Brigham Young University, built a prototype underground greenhouse with local farmers near La Paz, Bolivia, at high altitude where nighttime frost is a year-round risk. They called it a **walipini**, Aymara for "place of warmth," and published a free construction manual afterward that's largely responsible for the design spreading to North American gardeners since.

How it actually works

The core mechanism is easy to misstate: soil isn't insulation here, it's **thermal mass**. Dirt's actual insulating value is low, roughly R-0.125 to R-0.25 per inch, so matching a standard R-8 insulated wall would take on the order of 11 feet of solid soil. What a 6–8 foot pit actually buys is stability: soil at that depth holds close to the region's mean annual temperature, commonly 45–62°F across the continental US depending on location, largely immune to a single cold night the way the air above ground isn't. Add passive solar gain through an angled, south-facing glazed roof, and the combination holds cold-hardy crops well above killing temperature through winter. It doesn't add heat the way a furnace does, it buffers against losing what's already there, which is exactly why this design's real ceiling is season extension for cold-hardy greens, not tropical fruit through a hard winter.

Real design specs

Element	Spec	Why
Pit depth	6–8 ft in most of the continental US; 3–4 ft in USDA zones 3–4, paired with a taller glazed wall	Deeper reaches more stable soil temperature; shallower zones need the glazing to compensate for a colder, less stable subsoil
Orientation	Long axis east–west	Maximizes the south-facing glazed roof area exposed to low winter sun
Glazing angle	Calculated to sit perpendicular to the sun at solar noon on the winter solstice, for your specific latitude	Maximizes penetration and minimizes reflection during the weakest sun of the year, the actual design constraint that matters most
Glazing material	Twin-wall polycarbonate (8–10mm) typical	Roughly R-1.6 to R-2, 80–82% light transmission, and a real 10–15 year service life; plain poly sheeting is cheaper but degrades and insulates far less

USDA zones 4 through 8 see the clearest benefit from this design; below that, insufficient winter sun makes even a correctly built walipini struggle to hold useful daytime warmth.

WARNING

The viral '\$300 walipini' figure is a different structure than the one you'd actually build

The Benson Institute's original Bolivian pit, and the "\$300 underground greenhouse" figure that gets repeated from it, was an unframed dirt pit with loose plastic sheeting, no drainage system, and no code requirements to meet. A real North American build with proper perimeter drainage, framing, and polycarbonate glazing runs closer to \$15–40 per square foot, commonly \$2,000–6,000 for a 10×20 ft structure once professional excavation (\$500–2,000 depending on soil and access) is included. Budget for the real version, not the headline number.

Building it: the real sequence

1. Call 811 (the national "call before you dig" hotline) to get underground utilities marked before any excavation, then lay out the pit's dimensions and orientation on the ground.
2. Excavate to the planned depth, sloping the floor slightly toward one low corner or edge so water has somewhere to go rather than pooling in the middle.
3. Lay a thick layer of gravel or crushed stone across the pit floor, and install the perimeter French drain (a gravel-filled trench with perforated pipe, sloped to daylight or a dry well) before building anything

on top of it; retrofitting drainage after the walls and roof are in is a much bigger job.

4. Build the retaining walls for the pit's below-grade sides. For a timber-framed wall, set treated posts (commonly 6x6) into concrete or compacted gravel footings roughly 3 feet deep, wrap the buried portion of each post in 6-mil plastic sheeting to slow rot, then connect the posts with horizontal boards to form the wall face.
5. Frame the sloped roof structure over the walls, angled per your latitude's winter-solstice sun as covered above, then install and seal the glazing, sealing every edge and seam against drafts is what actually keeps the structure's heat retention working as designed.
6. Mound the excavated soil against the three non-glazed sides (typically north, east, and west) as an additional earth berm, adding further thermal mass and wind protection beyond the pit walls themselves.
7. Install the ventilation, a thermal chimney vent near the roof peak and ground-level intake vents, before planting anything; adding it as an afterthought after a mold or overheating problem shows up is a much worse way to learn you needed it.

What actually rules a site out

- **A high water table.** Keep at least 5 feet of clearance between the pit floor and the water table; digging into or near it turns the structure into a basin that floods rather than a stable growing space.
- **Poor drainage.** A real perimeter French drain and correct site grading are what actually prevent flooding and foundation instability, not hope that the soil drains on its own.
- **No ventilation plan.** A sunken structure traps humidity and summer heat both; a thermal chimney or ground-level passive vents are what prevent mold, disease, and a greenhouse that cooks its own crops in July.

Northern Utah note: check the water table before digging, not after

Wasatch Front groundwater runs seasonally high, commonly 0–10 feet deep in parts of the valley, peaking March through June, exactly the months a spring build is most tempting. Check actual local groundwater depth (Utah Geological Survey data, or a local well log) before committing to a full 6–8 foot pit; a shallow water table is a real, common reason to build the shallower, taller-glazed-wall version instead, or an above-grade alternative entirely. Valley-floor clay soils here also shrink and swell significantly with moisture, a real structural risk for below-grade walls that a sandier, foothill-adjacent site doesn't carry to the same degree.

Sources

- Benson Institute origin, Bolivia, and the "place of warmth" naming: Walden Labs; original construction manual: Open Source Ecology
- Soil as thermal mass versus insulation, real R-value, and mean earth temperature by depth: Greenhouse Score
- Design specs, orientation, glazing angle, and glazing material comparison: Eco-Savvy; Ceres Greenhouse Solutions
- Realistic North American construction costs versus the Bolivian original: CF Greenhouse; Craft Camp
- Water table clearance, drainage, and ventilation requirements: Charley's Greenhouse
- Wasatch Front groundwater depth and seasonal timing: Utah Geological Survey; clay shrink-swell soil risk: AccuRite Excavation
- Construction sequence (utility locating, excavation, drainage, retaining wall framing, roof framing, berming): Mother Earth News; Harvest Savvy

Building a Food Forest

The Water & Food chapter's Tier 3 Greenhouse / Season Extension item and The Act of Thriving's Physical Foundation chapter both point here for the actual design behind "permaculture" and "food forest." This guide is that design: the real 7-layer structure, how long it actually takes to become productive, and an honest look at which permaculture claims have real evidence behind them and which don't.

Assess the site before laying out a single layer

The seven layers below only work in a real arrangement if you actually know how sun, water, and wind move across your own site first, guessing at this is how a canopy tree ends up shading the exact bed that needed full sun. Spend real observation time before committing to a layout, ideally across at least one full season, not one afternoon:

- **Sun mapping:** note which parts of the site get full sun, partial shade, and deep shade at different times of day, and how that shifts through the seasons as the sun's angle changes. Sketch it on a simple base map of the property; light-demanding herbaceous and root crops go in the sunniest spots, shade-tolerant understory and groundcover plants go in what's left.
- **Water flow:** after a real rain, walk the site and note where water actually pools, where it runs off fast, and where it soaks in. Low, slow-draining spots are where a swale or a water-loving plant belongs; a spot that stays wet longest is also where root rot becomes a real risk for anything planted there.
- **Wind:** note the prevailing wind direction, since that determines where a windbreak row of hardy shrubs or trees actually helps versus where it just shades something that needed sun instead.

Put this together on one base map showing existing trees, structures, slopes, and utility lines before placing a single new plant. In the northern hemisphere, canopy trees generally belong on the north side of the design so their shadow falls away from the shorter layers rather than across them.

The real design: seven layers, not one

A food forest mimics a natural woodland's vertical structure instead of a single layer of row crops, stacking multiple productive layers into the same footprint.

Layer	What goes here
Canopy	Full-sized fruit and nut trees, spaced to let real light reach everything below
Understory	Smaller, shade-tolerant fruit trees
Shrub	Berry bushes and mid-sized fruiting plants
Herbaceous	Culinary and medicinal herbs, vegetables
Groundcover	Low, spreading edible or living-mulch plants
Vine / climber	Climbing fruit and vegetables trained up trunks and structures
Root / rhizosphere	Perennial root crops sharing soil space with everything above

The design logic is filling every niche a real forest edge would, not planting seven layers for their own sake; a small, well-planned food forest can skip a layer entirely if nothing genuinely useful fits it on that site.

An honest timeline and labor curve

This is the actual tradeoff for less land and less long-term labor: years of upfront patience and work before the system carries itself.

Phase	Timeframe	What's happening
Establishment	Years 0–3	Annuals and herbs already producing; shrubs and understory still filling in. Heaviest labor: 2–4 hours/week per 500 sq meters for weeding, watering, and pruning.
Adolescent	Years 4–7	Shrubs fruiting well, canopy trees beginning to bear. Labor drops to roughly 1–2 hours/week for the same area.
Mature	Year 8+	Full canopy, peak system productivity. Under an hour a week in most reports, with seasonal spikes for spring mulching and winter pruning.

Grafted fruit trees typically bear in 2–5 years depending on species; a full-sized canopy tree can take considerably longer to reach real productive maturity. Plan the annual and herb layers to carry real food production during those first several years, not the trees.

Real case studies, at their actual confidence levels

Two real, long-running examples are worth knowing, and they're not interchangeable.

Martin Crawford's forest garden (Devon, UK, established 1994)

One of the most cited forest gardens in the world, 2.1 acres, still running after three decades. Worth knowing honestly: even Crawford's own published material doesn't reduce the garden to a clean yield-per-acre figure, he specifically argues that comparing systems by yield alone misses what sustainability actually costs. Treat this as the best-documented example of the design holding up over decades, not a source for a specific output number.

Mark Shepard's New Forest Farm (Viola, Wisconsin, 15 years, 106 acres)

A converted row-crop grain farm turned into a commercial-scale perennial system, hazelnuts, chestnuts, walnuts, and apples, roughly 250,000 trees planted. This is the closer US-climate analog for what a mature food forest looks like at real scale, and the strongest evidence that the design works commercially, not just in a hobbyist backyard.

What the land-per-person numbers actually rest on

The oft-repeated "quarter acre per person" figure for permaculture, combining fruit trees, poultry, and aquaponics, traces back to homesteading guides rather than research; other sources put real full self-sufficiency closer to a half-acre to a full acre. The one figure with genuine research behind it, roughly 4,000 square feet per person, comes from John Jeavons' biointensive method, an intensive annual-crop spacing technique, not a food forest's perennial guild design. Treat any specific land-per-person number here as a loose planning range, not a benchmark with the same footing as a directly measured yield.

WARNING**'Dynamic accumulators' are permaculture folklore, not a documented mechanism**

Permaculture literature widely claims certain plants (comfrey is the most common example) mine nutrients from deep soil layers and concentrate them near the surface for other plants to use. A search of the actual scientific literature turns up no studies supporting this specific mechanism, and the term isn't used by soil scientists at all. What real evidence does show: a plant like comfrey has most of its roots in the top foot of soil, not deep down, and it only shows elevated nutrient levels when it's already growing in nutrient-rich soil. Chop-and-drop mulching with any nitrogen-rich green material is a real, useful practice; the specific "dynamic accumulator" framing for why it works isn't backed by real evidence.

Swales: real, but genuinely conditional

Swales, shallow trenches on contour that slow and sink rainwater, are permaculture's standard water-harvesting earthwork, and they have real evidence behind them in the right conditions: one study found trees near mulched water-harvesting earthworks grew 33% larger than those without. They're also not universal. Standard swales are only recommended on slopes under about 15%, steeper terrain risks the trapped water lubricating soil layers and triggering a slide. And a site with an already-high water table shouldn't have one at all, for the same reason that site disqualifies a walipini: there's nowhere left for the water to go. Site conditions decide whether this technique helps or actively causes a problem, not general climate alone.

Northern Utah note: real, but under-documented here

Food forests are viable in the Wasatch Front's semi-arid climate, but they're genuinely less documented here than in the wetter regions most published case studies come from. Two real regional considerations: **caliche**, a cemented calcium-carbonate hardpan real in parts of the Southwest, blocks root penetration outright where it occurs and needs checking for before committing to tree placement; and **chill-hour matching** for the canopy layer, tart cherries are more reliable than sweet cherries at Wasatch Front elevation, and any fruit variety needs its chill-hour requirement checked against local winter patterns, not just its cold-hardiness zone. USU Extension's own fruit variety recommendations are the real, regional-specific starting point rather than a generic national planting guide.

Sources

- The 7-layer food forest design: Chelsea Green
- Martin Crawford's forest garden and his own framing on yield versus sustainability: Gardens Illustrated; Agroforestry Research Trust
- Mark Shepard and New Forest Farm: New Forest Farm; Wikipedia
- Fruit tree bearing timelines and food forest labor curve by phase: GrowPerma
- John Jeavons' biointensive land-per-person figure: Ecology Action
- Dynamic accumulators, lack of scientific support: Garden Myths; Temperate Climate Permaculture
- Swale effectiveness, slope limits, and high-water-table risk: Permies; Liberation Ecology
- Arid-climate and Southwest food forest challenges, caliche: Urban Agriculture & Regional Food Systems; Caliche
- Wasatch Front fruit variety and chill-hour guidance: USU Extension

- Permaculture site assessment method (sun mapping, water flow, base mapping): Permaculture Practice; Treeyo Permaculture

Improvised Cold Storage: Root Cellars & Evaporative Cooling

The Water & Food chapter's Skills to Build section names "root cellaring" as part of food preservation without relying on grid electricity, without explaining how. This guide is that explanation: the actual temperature and humidity targets by crop, four real construction methods ranging from a buried trash can to a full earth-bermed cellar, and an honest look at what evaporative cooling can and can't do, since it's genuinely oversold online.

The real targets: temperature and humidity by crop

"Cold storage" isn't one target; different crops fail in different ways if the humidity is wrong, even at the right temperature. These figures come from university extension research, not general folk advice.

Crop group	Temperature	Humidity	Examples
Cold & very moist	32–40°F	90–95%	Beets, carrots, parsnips, turnips, celery, winter radishes, leeks, Jerusalem artichokes
Cold & moderately moist	32–40°F	80–90%	Potatoes, cabbage, apples
Cool & dry	32–50°F	50–60%	Garlic, onions

Getting the humidity wrong in either direction fails differently than getting the temperature wrong: too dry and root vegetables shrivel; too damp (or too little airflow) and mold takes over. Shelves standing 1–3 inches off the walls, not flush against them, are what actually keep air moving enough to prevent that.

Four ways to actually build this, by effort and property type

Method	Effort	Best fit
Buried galvanized trash can	Low, a weekend	Small harvest, no basement, renters or small yards
Insulated box against a north wall (garage, shed, porch)	Low–moderate, no digging	Suburban homes with an unheated outbuilding, climates where winter lows stay near 32–50°F
Window well conversion	Moderate	Homes with an existing, unused basement window well
In-ground or earth-bermed walk-in cellar	High, real excavation	Larger harvests, a permanent Tier 3 setup, enough yard and the right water table

The **buried trash can** version: drill drainage holes in the bottom, set it in a gravel-lined hole with 3–4 inches of the rim above grade, and layer produce inside separated by straw, topped with a lid, then a foot of straw, then a weighted tarp. The **insulated box** version needs plywood or rigid foam construction, protection from rain, rodents, and direct sun, and enough ventilation to avoid condensation, since it's relying on the surrounding unheated space staying in range rather than the earth's own temperature. A full **walk-in cellar** needs its floor at least 4 feet below the surrounding grade to reach stable earth temperature, and its footing dug below the local frost line, not just deep enough to look sufficient.

The **window well conversion**: pick a well on the north side of the house if there's a choice, less sun exposure means a more stable temperature. Remove the window's glass and replace it with an insulated panel, a sandwich of 1-2 inch rigid foam board glued between two layers of half-inch exterior-grade plywood, with vent holes cut through it and screened to keep out insects and mice. Cover the well itself with a sheet of OSB or plywood, weighted down, with a layer of straw bales on top for extra insulation, and insulate the well's own side walls with rigid foam if the basement side of that wall runs warmer than you want the produce to see; a warm basement wall bleeding heat into the well defeats the purpose otherwise.

The traditional zero-structure option: a potato clamp

For a large one-time harvest with no cellar at all, a **clamp**, an outdoor mound, is a real, centuries-old method that saw wide use again during WWII food rationing. Lay 6–8 inches of straw on bare soil, pile produce on top as steeply as it will hold (roughly 32–40 inches high), cover with another 6–8 inches of straw, then cap the whole mound with 6–8 inches of packed soil. Leave straw exposed at ground level and poke a few straw "chimneys" through the soil cap every few feet; the point is a slow upward airflow that vents excess moisture without losing the earth's insulating heat. A shallow drainage ditch dug around the base, with that soil used for the cap, keeps the clamp from sitting in standing water.

Evaporative cooling: real, but genuinely climate-dependent

A **zeer pot** (a porous unglazed clay pot inside a slightly larger one, wet sand packed between them, a damp cloth over the top) cools by evaporation: as water pulls out through the porous clay and evaporates, it draws heat from the inner pot. It requires no power and almost no material cost, and real research backs a genuine effect: pot-in-pot systems average a 15–27°F drop below ambient temperature, with average cooling efficiency around 67%. Build it with an outer pot roughly 2 inches wider in diameter than the inner one, and pack wet sand into that gap on all sides, plus a 1-2 inch layer in the bottom, keeping both pots' rims level with each other (or the inner one just barely higher). Keep the sand saturated, not just damp, and cover the open top with a wet cloth; the whole system's cooling comes from that sand and cloth actually evaporating, not from the clay alone.

WARNING

A zeer pot does not get as cold as a refrigerator, and most online claims oversell it

A modern refrigerator holds roughly 39°F. A zeer pot's best documented case, under true desert conditions (10–30% relative humidity, ambient temperature under about 65°F), reaches only around 43°F. Under more ordinary hot, dry conditions it typically lands closer to 55–60°F, still enough to meaningfully extend produce life, but a genuinely different, warmer target than "refrigeration." It also needs upkeep most fridges don't: water added one to three times a day, and a shaded, well-ventilated spot, since wind speed and evaporation surface area are what actually drive its performance.

The harder limit: evaporative cooling barely works at all above roughly 40% relative humidity, since the air is already too saturated to pull much more moisture out of the sand. That makes it a poor fit for the humid Southeast or Gulf Coast, and a genuinely good fit for arid and semi-arid Western climates, including Utah's, where summer relative humidity commonly runs well under that threshold.

Two mistakes that ruin otherwise correct storage

- **Storing apples (or other fruit) next to potatoes.** Ripening fruit gives off ethylene gas, which speeds up sprouting in potatoes and hastens spoilage generally. Keep ethylene producers, apples, pears, peaches, tomatoes, away from root vegetables entirely, or wrap the fruit to cut down on the gas that escapes.
- **Skipping the potato curing step.** Potatoes need 7–10 days in a warm, dark spot right after harvest to toughen their skins before they go into cold storage; moving them straight to 32–40°F skips that step and shortens real storage life. Note also that grocery-store potatoes are usually treated with a sprout

inhibitor and won't behave the same way homegrown potatoes do, worth knowing if testing a storage method before a real harvest.

Situational option: a spring house

If a property has an actual flowing spring, a small structure built directly over or beside it, using the constant year-round temperature of spring water (commonly 40–50°F) for cooling, is a genuine traditional method with centuries of use. It isn't something to build from scratch without a real spring; it's listed here for completeness, not as an option most households can pursue.

Northern Utah note: check your actual frost-line depth before digging a permanent cellar

Required footing depth (a reasonable proxy for how deep the ground actually freezes) varies significantly even within the state: 30 inches is the common minimum across Salt Lake, Davis, and Utah counties, 18 inches in St. George, and 36–48 inches or more at higher elevations like Park City. A cellar floor that doesn't clear this depth risks freezing produce in a hard cold snap regardless of how well-insulated the structure above it is. Confirm the exact figure for your specific jurisdiction with your county building department rather than assuming the valley-floor number applies everywhere.

Sources

- Crop-specific temperature and humidity targets: University of Missouri Extension, MP562; University of Alaska Fairbanks Cooperative Extension
- Buried trash can construction: Fine Gardening; Inhabitat
- Window well and insulated-box no-basement alternatives, and window-well insulated-panel construction: Our Stoney Acres; Common Sense Home
- Earth-bermed cellar depth requirements: Ecohome
- Potato clamp construction, ventilation, and WWII-era history: Wikipedia; Pocket Farm Magazine
- Zeer pot / pot-in-pot cooling performance, real temperature drop and efficiency figures: Encyclopedia MDPI; Wikipedia
- Zeer pot construction dimensions, pot-size gap, and sand-layer thickness: The Homesteading Hippy; Zeer Pot Fridge
- Zeer pot myth-busting and real achievable temperatures: Rebuilding Civilization; Zeer Pot Fridge
- Ethylene gas and produce storage mistakes: Homestead Survival Site

- Potato curing before cold storage: Melissa K. Norris
- Spring house history and function: Wikipedia; The Goschenhoppen Historians
- Utah frost-line depth by county: Sandstone Concrete Design; ProGrade Calculators

Hunting, Trapping & Field Dressing Basics

The Water & Food chapter's Tier 3 names hunting and trapping as a real self-sufficiency skill, one the manual itself says takes years of practice, not a single emergency, to build. This guide covers the actual licensing step most people skip, how the three real trap styles work, and the field-dressing sequence that decides whether a harvest turns into safe meat or wasted meat.

Get licensed before you need the skill

Every U.S. state requires a hunter education course before issuing a hunting license to anyone born after a state-specific cutoff date, and the course itself is where most of the real safety and ethics content actually lives: safe firearm handling and transport, hunting ethics and fair chase, wildlife conservation, and state-specific regulations. Some states run the full course online; others require an in-person field day before certification is complete. Do this now, while the normal licensing system still functions, not after; it isn't something a book replaces in a real emergency, and a hunter education card is typically valid for life once earned.

Trapping is regulated separately from hunting in most states and generally requires its own license. A landowner trapping their own deeded land is sometimes exempt, but check the specific state rule rather than assuming. Daily or near-daily trap checks are a legal requirement in most jurisdictions, not just an ethical preference: most states require checking restraining traps at least once every 24 to 48 hours, since an animal left longer suffers unnecessarily and the meat or pelt can spoil.

The three real trap styles

Snares, foothold traps, and body-grip traps cover most legal trapping. A snare is a simple loop of cable hung across a trail, den entrance, or fence gap an animal is already using; it's the cheapest option, the easiest to carry in quantity, and a reasonable starting point for rabbit-sized game. Build it from 3/32 to 1/8 inch stranded galvanized cable with a sliding lock, and use a breakaway lock, one that releases at roughly 350 lbs of pull, so a non-target animal like a deer or a dog can pull free rather than being held or injured. Loop diameter is state-regulated, often capped around 10 inches for most furbearer sets, so check the actual limit before building one rather than guessing.

A foothold trap uses spring-loaded jaws that clamp onto a foot or leg when the animal steps on a trigger pan in the center; it's the standard choice for mid-to-large furbearers like fox, coyote, bobcat, and raccoon, and it's built to hold the animal, not kill it outright, which is exactly why the daily-check rule matters. Setting one:

dig a shallow bed at ground level sized to the trap, sift loose dirt underneath so the pan sits level, stake it solidly so the animal can't drag it off, then check for wobble by pressing down on both jaws and both levers before covering the pan itself with a pan cover and a light sifting of dirt or leaves.

A body-grip trap closes around the animal's body or neck and is intended to kill quickly; it needs careful placement to avoid catching a non-target animal or pet. Setting one is the trap style most likely to injure the trapper, not the animal: a #220 or #330 body-grip has enough spring force to break a hand or wrist if compressed carelessly. Use setting tongs to compress both springs, not bare hands, on anything beyond the smallest sizes, and always attach the safety catch (a small metal clip that holds the frame open) before your hands go anywhere near the trigger, removing it only once the trap is fully staked and positioned.

Start narrow rather than broad: a beginner who focuses on one or two species (rabbits with snares, or raccoons with foothold traps) builds the real underlying skill, reading tracks, trails, and signs of recent activity, faster than someone who spreads a dozen trap types across unfamiliar terrain.

Field dressing: the 30-minute window that actually matters

Field dressing means removing the internal organs from a harvested animal, and the real deadline is about 30 minutes after the kill, not "sometime before you get home." Bacteria multiply fastest in the gut cavity, and every extra minute of the animal's own body heat sitting against exposed meat is working against you.

1. Wear rubber or nitrile gloves before starting, not just for cleanliness: this protects against real zoonotic disease risk, not only bacterial contamination.
2. Work with a sharp knife (a fixed 4–6 inch blade is standard) and clean hands or gloves; a dull blade tears rather than cuts and is more likely to slip.
3. Cut from the pelvic bone up to the breastbone, staying shallow enough to open the body cavity without puncturing the intestines or stomach; a punctured gut contaminates the meat around it.
4. Cut the diaphragm, the muscle wall separating the lower body cavity from the chest cavity, free along the rib line on both sides. This step is easy to miss entirely and it's the reason a reader following only steps 2 and 4 gets physically stuck: the diaphragm blocks the reach into the chest cavity until it's cut free.
5. Reach up into the chest cavity, grasp the esophagus and trachea together, and pull them free along with the rest of the connected organs, cutting away connective tissue as needed rather than tearing.
6. Skin around the tarsal (hock) glands on the legs rather than through them, and use a separate knife for any cut near them if one is available; these glands carry strong-smelling secretions that taint meat on contact with a blade or bare hands.
7. Tip or hang the carcass so any pooled blood drains; 15–20 minutes head-down against a tree, or propped on a downhill slope with the cavity braced open with a stick, both work if no tree is available.

8. Wipe the cavity out and get airflow into it immediately; don't rinse with untreated water, which can introduce more bacteria than it removes.
9. Disinfect knives and hands afterward with a 50% bleach solution, and avoid cutting through or handling the brain, spinal cord, eyes, spleen, tonsils, or lymph nodes at any point in the process; these carry the highest risk in areas with chronic wasting disease (CWD) in the local herd.

Cooling: the second deadline, right behind the first

The goal is to get the internal temperature of the meat below 40°F as fast as possible, and how urgent that is depends directly on the air temperature. Above roughly 70°F, field dress immediately and consider skinning and quartering right there to expose more surface area to cooling air, rather than waiting until you're back at a vehicle or camp. Any time the air is above freezing, and especially above 40°F, pack ice or snow directly into the open chest cavity and between the hind legs, the two places body heat retains longest.

WARNING

A warm carcass left whole overnight is a real spoilage risk, not just a quality concern

Gut bacteria and surface bacteria both grow fastest in the 40–140°F range, the same danger zone that applies to any other meat. A deer or similar-sized animal left ungutted, or gutted but not actively cooled, for several hours in mild weather can spoil from the inside out before it ever reaches a processor, with no obvious external sign until the smell or texture gives it away. Treat the cooling step as part of the harvest, not an optional finishing touch.

Quick Reference

Trap type	Best for	Check interval
Snare	Rabbit-sized game; cheapest, easiest entry point	Daily minimum, most jurisdictions
Foothold trap	Mid-to-large furbearers (fox, coyote, bobcat, raccoon)	Every 24–48 hours, check state law
Body-grip trap	Quick dispatch; needs careful non-target placement	Every 24–48 hours, check state law

Full checklist:

- Hunter education course completed and license current, before it's needed for real
- Trapping license and specific state trap-check interval confirmed, if trapping
- Fixed-blade knife (4–6 inch) kept sharp and dedicated to field use

- Setting tongs and a safety catch/gripper on hand for any body-grip trap larger than the smallest sizes
- Rubber or nitrile gloves and a bleach solution for disinfecting knives and hands after dressing
- 30-minute field-dressing window understood and practiced conceptually before a real harvest
- Cooling plan (ice, quartering, shade) ready before the season it'll actually be needed in
- State tagging and transport rules checked; they vary and change by season
- Local CWD status checked, and brain/spinal/lymph tissue avoided accordingly

Sources

- Hunter education course content and format: Hunter-ed.com; Texas Parks & Wildlife
- Trap styles and beginner technique: HuntWise; Fur Institute of Canada
- Trapping licensing and daily check requirements: Washington Dept. of Fish & Wildlife; Mississippi Dept. of Wildlife, Fisheries & Parks
- Field dressing steps and timing, including the diaphragm cut: Montana Knife Company; I Learn to Hunt; National Deer Association
- Cooling and temperature guidance: Redmond Hunt; Michigan State University Extension
- Body-grip trap setting tools and safety catch use: Trapping Today
- Foothold trap bedding, staking, and pan-cover setting procedure: Hunter-ed.com
- Snare cable specs, loop-diameter regulation, and breakaway lock requirements: Minnesota DNR; Minnesota DNR
- CWD and zoonotic-disease precautions during field dressing: CWD Alliance
- Tarsal gland contamination avoidance: Rokslide

Foraging Wild Edibles Basics

The Water & Food chapter's addendum names foraging as a real skill worth developing, and it's a real skill with real poisoning risk: some of North America's deadliest plants look almost identical to popular edible ones. This guide covers the specific look-alikes that actually kill people, the one identification rule that reliably works for the most common mistake, and why the Army's famous edibility test is a last resort, not a beginner's method.

Positive identification, not a process of elimination

The single rule that matters more than any other: never eat a wild plant based on a partial match to a picture or a vague memory of "I think this is the edible one." Multiple confirmed identification points, ideally cross-checked against a real field guide or an experienced forager, come before tasting anything. A meaningful share of plant poisonings happen specifically because a beginner matched a plant to the wrong entry in a guide, not because they ate something with zero resemblance to anything edible.

The look-alikes that actually kill people

Water hemlock is widely considered the most acutely toxic plant native to North America, responsible for dozens of confirmed deaths, and its root is the specific danger: it's been mistaken for parsnip, wild carrot, Jerusalem artichoke, and yampa, all genuinely edible roots that grow in similar wet, streamside habitat. A small taste can cause seizures within minutes. Look for the real tells, not just the habitat: a smooth, hollow stem with reddish-purple streaks or blotches, especially near the base and at the leaf nodes; leaves that are pinnately compound with sharply toothed leaflets whose veins run to the notches between teeth rather than out to the tips; and, most definitively, a root that shows internal horizontal chambers holding a yellowish, oily liquid when cut lengthwise, a feature no edible look-alike shares.

Poison hemlock, a related but different plant, causes a similar problem by resembling edible members of the carrot family like biscuitroot, and it's often confused specifically with wild carrot (Queen Anne's lace). The real tell: poison hemlock's stem is smooth and hairless with random purple or reddish blotches, while wild carrot's stem is fuzzy with fine hairs and no blotching, a distinction sometimes remembered as "the Queen has hairy legs." Poison hemlock also grows taller, often 6 feet or more, against wild carrot's roughly 3 feet, and crushed poison hemlock foliage has a musty, mouse-urine-like odor rather than wild carrot's carrot-like smell.

Death camas is the other repeat killer: several fatal poisonings happen in the U.S. most decades from confusing its bulb with wild onion or edible camas bulbs, which grow in the same range and look similar enough at a glance to fool an inexperienced forager. Beyond the smell test below, death camas leaves are grass-like but noticeably rough or slightly abrasive to the touch, where wild onion leaves are smooth, succulent, and grooved in a U-shape down the middle; death camas flowers form a loose spike of small greenish-white to cream six-petaled blooms, while wild onion flowers cluster into a rounded, bell-shaped umbel; and the death camas bulb itself is wrapped in a dark, papery coat, where a wild onion bulb is white and more conical with no dark mesh.

The one test that actually works here

Every true wild onion, garlic, and ramp has an unmistakable onion or garlic smell the moment any part of the plant is crushed or cut, no exceptions. Death camas has no onion smell at all. If a bulb that looks like an onion doesn't smell like one, do not eat it, full stop; this single smell test resolves the single most common fatal look-alike mistake in North American foraging.

Beyond these two, watch for general warning traits rather than relying on memorizing every dangerous species: milky sap, fine hairs or spines, umbrella-shaped flower clusters (the carrot family contains both prized edibles and its deadliest impostors), and any bitter almond smell, which usually signals a cyanogenic compound like amygdalin, concentrated specifically in the seeds, pits, and wilted leaves of stone fruits (wild cherry, plum, peach, apricot) and in bitter almonds, not in the ripe flesh itself. Treat these as reasons for extra scrutiny, not as blanket rules with no exceptions: dandelion and properly prepared milkweed both have milky sap and are genuinely edible, and plenty of safe carrot-family plants share the umbrella-flower shape with their dangerous relatives. The trait means look closer and confirm positively, not automatically discard, and its absence doesn't mean a plant is automatically safe either. Never eat a mushroom based on a foraging guide alone; edible and deadly mushroom species overlap enough in appearance that mushroom identification is its own specialized skill, not a subset of general plant foraging.

A plant worth actually being able to identify

Everything above is a warning list; it's worth balancing that with at least one wild edible a beginner can learn to identify with real confidence. Cattail is a strong choice: once its distinctive brown, cigar-shaped seed head has formed, there's no toxic look-alike to confuse it with at all, identified by its long, strap-like, spongy leaves and that unmistakable seed head. The one caution applies earlier in the season, before the seed head forms, when young cattail shoots can be confused with toxic iris shoots; the reliable tell there is the base of the leaves, iris leaves are flat and fan out from the base, while cattail shoots are round in cross-section. The other real caution with cattail isn't identification at all but water quality: it readily takes up pollutants from the water it grows in, so the harvest site matters as much as the plant itself.

The Universal Edibility Test is a last resort, not a method

The U.S. Army's Universal Edibility Test, developed for soldiers with no plant identification skill and no other food source, involves separating a plant into parts, testing each part for skin contact reaction, then for reaction on the lips and tongue, then eating a small amount and waiting hours between each step. It's a real, documented technique, but it exists specifically for the scenario where positive identification has already failed and eating something is the only remaining option. It doesn't detect every toxin (some poisons cause no reaction in a small test dose but real harm at a meal-sized quantity), and it takes the better part of a day to run properly. Treat it as a genuine last resort for a true survival scenario, not a shortcut around learning real identification.

When to defer to a real class

A local foraging class or guided walk, run by someone who can point at the actual plant in front of you and name it with certainty, teaches identification faster and more safely than any book alone, because a book can't correct you when you're looking at the wrong plant. This is exactly the kind of skill where a few hours with a real instructor is worth more than weeks of self-study, particularly before the first season you'd rely on foraged food for real calories rather than as a supplement.

Quick Reference

Danger	Mistaken for	Key tell
Water hemlock (root)	Parsnip, wild carrot, Jerusalem artichoke, yampa	Reddish-purple streaked hollow stem; cut root shows oily-liquid-filled chambers, no edible look-alike has this
Death camas (bulb)	Wild onion, wild garlic, edible camas	No onion/garlic smell when crushed — true alliums always have one; also rougher grass-like leaves and a dark papery bulb coat
Poison hemlock	Biscuitroot, wild carrot (Queen Anne's lace)	Smooth purple-blotched stem (vs. wild carrot's hairy, unblotched stem) and a musty, mouse-urine smell when crushed
Toxic berries/mushrooms	Edible berries and mushrooms	Positive ID from an experienced source, not a picture match
Cattail (safe once seed head forms)	N/A — no toxic look-alike once mature	Unmistakable brown cigar-shaped seed head; young shoots only risk confusion with iris (flat fan-based leaves vs. cattail's round shoot)

Full checklist:

- Positive, multi-point identification confirmed before tasting anything, every time
- The onion-smell test applied to any bulb before treating it as a wild onion or garlic
- Carrot-family plants (umbrella flower clusters) treated with extra caution given water hemlock and poison hemlock's resemblance to real edibles, and checked against their specific stem and smell tells
- General warning traits (milky sap, fine hairs, umbrella flowers) treated as reasons for extra scrutiny, not as automatic disqualifiers or automatic reassurance
- Mushroom foraging treated as its own separate skill, not attempted from general plant knowledge
- A local foraging class or experienced guide used for real identification practice before relying on foraged food
- Universal Edibility Test understood as a genuine last resort, not a beginner's shortcut

Sources

- General foraging safety rules and warning traits: GORE-TEX Brand; U.S. Fish & Wildlife Service
- Universal Edibility Test origin and steps: MasterClass; TruePrepper

- Water hemlock toxicity, look-alikes, and stem/root identification: Growit Buildit; Cowboy State Daily; Cornell Weed ID; Nevada Department of Agriculture
- Poison hemlock versus wild carrot (Queen Anne's lace) identification: Ohio State BYGL; King County, Washington
- Death camas and the onion-smell identification rule, plus leaf/flower/bulb tells: Wikipedia; Idaho Fish and Game; Gardening Chores
- Cyanogenic (bitter almond smell) risk in stone fruit pits and wilted leaves: Phys.org
- Cattail identification and the young-shoot/iris look-alike distinction: Farmers' Almanac; Survival Common Sense

Backyard Poultry & Small Livestock Basics

The Water & Food chapter's Tier 3 names small livestock, chickens most commonly, as a real self-sufficiency food source, but only mentions it as a materials line item. This guide covers why it's worth doing at all (the one real nutritional gap a garden can't close), then the actual housing, predator-proofing, and legal-check steps that decide whether a backyard flock survives its first year.

Why keep poultry at all: the vitamin B12 case

What to Grow covers eleven crops between calorie staples, vitamin completeness, and secondary nutrition, and is honest that none of them, or any plant crop, closes one real gap: vitamin B12. That's not a matter of picking a different vegetable; B12 is produced by microorganisms, not plants. Eggs are a real, practical way to close it at home.

A large egg carries about 0.6 mcg of B12, roughly 25% of an adult's 2.4 mcg daily requirement, concentrated almost entirely in the yolk. Two eggs a day covers around half the daily need, which in practice means eggs are a real, meaningful contributor to closing this gap, alongside other sources, not a complete standalone solution on their own.

WARNING

The honest caveat: an egg's B12 content depends on what the hen eats

B12 in an egg yolk directly reflects the B12 in the hen's own diet. Commercial layer feed is fortified specifically to produce B12-rich eggs; hens surviving on kitchen scraps, free-ranging, and whatever a household can grow for them, exactly the situation once commercial feed stops being available, may produce meaningfully less B12-dense eggs than the ones this math is usually quoted from. This doesn't make keeping hens pointless for this gap, but it means the food-storage answer (a shelf-stable B12 supplement, covered in the Water & Food chapter's own supply list) is the actual fallback once feed access changes, not a backup plan that never gets used.

Poultry meat carries B12 too, for households that go beyond eggs to the meat production covered further down this page. Either way, the real point stands: this is the one nutritional gap on this site that a garden, of any method, structure, or crop selection, genuinely cannot close, and animal protein of some kind is the only thing that does.

Check the local ordinance first, not last

Backyard chicken rules are set at the city or county level, not the state level, and they vary enormously between neighboring towns. Most jurisdictions that allow hens set a flock-size limit (commonly 4 to 8 birds), require the coop to sit a minimum distance from property lines (5 to 50 feet depending on the city), and ban roosters outright because of noise ordinances, even where hens are explicitly legal. Some require a one-time or annual permit through animal control or the local planning office, typically a modest fee. Call and ask before building anything; this is a five-minute phone call that avoids a coop you have to tear down later.

Space and ventilation, by the numbers

Element	Minimum	Note
Coop interior	3–4 sq ft per bird	More is better for health and reduces pecking-order stress
Outdoor run	8–10 sq ft per bird	Chickens confined below this size develop real behavioral problems
Interior height	3–4 ft to stand	5–6 ft recommended so a person can stand inside to clean it
Ventilation	1 sq ft opening per 10 sq ft floor	Placed high on the walls, near the roofline

Ventilation is easy to underrate: chickens tolerate cold far better than they tolerate a buildup of ammonia from their own droppings, so a coop that's warm but stuffy is a worse design than one that's cold but well-ventilated.

Predator-proofing: the mistake almost every beginner makes

Chicken wire keeps chickens in; it does essentially nothing to keep a determined predator out. Use half-inch or quarter-inch welded hardware cloth on every opening instead, including any gap a raccoon's or weasel's paw could reach through. Raccoons, dogs, and foxes dig, so either bury hardware cloth 18 to 24 inches straight down around the coop's perimeter or bend it into an L-shaped apron that runs 18 to 24 inches outward along the ground, which stops digging just as effectively without needing as deep a trench. Raise the coop itself at least 12 inches off the ground where practical; it removes a hiding spot for rodents and snakes underneath and adds a layer of separation from ground-level predators.

WARNING

A single hook-and-eye latch is not a real predator lock

A raccoon can open a simple hook-and-eye latch; this is one of the most common causes of an otherwise well-built coop losing its whole flock in one night. Use a two-step latch on every access door, a spring-loaded bolt or a padlocked hasp, anything a paw can't operate with one motion.

Feed, water, and daily care

A laying hen eats roughly a quarter-pound of feed a day; a commercial layer feed covers nutritional needs most households can't easily replicate from scratch, though kitchen scraps and free-ranging supplement it well. Store feed in a rodent-proof metal or heavy plastic container, not the paper bag it ships in; an open feed bag is one of the fastest ways to attract the rodents that in turn attract the predators you just spent effort keeping out. Fresh water needs daily checking, more often in freezing or hot weather, since chickens stop laying reliably within days of inconsistent water access.

Growing your own feed: real options once commercial feed stops being available

The B12 case above already flags the real problem: a hen surviving on kitchen scraps and forage alone tends to produce less nutrient-dense eggs than one on a commercial or fortified diet. These three methods are real, documented ways to improve a homegrown diet, but only one of them actually touches the B12 gap itself; the other two are worth growing for general nutrition, not as a workaround for that specific gap.

Method	What it takes	Real payoff
Black soldier fly larvae	A dedicated bin fed on food scraps and other organic waste; the colony is largely self-sustaining once established	The one method here that actually helps with B12: research has found real, bioavailable B12 in the larvae themselves, alongside 40–60% protein and calcium useful for shell strength
Sprouted grain fodder	Soak whole grain (barley is easiest; wheat, oats, and rye also work) then rinse and drain twice a day for about a week, no soil required	Sprouting measurably improves the grain's own nutrition: barley's crude protein rises from roughly 12.7% to 15.5%, and digestibility roughly doubles, from about 40% to 80%. Real, but this is a protein and digestibility gain, not a B12 one; grain is still a plant
Comfrey	A perennial patch, cut back several times a season	A real high-protein forage crop (roughly 22–27% protein) worth growing for that reason alone, not for B12

WARNING**Only the larvae actually help with B12; grain and comfrey don't, whatever you may have read**

Black soldier fly larvae are animal-derived, an insect, not a plant, which is why they can carry real B12 the way eggs or meat do. Grain and comfrey are both plants, and the B12 claims that circulate for each don't hold up the same way: comfrey's measured B12 activity is low enough that a hen (or a person) would need an unrealistic quantity to get a meaningful amount, and may reflect soil-bacteria contamination rather than anything the plant itself produces; claims that sprouting "adds" B12 to grain rest on the same shaky bacterial-contamination logic, not a documented, reliable effect. Grow all three for what they actually deliver, protein and general nutrition from grain and comfrey, protein and real B12 from the larvae, and keep the B12 gap itself resting on eggs, meat, larvae, or a stored supplement, not on grain or comfrey.

Actually running each of the three

Sprouted grain fodder: soak whole grain in cool water, at least 2 inches above the grain, for 12–24 hours, then drain and spread it no more than ½ inch deep in a shallow tray with drainage holes; deeper than that and the center mats down and molds instead of sprouting. Rinse and drain 2–3 times a day, enough to keep it moist without ever leaving standing water in the tray, standing water is what actually causes the mold and odor problems this method is prone to. Keep the trays somewhere in the 63–75°F range; direct light isn't necessary. Most grain is a usable feed mat within 6–9 days, once it's grown a few inches of green shoot on top of a solid root mat you can lift out and feed whole.

Black soldier fly larvae: the larvae harvest themselves if the bin is built right, which is most of the appeal. A simple version is a lidded tote with drain holes in the bottom, an angled ramp built inside leading up to a hole near the top edge, and a collection container mounted outside that hole. Mature larvae (called prepupae at this stage) instinctively climb up and out of the food waste searching for a dry place to pupate, crawl up the ramp, and drop through the hole straight into the collection container with no sorting required. Start a colony either by buying a starter batch of larvae from a supplier, the more reliable route for a first attempt, or by leaving the bin open outdoors in warm weather and letting wild soldier flies lay eggs in it on their own, which works but takes longer and depends on flies already being active in the area. Feed it food scraps and other organic waste at roughly 2–3 lbs per square foot of bin surface per day once established; overfeeding faster than the colony can process invites the odor and rot problems a working bin otherwise avoids.

Comfrey: most comfrey grown for feed today is the Russian variety's Bocking 14 cultivar specifically, a sterile hybrid that produces no viable seed, so it has to be started from root cuttings or crown divisions, not seed. Slice a healthy root into 2–3 inch sections and plant them horizontally about 2–3 inches deep, or divide an

established crown by cutting straight across it a couple of inches below the top and splitting that top section into pieces, each with at least one growing point. Either method establishes a new, spreading-only-by-root-fragment patch rather than the aggressively self-seeding comfrey species some other cultivars are.

Going beyond eggs: what changes for real self-sufficiency

Keeping a flock alive for eggs is a different, easier problem than treating poultry as an actual protein source. Slaughtering and processing a bird for meat is a real skill with its own learning curve, cleanliness requirements, and equipment (a killing cone, a scald pot, a plucker or the patience to hand-pluck); most first-time keepers should plan to learn this from an experienced person or a real class rather than from a written description alone, the same reasoning this manual applies to other genuinely hands-on skills. Maintaining a breeding population (keeping a rooster, incubating or letting a hen brood eggs) is the step that turns a flock into a renewable food source instead of a stock that eventually runs out, but it also reintroduces the rooster-noise problem most local ordinances exist to prevent, worth resolving before Tier 3 conditions make it moot.

Quick Reference

Step	Why it matters
Call the local ordinance office first	Flock limits, setback distances, and rooster bans are set locally, not by state law
Half-inch hardware cloth, not chicken wire	Chicken wire stops chickens from leaving; it doesn't stop predators from entering
Bury or apron the perimeter 18–24"	Stops digging predators (raccoon, fox, dog)
Two-step latches everywhere	A raccoon can open a single hook-and-eye latch
Rodent-proof feed storage	An open feed bag attracts the pests that attract predators

Sources

- Egg B12 content, daily adult requirement, and yolk concentration: [How Much Blog](#); [Topvitamine](#)
- Egg B12 content tracking the hen's own diet, and the effect of feed quality: [How Much Blog](#)
- No reliable plant source of vitamin B12: see [Sources on What to Grow](#)

- Sprouted fodder method and the real nutritional improvement from sprouting grain: Backyard Poultry; Mother Earth News
- Black soldier fly larvae protein content and home-scale raising: Hobby Farms; Morning Chores
- Black soldier fly larvae's real, bioavailable vitamin B12 content (Texas A&M research): Petfood Industry
- Comfrey protein content as poultry forage: Allotment Garden; BackYard Chickens
- Comfrey's B12 claim, low measured activity, and possible soil-contamination source: Journal of Plant Foods; Richters Herbs
- Sprouted fodder tray thickness, soak time, rinse frequency, and days to feed-ready: Mother Earth News; 104 Homestead; The Prairie Homestead
- Black soldier fly larvae self-harvesting ramp design and colony starting: Hobby Farms; Permies
- Bocking 14 comfrey as a sterile hybrid propagated only by root cuttings or crown division: Strictly Medicinal Seeds; Mad Cat Farm
- Sprouted grain's disputed B12 claim, no reliable evidence beyond possible bacterial activity during sprouting: Traditional Oven; FitAudit
- Coop space, height, and ventilation requirements: Backyard Chickens Hub; Happy Morning Farm
- Predator-proofing methods (hardware cloth, apron, latches): From Scratch Farmstead; Easy Coops
- Local ordinance variation, flock limits, and rooster bans: FlockGuide; Purina Animal Nutrition

Row Crop & Raised Bed Gardening

What to Grow covers which crops to plant and how to save their seed. This guide is the method underneath that: how to actually build a bed, prepare the soil, space and plant what you chose, deliver real water, start and harden off transplants, tell when each crop is actually ready, handle the pests that show up, and keep something coming out of the ground all season instead of one harvest and then bare dirt. This is the default growing method most households will actually use, in-ground rows or raised beds, not a food forest or a hydroponic system, both covered separately.

Raised beds or in-ground: the real tradeoff

Neither is universally better; they trade different things.

	Raised beds	In-ground rows
Spring start	Soil warms up to 5°F faster, plant earlier	Warms slower, especially in shaded or clay-heavy yards
Water	Dries out faster, exposed sides lose moisture; water more often	Holds moisture longer once established
Soil quality	You control it completely, fill with a real mix from day one	Depends on what's already there; amending takes longer to pay off
Cost & labor	Lumber or blocks plus fill soil, a real upfront cost	Free to start, but tilling or double-digging poor native soil is real labor
Fall	Cools faster too, season ends a bit sooner than the spring gain suggests	Holds warmth longer into fall

A raised bed is the better call on a site with poor or contaminated native soil, a short season where every early-spring week matters, or a gardener who can't kneel to ground level. Straight in-ground rows are the better call on a site that already has decent soil and more space than budget for lumber and fill dirt.

Building a raised bed, if that's the choice

Material	Spec	Why
Lumber	Untreated cedar or pine 2×6 or 2×12 boards	Untreated wood avoids chemicals leaching into food soil; cedar resists rot longer than pine but costs more
Height	Minimum 6 in., ideally 12 in. or more	6 in. works for shallow-rooted greens; 12 in.+ gives root crops and tomatoes real depth and holds more of the good fill soil you're paying for
Footprint	Max 4 ft. wide, any length up to 8–10 ft. before it needs a center brace	4 ft. keeps every part of the bed reachable from the side without stepping into it and compacting the soil
Hardware	Corner brackets or 3 in. deck screws driven through pre-drilled pilot holes	Screws through end-grain without a pilot hole tend to split cedar; brackets are the simpler option for a first build

Assembly is straightforward: cut boards to length, screw or bracket the four corners into a rectangle, and set it directly on cleared, leveled ground, no bottom needed. Fill with the same real mix described in the bed-prep section below rather than bagged topsoil alone. A bed longer than 8 feet benefits from a center cross-brace (a board running the short way, screwed to both long sides) to keep the sides from bowing outward once full of wet soil.

Bed prep: getting the soil ready before anything goes in it

Whichever you choose, the soil itself is what actually grows the plant, not the structure around it. Work compost or aged manure into the top 8–12 inches before the first planting; a raised bed's fill soil should be a real mix (topsoil, compost, and a coarse material like perlite or coarse sand for drainage), not just bagged topsoil on its own, which compacts hard over a season. In-ground beds with heavy clay, common along the Wasatch Front, benefit from the same compost addition plus avoiding working the soil while it's wet, which breaks clay into compacted clumps that take a full season to recover from.

The tool list for all of this is short: a spading fork or shovel to turn and amend soil, a hard rake to level it, hand trowel for transplanting, hoe for weeding between rows, and a pair of pruners or scissors for harvest and staking work. None of it needs to be specialized; a basic set covers everything in this guide.

Spacing: intensive beats traditional rows in a home garden

Traditional row spacing, with 18–36 inches left bare between rows, was designed for a tractor or a hand-pushed cultivator to pass through, not for a bed you tend by hand from the sides. In a raised bed or a hand-tended in-ground plot, that aisle space is just wasted growing area. Intensive spacing, planting in a grid or offset pattern close enough that mature leaves just touch, fills 30–50% more of the same bed and can raise total yield meaningfully for crops like bush beans, since the plants shade out weeds and hold soil moisture for each other instead of leaving bare dirt to dry out and weed.

The real limit: plants still compete for light, water, and nutrients even at the closer spacing intensive methods recommend, so don't crowd tighter than a variety's own seed packet or plant tag says just because the bed has room. A denser stand of smaller plants usually still out-produces a sparser stand of larger ones per square foot, but only up to the point the packet's own spacing already accounts for.

Watering: depth and frequency, not a daily habit

Most vegetables need roughly 1–1.5 inches of water a week, from rain, irrigation, or both, delivered deep enough to reach 6–8 inches into the soil, which is where most of a vegetable's actual root mass sits. Watering shallowly and often trains roots to stay near the surface, where they dry out faster and are more exposed to heat; watering deeply and less often pushes roots down into soil that stays moist longer between waterings.

Soil type	Realistic frequency
Sandy, fast-draining	2–3 times a week
Loam or clay, holds moisture	Once or twice a week
Raised bed (any soil)	More often than the same soil in-ground, exposed sides dry it out faster

Check before watering rather than watering on a fixed calendar: if the soil is still damp 2 inches down, wait. A finger pushed into the soil tells you more than a schedule does.

To actually deliver that inch of water rather than guess at it: set a straight-sided container (a tuna can works) in the bed and run a sprinkler or soaker hose until it collects 1 inch, then note how long that took, that's your baseline watering time going forward. A soaker hose or drip line laid along the base of the plants is the more efficient choice over a sprinkler for a bed of any real size: it puts water at the root zone instead of on the leaves, where standing moisture invites fungal disease, and loses less to evaporation and wind drift. A watering can or hose-end wand works fine for a single raised bed; for anything larger, the up-front cost of a soaker hose pays for itself in water saved and disease avoided.

Succession planting: how to actually get a continuous harvest

A garden planted all at once in spring produces a glut for a few weeks and then nothing. Succession planting staggers when things go in the ground so something is always coming ready.

- **Same crop, staggered starts.** Plant a new round of a fast crop (lettuce, radishes, bush beans, spinach) every 1–3 weeks instead of all of it on one day, so each round finishes as the last one is picked out.
- **Replace as you harvest.** The moment an early crop (spinach, peas) is done for the season, pull it and plant a second crop, a heat-lover if it's now summer, or a fall crop like more spinach or brassicas if the season's turning.
- **Stagger varieties, not just planting dates.** Planting an early-maturing and a late-maturing variety of the same crop on the same day spreads the harvest without any extra planting trips.

Northern Utah note: plant by hardiness group and real frost dates, not a national seed packet

USU Extension groups Wasatch Front vegetables into hardiness bands with their own planting windows: hardy crops (broccoli, cabbage, onions, peas, spinach) from roughly March 1–April 15; semi-hardy crops (beets, carrots, lettuce, potatoes) from March 20–May 1; tender crops (beans, corn, cucumbers, squash) only after the real risk of frost passes, roughly May 5–June 1. Actual last-frost dates vary by 5 weeks across the Wasatch Front itself, April 17 in Bountiful versus May 21 in Provo, so check your own city's average last frost, not a generic Utah date, before starting the tender group.

Planting the five staples this site actually recommends

What to Grow names five crops worth the real garden space: potatoes and dry beans and corn and winter squash for calories, cabbage and other brassicas for the vitamin C storage alone doesn't cover. Here's how to actually plant each one in a row or raised bed.

Crop	Depth & spacing	Real technique
Potatoes	Seed pieces (1.5–2 oz, one eye each) 3–5 in. deep, 10–12 in. apart, rows 30–36 in. apart	Hill soil 4 in. up the stem once plants reach 6–8 in. tall, and again as they grow, until hills are about 12 in. high. Hilling isn't optional: tubers exposed to light turn green and produce solanine, a real toxin, not just a cosmetic issue.
Dry beans	1 in. deep, spaced per variety, bush types tolerate intensive spacing well	Direct-seed after the real risk of frost passes. Leave dry-bean pods on the plant until they rattle and the plant itself has died back; pulling them early for a bigger harvest defeats the point of a dry-storage crop.
Corn (dent or flint)	1–1.5 in. deep, 8–12 in. apart, rows 30–36 in. apart	Plant in a block of several short rows, not one long row: corn is wind-pollinated, and a block lets pollen actually reach neighboring plants reliably, the same isolation logic What to Grow covers for seed-saving applies to getting a good ear in the first place.
Winter squash	1 in. deep, sprawls 4–6 ft. per plant left on the ground	Trellis it instead of letting it sprawl: one trellised plant realistically yields 20–40 lbs from as little as 16 sq ft, a real space advantage in a raised bed, and the vines get better airflow off the ground, which means less fungal disease too.
Cabbage and other brassicas	Transplant, not direct-seeded from scratch in most home gardens; space 12–18 in. apart	Part of the hardy group, plant among the earliest things in the ground in spring per the Northern Utah note above.

Corn, beans, and squash together: the Three Sisters, a real, evidence-backed pairing

Plant all three staples together on the same mound and they do real work for each other: corn gives beans something to climb, beans fix nitrogen the corn and squash both use, and squash's broad leaves shade out weeds and hold soil moisture. Build mounds 18–24 in. across and 4–6 in. high, spaced 3–4 ft. apart center to center. Plant corn first; once it reaches about 4 in. tall (roughly 2–3 weeks later), plant pole beans, not bush beans, around each stalk; three to four weeks after the corn, plant squash between the mounds. Documented yields run 50–110% higher per square foot than growing the same three crops separately, a real, measured number, not a permaculture folklore claim.

Planting the secondary crops that round out the diet

What to Grow also names six secondary crops that close real gaps the five staples above leave open: vitamin A, calcium, iron, dietary fat, and the flavor variety that keeps a long-term diet from becoming monotonous. Here's how to plant them.

Crop	Depth & spacing	Real technique
Carrots	$\frac{1}{4}$ – $\frac{1}{2}$ in. deep, thin to 3 in. apart, rows 12–18 in. apart	Thin seedlings rather than sowing at final spacing; crowded carrots stay stunted and forked instead of growing straight
Kale and chard	$\frac{1}{4}$ – $\frac{1}{2}$ in. deep, 12–18 in. apart	Part of the hardy group, plant early alongside cabbage; both tolerate light frost and are worth succession-planting into fall for a second round
Onions	$\frac{1}{2}$ –1 in. deep, 3–4 in. apart	Stop watering as bulbs mature and the tops begin to fall over; excess water at that stage delays curing and causes real storage problems later
Garlic	Cloves 2–3 in. deep, 3–4 in. apart, rows 6–10 in. apart	Plant in fall for a summer harvest, not spring; the same curing caution as onions applies once it's time to pull
Sunflowers (oilseed type)	1–1.5 in. deep, 6 in. apart, rows 30 in. apart	Choose an oilseed variety specifically, not an ornamental one, if the goal is pressing oil rather than just cut flowers
Tomatoes and peppers	Transplant after the real risk of frost passes	Tender crops in the same group as beans, corn, and squash for Wasatch Front timing; stake or cage tomatoes rather than letting them sprawl
Culinary and medicinal herbs	Varies widely by herb	Most tolerate the same intensive spacing as vegetables; see Herbal Medicine & the Home Apothecary for which ones are actually worth the bed space

Tomatoes and peppers have to be started indoors weeks before they ever see the garden

Neither reaches transplant size from a direct-sown seed before the Wasatch Front season is over. Start tomato seed indoors 6–8 weeks before your local last-frost date, and pepper seed 8–10 weeks before, peppers are slower to germinate and grow. Once seedlings have their first true leaves and outdoor nights are reliably above 50–55°F, harden them off over 7–14 days: set them outside in a sheltered, shaded spot for an hour or two the first day, and increase both sun exposure and time outdoors a little each day, before transplanting into the bed. Skipping the hardening-off step, moving a windowsill seedling straight into full sun and wind, commonly scorches or kills it within days even after the frost risk itself is gone.

Knowing when it's actually ready to harvest

Several of these crops don't announce their harvest window the way a ripe tomato does; picking on a guess instead of a real cue either wastes weeks of growing time or ruins a crop meant to store.

Crop	Real ripeness cue
Potatoes	Vines yellow and die back for a full storage crop; a few new potatoes can be dug earlier once plants flower. After digging, cure in a dark spot at 55–60°F for 10–14 days before moving to cold, dark 40–45°F storage; skipping the cure shortens storage life significantly
Winter squash	Skin resists a fingernail pressed into it, and the stem has begun to dry and turn brown. Cure most types at 80–85°F for 10–14 days to harden the skin further and sweeten the flesh; acorn squash is the exception and doesn't need curing
Onions	Tops yellow, then fall over and dry at the neck on their own; don't bend them down early to force this. Cure in a warm, dry, well-ventilated spot out of direct sun for 2–3 weeks until the necks are fully dry and papery before storing
Garlic	Bottom 3–4 leaves have browned while several upper leaves are still green; pulling too late causes the bulb wrappers to split and rot in storage. Cure the same way as onions, warm, dry, ventilated, out of the sun, for 3–4 weeks
Corn (dent or flint, for dry storage)	Husks and silks have turned fully brown and dry, ideally after a light frost; kernels show a visible dent at the crown as the soft starch inside shrinks. This is a different, later cue than sweet corn's milk-stage harvest, don't use sweet-corn timing on a dry-storage variety
Dry beans	Pods have dried, browned, and rattle when shaken, and the plant itself has largely died back, as already noted above
Cabbage	Head feels solid and dense when squeezed, not spongy; harvest before it splits, which happens if it's left too long after reaching full size, especially after rain
Carrots	Shoulders (the top of the root, visible at soil level) reach ½–¾ inch across for most varieties; taste-test one before pulling the rest if unsure
Sunflowers (oilseed, for pressing)	Back of the flower head turns from green to yellow-brown and petals drop; cut the head and finish drying indoors before threshing out the seed

When something's actually eating the crop

Three pests account for most of the damage a home garden along the Wasatch Front actually sees.

Pest	How to identify it	What to do
Aphids	Small (pinhead-size) green, black, or gray insects clustered on new growth and leaf undersides; sticky honeydew residue and curling, yellowing leaves are the giveaway even before you spot the insects themselves	A strong jet of water knocks most of them off; insecticidal soap handles a heavier infestation. Check new transplants before they go in the bed, aphids travel in on nursery stock
Cabbage worms	Pale green caterpillars, well camouflaged against cabbage-family leaves, plus small white or yellow butterflies fluttering low over the bed during the day, those are the adults laying eggs	Floating row cover over brassicas from transplant onward keeps the egg-laying adults off entirely; without cover, hand-pick worms and look for the ragged holes and dark green droppings that mean they're already present
Squash bugs	Flat-backed, brownish-gray adults and clusters of bronze, football-shaped eggs on the undersides of squash leaves; wilting that starts at the base of the plant and spreads is the field sign	Check leaf undersides weekly starting when plants are small and crush egg clusters by hand; adults hide under boards or mulch near the plant base overnight and can be trapped and destroyed that way

What this doesn't replace

Crop rotation and soil fertility over multiple seasons are covered in What to Grow rather than repeated here. For extending the season earlier in spring or later into fall beyond what succession planting alone buys, see Building a Walipini and its own growing-technique guide, Growing in a Walipini. If the goal is a low-labor perennial system instead of an annual bed replanted every year, see Building a Food Forest.

Sources

- Raised bed versus in-ground tradeoffs, spring soil warming rate: University of Maryland Extension; USU Extension
- Potato planting depth, spacing, and hilling technique, including the greening/solanine risk: Savvy Gardening; University of Minnesota Extension; Grow a Good Life
- Winter squash trellising, vine spacing, and yield-per-square-foot: Epic Gardening; Abundant Mini Gardens
- Three Sisters mound technique, planting sequence, and documented yield increase: Old Farmer's Almanac; LawnsGuide; University of Arkansas Extension
- Corn spacing and block planting for wind pollination: USU Extension, Wasatch Front Vegetable Chart
- Carrot, onion, and garlic planting depth, spacing, and curing/storage technique: USU Extension, Carrots; USU Extension, Onions; USU Extension, Garlic

- Sunflower planting depth, spacing, and oilseed variety selection: EOS Data Analytics; West Virginia University Extension
- Intensive/square-foot spacing versus traditional row spacing, yield comparison: Old Farmer's Almanac; Simply Smart Gardening
- Watering depth, weekly amount, and soil-type frequency: USU Extension; University of Maine Extension; Clemson HGIC
- Succession planting methods and interval scheduling: West Virginia University Extension; University of Maryland Extension
- Wasatch Front vegetable hardiness groups and planting dates, real last-frost variation by city: USU Extension; USU Extension, Wasatch Front Planting Dates
- Clay soil handling, avoiding tillage while wet: USU Extension
- Raised bed construction, lumber choice, height, and footprint: University of Maryland Extension; Savvy Gardening
- Effective watering delivery methods, soaker hose and drip versus overhead sprinkler: USU Extension; Clemson HGIC
- Tomato and pepper indoor seed-starting timeline and hardening-off procedure: USU Extension; University of Minnesota Extension
- Potato, onion, and garlic curing procedures for storage: University of Minnesota Extension; USU Extension; USU Extension
- Winter squash curing and ripeness test: Epic Gardening; University of Minnesota Extension
- Dent and flint corn harvest timing, dent stage, and dry-down distinguished from sweet corn's milk stage: Gardener's Path; Ask Extension
- Cabbage harvest timing and head-splitting risk: University of Minnesota Extension
- Aphid, cabbage worm, and squash bug identification and home-garden treatment: Penn State Extension; IFA Country Stores

Growing in a Food Forest

Building a Food Forest covers the design: the seven layers, the establishment timeline, and which permaculture claims actually hold up. This guide picks up once that design is in the ground: how to actually plant the tree itself, what to plant around it and how far apart, how and when to prune the fruiting layers with the right tool, how to spot the pests and disease that actually show up, how to tell fruit is ready, what polyculture pest management can and can't do, and how to stagger harvest across layers that mature on completely different timelines.

Planting the tree itself: the step guild design skips over

Building a Food Forest covers layout and spacing; this is the actual mechanics of getting a tree into the ground so it survives to be worth building a guild around.

Dig the hole no deeper than the root system itself, planting too deep is the single most common cause of a new tree failing, and about two to three times as wide as the roots' spread, for a bare-root tree, or three times the width of the container for a potted one. The goal is a hole depth equal to the distance from the trunk's flare (where it visibly widens into the roots) to the bottom of the root mass, so the flare sits right at, or very slightly above, the final soil surface once backfilled; a grafted tree's graft union (the visible bulge or scar low on the trunk) should sit 4–6 inches above the soil surface, or 2–3 inches for a dwarf or semi-dwarf rootstock. Backfill with the same native soil that came out of the hole, broken up but not heavily amended, research consistently finds trees establish just as well in unamended native soil, and firm it gently as you go to remove large air pockets without compacting it hard. Water in thoroughly right after planting to settle the soil around the roots.

Staking is the exception, not the default: most young trees don't need it, and a little trunk movement in the wind actually builds the reaction wood that makes a trunk structurally strong over time. Stake only on a genuinely exposed, windy site or with an extremely dwarf rootstock that can't support its own top growth yet, and remove the stake within a year once the tree can stand on its own.

Guild composition: what actually goes around a fruit tree

A guild is a small cluster of plants placed around a central fruit tree so each does a real, specific job: something to fix nitrogen into the soil, something to attract pollinators or the insects that eat pests, something to physically compete out weeds, and something to deter a specific animal pest.

Job	Real examples	What it actually does
Nitrogen-fixer	White clover, blue wild indigo, goumi or sea buckthorn at the drip line	Bacteria in these plants' root nodules convert atmospheric nitrogen into a form the soil, and the tree, can use
Pollinator/predator attractor	Yarrow, anise hyssop, mountain mint, borage	Draws in bees for fruit set, and predatory or parasitic insects that keep aphids and other pests in check
Groundcover/weed suppressor	White clover, low-growing herbs	Physically occupies the soil surface a weed would otherwise colonize, and holds moisture
Animal deterrent	Daffodils at the inner ring	Toxic to voles and deer, planted close to the trunk specifically to discourage them from girdling bark or roots

Comfrey shows up in almost every published guild design, and it earns its place for a real reason: it's an excellent chop-and-drop mulch plant, cut back several times a season and dropped at the base of the tree as green mulch. That's a genuinely useful practice on its own. It is not, as Building a Food Forest already covers, evidence of comfrey mining nutrients from deep soil layers, a specific mechanism the scientific literature doesn't actually support. Plant it for the mulch, not the folklore.

Where each ring actually goes: keep herbaceous guild plants at least 24 inches out from the trunk itself, closer than that competes directly with the tree's own root flare. Animal-deterrent plants like daffodils go in the innermost ring, 6–12 inches from the trunk on a young tree. Most of the working guild, nitrogen-fixers, attractors, and groundcover, sits from there out to the tree's drip line, roughly 6–15 feet from the trunk depending on the tree's eventual size; that's the zone the tree's own roots actively forage in, so it's also where a guild does the tree the most good. Plant the guild at the same time as the tree or within its first season, rather than waiting for the tree to establish first; an empty ring just becomes bare soil a weed colonizes before the guild ever gets planted.

Using the establishment years for the staples this site actually recommends

Building a Food Forest's own labor curve shows years 0–3 with full sun still reaching the ground between young, not-yet-productive canopy and understory trees, exactly the gap What to Grow's recommended annual staples can use instead of sitting bare or going to weeds. Corn, dry beans, and winter squash, three of that guide's five recommended crops, are the classic Three Sisters combination: corn gives the beans something to climb, the beans fix nitrogen the whole planting uses, and squash's broad leaves shade out

weeds and hold soil moisture, the same real, evidence-backed pairing covered in full in Row Crop & Raised Bed Gardening. Plant it in the sunny gaps between young trees during exactly the establishment years when a food forest isn't feeding anyone on its own yet.

Potatoes fit the same establishment-year logic in the root layer, in loose soil between young trees rather than fighting the developed root systems mature trees eventually have. Cabbage and other brassicas are less of a fit here: they're a true annual bed crop most years, better suited to the row-crop or raised-bed method than woven into a perennial guild, though a bed of them in a sunny establishment-year gap works exactly like it would anywhere else. None of the five recommended staples belongs in the mature system's own layers once canopy closes; that's the tradeoff Building a Food Forest's labor curve already describes, years of open ground giving way to a closed, low-labor perennial canopy that doesn't have room for row crops anymore.

Secondary crops: one belongs here permanently, the rest just for establishment

What to Grow's six secondary crops split the same way the five staples do, mostly establishment-year fillers, with one real exception.

Culinary and medicinal herbs are the exception, and they're not really a workaround here at all:

herbaceous plants, including herbs, are already one of the seven real layers in Building a Food Forest's own design. Perennial herbs (oregano, thyme, chives, many mints) belong in the mature system permanently, doing guild work (pollinator attraction, groundcover) and kitchen work at the same time. Annual culinary herbs (basil, cilantro) behave like the establishment-year annuals below instead, useful in the sunny gaps while they last, then replaced as canopy closes.

Carrots, onions, and garlic follow potatoes into the root layer during the establishment years, for the same reason: loose, undisturbed soil between young trees rather than a fight with mature root systems later. Sunflowers and tomatoes or peppers follow corn and squash into the sunny establishment-year gaps, useful annual production while the canopy fills in, and equally not something the mature, closed system has room or light for afterward. None of these five change the underlying tradeoff Building a Food Forest already describes: real annual production for a few years, in exchange for a low-labor perennial system once the canopy actually closes.

What the evidence actually says about polyculture and pests

The honest picture is real but more limited than permaculture writing sometimes implies. Reviews of the research find that diverse plantings genuinely reduce specialized pest loads and slow the spread of insect-

transmitted plant viruses, largely through two real mechanisms: a pest has a harder time finding its one preferred host plant in a mixed planting than in a monoculture block of it, and a more diverse planting supports more of the predator and parasitoid insects that eat pests. That's a real, evidence-backed effect, not folklore.

What the same research is honest about: results are inconsistent crop to crop, some companion plants can themselves harbor pests or disease rather than deterring them, and the mechanism is genuinely more complex and less predictable than a simple pairing chart suggests. Treat guild planting as a real, useful layer of pest management, not a substitute for watching your own trees and stepping in when something specific shows up.

Pruning the fruiting layers

Prune fruit trees and cane berries while they're dormant, after the coldest part of winter has passed but before new growth starts, typically late January through early March in northern Utah. Pruning too early in fall or winter, or too late once growth has resumed, both increase the tree's exposure to cold damage or disease. Dormant-season pruning has three real advantages: most tree diseases are inactive too, so cuts are less likely to introduce infection; the tree isn't putting energy into leaves you're about to remove; and bare branches make the actual structure, and any dead or crossing wood, easy to see.

- **Remove dead, damaged, or diseased wood first.** Cut back to healthy wood, or to the branch collar if removing the whole limb, before making any shaping decisions.
- **Thin to open the canopy.** Good light and airflow through the center of the tree improves fruit bud development and fruit quality, and reduces the humid, still air that fungal disease needs.
- **Leave the branch collar intact.** Cutting flush with the trunk removes the tissue the tree actually uses to heal the wound; cutting too far out leaves a stub that dies back. Cut just outside the collar, not through it.

Finding the branch collar in practice: look for a slightly raised ridge in the bark where the branch meets the trunk, and often a subtle swelling just below it, that's the collar. The branch bark ridge (where the bark itself rises up in a line mirroring the branch's angle) marks the top edge of the correct cut; angle the cut down and away from the trunk from there, just outside the collar's swelling, never flush against the trunk itself.

Branch diameter	Right tool
Up to 1 in.	Bypass hand pruners (the curved-blade type that slides past a lower blade like scissors, not the flat anvil type, which crushes tissue)
Up to 2 in.	Bypass loppers, the long-handled version of the same cutting action
Up to 3 in. or a bit more	A pruning saw
Larger than 3 in.	Consider whether the cut is really necessary; a cut this large on a home fruit tree is a bigger wound than most guild-scale trees need or recover from quickly

A light summer pass, removing water sprouts (the vertical, non-fruiting shoots that spring up on established wood) and anything blocking light to ripening fruit, is useful in addition to dormant pruning, not instead of it; avoid heavy cuts late in the growing season, which pushes new growth that won't harden off before winter.

Spotting trouble before it costs the harvest

Three problems account for most home fruit-tree losses.

Problem	How to identify it	What to do
Aphids	Small green, black, or grayish insects clustered on new growth and leaf undersides, sticky honeydew and curling or yellowing leaves are the visible tell even before you spot the insects	A strong water spray dislodges light infestations; insecticidal soap for heavier ones. A healthy guild's predator-attracting plants help keep this in check on their own over time
Coddling moth	Small (roughly 3/8 in.) grayish-brown moths and, in the fruit itself, brownish threadlike tunnels toward the core with crumbly frass at the entry hole, that damage inside the fruit is usually the first sign a grower actually notices	Pheromone traps hung at bloom time catch males and give an early warning; picking up and destroying dropped fruit promptly breaks the larval cycle before it completes
Fire blight	Blackened, wilted shoot tips that curl into a distinctive hook shape, sometimes called a shepherd's crook, plus dark, sunken cankers on branches that can ooze	Prune out affected wood well below the visible damage, disinfecting pruning tools between cuts with rubbing alcohol or a bleach solution so it isn't spread to the next cut; there's no cure once a branch is infected, only removal

Knowing when the fruit is actually ready

Unlike an annual vegetable, most tree fruit doesn't have one obvious cue, and getting it wrong in either direction (picking too early, or leaving certain fruit on the tree too long) genuinely costs flavor and storage life.

Fruit	Real ripeness cue
Apples	Lifts free from the branch with a gentle upward twist rather than needing to be yanked; background skin color has shifted from green to yellow, and seeds inside are turning brown to black rather than white
Pears	Don't rely on feel or color, ripe and unripe pears are both still firm on the tree and most varieties don't change color. Instead, cup the fruit and lift gently; if the stem releases easily, pick it. Pears are meant to finish ripening off the tree, not on it, left too long on the branch they turn mealy and lose flavor
Peaches	No green left around the stem, the sun-facing side has colored to a dusky red and the shaded side to yellow; the fruit gives slightly to a gentle squeeze and releases with a light upward twist rather than a hard pull

Harvest staggers across the layers, by design, not by accident

A single-crop annual garden bunches its harvest into a few weeks. A mature food forest spreads it across the whole season almost automatically, because the layers themselves mature on different timelines: herbaceous and groundcover plants often produce something within the first year, berry shrubs typically bear in their second or third year, and canopy fruit and nut trees take considerably longer to reach real production. Within a single season, that same spread repeats: early greens and herbs come on before the shrub layer's berries ripen, which finish well before the canopy's fruit does. Track roughly what's ready by layer and month for your own site after the first couple of seasons; a mature system rewards knowing its own actual rhythm more than following a generic calendar.

WARNING

A guild doesn't mean 'plant it and walk away'

Guilds reduce maintenance relative to a bare fruit tree in turf, they don't eliminate it. Comfrey and other chop-and-drop plants still need cutting back on a schedule to actually deliver their mulch value; nitrogen-fixing shrubs still need occasional pruning to keep them from shading out the tree they're meant to support; and a guild that's colonized by an aggressive spreader (mint is the classic example) needs the same intervention any garden does when one plant takes over. Budget real, if reduced, ongoing attention, per the labor curve in Building a Food Forest, not zero.

Sources

- Guild design, functions (nitrogen-fixer, attractor, mulcher), and the classic apple guild example: James Madison University Edible Food Forest; GrowPerma
- Nitrogen-fixing guild plants, real examples: Berries & Barnacles; Lakeside Community Garden
- The Three Sisters (corn, beans, squash) as an establishment-year intercrop, mound technique, and documented yield increase: see Sources on Row Crop & Raised Bed Gardening
- Secondary crop planting technique (carrots, onions, garlic, sunflowers, tomatoes, peppers): see Sources on Row Crop & Raised Bed Gardening; secondary crop nutritional rationale: see Sources on What to Grow
- Polyculture and crop-diversity pest management evidence and its real limits: ScienceDirect; PMC, Crop Diversity in Agroecosystems for Pest Management; Agronomy for Sustainable Development
- Fruit tree dormant pruning timing and technique, branch collar: Growing in the Garden; The Giving Grove; UF/IFAS Gardening Solutions
- Comfrey as chop-and-drop mulch versus the "dynamic accumulator" claim: see Sources on Building a Food Forest
- Fruit tree bearing timelines by layer: GrowPerma
- Bare-root and potted tree planting technique, hole sizing, graft union depth, backfill, and staking: UC ANR, The Real Dirt; UGA CAES; Iowa State Extension
- Guild plant spacing from the trunk and drip line: Permaculture Apprentice; Mortal Tree
- Pruning tool selection by branch diameter and branch-collar identification: Iowa State Extension; Colorado State Forest Service; BrightYardTools
- Aphid, codling moth, and fire blight identification and management: Raintree Nursery; USU Extension, Fruit IPM Advisory
- Apple, pear, and peach ripeness cues: Apples Extension; USU Extension; Farmers' Almanac

Growing in a Walipini

Building a Walipini covers the structure: pit depth, orientation, glazing, and the site conditions that rule a build out entirely. This guide is what happens after it's built: how to actually plan a growing calendar that uses the extended season a walipini exists for, and the humidity and condensation problems a sunken, less-ventilated structure creates that an open garden bed never has to deal with.

Plan a calendar, not just a planting

A walipini's entire value is holding cold-hardy crops through a season they couldn't survive outside; a single spring planting wastes most of that capability. Cold-hardy greens (spinach, lettuce, kale, chard, Asian greens) and root crops (carrots, beets, radishes) are the realistic year-round crops here, planted in succession the same way an outdoor bed is, new rounds every 2–3 weeks, so something is always at a harvestable stage through winter. Reserve the warmer months for anything that actually benefits from a longer, more protected season, an earlier tomato or pepper start than the open garden allows, then move heat-lovers back outside once the risk of frost is fully past and free up the walipini for the next cold-hardy round.

Running that many overlapping successions works best out of trays rather than committing the whole bed to one round: start each new round in shallow seed trays with drainage holes, filled with a light seed-starting mix rather than garden soil, kept moist but never soggy until germination, then transplant seedlings into the main bed as soon as the previous round is harvested out and space opens up. This keeps the bed itself continuously productive instead of sitting half-empty while a new round gets to transplant size.

Remember what Building a Walipini already establishes: the structure buffers temperature, it doesn't generate heat. It's genuinely capable of carrying hardy greens through winter cold; it is not a reliable way to fruit a tomato or pepper plant through the coldest months without real supplemental heat on top of it.

Which of the five recommended staples actually belong in here

What to Grow names five crops worth real garden space, and a walipini is a good fit for exactly one of them outright, plus a real but limited use for a second.

- **Cabbage and other brassicas fit well.** They're squarely in the cold-hardy category a walipini exists for, and they're the crop this space is actually built to extend, not a stretch use of it.

- **Potatoes have a real but narrow use: an extra-early or extra-late start, not a full-season crop.** Chitting (pre-sprouting) seed potatoes in the walipini in late winter, or planting an early round for harvest well before the outdoor season allows, uses the space well. A full-season potato crop grown entirely inside doesn't: tubers take real floor space and months to mature, which is a poor return on a structure this limited in square footage compared to just planting potatoes outside on the schedule in Row Crop & Raised Bed Gardening.
- **Corn, dry beans, and winter squash don't belong in here.** All three are tender, full-season crops that want to be outside in real summer heat, not the cold-hardy niche this structure is built for; corn additionally needs wind movement across a real stand to pollinate, which a sealed pit doesn't provide, and squash's sprawl would consume the entire footprint for one or two plants. Grow this trio outside on the schedule already covered in Row Crop & Raised Bed Gardening, ideally as the Three Sisters planting covered there, and reserve the walipini for what it actually extends.

And the secondary crops: two real fits, three that don't belong

- **Kale and chard fit exactly like cabbage does.** They're the same cold-hardy category, and belong in the same succession rotation as the greens covered above.
- **Herbs are a genuinely good match, not just a tolerable one.** Many culinary and medicinal herbs are cold-tolerant or directly benefit from the same season extension cabbage does, and unlike the tender staples below, they don't need pollinator access or field-scale space to be worth growing. Rotate them in with the cold-hardy greens the same way.
- **Carrots have the same narrow, early-or-late use potatoes do,** not a full-season crop, for the same floor-space-versus-return reason.
- **Onions, garlic, sunflowers, tomatoes, and peppers don't belong in here** for the same reasons corn, beans, and squash don't: tender, full-season, or simply too space-hungry for what a walipini is actually built to extend. Grow all five outside on the schedule in Row Crop & Raised Bed Gardening.

Humidity and condensation: the walipini-specific problem

A sunken structure with limited ventilation traps moisture in a way an open bed or a well-vented above-ground greenhouse doesn't. That matters because condensation, not just humidity in the air, is what most fungal disease actually needs: high humidity lets fungal spores form, but it's water condensing directly on a leaf surface that lets those spores germinate and infect the plant. Above roughly 80% relative humidity, infections like leaf mold become a real risk; above 90%, fungal disease develops fast.

Those thresholds aren't guessable by feel. A basic digital hygrometer, the same inexpensive gauge sold for greenhouses, reptile tanks, or humidors, run \$10–15 and gives an actual number to check against rather

than a hunch; hang it at plant height rather than near the door or vents, where readings skew lower than what the crop is actually sitting in.

- **Vent on a schedule, not just when it feels humid.** Cracking vents open in the late afternoon, before the day's heat fully leaves, lets cooler, drier outside air in while warm moist air escapes, the same principle a thermal chimney uses passively.
- **Water in the morning, not the evening.** Foliage that stays wet overnight in an already-humid, poorly-vented space is close to the worst-case condition for fungal infection. Watering early enough that leaves dry out during the day removes that overnight window.
- **Space plants for airflow.** The same crowding that helps an outdoor intensive bed shade out weeds works against you here, still air between crowded leaves is exactly where condensation and disease take hold first.
- **Clean up at season's end.** Fungal spores overwinter on old plant debris and start the next season's infection early; a real end-of-season clear-out is worth the time it takes.

Damping-off is the fastest way to lose a whole tray of seedlings

Young seedlings are the most vulnerable stage: damping-off, a fungal disease that topples an apparently healthy seedling at the soil line overnight, thrives in exactly the warm, overly wet conditions an underventilated walipini can create at seed-starting time. Don't overwater seed trays, and don't crowd them; both are correctable causes, not bad luck.

What actually changes if it's a greenhouse instead of a walipini

If you're growing in a standard above-ground greenhouse rather than a walipini, the core skill shifts from managing humidity to managing heat swings. An above-ground structure has none of the earth's thermal buffering a walipini relies on, so it overheats hard on a sunny day, sometimes dangerously fast, and loses heat just as fast once the sun sets. The practical differences: active venting and shade cloth become a daily, not occasional, concern in summer; supplemental heat on cold nights is usually necessary rather than optional, since there's no soil mass holding yesterday's warmth; and ventilation, generally easier to build into an above-ground structure with roof and side vents, means humidity and fungal pressure are often more manageable than in a sunken pit, even though they're not eliminated. Treat this section's succession-planting approach as still useful in a greenhouse, and the humidity-management section above as the walipini-specific half of this guide, not something to import wholesale into a structure with a very different heat profile.

Sources

- Condensation versus humidity as the actual disease trigger, and infection humidity thresholds: UMass Amherst CAFE; SmartFog
- Hygrometer use and placement for accurate greenhouse readings: Greenhouse Management
- Venting strategy, timing, and horizontal airflow for humidity and disease control: Greenhouse Management; UMass Amherst CAFE, Disease Management
- Damping-off and seedling-stage disease risk: Cornell Greenhouse Horticulture
- Walipini structure, thermal buffering versus insulation, and season-extension ceiling: see Sources on Building a Walipini
- Potato planting timeline and real space requirements, corn's wind-pollination need, and winter squash's real vine spread: see Sources on Row Crop & Raised Bed Gardening

Hydroponics & Aquaponics Basics

Growing without soil at all, in a nutrient solution (hydroponics) or in a closed loop with fish supplying the nutrients (aquaponics). Neither is covered anywhere else on this site: the real system types and how to build one, aquaponics' nitrogen cycle and tank setup, nutrient mixing and pH/EC management, grow-light requirements, what crops genuinely do well, and the honest tradeoff this method carries that row crops, a food forest, and a walipini mostly don't: most of these systems depend on continuous electricity to keep the water moving, oxygenated, and lit.

Four real system types, and which one actually fits a beginner

System	How it works	Real tradeoff
Wick	A wick draws nutrient solution up from a reservoir to the roots by capillary action, no pump at all	The simplest and only genuinely no-electricity option; can't support larger or heavier-feeding plants as well as the pumped systems below
Deep water culture (DWC)	Roots hang directly in an aerated nutrient reservoir; an air pump and air stone keep it oxygenated	The most forgiving pumped system for a first build, a basic version can be built for well under \$50, but needs weekly nutrient changes and steady water temperature
Nutrient film technique (NFT)	A thin, continuously flowing film of nutrient solution runs through channels past the roots	Scales well for leafy greens and is standard in commercial lettuce production; a pump failure dries roots out fast since there's no reservoir of standing water at the roots themselves
Ebb and flow	A grow bed is periodically flooded with nutrient solution, then drained back to a reservoir	The most versatile of the four, handles everything from herbs to peppers and small tomatoes, at the cost of more moving parts (a pump and a timer) than DWC

For a household new to this and thinking about resilience, not just yield, wick systems deserve more attention than they usually get: they're the one option here with nothing to fail during a power outage. The three pumped systems all trade that resilience for higher yield and a wider range of what they can grow.

Building a DWC bucket: the actual materials and steps

This is the system worth building first: it's the cheapest, the most forgiving of mistakes, and everything below scales up conceptually to the other three once it's understood.

Material	Spec	Approximate cost
Bucket	One food-grade 5-gallon bucket per plant, look for the fork-and-knife symbol stamped on the bottom, opaque or painted so light can't reach the roots and grow algae	\$5–8
Net pot	One 6-inch net pot with lid, sized to a hole cut in the bucket lid	\$3–5
Air pump and air stone	A pump rated for 1–2 liters per minute per gallon of water in the bucket, so a 4-gallon fill needs at least a 4–8 L/min pump, plus one 4-inch air stone and a length of airline tubing	\$12–20
Growing medium	Expanded clay pebbles (also sold as hydroton or LECA), enough to fill the net pot and hold the plant upright	\$8–12

Assembly: cut a hole in the bucket lid sized to the net pot so it sits with about an inch of the bottom submerged once the bucket is filled. Drill a second, smaller hole in the lid for the airline tubing. Fill the bucket with nutrient solution (mixed per the section below) to just below the net pot's base, drop the air stone to the bottom of the bucket, and run the tubing out through its hole to the pump, which sits outside the bucket and above the waterline so water can't siphon back into it. Line the net pot with a thin layer of growing medium, set the seedling or rockwool cube inside, then fill around it with more medium to hold it upright.

WARNING

Run the air pump continuously, never on a timer

One plant per bucket is the rule; two compete for dissolved oxygen and root space and both suffer. A few hours without the air stone running in warm water is enough to start root rot, so this is not a component to economize on or leave switched off overnight.

The other three systems scale the same logic up: an NFT system replaces the bucket with a slightly sloped channel (food-grade 3–4 inch PVC pipe works well for a small build, holes drilled 6–8 inches apart for net pots, roughly 1 inch of drop for every 4 feet of channel length) fed by a submersible pump in a reservoir at a flow rate of 3–5 gallons per hour per channel, with the far end draining back to that same reservoir. A wick system needs no pump at all: a reservoir sits below a growing container, and a few strips of absorbent

wicking material (cotton rope or felt strips work) run from the solution up into the growing medium, carrying water and nutrients up by capillary action alone. Ebb-and-flow adds a grow bed above the reservoir, a submersible pump on a timer that floods the bed on a schedule (typically a few times a day for 15–30 minutes) and lets it drain back down between cycles.

Starting seeds for a soilless system

Regular seed-starting mix doesn't drain the way these systems need. Rockwool cubes or foam starter plugs are the standard approach: soak the cube in pH-adjusted water (5.5–6.5) for a few minutes until fully saturated, then push one or two seeds into the hole in the top with a toothpick, about a quarter-inch deep. Keep the cubes moist and, if using a humidity dome, remove it daily to let fresh air in and check for mold. Once the seedling is 2–3 inches tall with a couple of true leaves, move the whole cube, root disturbance and all, directly into the net pot's growing medium; there's no need to remove it first.

Aquaponics: the nitrogen cycle is the whole system

Aquaponics closes the loop: fish waste supplies the plants' nutrients, and the plants clean the water the fish live in. The mechanism that makes this actually work is bacterial, not a design trick: *Nitrosomonas* bacteria convert the ammonia fish produce into nitrite, and *Nitrobacter* bacteria convert that nitrite into nitrate, the actual form of nitrogen plants can use. None of that bacteria exists in a brand-new system on day one.

WARNING

A new system has to be cycled before fish or plants can safely go in it

Building a working bacterial colony from scratch takes 30–45 days of running the system with an ammonia source and no fish yet, seeded with bacterial supplements or media from an already-established system, that timeline can drop to 10–20 days. Adding fish before this cycle is established is the single most common way a new aquaponics system fails: ammonia builds up with no bacteria to convert it, and it's directly toxic to the fish.

Tilapia is the standard beginner fish: hardy, fast-growing, and tolerant of the water-quality swings a new system inevitably has, but it needs water in the 75–85°F range and growth slows sharply below 60°F, a real heating cost in Utah's climate for anything but an indoor or actively heated setup. Start with a low stocking density, roughly 20–30% of the system's eventual fish capacity, and fast-growing leafy greens (lettuce, herbs, Asian greens) rather than heavier feeders, both to protect a colony of bacteria that's still establishing itself.

What the tank itself actually needs

Component	Spec for a beginner setup	Why it's there
Fish tank	20–40 gallons for a first system; food-grade totes or barrels work as well as an aquarium tank	Bigger volume dilutes ammonia spikes and swings temperature more slowly, both of which buy a new grower time to react
Biofilter	A separate container (a 5-gallon bucket or small barrel) packed with a high-surface-area media, clay pebbles, lava rock, or plastic bio-balls all work, that water flows through before reaching the plants	This is where most of the nitrifying bacteria colony actually lives; the grow bed's growing medium helps too, but a dedicated biofilter gives the colony far more surface area to establish on
Heater	Sized to 3–5 watts per gallon of tank volume, thermostat set in the mid-70s°F for tilapia	Without one, water temperature tracks room or outdoor temperature, and tilapia growth and appetite drop sharply below 60°F
Dechlorinator	A capful of aquarium dechlorinator treatment per the bottle's directions, or let tap water sit uncovered for 24–48 hours before adding it to the tank	Chlorine and chloramine in tap water kill fish directly and also kill the nitrifying bacteria the whole system depends on

Cycle the tank for 4–6 weeks with an ammonia source and no fish before stocking it, matching the cycling timeline described in the warning above; adding fish to an uncycled tank is the single most common way a first aquaponics build fails.

Nutrient solution and pH: hydroponics' equivalent of soil fertility

In hydroponics without fish, the nutrient solution is mixed directly rather than produced by a biological cycle, which makes pH and concentration something to actively monitor rather than something soil buffers for you.

Buy a 3-part concentrate line (General Hydroponics' Flora Series, sold as Grow/Micro/Bloom, is the standard beginner choice) rather than trying to formulate a solution from raw salts. Start from dechlorinated water: fill the reservoir with tap water and let it sit uncovered for 24 hours, or use a treatment drop, since chlorine harms roots the same way it harms fish. Mixing order matters because the three parts can react with each other directly in concentrate form: add Micro first and stir it in completely, then Grow, then Bloom, one at a time, never combining two concentrates before they've hit water. Let the mixed solution sit and aerate for 30 minutes to an hour, then test pH and adjust into the 5.8–6.3 window with a pH-up or pH-down product made for hydroponics, waiting another 30 minutes after each adjustment before rechecking.

Measure	Typical range	Why it matters
pH	5.5–6.5 for most crops; 5.8–6.3 for fruiting crops like tomatoes	Outside this range, nutrients that are actually present in the solution become chemically unavailable to the plant, a deficiency the plant shows even though the fertilizer is right there
EC (electrical conductivity)	0.8–1.2 mS/cm for seedlings, 1.2–2.0 for herbs and leafy greens, 2.0–3.5 for fruiting crops	A direct measure of how concentrated the dissolved nutrients are; too low starves the plant, too high can burn roots

EC drifts on its own as the system runs: it falls as plants actively take up nutrients, and rises as plain water evaporates or transpires away and leaves the dissolved salts behind. Correct a low reading with concentrated nutrient stock, and a high reading by adding plain water, checked regularly rather than assumed stable once mixed.

None of this is guessable by eye. A combination pH/EC/temperature meter (pen-style meters that read all three run roughly \$15–20) is a real, non-optional tool for this method, not an accessory; if buying only one instrument to start, get the pH meter first, since a pH swing causes visible plant damage faster than an EC swing does. Whatever meter is bought, keep the calibration solution that comes with it and recalibrate against it every few weeks; an uncalibrated meter that reads confidently wrong is worse than no meter at all.

Grow lights: the requirement every one of these systems has if it isn't outdoors

A hydroponic or aquaponic system run indoors, in a garage, or in a basement needs a dedicated grow light; a sunny windowsill does not deliver enough usable light intensity for anything beyond a few weak, leggy seedlings. Two numbers matter here: the light's actual output at plant height, and how long it runs each day.

Crop stage	Target intensity	Hours of light per day
Seedlings	Roughly 20–30W of LED draw per square foot of growing area	16–18 hours
Leafy greens and herbs	Roughly 25–35W per square foot, aiming for a PPFD (a direct measure of light intensity at the leaf) of 200–400 micromoles per square meter per second	14–16 hours
Fruiting crops (tomatoes, peppers)	Roughly 35–50W per square foot, PPFD of 400–700 micromoles per square meter per second	12–16 hours

A full-spectrum LED grow light fixture is the standard choice; it runs cooler and cheaper to operate than the older high-intensity discharge lights this hobby used to rely on. Wattage is a starting point, not a guarantee: two fixtures rated at the same wattage can put out very different actual light at the leaf, so check a fixture's specifications for its PPFD rating at the mounting height being used, and mount it low enough to hit the target range at canopy height rather than trusting the package wattage alone.

What actually grows well, and what doesn't

Leafy greens and herbs are the reliable performers across every system type here, fast-growing, tolerant of the nutrient swings a home system inevitably has, and forgiving of a beginner's mistakes. Fruiting crops (tomatoes, peppers, strawberries) are realistic in ebb-and-flow or DWC once the grower has a season of experience, but need more support (trellising, hand-pollination since there's no wind or bees indoors) and are less forgiving of an inconsistent nutrient solution. Root crops and large vining plants are a poor fit for hydroponics generally; the space and support they need work against nearly every system type described above.

WARNING

An honest gap: none of the five staples this site recommends is a real hydroponic crop

What to Grow names potatoes, dry beans, corn, and winter squash for calories, and cabbage for vitamin C, precisely because they store. Hydroponics doesn't serve that goal well:

- **Potatoes** are technically possible, dedicated hydroponic potato setups exist, but they need a larger grow bed than any other crop here and most home systems simply aren't built for a tuber crop; this is a specialty project, not a beginner one.
- **Corn and winter squash** are, in the words of growers who've tried, "space hogs" that take over a whole home unit for one or two plants, a poor use of a system that's expensive per square foot to begin with.

- **Dry beans** grow genuinely well hydroponically, but for fresh green beans harvested young, not the mature, dried, shelf-stable beans What to Grow actually wants; letting pods mature and dry on the vine the way a dry-bean crop requires works against everything that makes a hydroponic system worth the cost and effort.
- **Cabbage and other leafy brassicas** are the one real fit, squarely in the leafy-greens category these systems are actually good at.

The honest read: hydroponics is a genuinely good tool for fresh vitamin-completeness crops and herbs, exactly the category What to Grow treats as secondary to calorie staples, not a substitute for growing the calorie crops that guide actually prioritizes. Row crops, a food forest, or a walipini are where those staples belong; see Row Crop & Raised Bed Gardening for all five.

WARNING

The real vulnerability: most of these systems need continuous electricity

This is the honest tradeoff against row crops, a food forest, or a walipini, none of which stop working the moment the power does. In DWC and aquaponics, dissolved oxygen in standing water can drop dangerously within 30–60 minutes without the air pump running, and by up to 50% within about 3 hours; root rot and, in aquaponics, fish death follow if power isn't restored in that window. An aquaponics system's bacterial colony itself needs oxygen too, an outage past roughly 12 hours risks a real bacterial die-off that crashes the nitrogen cycle and lets toxic ammonia build back up. An indoor system run under grow lights loses that light the same moment it loses the pumps, and a multi-day outage during an indoor grow costs real growth even if the roots themselves survive. A battery-powered backup air pump or a small power station bridges a short outage; for anything longer, this is a real, structural weak point of these systems that a wick setup, with no pump or light to fail in the first place, doesn't carry at all.

Secondary crops: this is where hydroponics actually earns its place

Unlike the five staples above, several of What to Grow's six secondary crops are genuinely strong hydroponic performers, not a compromise.

- **Culinary herbs, basil especially, are one of the best crops for any of the four system types.** Basil is a standard commercial hydroponic crop for a reason: it reaches harvest in about 4 weeks under good conditions, roughly twice the speed of soil-grown basil, and does well in a simple floating raft DWC setup specifically. Grow it on its own nutrient solution rather than mixed in with other crops; basil tuned for another plant's needs doesn't perform as well.

- **Tomatoes and peppers** are the same realistic ebb-and-flow or DWC crop already covered above, now tied to What to Grow's own recommendation for fresh vitamin C and variety, not just a generic "fruiting crop" example.
- **Carrots, onions, garlic, and sunflowers don't fit**, for the same root-crop and space reasons potatoes, corn, and squash don't: carrots and onions want real soil depth or a root-crop-specific system most home growers don't have, garlic needs months in the ground doing very little, and sunflowers grown for pressing oil need field-scale space no home hydroponic system offers.

Between this and the calorie-staple gap above, the honest shape of the tradeoff is consistent: hydroponics is a real, worthwhile method for exactly the leafy-green, herb, and fruiting-vegetable categories, and a poor one for calorie-dense storage crops, root crops, and anything grown at field scale, regardless of which of the six secondary or five staple crops is in question.

Sources

- Basil as a strong hydroponic crop, floating raft system suitability, and growth-rate advantage: National Library of Medicine; Upstart University
- Hydroponic system types, comparison, and beginner suitability: Gardyn; The Growcer; NoSoilSolutions
- Aquaponics nitrogen cycle, cycling timeline, and stocking guidance: Aquaponics Revolution; Soil Free Harvest
- Tilapia temperature requirements and beginner fish selection: Lakeway Tilapia; Urban Goes Green
- Nutrient solution pH and EC ranges by crop stage, Cornell CEA program: Cornell CEA; Cornell Greenhouse Horticulture; Gardyn
- Power-outage risk, dissolved oxygen depletion timelines, and bacterial die-off: Go Green Aquaponics; DiscountHydro; AquiFarm
- Hydroponic potato feasibility and real space requirements: Why Farm It; Bigger Garden
- Corn and winter squash as impractical, space-consuming hydroponic crops; dry beans as a strong hydroponic crop for fresh pods specifically: Backyard Garden Lover; Agri Farming
- DIY DWC bucket build materials, sizing, and one-plant-per-bucket rule: NoSoilSolutions; Hydroponic Horizons
- DIY NFT channel slope, pump flow rate, and assembly: Atlas Scientific; Growlode
- Rockwool and starter-plug seed-starting method: Bright Lane Gardens; Greener Hydroponics
- General Hydroponics Flora Series mixing order and pH adjustment: NoSoilSolutions; Aqualogi
- pH/EC/TDS meter selection and calibration for beginners: NoSoilSolutions; Urban Hydro Space
- Grow-light PPF, wattage-per-square-foot, and daily light hours by crop stage: Soil Free Harvest; Trimleaf
- Beginner aquaponics tank size, biofilter, heater, and dechlorination setup: Soil Free Harvest; Go Green Aquaponics

Perennial Vegetables

A food forest is a multi-year commitment built around trees and shrubs. Perennial vegetables are a much smaller step: a permanent bed of a handful of crops that come back every spring with no replanting, no seed-saving cycle, and none of a food forest's years-long design process. This guide is the real timeline and technique for the vegetables actually worth that bed space.

The real establishment timeline: patience up front, almost none after

Every perennial vegetable worth growing asks for the same trade Growing in a Food Forest describes at tree scale, just on a much shorter clock: real patience for the first year or two, then a harvest that repeats for a decade or more with very little ongoing work.

Crop	Planting depth & spacing	Establishment	Ongoing harvest & lifespan
Asparagus	Crowns in a trench 10–12 in. deep, covered with 2–4 in. of soil at planting and filled in gradually as shoots grow; crowns 12–18 in. apart, trenches at least 3 ft. apart	Plant crowns; no harvest at all the first year	Light harvest (3–4 weeks) year two, full 6–8 week harvest every year after; a well-kept bed produces 15+ years before it needs replanting
Rhubarb	Crowns just below the soil surface, buds pointing up and barely covered; 3–4 ft. apart in both directions, it gets large	Let it grow through year one with no harvest	Light harvest year two, full 8–10 week harvest from year three on; productivity drops after 5–10 years, at which point divide the crown rather than replant from scratch
Egyptian walking onions	Bulblets 1–2 in. deep, pointy end up; 3–4 in. apart for scallion-style harvest, 6–10 in. apart for larger individual bulbs	Productive within the first year	Multiply on their own every year, bulblets forming where a normal onion would flower, and "walk" a short distance as those bulblets fall and root; thin and replant to keep them where you want them
Sunchokes (Jerusalem artichokes)	Tubers 4–6 in. deep, 8–12 in. apart; deeper planting produces deeper, easier-to-contain tubers	Productive within the first year	A single planted tuber can produce several pounds of tubers by fall; see the containment warning below before planting a single one

During the no-harvest establishment year for asparagus and rhubarb, the plant still needs real care even though nothing's coming out of the bed: keep it weeded (young crowns compete poorly with weeds for light and water), watered through dry spells rather than left to fend for itself, and top-dressed with an inch or two of compost each spring. Let the asparagus fern (the feathery summer foliage) grow and yellow naturally in fall before cutting it back; that foliage is rebuilding the crown's root reserves for next year's harvest, cutting it back green sacrifices next season's yield.

WARNING

Sunchokes are the one crop on this page that needs a containment plan before planting

Unfussy, pest-resistant, and productive in nearly any soil sounds like an unambiguous win, and for calorie return per hour of work, it is. The same trait that makes them low-maintenance makes them genuinely difficult to remove once established: any tuber piece left in the ground resprouts, and a bed can spread well past its original footprint within a couple of seasons. Plant them in a bottomless

container sunk into the ground, a dedicated bed with a buried physical barrier, or somewhere spreading is actually fine, not open ground next to anything you'd mind them taking over.

Rhubarb's one real safety note

Only the stalks are edible. Rhubarb leaves contain concentrated oxalic acid and are genuinely toxic in enough quantity, real enough that this is the one common piece of rhubarb advice worth repeating rather than treating as obvious: compost the leaves or discard them, don't feed them to people or most animals.

Where these fit against the other three methods

Perennial vegetables don't replace Row Crop & Raised Bed Gardening's annual staples, potatoes, beans, corn, and squash still need replanting every year regardless of what else is in the garden, but they're a real complement: a dedicated corner that produces without competing for the bed space or labor those annuals need each spring. They also don't need a food forest's years-long design and canopy planning; a 4x8 bed of asparagus or a single sunchoke container is a realistic weekend project, not a multi-year commitment.

Sources

- Asparagus establishment timeline, harvest window, bed lifespan, planting trench depth and spacing: University of Minnesota Extension; North Dakota State University Extension; Practical Self Reliance
- Rhubarb establishment, harvest timeline, productivity decline, planting depth/spacing, and leaf toxicity: North Dakota State University Extension; Common Sense Home
- Egyptian walking onion bulblet planting depth and spacing: Garden Myths; Gardener's Path
- Sunchoke/Jerusalem artichokes, planting depth/spacing, yield, and real invasiveness/containment risk: Garden Betty; Joybilee Farm; Morning Chores

Regenerative Agriculture: Cover Crops, No-Till & Composting

The Act of Thriving's Long-Run Sustainability chapter makes the case that a garden meant to feed a household for decades, not just this season, has to return the nutrients it removes rather than depending on outside fertilizer forever. This guide is the actual technique behind that case: real cover crop species, timing, and seeding rates, the no-till method layer by layer, and a compost system built to the numbers, and the do's and don'ts, that actually make it work.

Cover crops: what to plant, and the timing that actually matters

A cover crop's job is holding and rebuilding soil between real harvests, not producing food itself.

Species	When to sow	Seeding rate	What it does
Crimson or red clover	By mid-September for reliable establishment	About ½ lb. per 1,000 sq. ft. broadcast by hand	Fixes nitrogen; red clover grows slower and is the standard choice for a longer-sitting bed
Hairy vetch	By mid-September	About ½–0.6 lb. per 1,000 sq. ft.	Fixes significant nitrogen, but reseeds itself aggressively enough to become its own weed if not terminated on schedule
Cereal (winter) rye	Can go in as late as early October and still help	About 2–2.5 lb. per 1,000 sq. ft.	The most forgiving, latest-plantable option; also the hardest of the three to kill once it's grown past a certain point

Sowing late enough that a cover crop doesn't establish real growth before winter wastes the seed; each of these has a real cutoff, not an approximate one, so plant on the schedule above rather than whenever there's a free weekend. Broadcast seed evenly by hand over prepared or lightly raked soil, then rake lightly again or walk over the bed to press seed into contact with the soil; most of these germinate fine without being buried at a specific depth the way a vegetable seed needs to be.

WARNING

Terminate 2–4 weeks before spring planting, not the week of

Killing a cover crop right before planting doesn't give its residue time to break down or its natural plant chemicals time to leach out of the soil, both of which can suppress the seeds you plant next. Cut it down with a mower, string trimmer, or scythe, or smother it under a tarp, 2 to 4 weeks ahead of your actual planting date. Rye left to grow past pollen shed, and vetch left past this window, both get noticeably harder to kill by cutting alone.

No-till: building fertility by not disturbing it

No-till (also called sheet mulching, lasagna gardening, or sheet composting, depending on who's teaching it) skips tilling or double-digging entirely and instead layers organic material, cardboard or newspaper to smother what's already growing, then compost, mulch, and more mulch, directly on top of undisturbed soil. The soil's own fungal networks and worm channels stay intact instead of being broken up every season, which is the actual mechanism behind the method's real benefits: less compaction, better water retention, and less weeding once a mulch layer is established and reapplied through the season. The tradeoff is patience again: a freshly sheet-mulched bed needs a season to break down before it's as workable as tilled soil, so this is a method to start the season before you need the bed productive, not the week you need to plant.

The actual layers, from the ground up: mow or cut whatever's growing down close to the soil first, no need to remove it. Lay plain cardboard (packing tape and glossy printed labels removed) or several sheets of newspaper directly over that, overlapping edges by several inches so weeds can't find a seam to grow through. Wet that layer down thoroughly, cardboard that's still dry doesn't smother anything and blows around. On top of that, add 2–4 inches of compost or aged manure, then 3–4 inches of mulch (straw, wood chips, or shredded leaves) as the top layer. Water the whole thing in well after building it, and again periodically through the season if rain doesn't do it; a dry sheet-mulched bed decomposes far more slowly than a moist one.

Composting: the real numbers behind a pile that actually heats up

A compost pile that just sits there is composting slowly no matter what; a hot pile, one that actually reaches 131–170°F and finishes in weeks instead of a year or more, needs to hit specific, real targets, not just "browns and greens mixed together."

Factor	Real target	Why
Carbon:nitrogen ratio	25:1 to 30:1 by volume, roughly 3 parts "browns" (dry leaves, straw, cardboard) to 1 part "greens" (food scraps, grass clippings, manure)	Too much nitrogen goes anaerobic and smells like ammonia; too much carbon simply never heats up
Pile size	At least 3x3x3 ft (about 1 cubic yard)	Below this, a pile can't retain enough of its own heat to reach hot-composting temperatures regardless of what's in it
Moisture	45–60%, like a well wrung-out sponge	Too dry stalls the microbial activity that generates heat; too wet goes anaerobic the same way excess nitrogen does
Turning	Every 3–7 days during the 4–12 week hot phase	Reintroduces oxygen the decomposition process consumes; a pile that's never turned cools down and slows to cold-compost speed

A simple, real starting recipe

Three wheelbarrow loads of dry leaves, two wheelbarrow loads of fresh grass clippings or food scraps, and two or three handfuls of already-finished compost or garden soil as a microbial inoculant, built as one pile rather than added to gradually. Building it all at once, instead of trickling material in over weeks, is what actually gets a pile hot; a pile that never gets enough mass at once to self-insulate stays a slow, cold pile no matter how long it runs.

WARNING

What never goes in the pile

Meat, dairy, and cooking oil or grease attract pests and rot rather than compost cleanly. Diseased or heavily weed-seeded plants can survive a home pile's heat and reinfect the garden wherever the finished compost ends up. Pet or human waste can carry pathogens a backyard pile doesn't reliably kill. Treated or painted wood, glossy or coated paper, and anything synthetic (plastic ties, produce stickers, synthetic fabric) don't break down and contaminate the finished product instead.

Finished compost has a specific, checkable look and feel, not just an elapsed time: dark brown to black and crumbly, like rich soil rather than recognizable scraps; a pleasant, earthy smell with no trace of ammonia or rot; none of the original material still identifiable by eye; the pile itself has stopped generating heat and feels roughly the same temperature as the outside air; and it's typically shrunk to about half its original built

volume. A pile that still smells sour, still has visible chunks, or still feels warm at the center isn't done yet, give it more time and another turn or two rather than using it early.

How this ties back to the rest of this site

None of this replaces the crop-specific technique in Row Crop & Raised Bed Gardening, the simple annual rotation already covered in What to Grow, or the multi-year design in Building a Food Forest; it's the soil-fertility layer underneath all three, the actual mechanism Long-Run Sustainability is describing when it talks about nutrients coming back to the land instead of leaking away with each harvest cycle.

Sources

- Cover crop species, sowing deadlines, and reseeding risk: University of New Hampshire Extension; University of Maryland Extension
- Cover crop termination timing and method: Iowa State University Extension; Cover Crop Strategies
- Cover crop seeding rates by species: USDA NRCS; Penn State Extension
- No-till/sheet-mulching method, layer order, and mechanism: UC ANR; Eartheasy
- Compost carbon:nitrogen ratio, pile size, moisture, and turning frequency: Planet Natural; Compost Magazine; Fine Gardening
- What not to compost and signs of finished compost: Morning Chores; Reencle; UF/IFAS Extension

Microgreens

Not a smaller version of a full-grown vegetable, a genuinely different crop: seeds grown to the point their first true leaves are just emerging, then harvested, at 7–14 days from seeding rather than weeks or months. That speed and the minimal setup it needs make microgreens worth knowing regardless of which growing method the rest of a household's food comes from. This guide covers seed density, watering method, light, and harvest technique alongside the timing and variety choice, not just the concept.

Setup: shallow, simple, and fast to start

A shallow tray, 2–3 inches deep, with drainage holes, over a simple growing medium (a thin layer of potting soil, or a reusable mat) is the entire setup. No pollination, no deep root system, and no months-long commitment to a single planting; a failed or finished tray costs a week, not a season.

Variety	Days to harvest	Why this one
Radish or mustard	5–7 days	The fastest options, and both brassicas, the same nutrient family already worth growing per What to Grow's secondary-crop table
Broccoli	7–10 days	A middle-speed option with a mild flavor most households find easier to use regularly
Sunflower or peas	10–14 days	Slower, but a real texture and flavor difference worth growing alongside the faster brassicas rather than instead of them

Harvest right at the point the first true leaves are just emerging above the seed leaves (cotyledons), not before and not much after; this is when flavor and nutrient concentration actually peak, not an arbitrary cutoff.

Seeding, watering, and light: the three details that make or break a tray

Seed density matters more here than in almost any other growing method on this site: sow far more thickly than a normal vegetable planting, close enough that seeds nearly touch, roughly 8–10 oz of small brassica

seed like radish or mustard per standard 10x20 tray, or about 1.5–2 tablespoons of very fine seed for a smaller tray, then start at the low end and adjust up or down based on how a given tray actually performs. A humid, low-airflow room supports less seed per tray before mold becomes a risk; a brighter, better-ventilated space can carry more.

Water from the bottom, not the top: set the tray in a shallow pan of water and let it wick up through the drainage holes, or pour water into an outer tray the growing tray sits inside. At this seed density, water poured directly onto the seedlings pools between them and reliably causes mold; bottom watering keeps the foliage itself dry while still reaching the roots.

Light matters as much as it does for any other indoor crop: 6–10 hours a day of bright light, either a sunny window or a basic grow light, is enough for most varieties (the exception is corn shoots, which are grown fully in the dark until harvest to keep them tender and pale). Without enough light, microgreens stretch tall, pale, and thin, called legginess, rather than growing into a shorter, sturdier, more flavorful crop.

Harvest with clean kitchen scissors or a sharp knife, cutting just above the growing medium so soil or mat fiber doesn't come away with the greens; a single cut across the whole tray at once, rather than pulling individual plants, is both faster and cleaner.

WARNING

The nutrient density is real, and it fades fast once cut

Microgreens genuinely carry 4 to 40 times the nutrient concentration of the same crop grown to full size, a real, measured difference, not marketing. That advantage starts dropping within 24 to 48 hours of harvest as the cut plant begins to oxidize, and even refrigerated, quality holds for only about 5 to 7 days. Treat a harvested tray as something to actually eat that week, not something to store the way a root cellar crop or a canned good works.

Why this belongs on this site regardless of method

Microgreens don't compete with any of the four growing methods already covered here, they slot alongside all of them. A soil tray on a counter works the same in a house with a full row-crop garden as in one with none at all. A walipini already extending a cold-hardy growing season has more than enough light and space to run trays through the parts of the year outdoor beds can't produce anything. And hydroponic systems, already good at leafy greens generally, handle microgreens on the exact same nutrient solution and equipment used for anything else grown there. In a genuinely short-notice situation, days to a first harvest instead of weeks or months is a real, practical advantage none of this site's other growing methods can match.

Sources

- Growing medium, tray depth, and general setup: Rise Gardens
- Days-to-harvest by variety and the cotyledon harvest stage: Wind River Greens; Bootstrap Farmer
- Nutrient density versus mature crops, and post-harvest degradation timeline: Wind River Greens; Nutrition Health Info
- Seeding density, bottom-watering to prevent mold, light requirements, and harvest technique: Bootstrap Farmer; Home Microgreens; Mumm's Sprouting Seeds

Staying Warm Without Power

This is currently three separate fragments across the site: one-room heating gets a single bullet in the Energy & Heat chapter, hypothermia recognition lives in Sanitation & Medical, and carbon monoxide safety lives in Fire-Starting & Generator Safety. This guide is the one place that actually walks through staying warm, start to finish, cross-linking the other two rather than repeating them.

Layer correctly, since it does most of the work for free

Three layers, each doing a different job:

- **Base layer:** moisture-wicking material against the skin. Not cotton; wet cotton actively pulls heat away from the body instead of insulating it.
- **Insulating layer:** wool or synthetic fleece, which traps warm air close to the body.
- **Shell layer:** blocks wind and moisture from getting to the layers underneath.

A hat matters more than it sounds like it should: any uncovered skin loses heat, and once you're otherwise dressed in layers, your head is usually the largest patch of skin still exposed, not because heads are uniquely lossy the way the old "you lose 40-45% of body heat through your head" claim suggests, but simply because it's what's left uncovered. Stay dry; damp clothing or bedding pulls heat away far faster than dry material, even at the same temperature.

Pick one room, and seal it

1. Choose the smallest interior room with as few exterior walls as possible. A room with one exterior wall loses heat far more slowly than a corner room with two or three; an interior bathroom or closet-adjacent bedroom often beats a room that looks more comfortable but bleeds heat through multiple walls.
2. Close the door and hang a blanket over it as a second seal.
3. Cover windows with plastic sheeting or heavy blankets; this is one of the biggest heat-loss points in most homes. A shrink-film window insulation kit, sold at any hardware store, works better than a loose sheet: tape the film to the window frame with the kit's own adhesive tape, leaving about an inch of overlap on all sides, then run a hairdryer on low heat over it to shrink out wrinkles and pull the seal drum-tight. Done well, this alone can cut a room's heat loss by 10-30%.
4. Stuff towels or rolled blankets against the bottom of the door and any obvious drafts.

5. Move the whole household into this one room rather than trying to heat the house. Concentrating people and heat sources in one small space is far more effective than spreading the same heat across a larger area.

WARNING**A sealed room still needs fresh air if you're running a combustion heater in it**

Every sealing step above assumes the room is unoccupied by an open flame or fuel-burning heater; the moment a propane or catalytic heater is running in it, that changes. An oxygen-depletion sensor shuts the heater's gas off once oxygen falls to roughly 18% (normal air is about 21%), which is a safety backstop, not a substitute for ventilation, it doesn't prevent carbon monoxide from building up in an airtight room before that point. Keep a window cracked open at least an inch and the door to the rest of the house open whenever a combustion heater is running, per CPSC's own winter heating guidance; never run one in a fully sealed space, even with an oxygen-depletion sensor and a CO detector both present.

Aim to keep the sealed room at 68°F or above where you can manage it. Below roughly 65°F, sustained indoor cold raises real hypothermia risk for older adults and anyone with reduced mobility; below about 61°F, resistance to respiratory illness drops too. The World Health Organization sets 64°F as a general minimum indoor temperature and recommends 68-70°F for a room with an elderly or sedentary occupant specifically.

TIP**Protect the rest of the house's pipes while you're sealed in one room**

Leave a cold-water faucet in the coldest part of the house, often a kitchen or bathroom on an exterior wall, running at a slow trickle. Moving water is harder to freeze than still water, since a trickle keeps drawing in slightly warmer supply water instead of letting the pipe sit static. It also relieves the pressure that actually bursts a frozen pipe: freezing itself doesn't split the metal or plastic, the pressure trapped between the ice blockage and a closed faucet on the other side does. It costs a little water for real insurance against a repair that costs far more.

Insulate from the floor, not just the air

This is the detail most people miss. A hard floor, tile, wood, laminate, conducts heat directly out of a body in contact with it, regardless of how warm the air in the room is. Put down a layer of clothing, blankets, or a

Safe heat sources, and what's never safe indoors

Source	Safe indoors?
A propane or catalytic heater with an oxygen-depletion sensor and tip-over shutoff, used with a working CO detector	Yes, this is the standard safe choice for indoor emergency heat
Body heat, sleeping close together, or a small tent pitched inside the sealed room	Yes, and free; a tent creates an even smaller air volume to warm than the room itself
A fireplace or wood stove that's properly installed and vented	Yes, if the chimney/flue is already in good condition; see the seasonal chimney-sweep guidance in the Energy & Heat chapter
A gas range or oven	Never. Not designed for space heating; produces dangerous carbon monoxide levels
A generator, propane camp stove, or charcoal grill used indoors, in a garage, or near a window or vent	Never. Same carbon monoxide risk as running it in a closed room

Full detail on CO risk, detector placement, and generator safety is already covered in Fire-Starting & Generator Safety; this guide isn't repeating it, just flagging where it applies here specifically.

Sleeping warm

- A sleeping bag rated for the actual temperature holds heat far better than loose blankets, since it's a sealed shape rather than something that shifts and gaps overnight. Read the tag carefully: most bags print a "Limit" rating, the temperature at which an average sleeper can survive the night curled up without waking from cold, not a "Comfort" rating, which is the temperature an average cold-sensitive sleeper actually sleeps comfortably at. Buy 10-15°F below the coldest temperature you actually expect, and know the printed rating assumes a base layer of clothing and a sleeping pad underneath, not a bare or thinly padded floor.
- Keep a hat on overnight; heat loss doesn't stop when you're asleep.
- Everyone in the sealed room, together, concentrates body heat that would otherwise be lost to separate cold rooms.

Infants need extra care, not bed-sharing for warmth

Infants under one year old lose body heat much faster than adults and should never sleep alone in a cold room, but the right response is room-sharing, not bed-sharing: keep the infant's own crib or bassinet in the same room as an adult, not in the adult's bed, since bed-sharing raises the risk of suffocation and SIDS regardless of the cold. Dress the infant in one more layer than an adult would wear in the same room, and use a wearable sleep sack rather than loose blankets, which are a suffocation hazard in a crib. Check on them more frequently than an older child or adult in the same room.

Recognize the warning signs

Know the early signs of hypothermia, shivering that eventually stops, confusion, slurred speech, before they progress; full recognition and response steps are in First Aid Basics. Confusion or loss of coordination in a cold environment is a medical emergency, not something to wait out.

Sources

- CDC, winter storm safety and power outage guidance (never use a gas range/oven for heat, carbon monoxide risk): CDC; CDC
- CDC, infant susceptibility to cold and carbon monoxide: University of Washington DEOHS (CDC-sourced)
- One-room heating strategy, floor insulation, and catalytic heater safety features: PowerOutage.us; Popular Science
- CPSC, winter heating ventilation requirements and oxygen-depletion sensor mechanism: CPSC
- AAP, infant room-sharing (not bed-sharing) and safe sleep clothing guidance: HealthyChildren.org / AAP
- Window insulation kit technique and heat-loss reduction: ENERGY STAR
- Minimum safe indoor temperature for older adults and general WHO guidance: National Institute on Aging
- Sleeping bag Comfort vs. Limit temperature rating (ISO 23537): Backpacking Light
- Head heat-loss myth correction: Cleveland Clinic
- Dripping-faucet technique for preventing frozen pipes, and pressure buildup (not the ice itself) as the actual cause of a burst pipe: American Red Cross; Consumer Reports

Building a Jean Pain Compost Heat Mound

The Energy & Heat chapter's Tier 3 Biomass Processing item is about squeezing more usable heat out of a finite woodlot. This is a different way to do exactly that: a large mound of chipped wood that generates its own sustained heat through decomposition, with water-filled tubing coiled through it to pull that heat out as hot water. It's also a real option for extending Utah's short growing season, the same goal behind the Water & Food chapter's Greenhouse / Season Extension item; see Building a Walipini for a real passive-only design this mound can add active heat on top of. See Stirling Engines for the honest reality of trying to pull electricity back out of this mound as it cools, rather than just heat.

Where this comes from

The method is named for Jean Pain, a French innovator who built large compost mounds on his land in southern France through the 1970s. His own account, documented in his book *Another Kind of Garden*, describes a mound roughly 18 feet across and 9 feet high, built from around 50-60 tons of chipped brushwood, that produced 140-145°F water at close to a gallon a minute, continuously, for as long as 18 months. He used that hot water for washing, cooking, and heating his home, and separately fed some of the same chipped material into an anaerobic digester to produce methane for a generator, a stove, and his truck.

Treat Jean Pain's own numbers as a ceiling, not a guarantee

Those figures come from his own account, not an independent or peer-reviewed study. The best real-world replication found for this guide, a compost heat mound built at Western Michigan University's Gibbs House to heat a hoop house through winter, used a smaller mound (roughly 13 feet across, 6.5 feet high) and reached soil temperatures of 40-70°F, useful for season extension, but far short of Jean Pain's domestic-hot-water numbers. Other documented backyard-scale builds land in between: a roughly 6-ton test mound produced water around 85°F at a 2-gallon-per-minute draw (up to 112°F when the loop sat stagnant), and froze up partway through winter; a separate backyard builder reported 145°F for the first 4 days, settling down to a sustained 110-115°F after that. Mound size, chip quality, climate, and insulation all matter, and a smaller or less carefully built mound will produce less heat for less time. Plan around this realistic range, not Jean Pain's own best-case historical figure.

How it actually works

Microbes breaking down the carbon in wood chips release heat as a byproduct, the same reaction behind any hot compost pile, just deliberately scaled up and insulated to sustain it for months instead of weeks. A coil of tubing buried in the pile acts as a heat exchanger: water (or an antifreeze loop) circulates through the coil, picks up heat from the surrounding compost, and comes out the other end hot.

Component	What it needs to be
Feedstock	Chipped or shredded brushwood and small branches, not whole logs; a wood chipper is effectively required. A high carbon-to-nitrogen mix (wood chips) generates more sustained heat than a nitrogen-heavy mix (fresh manure or grass alone). It must be freshly chipped, green wood, not dried or seasoned: green wood runs close to 100% moisture content relative to a tree's dry weight, versus roughly 20% for seasoned wood, and that moisture and the still-active cambium underneath the bark are what feeds the microbial reaction. A pile built from seasoned or dried chips largely won't heat up at all.
Moisture	Damp but not soggy, roughly the wrung-out-sponge feel used for any hot compost pile. Too dry and microbial activity stalls; too wet and airflow drops, which also stalls it.
Chip volume needed	Wood chips run roughly 20 lb per cubic foot dry, up to 40-60 lb per cubic foot once saturated with water. Convert a target mound's length x width x height in feet, divided by 27, to get cubic yards of chips to source. A documented real backyard build used a 10x10x15 foot chip pile as its material source, a useful concrete anchor for what a serious build actually requires.
Mound size	Documented builds range from about 6 feet across up to Jean Pain's original 18-foot mound. Bigger mounds hold heat longer, since the pile's own mass insulates the hot core, but need proportionally more chipped material to build, and see the fire-risk sizing note below before building at the larger end of this range.
Heat-exchange tubing	PEX or CPVC, or the black polyethylene tubing commonly used for drip irrigation. Standard PVC is not a good choice here, see below. Plan on roughly 300 feet of 1-inch tubing for a mound with about a 7-foot radius, coiled with about 7 inches between each pass; a smaller or larger mound scales this length roughly with its coil surface area, not its overall volume.

Building it

1. Chip or shred brushwood down to a consistent, small size; this is the single biggest driver of how fast and how hot the pile heats up.
2. Build a rough frame (a cylinder of chicken wire and stakes, or a bamboo/wood form) to hold the pile's shape as you fill it.

3. Fill in layers, wetting each layer as you go, and coil the tubing through the pile as you build, starting near the base and spiraling upward with roughly 7 inches between adjacent coils, rather than trying to thread it through after the fact.
4. Cap and compact the outside of the mound to hold moisture and insulate the core; a finished mound should feel firm, not loose and airy.
5. Connect the tubing ends to your water system (a simple gravity-fed loop to a storage tank, or a pump loop) and give the pile one to two weeks to reach working temperature before expecting useful hot water.

WARNING

Large wood-chip piles have a real, documented fire risk, and it's in real tension with building one big enough to work

Spontaneous combustion in large compost and wood-chip piles is a well-documented hazard, not a theoretical one: internal temperatures above roughly 158°F meaningfully raise the risk, especially in piles that are large, dry on the outside while insulated and hot inside, or unevenly mixed. Standard fire-safety guidance for wood-chip and mulch piles calls for keeping any pile at least 15 feet from structures, fences, or anything else flammable, and for capping individual pile dimensions to roughly 4-6 feet high, 6-10 feet wide, and 10-30 feet long specifically to limit how much heat and flammable material sit in one contiguous mass. That's smaller than several of the mound sizes described above, including Jean Pain's own 18-foot mound, and there's no way around the tension: a mound built at that scale for maximum heat output is also a larger fire risk than standard guidance recommends for a wood-chip pile. If you build at the larger end of the size range above, treat the 15-foot clearance as non-negotiable regardless of pile size, monitor internal temperature if you can (a long compost thermometer is cheap), and keep the pile's moisture consistent rather than letting it dry out and reheat unevenly after rain; if you want to stay inside the standard fire-safety dimension caps, plan around the smaller, hoop-house-scale output described below rather than Jean Pain's own numbers.

Why not standard PVC

Standard PVC pipe is only rated for sustained use up to about 140°F, right at or below the temperatures this method is meant to produce, and heat exposure over time makes PVC brittle and prone to failure. PEX and CPVC both tolerate higher sustained temperatures and are the better choice for tubing that will sit inside a hot compost mound for months at a time.

The methane half: a separate, higher-hazard system

Jean Pain's full method also included feeding material into a sealed anaerobic digester to produce biogas (roughly 60% methane, 40% carbon dioxide, with trace hydrogen sulfide), which he burned for cooking, electricity, and vehicle fuel. That's a materially different and more hazardous project than the compost mound above: biogas is explosive in roughly 10-30% air concentrations, requires gas-tight construction, pressure relief, and monitoring, and needs spark-free equipment and no open flame anywhere nearby. This guide deliberately doesn't walk through building one; treat a home biogas digester as a distinct, advanced project requiring its own dedicated study, not an add-on to a weekend compost-mound build.

Sources

- Jean Pain's original design, output figures, and duration: Wikipedia, Jean Pain; Walden Labs; Jean Pain, *Another Kind of Garden*
- Modern build technique and dimensions: Midwest Permaculture
- Independent replication and real-world output (Gibbs House hoop house study): Western Michigan University, Gibbs House Compost Heat Recovery System report
- Spontaneous combustion risk in compost/wood-chip piles: BioCycle
- Pipe material temperature ratings: The Engineering Toolbox; FlowGuard Gold, PEX vs. CPVC
- Biogas composition and explosion/safety hazards: Farm Energy (eXtension)
- Pipe coil spacing and tubing-length sizing: Walden Labs; Mother Earth News
- Wood chip weight per cubic foot and a documented 10x10x15 foot chip-pile build: Cornell Small Farms Program
- Fire-risk clearance and pile-dimension caps for wood-chip and mulch piles: Safety Insurance
- Documented backyard-scale output figures (6-ton test mound and a second private build): Mother Earth News
- Green vs. seasoned wood moisture content: Wikipedia, Green wood

Building a Rocket Mass Heater

The Energy & Heat chapter's Tier 3 equipment list assumes a standard wood stove, professionally swept and ready for the season. A rocket mass heater is a different, far more fuel-efficient way to burn wood: a purpose-built combustion chamber followed by a thermal-mass bench that keeps radiating heat long after the fire is out. See Stirling Engines for a real way to pull a bonus of electricity out of this same fire while it's burning.

How it actually works

A rocket mass heater burns wood sideways in a J-shaped chamber, then forces the hot gas up through an insulated "heat riser" where it mixes with air and burns a second time, reaching roughly 1,300 to 2,400°F. That near-complete combustion is the whole point: almost nothing is left to condense into creosote further down the line. The hot exhaust then runs through ducting embedded in a large thermal mass, commonly a cob (clay-sand-straw) bench or a barrel-and-bench combination, that soaks up the heat and radiates it slowly for hours after the fire has burned out, rather than losing most of that heat straight up a chimney the way an open fireplace does.

The efficiency claim, and where it comes from

The design traces back to Ianto Evans and the Aprovecho Research Center, and the commonly cited figure, 80-90% less wood than a conventional wood stove for the same heat, comes from that original source lineage rather than an independent lab test of every build. Treat it as the honest claim behind the design's intent, not a guaranteed number for a first-time DIY build; a poorly sealed or undersized heat riser will burn less cleanly and heat less effectively than a well-built one.

What it's built from

Component	What it's typically made from
Burn chamber and heat riser	Fire brick or another refractory (heat-resistant) material able to hold up to sustained temperatures above 1,300°F
Barrel	A steel drum set over the heat riser, both radiating heat directly and acting as part of the ductwork into the mass
Thermal mass	A cob mix (clay, sand, and straw) built up around ducting, commonly shaped into a bench so the stored heat is also a place to sit
Chimney	A standard insulated flue is still required for the small amount of exhaust that exits after the mass has extracted most of the heat

Real dimensions: the ratios that decide whether it burns clean or smolders

The three chambers, feed tube, burn tunnel, and heat riser, aren't sized arbitrarily; a standard J-tube design keeps them in roughly a 1:2:4 ratio of feed tube to burn tunnel to riser height. A 6-inch system, the practical minimum riser diameter and the most common size for a first build, works out to roughly a 12-inch feed tube, a 24-inch burn tunnel, and a 48-inch riser; an 8-inch system scales the same ratio up. Keep the cross-sectional area consistent through all three chambers rather than narrowing or widening partway through, since a mismatched area is one of the most common causes of a smoky, incompletely-burning build.

The riser also needs real insulation, not just refractory mass, to actually reach the temperature that drives clean secondary combustion. Two proven approaches: pack a perlite-and-clay-slip mix (mixed to a milkshake consistency) into the gap between two concentric pipes, or line firebrick with a ceramic fiber insulation blanket at least 1 inch thick, 2 inches performs better. A half-inch layer is a common first-build mistake and isn't enough insulation to reach full combustion temperature reliably.

Sizing the exhaust run and keeping it clear of anything that burns

Match the exhaust ducting's diameter to the riser, 6 or 8 inches for the systems described above. As a rule of thumb, a 6-inch system supports roughly 35 to 40 equivalent feet of horizontal run before draft weakens too much to pull exhaust reliably; an 8-inch system supports up to about 50 feet. Subtract roughly 5 feet of that budget for every 90-degree elbow in the path, and keep the overall horizontal-to-vertical ratio around 1:3, a taller, hotter vertical chimney section buys more horizontal run elsewhere in the layout.

Clearance to anything combustible, framing, furniture, stored goods, isn't optional and isn't a single universal number. An uninspected, non-listed masonry heater generally needs 36 inches of clearance under NFPA 211 unless it qualifies for a reduced-clearance exception (down to 4 inches) by meeting specific masonry-thickness requirements, at least 8 inches of outer wall and 5 inches around the flue channel, verified by whoever inspects the build. Single-wall stovepipe sections of the exhaust run typically need 18 inches of clearance under WETT standards. Don't guess at this figure for your specific build; confirm it against the standard your inspector or building department is actually using.

The test burn: what "small" actually means and what you're checking for

Do a real test burn on the bare core, feed tube, burn tunnel, and riser, before enclosing any of it in the thermal mass. Light a small fire and let it come up to temperature, then watch the exhaust: once the system is properly warmed up, a clean-burning core puts out exhaust that's clear or shows only water vapor, a brief white puff in the first few minutes and again as the fire dies down is normal. Any persistent yellow- or blue-tinged smoke once the system has had time to warm up means something in the riser, insulation, or draft needs fixing before the mass gets built around it and makes that fix far harder to reach.

Building the thermal mass without cracking or steaming it

Build the cob mass in layers rather than all at once, a few inches at a time, letting each layer set up before adding the next; a mass built too fast in one wet mass traps moisture that has nowhere to go. Give the finished mass real dry time, commonly one to several weeks depending on thickness and climate, before the first full-intensity fire. A rushed first fire in a still-damp mass can crack the cob or, in a worse case, generate enough trapped steam to spall material off explosively; a slow initial fire with the damper or airflow kept moderate for the first burn or two is the safer way to dry it the rest of the way.

The legal reality: this isn't automatically a permitted heating appliance

A site-built rocket mass heater doesn't carry a UL listing the way a manufactured wood stove does, and it exists in a genuine gray area for a permanent, code-compliant installation. The real path, rather than assuming either "anything goes" or "it's illegal," is that a rocket mass heater can be classified and permitted as a masonry heater under the International Residential Code's R1002 provision, which references ASTM E1602, the standard guide for solid-fuel masonry heater construction. In practice, that means asking your local building department specifically for a masonry-heater permit citing R1002, and expecting the process to involve either an engineer's stamp, a formal inspection against ASTM E1602's mass and clearance

requirements, or sign-off from a licensed masonry-heater mason, not a standard wood-stove permit application. Meeting that standard's mass, clearance, and construction requirements is what gives a local building department something concrete to inspect and approve against; at least one documented case (Washington state, 2018) shows a rocket mass heater passing permit inspection through exactly this path. Skipping this step matters beyond the legal risk too: some insurers are reluctant to cover a home with an uninspected, non-standard heating appliance.

WARNING**Combustion safety still applies in full**

A clean-burning design reduces creosote and chimney-fire risk when built correctly, but it doesn't eliminate carbon monoxide risk from a leaky joint, a botched heat-riser seal, or backdrafting. Install a working carbon monoxide detector in the same room, mounted per the manufacturer's instructions and positioned within 21 feet of any bedroom door on the same floor, matching NFPA 72 and International Residential Code placement rules for any fuel-burning appliance, and have the finished build reviewed by someone experienced with the design, or a certified stove installer, before relying on it as a primary heat source.

Sources

- Design origin, mechanism, and efficiency claims: Wikipedia, Rocket mass heater; Ianto Evans and Leslie Jackson, *Rocket Mass Heaters*; Aprovecho Research Center
- Combustion temperature and clean-burn mechanics: Common Sense Home
- Masonry heater code classification and ASTM E1602: Masonry Heater Association; ASTM E1602
- Documented permit case: The Building Code Forum
- Carbon monoxide and creosote safety practices: permies.com
- J-tube feed/burn-tunnel/riser dimension ratios and minimum riser diameter: permies.com
- Heat riser insulation methods and thickness: permies.com; Green Life Homestead
- Exhaust duct sizing and maximum horizontal run: permies.com; permies.com
- Clearance-to-combustibles requirements and reduced-clearance masonry exception: permies.com; Cornell Legal Information Institute
- Test-burn procedure and what a clean burn looks like: permies.com
- CO alarm placement rules (NFPA 72 / IRC): Merrimack, NH Fire Department

DIY Solar Water Heater

The Energy & Heat chapter's Tier 3 Passive Solar Design item is about capturing the sun's heat without any powered equipment. Applied to water instead of a room, that same principle builds real hot water for washing, dishes, and hygiene, the kind of hot water the Bathroom & Hygiene Without Running Water guide assumes you'll need to heat some other way.

The simplest version: a solar shower bag

Before building anything, know the zero-construction version already exists: a black plastic solar shower bag, filled with water and left in direct sun for a few hours, works on the same principle as everything below and needs no tools at all. It's worth having a couple on hand as a Tier 1 stopgap even if you build a larger system.

A real build: the batch (ICS) heater

A batch heater, also called an ICS (integrated collector-storage) heater, combines the solar collector and the hot water storage into one insulated box. Cold water enters the bottom of a dark-painted tank or coiled tubing inside the box; sunlight passes through a glazed (glass or clear polycarbonate) lid and heats the dark surface; hot water rises to an outlet at the top. Ordinary household water pressure moves the water through the system, no pump, controller, or electricity required.

Component	What it's typically made from	
Collector/storage tank	A dark-painted metal tank (an old water heater tank works well, as long as its lining and any prior contents were potable-safe, never reuse a tank or drum that held fuel, chemicals, or anything non-food-grade) or a long coil of black polyethylene or PEX tubing	
Absorber coating	A high-temperature flat black paint, a silicone-based or selective coating rated for sustained collector heat, not ordinary spray paint	Flat finishes outperform gloss by several degrees since gloss reflects more light away instead of absorbing it
Enclosure	An insulated wooden box sized to the tank, insulated on the back and sides the same way a cooler is	
Insulation	Rigid foam board, extruded polystyrene (roughly R-5 per inch) or foil-faced polyisocyanurate (roughly R-6 per inch), 2 to 4 inches thick on the back and sides	
Glazing	Tempered glass, an old window, or clear polycarbonate sheeting on the sun-facing side	
Plumbing	Standard fittings tying the unit into the household's existing cold-water inlet and hot-water outlet lines, plus a check valve on the cold-supply line and a temperature-and-pressure relief valve on the tank itself	

Size the tank to the household's actual hot-water habit rather than guessing: a single batch heater built from a 40 to 80 gallon reused water-heater tank covers a typical household's daily hot-water draw for washing and dishes in good sun. Tilt the glazing to roughly your latitude, close to 40–41 degrees for most of Utah's Wasatch Front, angled south, for the most direct exposure across the year; a slightly steeper angle trades a little summer output for better results in spring and fall.

A well-built batch heater commonly reaches 110-160°F in good sun and can cover 70-90% of a household's hot water needs during peak summer months.

WARNING

A sealed tank tied into household plumbing needs real pressure and scald protection

This isn't optional hardware. A tank plumbed into a pressurized household water line and heated by the sun can build dangerous pressure with nowhere to go; fit a listed temperature-and-pressure

relief valve rated for the tank's working pressure, positioned to sense the top few inches of water, with its discharge piped safely away per normal plumbing practice, the same device a standard water heater already has. Water at the upper end of this design's range, 160°F, causes a real scald injury in under a second of contact; install a thermostatic mixing valve at the hot outlet to blend it back down to a safe delivery temperature before it reaches a shower or sink, rather than trusting the tank's own output temperature to stay in a safe range on its own.

Freeze protection: what "drain-down" and "antifreeze loop" actually mean

A drain-down system works by removing the water from the exposed collector entirely rather than trying to keep it from freezing in place: a valve, either a simple manual one you close for the season or an automatic one triggered by temperature or the absence of flow, lets the collector's water drain by gravity into an insulated indoor storage tank whenever the system isn't actively running or the temperature drops toward freezing. An antifreeze loop instead fills the collector permanently with a non-toxic propylene glycol mixture, the same type used in RV plumbing, that never freezes at outdoor temperatures, and transfers its heat to the household's actual drinking water through a separate heat exchanger rather than ever mixing the two. Either approach is a materially bigger build than the simple batch heater described above; for most households, planning to drain and store the unit before the first hard freeze and running it spring through fall is the more realistic option.

WARNING

This is a warm-season tool in most of Utah, not a year-round one, unless you build for winter

A simple batch heater is not freeze-safe. The tank and exposed plumbing sit outside, exposed to the same overnight cold as anything else outdoors, and a hard freeze can split a tank or pipe built for this design. Plan on draining the unit before a hard freeze, or simply treating it as a spring-through-fall supplement to your regular water heater.

Sources

- Batch/ICS heater design and mechanism: Alternative Energy Tutorials; Building America Solution Center (PNNL)
- Real-world output and seasonal coverage: SolarPoweredWaterHeaters.com
- Freeze protection requirements and drain-down/antifreeze-loop design: The Encyclopedia of Alternative Energy; WePowr; drainback mechanism detail: BuildItSolar

- Temperature-and-pressure relief valve requirements: UpCodes; International Code Council
- Scald risk and thermostatic mixing valve use: InterNACHI
- Reused tank potable-safety considerations: BuildItSolar
- High-temperature absorber paint selection: BuildItSolar
- Rigid foam insulation R-value by material: R-Value Associates
- Check-valve and backflow guidance for household plumbing tie-in: Energy Trust

Sizing a Solar Array & Battery System

The Energy & Heat chapter's Solar Generator and Off-Grid Solar Array items both say to size against real load, not marketed capacity. This guide is the actual method: four load tiers, the formulas behind each, and the one Utah-specific number that undersizes most first attempts at this. See Sizing a Fuel-Powered Generator for the same load tiers applied to a generator instead, and an honest comparison between the two.

Four load tiers, not one number

"How much solar do I need" doesn't have one answer, because a household typically wants several different levels of backup, and they don't scale the same way.

Tier	What it covers	What actually scales it
Whole house	Everything: full HVAC, all kitchen appliances, laundry, water heater, every outlet	The house itself: square footage, insulation, climate zone. Headcount matters far less than the building does.
House essentials (critical loads)	Fridge/freezer, a well or sump pump, a furnace blower, key lighting, internet	Also the house: a fridge or a well pump draws the same wattage whether one person lives there or five. A bigger household adds only a smaller secondary load from more hot water, laundry, and cooking.
Non-house essentials	A portable power station running medical equipment, radios, laptops, and charging	Headcount, closely. This is literally each person's own devices and needs.
Bare essentials (recharging only)	Phones, headlamps, handheld radios kept topped off, nothing else	Headcount, almost linearly. A family of five's bare-minimum tier is genuinely close to five times a single person's.

Why this distinction matters for sizing, not just planning

A single formula that scales every tier by household size will oversize your portable power station if you live alone, and undersize your critical-loads panel if you have a big family in a small, efficient house. Size the top two tiers against your actual appliances and square footage; size the bottom two against your actual headcount.

Sizing the panels

Panel wattage = daily Wh needed ÷ (peak sun hours × 0.75) × 1.1–1.2

The 0.75 factor covers real-world losses: wiring resistance, charge controller conversion, panel angle, dust, and heat all take a bite out of a panel's rated output. The 1.1–1.2 is a margin for degradation and bad-weather days.

WARNING

Size against your worst month, not the annual average

Salt Lake City averages 5.1 peak sun hours per day annually, but that swings from roughly 8.3 hours in June down to about 1.8 hours in December, more than a 4x difference. A system sized off the annual average works great in summer and does almost nothing in the exact winter storm outage this manual is built around. Always size the panel array against your local worst-month figure, not the yearly average.

Sizing the charge controller

The charge controller sits between the panels and the battery, regulating how the panels' power actually charges the bank, and it comes in two types worth knowing apart. A **PWM controller** is essentially a fast switch: its output amps equal the array's current regardless of what the panels are rated at in watts, and it only makes sense for small systems under about 300W where the panel voltage closely matches the battery voltage. An **MPPT controller** is a DC-DC converter that trades surplus panel voltage for extra current, harvesting roughly 10-30% more usable energy from the same array; use MPPT for any system over 500W or where the panel voltage runs meaningfully higher than the battery's.

Controller amps (minimum) = (total array watts ÷ battery charging voltage) × 1.25

Use the battery's actual charging voltage, not its nominal voltage, a 12V-nominal battery often charges closer to 14.4V; using 12V in the formula undersizes the controller by roughly 20%. A 1,600W array on a 24V bank, for example, needs $1,600 \div 24 = 66.7\text{A}$, $\times 1.25 = 83.3\text{A}$, so you'd buy a controller rated at least 100A. Also check the controller's maximum input voltage rating against your panels' actual open-circuit voltage in series: cold weather raises a panel's voltage output, sometimes 20% or more above its rated figure on a freezing morning, and exceeding the controller's input rating can damage it.

Sizing the battery

Battery Wh = daily load × days of autonomy ÷ usable depth of discharge

Depth of discharge changes this a lot by battery chemistry: LiFePO4 (lithium iron phosphate) can safely use about 85% of its rated capacity, while lead-acid or AGM batteries should only be drawn down to about 50%, meaning a lead-acid bank needs nearly double the rated capacity for the same usable power. Most home systems target 2-5 days of autonomy; lean toward the higher end in a cloudy winter climate. Cold temperatures also reduce a lithium battery's usable capacity, so an unheated garage or shed installation needs extra margin beyond the autonomy math alone.

Sizing the inverter

Size the inverter's continuous rating to the sum of everything you'd realistically run at once, and its surge rating to your single largest motor-driven load. A fridge compressor or a well pump can spike 3-7x its running wattage for a second or two at startup; an inverter that looks fine on paper for continuous load can still fail to start a well pump if its surge rating is too low.

Calculate your own numbers

Plug in your own figures below to run the two formulas above directly. This doesn't replace understanding the method, it just does the arithmetic; the exact formula used is shown with your numbers filled in.

Daily energy needed (Wh)

e.g. 3600

List each device you'd run, multiply its watts by hours used per day, and add them up. Find watts on the appliance's nameplate/label; if it only lists amps, multiply amps × 120V (or 240V for large appliances) to get watts.

Days of battery autonomy

3

Worst-month peak sun hours

e.g. 1.8

Look up your own address at NREL's PVWatts Calculator (a free, real government tool), then use the lowest "Solar Radiation" value shown across all 12 months, not the annual average, same reasoning as the Salt Lake City example above.

Battery chemistry

Lithium (LiFePO4), 85% usable



Calculate

Want an exact reading instead of an estimate?

A plug-in power meter (a "Kill A Watt" or equivalent, roughly \$20-30) gives you a real number for anything that plugs into a standard outlet: plug the meter into the wall, the appliance into the meter, and leave it connected a full 24 hours to read the accumulated kilowatt-hours, this captures a cycling load like a fridge far better than a nameplate figure or a guess at hours-used. Most of these meters cap out around 1875W, check that against the appliance first. For a hardwired 240V load that can't plug into anything, a well pump, electric dryer, or central AC, a clamp meter at the breaker (a one-time reading, or worth having an electrician do if you're not comfortable near an open panel) or a whole-home monitor like Emporia Vue or Sense, installed at the panel, gives the same kind of real, continuous number per circuit.

Real anchor numbers by tier

Tier	Typical figure
Bare essentials	Roughly 150-300Wh/day per person for phone charging, a headlamp, and a handheld radio; a household's absolute floor is often cited around 500-1,000Wh/day total
Non-house essentials	Roughly 2-5kWh/day for a household's first 72 hours running a power station for medical equipment, communication, and charging; higher if a CPAP or oxygen concentrator is in that mix
House essentials (critical loads)	Roughly 1-2kW continuous for a typical critical-loads panel, spiking to 3-4kW when a well or sump pump cycles
Whole house	Roughly 10-20kWh/day for an energy-conscious off-grid household, versus about 29kWh/day for a typical grid-connected U.S. household; a 5kWh/day site needs roughly 1.5kW of panels, a 20kWh/day site roughly 6kW

Sources

- Panel and battery sizing formulas, depth of discharge by chemistry: How to Go Solar; AltE Store
- Salt Lake City peak sun hours by month: TurbineGenerator.org
- Critical-loads panel tiers and typical draw: Palmetto; SunWatts
- Emergency/portable power station daily targets: Entropy Survival
- Whole-house off-grid daily energy figures: The Act of Thriving, Physical Foundation chapter (this site)

- Plug-in power meter accuracy and use: Wikipedia, Kill A Watt; P3 International
- Clamp meters and whole-home circuit-level monitoring: Energy Vanguard
- Charge controller sizing formula, MPPT vs. PWM, and cold-weather voltage rise: Renogy; PowMr Academy

Sizing a Fuel-Powered Generator

The Fire-Starting & Generator Safety guide covers not killing yourself or a lineworker with one; it doesn't cover choosing the right size. This guide is that sizing math: running watts vs. starting watts, real fuel consumption by type, and the honest tradeoff between a generator and the solar and battery alternative.

Start from the same load tiers

The four load tiers in the solar sizing guide, whole house, house essentials, non-house essentials, and bare essentials, apply here too; a generator gets sized against the same real numbers, not a different framework. What's different about a generator is the sizing math itself and the fuel behind it.

Running watts vs. starting watts

Add up the running watts of everything you'd realistically run at the same time, then add just your single largest starting (surge) watts on top, not every device's surge added together.

WARNING

Starting watts is where undersizing actually happens

A fridge or well pump's motor can spike 2-6x its running wattage for a second or two at startup. A generator sized only against running watts will stall or trip the moment that motor kicks on, even though it looked adequate on paper. Check the appliance's starting watts, not just its running watts, before sizing against it.

Target running the generator at roughly 50-80% of its rated capacity with 20-25% headroom above your calculated load, not near its maximum. As a rough real-world anchor: most households cover their house-essentials tier with a 5,000-7,500 watt portable unit; a true whole-house standby unit (central AC included) typically runs 12,000-22,000 watts.

A generator's rated wattage assumes sea level, and much of Utah isn't

Most portable generators lose roughly 3% of their rated output for every 1,000 feet of elevation above sea level, thinner air means less oxygen for combustion. At 6,500 feet, common in Utah's mountain valleys and higher canyons, that's close to a 20% real-world derating from the number printed on the box. Build that margin into your sizing if you live or plan to run a generator at elevation, rather than discovering the shortfall during an actual outage.

Calculate your own numbers

Plug in your own numbers to size against your actual load. This doesn't replace understanding the method, it just does the arithmetic; the formula is shown with your numbers filled in. If you can't find a real number for an appliance, the typical-wattage table below the calculator is a reasonable stand-in.

Total running watts (everything at once)

e.g. 1800

Add up the running watts of everything you'd have on at the same time. Check each appliance's nameplate/label; if it lists amps instead of watts, multiply amps × 120V (or 240V for a large appliance like a well pump or electric range).

Largest single device's starting watts

e.g. 2200

Check the manual for "starting watts," "surge watts," or LRA (locked rotor amps × volts). If it's not listed, estimate 2-3x that device's own running watts, a real, commonly-cited range for motor-driven appliances.

Target load percentage

65

Calculate

Want an exact reading instead of an estimate?

A plug-in power meter (a "Kill A Watt" or equivalent, roughly \$20-30) gives you a real running-watts number for anything that plugs into a standard outlet, and leaving it connected 24 hours reads real accumulated energy use too. Most cap out around 1875W, check that against the appliance first. For a hardwired 240V load, a well pump, electric dryer, or central AC, a clamp meter at the breaker (or an electrician, if you're not comfortable near an open panel) or a whole-home monitor like Emporia Vue or Sense gives the same real number per circuit. One caveat either way: these tools read average current, not a motor's true instantaneous starting surge, so for starting watts specifically, the manufacturer's spec sheet ("LRA," locked rotor amps, times voltage) is still the more authoritative number.

Typical figures for common appliances, use the real nameplate value when you can find one; these are reasonable stand-ins when you can't.

Appliance	Running watts	Starting watts
Refrigerator	~700W	~2,200W
Well pump	~1,000W	~2,000-3,000W
Sump pump	~800W	~1,300-2,400W (2-3x running)
Furnace blower	~800W	~1,600-2,400W (2-3x running)
Window AC, 5,000 BTU	~500W	~1,500W
Window AC, 10,000 BTU	~900W	~2,700W

Fuel type: a real tradeoff, not a clear winner

Fuel	Consumption (typical mid-size unit)	Shelf life	Tradeoff
Gasoline	~0.25-0.8 gal/hr depending on load and generator size	Starts degrading in as little as 30 days untreated; stabilizer extends this to roughly 12-18 months	Cheapest and most available fuel, but needs active rotation and stabilizer to stay usable in storage
Propane	~2-3 gal/hr at full load; burns about 20-25% more by volume than gasoline for the same output	Effectively indefinite if the tank and valves aren't damaged	The best fuel for long-term storage without maintenance, at the cost of needing more volume and a propane-rated unit
Diesel	~0.6-3.0 gal/hr depending on load and size	Degrades slower than gasoline but still benefits from a biocide/stabilizer in long-term storage	Most fuel-efficient and durable option, but generally the highest upfront equipment cost

A dual-fuel unit (gasoline and propane) trades a small amount of efficiency for real flexibility, useful if you're not sure which fuel you'll actually be able to resupply.

Inverter vs. conventional: a real difference for medical electronics

An inverter generator produces meaningfully cleaner power, generally under 3% total harmonic distortion (THD), compared to 5-10% or higher from a conventional generator. That's not a marketing spec; a CPAP, an oxygen concentrator, or anything else with a circuit board and a precision power supply is more vulnerable to that dirtier power than a simple resistive heater or incandescent bulb is. If the Access & Functional Needs chapter's medical equipment applies to your household, an inverter generator is the safer default, not just the quieter and more fuel-efficient one.

Getting power from the generator to what you're running

Without a transfer switch or interlock kit (see Fire-Starting & Generator Safety for why backfeeding a wall outlet is never the answer), you're running extension cords from the generator to individual appliances, and cord gauge matters more than it looks like it should. A standard 12-gauge cord is fine for a 20A circuit at distances under 50 feet, but push past 50 feet, or run anything close to 30A, and you need to step up to 10-gauge; a cord that's too thin for its load and length drops voltage and heats up, both real fire and

equipment-damage risks, not just an efficiency loss. As a working rule: 10-gauge for generator use in general, and mandatory at 30A regardless of length.

Portable vs. standby

A portable generator needs a person to deploy, fuel, and run it every time, and needs a transfer switch or interlock kit (see the Fire-Starting & Generator Safety guide) to power your house's circuits legally and safely. A standby generator auto-starts on its own transfer switch within seconds of an outage and needs no manual intervention, at a real cost: several times the price of a comparable portable, plus professional installation. Neither is the objectively right answer; it's a genuine budget-versus-convenience tradeoff.

Generator or solar and battery: an honest comparison

A generator gets you back to near-full power immediately and doesn't care about cloud cover or the time of year the way solar does. Its real limit is fuel: a finite, resupply-dependent resource in exactly the kind of prolonged disruption this manual plans around, and the same disruption that makes fuel harder to buy is often the reason you need the generator in the first place. Solar's limit is different: capacity and weather, not a supply chain, once it's installed, it keeps working for free as long as the sun does. Many households reasonably want both: a generator for fast, high-wattage recovery in the first days, and solar plus battery for the indefinite stretch after fuel runs out or becomes hard to resupply.

Sources

- Running vs. starting watts and generator sizing method: BigRentz; Batteries Plus
- Fuel consumption by type: GRETECH; Generator Source
- Gasoline vs. propane shelf life: Ferrellgas; TruePrepper
- Inverter generator power quality and THD: Anker SOLIX; Erayak Power
- Typical appliance running/starting watts: SizeMyHome; HVAC Base
- Plug-in power meter accuracy and use: Wikipedia, Kill A Watt; P3 International
- Clamp meters and whole-home circuit-level monitoring: Energy Vanguard
- Generator altitude derating (roughly 3% per 1,000 ft): Genesal Energy; Generator Bible
- Extension cord gauge selection for generator use: Vantecable

Pedal Power: Bicycle Generators

The Energy & Heat chapter's Bicycle Generator item names this as a way to charge small batteries when solar input is low. This guide is the real detail behind that: honest output numbers, a real commercial option, the DIY design that actually works, and a viral claim about this exact technology that's worth knowing is false.

Realistic output, mechanical and electrical

A person's own sustained mechanical output varies a lot by fitness and duration: roughly 75W or less for casual pedaling with no real effort, about 100W sustained for an hour from an untrained adult, 150-200W from a fit recreational cyclist, and up to 250W from a trained athlete over extended periods.

WARNING

Electrical output is meaningfully lower than mechanical output

Generator conversion losses mean 100W of pedaling might only yield 31-74W of actual electricity, depending on the system's efficiency. Any pedal-power plan built around the mechanical number rather than the electrical one will disappoint.

A real commercial option

The K-Tor Power Box (roughly \$200) delivers 20-50W of continuous, smooth DC output at a pedaling cadence of about 90rpm, consistent with the real-world losses above rather than the higher mechanical figures. Its intended use is charging small and medium gadgets: phones, tablets, cameras, radios, walkie-talkies, flashlights. K-Tor's own guidance is refreshingly honest: nobody sustains an hour of pedaling, they recommend 10 minutes several times a day instead.

Building your own: what actually works

A DIY build has three real parts: a stand to hold the bike stationary, a generator to spin, and a way to get that generator's output safely into a battery. Mount the bike on a bicycle trainer stand (the kind sold for indoor winter training) rather than improvising a frame, it's built to hold a bike rigid under real pedaling force. A car

alternator, salvaged or bought used, is the generator most DIY builds actually use, since it's cheap, durable, and already built to charge a 12V battery.

If building a DIY pedal generator, drivetrain choice matters more than most builders expect. A direct chain-and-sprocket drive from the pedals to the generator runs up to 98% efficient. A friction drive (a roller pressed against the tire) runs only 80-90% efficient, wears the tire quickly, and its efficiency varies with tire pressure, making it inconsistent as well as lossy. Build a direct chain/sprocket drive if you're building one at all: connect a chain from the bike's own rear sprocket (with the bike in its lowest gear) to a second sprocket welded or clamped onto the alternator's shaft, sized so a comfortable 60-90rpm pedaling cadence spins the alternator up into its efficient range, typically 1,000-3,000+ rpm depending on the specific alternator.

An alternator's own internal voltage regulator and diode trio already rectify its output to a clean 13.5-14.5V DC suitable for charging a 12V battery, which is a real reason to use one instead of a bare DC motor. Still wire a blocking diode and a fuse in series between the alternator and the battery: without the diode, the battery can drain backward through the alternator's windings whenever you stop pedaling, and the fuse protects the wiring if something shorts.

Does adding a flywheel increase output?

No, and it's worth being precise about why not: a flywheel cannot create energy, only conservation of energy applies here, the same physics problem behind the debunked claim below. What a flywheel actually does is smooth pedaling's naturally uneven, pulsed torque (much harder on the downstroke than the upstroke) into steadier rotational speed. That steadiness keeps the generator running in its efficient RPM range instead of constantly moving in and out of it; a real documented example uses sprocket sizing to turn a 60-100rpm pedaling cadence into 2,000-5,000rpm at the alternator shaft, right in a small alternator's efficient band. Net effect: less of your effort is wasted as heat and vibration, not more electricity from the same effort than physics allows. It also reduces peak stress on your legs and the drivetrain.

The claim that gets oversold

A viral pitch for a bicycle-generator product claimed "pedal for one hour and you have electricity for 24 hours." The real, documented output: about 120Wh from an hour of pedaling, averaging out to roughly 5W over a full day, enough for some phone charging and a few small lights, not a house. The hour of pedaling that produces it also burns roughly 550 kcal, a real cost nobody selling these mentions. Treat any bicycle-generator claim that doesn't specify actual watt-hours with real skepticism.

Pedal power or a small solar panel

For the same 20-50W of charging capacity, a small solar panel costs less than a \$200 purpose-built pedal generator and needs zero ongoing physical effort once installed. Pedal power's genuine advantage is working when solar can't: at night, during heavy overcast, or in deep winter when panel output drops, exactly the niche the manual's own equipment list already names.

Charging a thermal battery instead of an electrical one

Running pedal-generated electricity straight into a resistive heating element, rather than a battery, skips a real loss: converting electricity to heat through a resistor is close to 100% efficient, while charging a battery loses another 10-20% to round-trip inefficiency on top of the generator loss already at play. For heat specifically, resistor-to-thermal-mass is the more efficient path of the two. Skipping the generator and resistor entirely, using a direct mechanical friction heater instead, is more efficient still, since virtually all mechanical work against a resistive load becomes heat directly, though this means building a genuinely unusual DIY device rather than buying one.

WARNING

This is a trickle charge, not a fast one

Even at a generous 50W electrical output, an hour of pedaling delivers only 50Wh, enough to raise about 10kg of sand by roughly 20°F. This is a real, legitimate supplement to a thermal-mass system like a Jean Pain mound or a rocket mass heater's bench, not a fast or primary way to heat one.

Sources

- Sustained human mechanical power output by fitness level: Mapawatt; PedalPC
- K-Tor Power Box specifications and use guidance: K-Tor; Walden Labs
- Direct chain drive vs. friction drive efficiency: Low-Tech Magazine
- Flywheel smoothing and alternator RPM matching: Hackaday; Early Retirement Extreme Forum
- "Free Electric" bike claim, debunked with real output figures: Metabunk; Science for Sustainability
- Resistive heating efficiency and thermal-battery charging: Polar Night Energy, Sand Battery technical documentation
- DIY alternator-based bicycle generator build (trainer stand, sprocket ratio, diode trio, blocking diode): Appropedia; Practical Survivalist

Stirling Engines: Turning Stored Heat Back Into Power

Everything else on this site about wood stoves, the Jean Pain mound, and the rocket mass heater is about generating and storing heat. A Stirling engine runs the other direction: it turns a heat source, live or stored, back into mechanical or electrical power. Here's how it actually works, what it really produces, and why it behaves differently on a cooling thermal battery than on a fire you're actively feeding.

How it works, and its real advantage

A Stirling engine runs on external combustion: a sealed working gas is cyclically heated and cooled between a hot side and a cold side, and that temperature difference drives a piston. Because the heat source is external and never touches the working gas directly, a Stirling engine is genuinely fuel-agnostic, wood, propane, solar-thermal concentration, or waste heat from something else entirely all work, unlike a fuel generator locked to one specific fuel type.

Real efficiency, stated honestly

Small Stirling engines are commonly cited at 5-15% real-world efficiency, well below their theoretical Carnot-limit ceiling. Documented small builds have come in as low as 1-6% at modest input power. A better research example recovered heat from a source as cool as 70°C and produced 30-40W at about 14% efficiency. Know the temperature threshold before planning around one: most small hobby and DIY Stirling engines need a hot-side temperature difference of at least 150-300°C to run at any meaningful output, well above what a lukewarm surface or gentle heat source provides. A specialized "low-temperature-difference" design can start moving on as little as 15°C, but those are a different, more specialized engine, not what a typical kit or garage build uses.

WARNING

Precision machining is the real bottleneck

Seal friction, dead volume, and internal gas leaks kill a Stirling engine's efficiency faster than anything else. A well-made kit or commercial unit will meaningfully outperform a garage-built one for exactly this reason; this is a harder DIY build to get right than a pedal generator.

The realistic use case: combined heat and power

The practical application isn't a standalone power source, it's a bolt-on to heat you're already generating. If a wood stove is running 10 hours a day for actual heating anyway, adding a Stirling generator can realistically produce 50-100Wh of bonus electricity over that period: a genuine, worthwhile extra, not a primary power plan on its own.

Where to find it: ready-made commercial CHP-oriented Stirling units are genuinely rare, most manufacturers target natural gas or wood pellets rather than a standard wood stove. The RIGID RS1000 is one real example built for exactly this pairing, starting to generate once its hot chamber reaches roughly 180°C and producing up to 1kW electrical alongside usable hot water. Outside a purpose-built unit like that, this remains a genuinely harder DIY build than most others on this site, plan on a kit or a real machining background, not an afternoon project.

A more available comparison: thermoelectric generators

A thermoelectric generator (TEG), the Seebeck-effect technology behind BioLite-style camp stoves, does a similar job with no moving parts at all: typically 3-10W, commercially available today, simpler and more durable than a Stirling engine, at a lower practical ceiling. A Stirling engine has a higher theoretical output and can scale further, at the cost of real mechanical complexity a TEG doesn't have. For a simple, buy-it-today option, a TEG stove is the more practical starting point; a Stirling setup is the higher-effort, higher-ceiling path.

The thermal-battery caveat

A Stirling engine needs a sustained temperature difference to keep running, and a live, fed fire holds that difference steadily. A discharging thermal battery, a cooling Jean Pain mound, a cooling rocket-mass-heater bench, doesn't: output would decline as the stored heat runs down, the same way a candle dims as it burns rather than holding a constant brightness. Don't expect a Stirling engine paired with stored thermal mass to behave like a battery with steady voltage; it behaves like a fire dying down, because that's genuinely what's happening to the heat source underneath it.

Sources

- Stirling engine mechanism and fuel-agnostic external combustion: Physics Forums
- Real-world small Stirling engine efficiency figures: Solar Powered Project; DIY Solar Power Forum

- Combined heat and power use case and realistic daily output: off-grid cabin/RV Stirling CHP documentation
- Thermoelectric generator (TEG) output and BioLite-style stove comparison: Wikipedia, BioLite; Resilience.org
- RIGID RS1000 commercial CHP Stirling unit and startup temperature: RIGID
- Minimum hot-side/cold-side temperature difference for small and low-temperature-difference Stirling engines: Real World Physics Problems

Ham Radio Licensing & Off-Grid Mesh Networking

The Communication chapter's core skill guide covers choosing between GMRS and ham radio at a high level. This is the actual next step: what a Technician license costs and requires, when GMRS is the better call instead, and how to set up a licence-free LoRa mesh network with Meshtastic, a capability that keeps growing at Tier 3 and 4 the way a stored battery bank doesn't.

GMRS or a ham license: the concrete tradeoff

Both are legal, licensed ways to use serious radio power, and they solve different problems.

	GMRS	Technician ham license
Cost	\$35 for a 10-year license, no exam	\$35 FCC fee per person, plus a roughly \$15 exam session fee, both one-time
Who's covered	One license covers you and your immediate family (spouse, kids, parents, siblings, in-laws), regardless of whether they live with you	Strictly individual; every operator needs their own license and exam
Power	Up to 50W on repeater channels, 5W on the main channels	Up to 1,500W above 50 MHz (in practice, most handhelds run 5W and mobiles 50W)
Repeaters	Open to any GMRS licensee, but cannot legally be linked together over the internet to extend range beyond the local repeater	Thousands of repeaters, many legally linked (IRLP, EchoLink, AllStarLink) for regional or nationwide reach
Modes	Analog FM voice only, plus basic text/GPS data	VHF/UHF digital voice, packet/APRS, satellite work, and a path to HF once you upgrade past Technician

A reasonable household plan: get GMRS for simple, no-test family coverage, and have at least one person also get a Technician license for the added range and modes GMRS structurally can't reach.

Getting a Technician license

1. Study the current question pool. The exam draws 35 questions from a standard pool that gets replaced every four years (the pool in effect now runs July 2026 through June 2030), so confirm any study material or app is using the current pool before relying on it.
2. **Register for an FCC Registration Number (FRN) before exam day, not after.** Every first-time applicant needs one to give the volunteer examiners at the session; it's free and takes a few minutes at the FCC's own CORES registration system. Showing up without one is one of the most common reasons a first-time test-taker gets turned away or delayed at their own exam session.
3. Pass with 26 of 35 correct (about 74%). **No Morse code is required**; it was dropped from every U.S. license class in 2007.
4. Take the exam through an FCC-accredited Volunteer Examiner Coordinator (ARRL-VEC is the largest). Both in-person sessions and remote, video-proctored online sessions are common now; not every VEC offers remote testing, so check before counting on it.
5. Pay the exam session fee (commonly around \$15, collected by the local VE team) and, after passing, the separate \$35 FCC application fee paid directly through the FCC's licensing portal. The license is typically issued within 24-48 hours.

Where to find it: ARRL's own Getting Licensed page and exam session finder; free practice exams at HamStudy.org and ARRL's own exam review tool, both pulling from the real current question pool.

What a Technician license actually authorizes

Full privileges on every amateur band above 50 MHz, at up to 1,500W. HF access is narrow: CW-only on small segments of 80m, 40m, and 15m, and both phone and data on 10 meters. If your interest is regional HF communication (see NVIS below), a Technician license alone won't get you there; that requires upgrading to General.

Off-grid mesh networking with Meshtastic

Meshtastic uses long-range, low-power LoRa radio to relay text messages and GPS location between small handheld nodes, hopping from node to node without cell service, Wi-Fi, or a repeater. In the U.S. it runs in the 902-928 MHz band under the FCC's unlicensed Part 15 rules, not because there's no regulation, but because it fits inside power limits (roughly 1W conducted, capped further by antenna gain) that don't require a license to operate.

Device	Approx. price	Notes
Heltec V3 (LoRa32 V3)	~\$25	Cheapest common entry point, includes a small OLED screen
RAK WisBlock starter kit	~\$25-37	Modular, widely used for a first build
LILYGO T-Deck / T-Deck Plus	~\$43-85	Built-in keyboard and touchscreen; Plus adds GPS and a bigger battery
LILYGO T-Beam Supreme	~\$85-120	Onboard GPS
Solar repeater node (e.g., RAK WisMesh Solar Repeater)	~\$70-130	Fixed relay point to extend a mesh's coverage without a battery to recharge

Set up through the Meshtastic phone app (Android, iOS, or web) over Bluetooth: flash the node, name it, and join or create a channel. It's text and location only, there's no voice calling on this network.

Set the region or the node won't transmit at all

A brand-new node ships with its region set to "Unset," and it will silently refuse to transmit any packet until that's fixed, one of the most common "why isn't this working" moments for a first-time setup. In the Meshtastic app, tap the connected device, go to Settings → LoRa → Region, and set it to **US** (the 915 MHz band used across North America). Every node you want to talk to needs the same region and the same modem preset; a mismatch there looks identical to a dead node.

WARNING

The default channel is effectively public

Meshtastic's default public channel ("LongFast") uses a trivial, publicly known encryption key, so treat anything sent on it as visible to anyone else running Meshtastic nearby. For anything you actually want private, create your own channel with a real AES-128 or AES-256 key and share that channel's name and key only with your own group, everyone on the channel needs the same one to communicate.

Realistic range varies enormously by terrain, and marketing numbers tend to cite the best case: expect roughly 2-10 miles with a decent antenna and clear line of sight, often just a few hundred meters to a couple of miles in a city with buildings in the way, and as little as a quarter mile in dense wet forest. A documented

mountain-to-mountain link once reached 205 miles, worth knowing as the extreme ceiling, not a planning number.

NVIS: regional HF without a repeater

Near Vertical Incidence Skywave (NVIS) is an HF technique that deliberately beams a signal almost straight up so it reflects back down at a steep angle instead of skipping over the horizon, covering roughly 100 to 300 miles with no repeater, no tower, and no internet link required at all. That makes it one of the few communication methods on this page that keeps working even if every local repeater site loses power.

The antenna itself works backwards from normal long-distance HF advice: a horizontal half-wave dipole mounted low, roughly a fifth of a wavelength above ground (a common example is a dipole peaking around 15 feet), on the lower HF bands, 40, 60, or 80 meters. NVIS requires a General class license or higher; Technician's only phone privilege (10 meters) doesn't behave the same way and isn't the band NVIS actually uses.

Why licensing actually matters, beyond the legal requirement

The FCC does levy real penalties for unauthorized or interfering operation, not routinely, but when it acts, the amounts are serious: a \$34,000 forfeiture affirmed in 2025 against someone who repeatedly interfered with U.S. Forest Service communications, a proposed fine as high as \$60,000 out of the FCC's Miami field office the same year, and a \$25,000 fine against an already-licensed ham who ran an unauthorized FM broadcast station. Enforcement generally targets significant, repeated interference, not a first-time mistake, but the amounts show this isn't a symbolic rule. Beyond the legal risk, licensing is also what gets you welcomed onto a repeater during an actual emergency: most ham and GMRS repeaters are maintained by volunteers or clubs who expect valid licensing from anyone using their system, not just goodwill.

Sources

- Technician exam format, question pool, and licensing steps: ARRL; Ham Radio School
- FRN required before taking the exam, effective May 2021: ARRL
- FCC application fee and exam session fees: ARRL; FCC
- Remote/online exam sessions: ARRL
- GMRS license fee, family coverage, and power limits: FCC; eCFR §95.1767
- GMRS repeater linking restrictions: National Communications Magazine

- Meshtastic regulatory basis, power limits, and channel security: Meshtastic docs; eCFR §15.247; Meshtastic channel docs
- A node won't transmit until its region is set, and the US915 region setting: Meshtastic docs; Meshtastic initial configuration
- Meshtastic device options and pricing: NodakMesh
- Meshtastic real-world range figures: SDR Store; technodabbler; Wikipedia
- NVIS propagation and antenna setup: jpole-antenna.com; Ham Radio School
- FCC enforcement actions and penalty amounts: FCC; ARRL

Medical Kits: What Actually Goes in Each One

This site's Tier 1-4 progression builds up a trauma kit, bulk medical supplies, a surgical kit, and a community cache, but always sorted by tier, never by *where the kit actually lives*. The Go-Bags & 72-Hour Kits guide's own health row just says "first aid kit" and points to First Aid Basics, which teaches technique, not contents. This guide fills that gap directly: what actually goes in a portable go-bag kit, a stationary home kit, a vehicle kit, and a Tier 4 community cache, and why each one is genuinely different from the others, not just a bigger or smaller version of the same list.

Which kit does which job

Kit	Built for	The one constraint that shapes it
Go-bag / IFAK	Trauma, in the first minutes, away from home	Weight and size; every item has to earn its place
Home medical kit	Everyday injuries and illness, sheltering in place	Space isn't scarce; depth and quantity matter more than portability
Vehicle kit	Roadside trauma, the most statistically likely injury most people will personally see	Extreme temperature swings degrade meds and adhesives faster than home storage
Community cache (Tier 4)	Coverage across a neighborhood, not one household	Access rules, training, and real legal limits on what can be stocked

The go-bag kit: a real IFAK, not a box of bandages

An Individual First Aid Kit (IFAK) is built around a narrow, specific job: stopping life-threatening bleeding in the first few minutes, before EMS arrives. That's a different design goal than a home first aid kit, and the contents reflect it.

Item	Why it's in this kit specifically
Commercial tourniquet (CAT or SOFT-T)	The core item; this site's own shopping list already calls for it, never an improvised substitute
Hemostatic gauze	Packs a wound a tourniquet can't reach (the neck, armpit, groin)
Compression bandage (Israeli bandage)	Holds pressure on a wound hands-free once it's packed
Chest seal	For a penetrating chest wound; not currently stocked anywhere else on this site, and it's a standard IFAK item
Nitrile gloves, 2+ pairs	Bleeding control means direct contact with someone else's blood
Trauma shears	Cutting clothing away from a wound fast, without a blade near skin
Permanent marker	Write the tourniquet application time directly on the tourniquet or the patient's skin; EMS needs that time, and it's the detail people forget to pack
Emergency blanket	Shock and blood loss both drop body temperature fast

This kit is small on purpose

Every item above earns its place because it treats the handful of injuries that actually kill people before help arrives: uncontrolled bleeding, an airway problem, or shock. It is not a substitute for the home kit below; a full, bulk range of bandages, ointments, and OTC medications belongs there instead, not crammed into this small trauma-focused kit. That's separate from the few days of each person's actual prescription medication that Go-Bags & 72-Hour Kits already calls for packing in the bag itself; that still belongs in the go-bag, just not inside this kit specifically. See First Aid Basics for how to actually use a tourniquet and pack a wound, and consider a real Stop the Bleed course; owning this kit isn't the same as knowing how to use it under pressure.

The home medical kit

This is the kit that has room to be complete. It absorbs everything this site's own Tier 1-3 Medical Care shopping list already calls for, consolidated into one list instead of a tier-by-tier drip feed, plus the baseline the American Heart Association and American Red Cross recommend for any home kit.

Category	Contents	Note
Wound care baseline	2 absorbent compress dressings (5x9 in), 25 assorted adhesive bandages, 10 yd adhesive cloth tape, 5 antibiotic ointment packets, 5 antiseptic wipe packets, gauze rolls and roller bandages, sterile gauze pads	The AHA/Red Cross first aid guidelines' own minimum-contents table
Beyond the baseline	2 packets aspirin, hydrocortisone ointment, an instant cold compress, a breathing barrier with a one-way valve, 2 pairs nonlatex gloves, tweezers, a non-mercury oral thermometer	Same source; rounds out the basics for burns, allergic skin reactions, and CPR
This site's Tier 1 additions	Digital thermometer, pulse oximeter, basic OTC medications (pain relievers, antihistamines, anti-diarrheal, antacids), a 14-day supply of every household prescription	Already on the shopping list; belongs in this kit specifically, not just "somewhere in the house"
This site's Tier 2 additions	Manual blood pressure cuff, stethoscope, otoscope, SAM splints, a sterilization method (pressure cooker or alcohol burner), bulk gloves/masks/gauze/tape	For when a hospital visit isn't realistic for anything short of a true emergency
This site's Tier 3 additions	Suture/staple kit, dental kit, a real medical library (Where There Is No Doctor and similar)	Get real training before using the suture kit; owning it isn't the same as knowing when and how

Store it as one kit, not scattered supplies

A first aid kit that's actually a shoebox in one closet plus a bottle of aspirin in another plus the thermometer in a junk drawer doesn't function as a kit under stress. Consolidate everything above into one container, in one known location, and make sure every adult in the household knows where it is.

The vehicle kit

The Vehicle Emergency Kit & Roadside Basics guide already covers the mechanical side of a vehicle kit; the medical side of it deserves its own note, because a parked car is a genuinely hostile storage environment that nothing else on this site addresses.

A parked car runs hotter than any medication label allows for

Interior temperatures in a parked car can exceed 140°F even on a mild, sunny day, in Utah's own summer heat often well before noon. Most medications are only tested and labeled stable at 68-77°F room temperature; degradation from heat exposure is a real chemical breakdown, not a cosmetic issue, and a pill or auto-injector that looks completely normal can already be compromised. Epinephrine auto-injectors, nitroglycerin, insulin, and albuterol inhalers are specifically heat-sensitive and are poor choices to leave in a vehicle kit long-term. Adhesive-backed items aren't exempt either: adhesive bandages and medical tape genuinely lose their stick with repeated heat cycling, the same failure mode that leaves a bandage that won't stay on when you actually need it. A tourniquet's nylon webbing and plastic buckle are about the only thing in this kit that's genuinely heat-indifferent; treat everything else, adhesives included, on a rotation schedule between the car and the house rather than leaving it parked for months.

Beyond that heat caveat, the vehicle kit's trauma contents should mirror the go-bag IFAK above: the CDC puts car crashes at roughly 2.1 million emergency room visits a year in the US, making a roadside accident one of the most statistically likely serious trauma events most people will ever personally witness, and the same tourniquet-and-hemostatic-gauze logic applies just as much there as anywhere else.

The community cache (Tier 4)

This site's Tier 4 Medical Care content describes a "Shared Medical Cache" in one general sentence: bulk trauma and medication stock, sized for the neighborhood, with access rules agreed in advance. Here's what that actually looks like in practice.

Real sizing logic exists for this, and it doesn't have to be invented from scratch. ANSI/ISEA Z308.1, the standard behind OSHA's workplace first aid kit requirement, defines kits at 10-, 25-, 50-, and 100-person scales, with a common industry benchmark of one kit per 25 people. That's a reasonable starting point for sizing a neighborhood cache: count the households you're actually planning to cover, and size against the nearest bracket rather than guessing.

Component	What it actually means
Community medical reserve	Bulk trauma and medication stock, sized using the ANSI benchmark above, not per-household guesswork
Trained-responder roster	Names, skills, and availability, kept current; the actual point is knowing who to call fast, not a binder nobody reads
Access rules	Decided in advance, in writing, before the cache is needed, not improvised during an emergency
Shared reference copies	Distributed across multiple households so losing one copy doesn't lose the only one

The real legal line on stockpiling antibiotics

Prescription antibiotics legally require a licensed provider's direction; buying them without any prescription from an unlicensed source is illegal, not a gray area. There is a legitimate path: some physicians write a standby prescription for exactly this purpose, and several US-based telemedicine services fill emergency-use antibiotic prescriptions through licensed physicians and pharmacies. A community cache that wants to include antibiotics should go through one of those legitimate channels, ideally with a household member's own doctor, not treat this as a workaround.

What about pets

Veterinary kits aren't covered here. Pet Evacuation & First Aid Basics already has a real, species-specific kit-building section, gauze, vet wrap, a properly sized muzzle, saline, plus genuinely different needs for reptiles and small mammals, and duplicating it here would just be a worse copy of a guide that already does the job.

Sources

- Stop the Bleed / American College of Surgeons, core IFAK contents including tourniquet, hemostatic gauze, chest seal, and the time-stamping marker: Stop the Bleed
- American Heart Association / American Red Cross, 2024 First Aid Guidelines, Table 2, minimum contents for a first aid kit: AHA/Red Cross
- ANSI Blog, ANSI/ISEA Z308.1-2021 workplace first aid kit classes and person-count sizing (10/25/50/100-person kits, the one-kit-per-25-people benchmark): ANSI
- People's Pharmacy and Health In Hand, heat degradation of medication, FDA-labeled stable storage range (68-77°F), and specific heat-sensitive drugs (epinephrine, nitroglycerin, insulin, albuterol): People's

Pharmacy; Health In Hand

- SafetyCulture Marketplace, heat's effect on adhesive bandages and first aid kits left in a hot car:
SafetyCulture
- JASE Medical, the legal path for a standby emergency antibiotic prescription through a licensed physician:
JASE Medical
- CDC, roughly 2.1 million annual emergency room visits from motor vehicle crash injuries in the US: CDC

Understanding START Triage

The decision logic behind sorting multiple injured people by severity, not a replacement for practicing it on simulated patients. This is a Stage 3 self-sufficiency skill from the Medical Care chapter and its addendum, and the decision tree itself is genuinely teachable in text, the same way a checklist is, even though becoming fast and automatic at it takes real practice.

This is for multiple casualties, not one injured person

START (Simple Triage And Rapid Treatment) exists to solve one specific problem: more injured people than you can treat at once, so you have to decide who gets help first. If you're dealing with a single injured person, don't triage them, just help them; see the first aid basics guide for that.

The four categories

Tag	Meaning	What it signals
Green (Minor)	Walking wounded	Can wait; treat everyone else first
Yellow (Delayed)	Serious but stable	Needs care, but survivable if it waits
Red (Immediate)	Life-threatening, treatable	Highest priority; treat or evacuate first
Black (Deceased/Expectant)	Not breathing, even after airway repositioning	Beyond what first aid can change

The decision sequence, in order

START is built to tag each person in about 30 seconds, by walking through the same five questions in the same order every time. Once you've assigned a tag, move to the next person; you're sorting quickly, not treating yet.

1. **Call for anyone who can walk to move to one spot.** Everyone who gets up and walks there on their own is tagged **Green**. Someone able to hear you, understand the instruction, and walk is very unlikely to die in the next hour; that's the entire logic behind checking this first, before anything else.

2. **For everyone who didn't get up, check breathing.** If they're not breathing, reposition the airway (tilt the head back, lift the chin) the same way you would before rescue breaths. Still not breathing after that? Tag **Black**. If breathing starts once the airway is open, tag **Red** immediately and move on; don't stay to treat yet.
3. **If they were already breathing on their own, check the rate.** Faster than about 30 breaths a minute (roughly one breath every two seconds) suggests shock or respiratory distress; tag **Red**. Slower than that, continue to the next check.
4. **Check perfusion: a radial pulse (at the wrist) or capillary refill.** Press a fingernail until it goes pale, then release; longer than about 2 seconds to return to normal color, or no radial pulse at all, means poor circulation; tag **Red**. A normal pulse and quick refill means continue.
5. **Check mental status: can they follow a simple command?** "Squeeze my hand" or "open your eyes" is enough. Can't follow it, or too altered to respond meaningfully? Tag **Red**. Can follow it? Tag **Yellow**.

Five questions, and every person ends up tagged Green, Yellow, Red, or Black by the time you're done with them. Move to the next person immediately after tagging; treatment happens in tag order once everyone's sorted, not as you go.

Why this specific order

Each question is placed to catch the deadliest, most reversible problems first: an unrepositioned airway or a rapid respiratory rate kills faster than almost anything else a bystander can actually fix in the field, so those come before circulation and mental status, which still matter but progress more slowly. The order isn't arbitrary; it's sorted by how fast each problem kills and how quickly it can be caught.

How to actually mark the tag on a person

Sorting someone into a category only helps the next responder if the tag is physically visible on them, not just decided in your head. Commercial triage tags (color-coded cardstock with a tear-off strip matching the category) are the real, purpose-built tool, and worth keeping in a CERT kit or car if you've taken the training. Without one, colored surveyor's tape or ribbon, tied around a wrist or ankle, works as a real substitute, keep a roll each of red, yellow, and green on hand for exactly this. As a last resort with literally nothing else available, writing the color directly on the person's forehead or a piece of exposed skin with a permanent marker communicates the same information; legible and visible matters more than which of these three methods you use.

Retriage: tags aren't permanent

A mass-casualty scene keeps changing after the first pass. Someone tagged Yellow can deteriorate to Red while you're working through everyone else; someone tagged Red who gets a few minutes of care can sometimes be safely reclassified. Re-check tags periodically rather than treating the first sort as final, especially for anyone tagged Yellow.

What this doesn't replace

Reading this sequence is not the same as being fast and automatic at it under real stress, with real people, in a chaotic scene. **CERT (Community Emergency Response Team) training** is free in nearly every Wasatch Front city, run through the local fire department, and includes hands-on practice running START on simulated patients, exactly the repetition that turns a five-step list into instinct. This guide is the "what" and "why"; CERT is where the "fast and correct under pressure" part actually gets built.

Where to find it: search "[your city] CERT training." Salt Lake City, South Salt Lake, West Valley City, American Fork, and most Wasatch Front cities run their own free programs.

Sources

- START triage algorithm, decision sequence and thresholds: EMS1; HHS Radiation Emergency Medical Management (REMM)
- CERT training availability and content, Wasatch Front cities: CERT-LA
- Physical tagging methods (commercial tags, colored tape/ribbon): CERT-LA; Wikipedia

Pregnancy, Childbirth & Newborn Care

The Medical Care chapter names midwifery in one line and means it: assisting childbirth is a real skill worth building through a class or an experienced mentor, not from a page. This guide isn't a substitute for that training. It's bounded, real guidance for the scenario this book plans around throughout, help genuinely isn't coming, and something is happening regardless.

What this guide is, and isn't

This covers prenatal planning, recognizing real labor, what actually helps if delivery happens before real care arrives, and immediate newborn care. It does not cover how to manage a complicated delivery, that's exactly the training this book already points to. The World Health Organization's own framing is the right one to start from: the large majority of births proceed normally without intervention, and an attendant's real job is hygiene, warmth, and watching for bleeding, not actively "delivering" a baby.

Prenatal planning

Pregnancy is the one medical scenario in this entire book with an actual known timeline, which makes advance planning genuinely more effective here than almost anywhere else.

- Know the due date and keep a physical copy of prenatal records (blood type, any complications, planned delivery location) with the household's other emergency documents.
- Identify, in advance, at least two realistic routes and destinations for reaching real obstetric care, and a backup plan for if travel isn't possible at all.
- Know your own or your household member's Rh factor; Rh-negative status matters for a real medical decision (RhoGAM) that only a provider can make, but knowing it in advance saves real time if care becomes available partway through an emergency.

WARNING

Pregnancy Symptoms That Are Always a Real Emergency

Heavy vaginal bleeding, a severe headache that doesn't resolve, sudden vision changes (blurring, spots, or flashing lights), and a noticeable, sustained decrease in fetal movement are not symptoms to wait out. The headache and vision changes specifically can signal preeclampsia, a real, dangerous

complication that a layperson genuinely cannot manage without medical care. Any of these means real care, not home management, is the priority, regardless of how far from help you actually are.

Recognizing real labor

True labor contractions are regular, get closer together over time, and keep getting stronger regardless of position or activity; Braxton Hicks (false labor) contractions are irregular and often ease up with rest or a position change. Once labor is confirmed, a water breaking, contractions 5 minutes apart lasting a minute each for a first birth, or any bleeding, get moving toward real care immediately rather than waiting to see how things progress.

If delivery happens before help arrives

Most births genuinely do proceed normally. The steps below are for the specific situation where labor has progressed too far to reach real care in time.

1. Wash your hands and forearms with soap and clean water for a full **3 minutes** before touching anything.
2. Let the mother find whatever position is most comfortable; don't force a specific position.
3. As the head emerges, support it gently, don't pull. The rest of the body typically follows within one more contraction.
4. Dry the baby immediately and place them skin-to-skin on the mother's chest, then cover both with a warm blanket. A newborn loses heat fast, real hypothermia risk within minutes, and skin-to-skin contact is the single most effective way to prevent it.
5. **If the baby isn't crying or breathing within the first few seconds after drying**, stimulate them: rub the back firmly but not roughly, or flick a fingertip against the sole of the foot, for 10-15 seconds. Most babies respond to this alone. If there's still no effective breathing after that, this is exactly the kind of emergency described below, get to real care by whatever means are actually available, this guide can't safely walk you through actual newborn resuscitation beyond this first step.
6. **Leave the umbilical cord intact if there's any realistic chance of reaching real care**, even delayed by hours; there's no urgency to cut it. If you must cut it because help genuinely isn't coming, tie it off tightly in two places roughly a hand's width apart with clean string or ribbon, then cut between the two ties with a clean (ideally sterilized) blade.
7. The placenta typically delivers on its own within about 30 minutes. Let it come on its own with gentle guidance only; never pull on the cord or placenta to speed this up, which risks a real hemorrhage.

Postpartum Hemorrhage Is the Leading Cause of Maternal Death Worldwide, and Uterine Massage Is a Real Response

After the placenta delivers, firmly massage the mother's lower abdomen, over the uterus, in a circular motion. This encourages the uterus to contract, which is what actually controls bleeding after birth; a uterus that stays soft and doesn't contract is the single most common cause of dangerous postpartum bleeding. This is a real, evidence-backed action a layperson can take, not a folk remedy, and it's worth doing immediately and continuing while arranging evacuation to real care, not a substitute for it. Heavy bleeding that continues despite firm massage is a true emergency; get to real care by whatever means are actually available.

WARNING

What's Genuinely Beyond Home Management

A baby presenting anything other than head-first (breech), the umbilical cord emerging before the baby (cord prolapse), labor that stalls for hours without progress, seizure activity in the mother, or bleeding that doesn't respond to uterine massage are all real emergencies beyond what this guide, or any guide, can safely walk a layperson through. Treat any of these as a reason to reach real care by whatever means are actually available, not a problem to solve at home.

Immediate newborn care

- **Warmth first.** Dry the baby thoroughly and keep them skin-to-skin with the mother, covered, since a term newborn in an unheated space can become dangerously cold within minutes.
- **Cord care once cut:** keep the stump clean and dry. Don't apply anything to it, alcohol included; plain clean-and-dry care has real evidence behind it over antiseptics.
- Encourage breastfeeding within the first hour if the mother is able; it supports the mother's own uterine contraction (helping with the hemorrhage risk above) as well as feeding the baby.

WARNING

Real Newborn Danger Signs

Difficulty breathing, a bluish tint to the skin or lips, persistent lethargy or a baby who won't wake to feed, refusal to feed at all, fever, seizure activity, or redness, swelling, or discharge at the cord stump or eyes are all reasons to seek real care immediately, not signs to monitor overnight.

Sources

- WHO, essential newborn care principles (thermal care, skin-to-skin, cord care): WHO
- Emergency childbirth steps (handwashing, supporting the head, cord management, delivering the placenta): Water Safety Guy; Ohio State Health & Discovery
- Postpartum hemorrhage as the leading cause of maternal death, and uterine massage as first-line response: Cochrane; American Nurse
- Newborn cord care (clean, dry, no antiseptic) and danger signs: Healthy Newborn Care, NCBI Bookshelf
- Preeclampsia warning signs (severe headache, vision changes) during pregnancy: American College of Obstetricians and Gynecologists
- WHO newborn stimulation technique (back rub, foot flick) before resuscitation: WHO / Healthy Newborn Network

Isolating a Sick Household Member

The Medical Care chapter calls quarantine "the single most effective way to keep a stomach illness from taking down the whole household at once," in one sentence, with no actual how-to. This guide is that how-to: setting up the space, what "dedicated dishes and towels" means in practice, the cleaning routine, and when it's actually safe to stop.

Why this is worth taking seriously

Disease, not the disaster itself, is the leading cause of death in the weeks after most emergencies. In a household already under stress, without easy access to a doctor, a stomach illness that spreads to everyone at once is far more dangerous than the same illness in one person. Isolating the first sick person is cheap, fast, and the single best thing you can do to keep it that way.

Setting up the space

- **A separate bedroom and bathroom**, if your home has one to spare. This is the single biggest factor in whether isolation actually works.
- **If you have to share a bathroom**, clean high-touch surfaces, counters, faucet handles, light switches, and the doorknob, after every time the sick person uses it, not just at the end of the day.
- **Ventilation matters if you're sharing any space**. Open a window to increase air circulation rather than relying on a closed door alone.
- The sick person eats in their own room if at all possible, rather than at a shared table.

What "dedicated items" actually means

Item	Rule
Dishes, cups, utensils	Do not share. Wear gloves when collecting and washing them; wash with soap and hot water, or run through a dishwasher.
Towels and bedding	A separate set, used only by the sick person, until they've recovered.
Electronics	Phones, remotes, tablets, don't share, or wipe down before anyone else touches them.
Hand sanitizer	Not a substitute for soap and water here. Alcohol-based sanitizer doesn't reliably kill norovirus and similar stomach-illness viruses; wash hands with soap and water instead, every time.

Cleaning after a vomiting or diarrhea incident

Stomach-illness viruses like norovirus spread easily from contaminated surfaces, and ordinary cleaning products often aren't strong enough.

1. Wear gloves. Contain and remove any solid waste first.
2. Mix a bleach solution: **5–25 tablespoons of household bleach (5–9%) per gallon of water**. Use the stronger end of that range for a heavily soiled area.
3. Apply the bleach solution to the affected surface and let it sit for at least **5 minutes** before wiping.
4. Clean the same area again afterward with regular soap and hot water.
5. Wash any contaminated laundry separately, on the hottest setting the fabric allows, and take out the trash.
6. Wash your hands with soap and water when you're done, even if you wore gloves the whole time.

Keeping the sick person hydrated

Isolation prevents spread, but the sick person's own real risk with a stomach illness is dehydration, not the illness itself. If commercial oral rehydration solution (Pedialyte or similar) isn't on hand, mix a real one: **6 level teaspoons of sugar and ½ level teaspoon of salt, dissolved completely in 1 liter of clean water**. It should taste no saltier than tears; don't guess at the salt measurement or add more than called for, too much salt is its own real danger. Make it fresh daily and discard what's left after 24 hours. Offer small, frequent sips rather than a large amount at once, which is more likely to come right back up.

Watch for real dehydration, not just the illness itself

In an adult: excessive thirst, little or no urination, dark urine, or dizziness. In a child: no wet diaper for 8 hours or more, a dry mouth, crying without tears, a sunken look to the eyes or soft spot, or unusual sleepiness. Any of these, or the person becoming unusually lethargic or unresponsive, is a reason to get real medical care, not something to keep managing with fluids alone.

When it's safe to end isolation

As a general rule, keep isolation in place until the sick person has been free of fever and other symptoms for at least **24 hours without the help of fever-reducing medication**. For a stomach illness specifically (vomiting or diarrhea), wait at least **48 hours** after symptoms fully stop before treating the household as back to normal, since these viruses stay contagious for a short window even after someone feels better.

Contagious longer than you'd guess

Norovirus and similar viruses can still be present in stool for two weeks or more after someone feels fully recovered. The 48-hour window isn't a guarantee of zero risk, it's the point where the household's overall risk drops enough to resume normal shared routines; keep the extra hand-hygiene vigilance going a while longer, especially for whoever's preparing food.

Before you need it

Decide which room in your home would become the isolation space before you actually need one, the same way the manual's own Tier 2 checklist asks. Stock a small dedicated kit for it in advance: a spare set of towels and bedding, disposable gloves, and a full bottle of unscented bleach, so setting it up during an actual illness is a five-minute task, not a scramble. For handwashing technique and hygiene without running water, see Bathroom & Hygiene Without Running Water.

Sources

- CDC, caring for someone sick at home (isolation space, dedicated items, cleaning, ventilation): CDC
- CDC, norovirus prevention, disinfection concentration, and when to end isolation: CDC
- CDC, norovirus infection control guidelines (bleach solution strength and contact time): CDC

- WHO oral rehydration solution recipe (reduced-osmolarity formula): Dateline Health Africa
- Dehydration warning signs in adults and children: GoodRx; Nemours KidsHealth

Herbal Medicine & the Home Apothecary

The Medical Care chapter's Tier 3 Herbal Medicine item is explicit that this requires real study, correct identification, dosing, and drug interactions all matter, not a folk-remedy shortcut. This guide is that real study: which common herbal remedies have actual evidence behind them, which don't, the dangerous plants that get mistaken for them, and where to get real training.

WARNING**Read this before anything else on this page**

Herbal medicine is not automatically safer than pharmaceutical medicine just because it's plant-based. Several plants below have real, documented toxic look-alikes that have killed people who misidentified them, and several common herbs have serious interactions with prescription medications. Positive identification of any wild plant before use is not optional, and anyone on prescription medication should check for interactions before adding an herbal remedy, ideally with a clinician or pharmacist who knows their history.

What actually has evidence behind it

Evidence quality varies a lot across common herbal remedies. Treat these honestly, not as a uniform list of "natural remedies that work."

Herb	Use	Evidence & cautions
Willow bark	Pain relief	Genuinely strong evidence, real human trials, working through the same mechanism as aspirin. Prepared as a decoction: simmer 1-2 teaspoons (2-4g) of dried bark in a cup of water for about 15 minutes, up to 2-3 cups a day. Same cautions apply: avoid in children with a viral illness (Reye's syndrome risk), avoid with bleeding disorders or blood thinners, avoid in pregnancy and with aspirin allergy.
Ginger	Nausea, especially pregnancy-related	Good evidence for pregnancy-related nausea (roughly 600-2,500mg/day); evidence for motion sickness specifically is weaker. Above about 4g/day it can interact with blood thinners.
Chamomile	Anxiety	Preliminary evidence for anxiety; no good evidence for insomnia despite its reputation as a sleep aid.
Yarrow	Traditionally used to stop bleeding	Only traditional/historical use and one supportive animal study, no human trials. Contraindicated in pregnancy (contains thujone) and can cross-react in people allergic to ragweed or other Asteraceae-family plants.
Plantain leaf (Plantago, not the banana relative)	Traditionally used for minor wound healing	Modest evidence from animal studies and small human studies; reasonable as a minor-wound supplement, not a substitute for real wound care.
Echinacea	Cold prevention/treatment	Genuinely disputed. A 2014 Cochrane review found no clear benefit for treating colds already underway.

St. John's Wort deserves its own warning

St. John's Wort is commonly used for mild depression, but it induces liver enzymes (CYP3A4) and a drug transporter (P-glycoprotein) that speed up the breakdown of many prescription drugs. Documented dangerous interactions include reduced effectiveness of hormonal birth control, immunosuppressants, and antiretroviral HIV medications, plus a risk of serotonin syndrome when combined with SSRIs. Don't add it to any existing medication regimen without checking first.

Dangerous look-alikes: the most important section on this page

Misidentification is the real danger in foraging for herbal remedies, not the remedies themselves. These pairings have caused real, documented poisonings and deaths.

Toxic plant	Gets mistaken for	Why it's dangerous
Poison hemlock	Wild carrot (Queen Anne's lace) or wild parsley	Contains coniine; as few as 6-8 leaves have been fatal in documented cases.
Water hemlock	Wild parsnip or other edible roots	Described by the USDA as the most violently toxic plant in North America; a small amount can be fatal.
Foxglove	Comfrey or borage (before flowering, the leaves look similar)	Contains cardiac glycosides; documented fatal poisonings exist from this exact mix-up.
Comfrey itself	Used historically as a healing herb	Contains pyrrolizidine alkaloids that damage the liver; the FDA banned oral comfrey supplements in 2001.
Pennyroyal essential oil	Confused with pennyroyal tea, a much weaker traditional preparation	The concentrated oil is liver-toxic with no antidote; documented deaths exist. This is a concentration problem, not just a plant-identity problem.
Kava	Used for anxiety	The FDA issued a hepatotoxicity advisory in 2002 after more than 100 documented cases of severe liver injury.

Turning a dried herb into an actual dose

Which preparation you use depends on which part of the plant you're working with, tough plant material and delicate plant material extract differently.

- **Infusion**, for leaves, flowers, and light stems (chamomile, yarrow, plantain): pour freshly boiled water over the herb and let it steep covered, 5-15 minutes for a beverage-strength tea, 20-30 minutes (or overnight) for a stronger, medicinal-strength one. This is what most people already think of as "making tea."
- **Decoction**, for tough material like bark, root, and seeds (willow bark): simmer the material directly in water for 20-45 minutes rather than just pouring hot water over it and waiting. Bark and root are too dense for a passive steep to pull much out.

If a remedy calls for both a tough and a delicate ingredient, decoct the tough part first, then turn off the heat and add the delicate part to steep in the still-hot liquid rather than boiling everything together the

whole time.

Growing, drying, and storing your own

1. Start with plants you can buy as identified nursery starts (yarrow, chamomile, calendula) rather than foraging for anything in the toxic-lookalike table above.
2. Harvest leaves and flowers in the morning after dew has dried but before the heat of the day, when essential oil content is typically highest.
3. Dry in a single layer out of direct sunlight with good airflow; a screen or hanging bundle in a warm, dry, dark space works without any special equipment.
4. Store fully dried herbs in airtight glass jars, labeled with the plant name and harvest date, out of direct light. Most dried herbs lose potency well before they become truly unsafe, so treat a year or two as a practical shelf life for potency, not a hard safety cutoff.

Homemade tinctures don't have a reliable dose

A folk-method tincture (plant material steeped in alcohol for weeks) has no measured weight-to-volume ratio the way a pharmaceutical tincture does, so "one dropper full" from one batch can be meaningfully stronger or weaker than the next. Treat homemade tinctures as imprecise, and start with a small test amount rather than assuming consistency batch to batch.

Getting real training

Books and this guide are a starting point, not a substitute for structured education, especially before treating anyone beyond minor, self-limited complaints. Real training paths include:

- The American Herbalists Guild, whose Registered Herbalist (RH) credential requires roughly 800 hours of education and 400 hours of supervised clinical practice.
- Accredited herbal medicine programs at institutions like Bastyr University and the Maryland University of Integrative Health.
- Structured but non-degree programs like the Chestnut School of Herbal Medicine and the Herbal Academy.

Sources

- Willow bark, ginger, chamomile, echinacea evidence review: NIH National Center for Complementary and Integrative Health (NCCIH) herb monographs; Cochrane review on echinacea for the common cold (2014)
- Comfrey ban and pyrrolizidine alkaloid toxicity: FDA public health advisory, July 2001
- Kava hepatotoxicity: FDA Consumer Advisory, March 2002
- Poison hemlock, water hemlock, and foxglove/comfrey poisoning cases: USDA-ARS Poisonous Plant Research; published case reports in clinical toxicology literature
- St. John's Wort drug interactions: NCCIH; FDA drug interaction advisories
- Herbalist training and credentialing: American Herbalists Guild; Bastyr University; Maryland University of Integrative Health
- Infusion vs. decoction preparation technique: Mountain Rose Herbs; The Public Herbarium
- White willow bark decoction preparation and dosing: The Good Old Way; Common Sense Home

Dental Emergencies & Basic Care

The Medical Care chapter's Tier 3 Suturing & Basic Dental item points to a dedicated reference and practice before you'd ever need this for real. This guide covers the actual technique: recognizing when a dental problem is a real medical emergency, pain management that works (and the one that doesn't), saving a knocked-out tooth, temporary filling material, and an honest look at DIY extraction as a genuine last resort.

WARNING

Read this before anything else on this page

A tooth infection can become a life-threatening emergency, not just a bad toothache. Facial or neck swelling, difficulty swallowing, difficulty opening your mouth, or any trouble breathing means get to real medical care immediately, regardless of what tier you're in or how far away it is. Everything else on this page assumes the problem is painful but not an airway emergency.

Recognizing a real emergency versus a manageable problem

An untreated dental abscess, an infection at a tooth's root, can spread into the floor of the mouth and neck, a condition called **Ludwig's angina**. It's rare, but it's the most common serious complication of a simple abscessed tooth (over 90% of cases start exactly that way), and it can progress from a bad toothache to airway obstruction and sepsis within hours, not days, even with antibiotics already started. Mortality with prompt treatment is around 8%; without it, it's substantially higher.

Sign	What it means
Swelling under the jaw or in the neck, not just the cheek	The infection may be spreading beyond the tooth itself
Difficulty swallowing or a change in your voice	Possible airway involvement, treat as an emergency
Trouble fully opening your mouth (trismus)	A sign of spreading infection, not just local pain
Fever, feeling generally ill, rapid heartbeat	Signs the infection may be systemic

Any of these means get to real medical care, a hospital emergency department, not just a dentist's office if one isn't reachable, regardless of tier. A tooth can be dealt with later; an airway can't.

Toothache pain management that actually works

- **Ibuprofen or acetaminophen**, taken as directed, is the real first line, an oral anti-inflammatory or analgesic actually gets into your bloodstream and reaches the source of the pain.
- **A warm salt water rinse** (half a teaspoon of salt in 8 oz of warm water, swished for 30 seconds) reduces swelling and cleans the area.
- **A cold compress** against the outside of the cheek reduces swelling and dulls pain.
- **Topical benzocaine gel** (an over-the-counter dental pain product) numbs the area directly for up to about 30 minutes at a time.
- **Clove oil** applied to the tooth with a cotton swab is a real, traditional remedy with genuine numbing properties (eugenol, its active compound, is itself a dental anesthetic ingredient), though it manages pain rather than treating the underlying cause.

WARNING

Never put aspirin directly on a tooth or gum

This is a real, common, and actively harmful myth. Aspirin only works once it's absorbed into your bloodstream, holding the tablet against a tooth or gum does nothing for the pain. What it does do is burn the tissue: aspirin is acidic, close to the acidity of stomach acid, and direct contact causes a real chemical burn, a white or gray patch that's painful in its own right and takes weeks to heal, on top of the toothache you already had. Swallow it as directed instead, or use one of the methods above.

A knocked-out tooth: the first 30 to 60 minutes actually matter

1. Pick the tooth up by the crown (the white, visible part), never the root.
2. If it's visibly dirty, rinse it briefly, no more than 10 seconds, under cold water or milk. Don't scrub it or wrap it in anything.
3. If you can, gently reinsert it into its socket and have the person bite down softly on gauze to hold it in place.
4. If reinsertion isn't possible, store it in milk (real dairy milk preserves the root's ligament cells far better than water or a dry container) or in the person's own saliva if milk isn't available.
5. Get to a dentist or emergency department as fast as possible. Reimplantation works best within the first 30 minutes, and the odds drop substantially, though real success is still possible up to about 60 minutes with correct handling and storage.

A lost filling or crown

An over-the-counter temporary filling kit (zinc oxide, calcium sulfate, or glass ionomer material, sold at any pharmacy) can plug the hole and seal the exposed area until real dental care is available. To actually use one: brush and rinse the mouth first so no food debris gets sealed into the cavity, dry the tooth as best you can, then mix the kit's material per its own package directions if it requires mixing. Roll a small amount into a ball, press it into the cavity with the applicator tool provided, and pack it in gradually rather than trying to fill the whole space in one push; don't overfill above the tooth's surface. Bite gently together to help seat it, then keep the area dry and avoid eating or drinking on that side for the time the package specifies, commonly 15 minutes to a few hours, while it sets. Orthodontic wax works as a stopgap if no kit is on hand: it won't restore the tooth, but it covers a sharp edge or exposed nerve enough to make eating and talking tolerable. Either is genuinely temporary, meant to bridge days, not a substitute for an actual filling.

DIY extraction: a genuine last resort, not a routine option

Pulling your own or a family member's tooth carries real, serious risks: incomplete removal leaving root fragments behind, uncontrolled bleeding, damage to the jaw or nerve, and introducing new infection into an already-compromised area, sometimes worse than the problem it was meant to solve. This is something to attempt only when every other option is genuinely exhausted, real medical or dental care isn't reachable in any realistic timeframe, and the tooth is causing real, worsening harm, not a routine Tier 3 skill to practice for its own sake.

The real reference for this, if it ever comes to it

Where There Is No Dentist (Hesperian Health Guides) is a legitimate, widely used, free reference specifically written for exactly this situation: real diagnostic and treatment guidance, illustrated for a reader with no dental training, including when and how extraction is actually done. It's already named in this chapter's own Medical Library item; read it before you need it, not during.

Prevention is still the highest-leverage move

The single best Tier 1 dental action is getting a real checkup and any needed work done now, while normal dental care is available, not stockpiling supplies for problems a checkup could prevent outright. Basic hygiene matters more, not less, when water is limited: brushing and rinsing still work with a cup of water rather than a running tap, covered in the Bathroom & Hygiene Without Running Water guide.

Sources

- Ludwig's angina, cause, progression, and mortality: Cleveland Clinic; StatPearls/NIH
- Toothache pain management, OTC options, and clove oil: Healthline; Colgate
- Aspirin-on-the-gum chemical burn risk: Carolina Smiles Family Dentistry; DentisX
- Knocked-out tooth first aid, reimplantation window, and milk storage: Cleveland Clinic; Mayo Clinic
- Temporary filling materials and orthodontic wax as a stopgap: NewMouth
- Temporary filling kit application technique (mixing, packing, setting time): Jackson Ave Dental; Sayva Dental
- *Where There Is No Dentist*, Hesperian Health Guides, free field-dentistry reference: Hesperian

Wills, Power of Attorney & Guardianship

The Document Go-Bag guide already lists wills, powers of attorney, and guardianship papers among the documents to gather and protect. It doesn't cover how to actually create them, which is the real gap: most households don't have these documents at all, not just unprotected copies of them. This guide is that missing step.

Why this is a Tier 1 skill, not a someday task

Survey estimates of how many Americans have a will range from about 24% to 46% depending on how the survey is done, phone polls consistently find more will-holders than online panels, but every methodology agrees most adults don't have one. A 2026 nationally representative survey found 56% of U.S. adults have zero estate planning documents in place of any kind, not just a missing will. None of this requires a disaster to matter: incapacity from an ordinary accident or sudden illness raises the exact same questions a disaster does, who makes your medical decisions, who can pay your bills, who raises your kids, and it can happen on an ordinary Tuesday.

What actually happens without these documents

Dying without a will means your state's **intestate succession** law decides who inherits, a fixed formula that doesn't know or care what you actually wanted, and typically prioritizes a spouse and children, then parents, then siblings, in an order and split you don't get to choose. If you have minor children and no other living parent named, a court decides who raises them, based on the child's best interest as the court sees it, not necessarily who you would have picked. Becoming incapacitated without a financial or healthcare power of attorney on file is often worse in practice: your family may need to petition a court for a conservatorship or guardianship over you, a slower, more expensive, and more public process than paperwork you'd already signed.

The four documents, and what each one actually does

Document	What it does	When it takes effect
Will	Names who inherits your property, and, if you have minor children, names their guardian	Only after death
Financial power of attorney	Names someone to pay bills, manage accounts, and handle your finances	As soon as it's signed (a non-durable POA), or only upon incapacity (a durable POA, the version almost everyone actually wants)
Healthcare power of attorney / advance directive	Names someone to make medical decisions for you, and can spell out your own treatment wishes directly	Only when a doctor determines you can't make your own decisions
HIPAA authorization	Lets a named person actually see your medical records and talk to your providers	As soon as it's signed

A healthcare power of attorney names a decision-maker; an advance directive (sometimes called a living will) spells out your own wishes directly, useful even to someone who already has an agent, since it tells that agent what you'd actually want rather than leaving them guessing. Sign a HIPAA authorization alongside the healthcare power of attorney: without it, your named agent can legally have the authority to decide but still get turned away by a hospital that won't discuss your records with them.

WARNING

If you have minor children, the guardianship line is the one that matters most

A will's guardianship nomination is what a court actually looks to first when deciding who raises your kids if both parents are gone; without it, that decision goes to a judge who has never met your family. Name a primary guardian and a real backup, someone willing and able, that you've actually asked, not just a relative it would be awkward to leave out.

DIY versus an attorney

Option	Typical cost	Best fit
DIY (free template or handwritten)	Free–\$100	A single adult with a simple, small estate and no minor children; still carries real execution risk, see below
Online will service	\$10–\$250 (commonly around \$160)	A simple estate with clear wishes and no unusual family or asset situations
Attorney-drafted	\$250–\$1,000+ for a basic will; more for trusts or a complex estate	Blended families, business ownership, a special-needs dependent, significant assets, or any real disagreement risk among heirs

The dollar difference is real, but it's not the deciding factor. A will's job is to hold up exactly once, after you're not around to fix a mistake in it, so the more complicated your actual situation is, the more that one-time correctness is worth paying for.

Getting it witnessed correctly: where DIY attempts most often fail

A will isn't valid because you wrote and signed it, it's valid because your state's specific execution rules were followed, and this is the step a DIY attempt most often gets wrong. Most states require the will-maker's signature plus at least two witnesses, ideally people who don't inherit anything under it, signing within a reasonable time of watching you sign or acknowledge it. Notarizing a **self-proving affidavit** alongside the witnessed signatures isn't required to make the will valid, but it lets a court accept it without tracking down your witnesses later to testify, worth doing even though it's optional.

About 27 states plus D.C. also recognize a **holographic will**, entirely in your own handwriting and signed, with no witnesses required at all, but the rules for what counts vary by state and this format carries more risk of an ambiguous or incomplete document holding up in court.

WARNING

Don't notarize a handwritten (holographic) will

If you're relying on the holographic-will path, skip the notary. In some states, notarizing a document that was supposed to qualify as holographic can actually void it, since notarization isn't part of what makes that format valid in the first place. A witnessed will and a holographic will are two different, non-overlapping paths to a valid document; don't mix their requirements.

Northern Utah note: Utah's actual rule

Utah Code § 75-2-502 requires the will-maker's signature plus two witnesses for a standard will. Utah also recognizes holographic wills: no witnesses or notary needed if the signature and the material portions, the parts naming who gets what, are entirely in your own handwriting.

Where to get real help without paying full private rates

- **Your state bar's lawyer referral service.** Nearly every state bar runs one: describe your situation, get matched with an attorney who actually handles estate planning, and the first consultation is typically free or capped around \$25–\$50 for the first 30 minutes.
- **Legal aid.** Income-qualified households (commonly 125–200% of the federal poverty level) can often get a will and basic estate documents drafted for free through a state or local legal aid organization.

Storing what you create

Once these are signed, they belong with the rest of your vital documents: the Document Go-Bag guide covers the fire/water-rated safe, the go-bag copy, and the digital backup these documents should go into alongside everything else. Tell your named agents and guardian where to find the originals; a perfectly executed document nobody can locate when it's needed accomplishes nothing.

Sources

- 2026 estate planning ownership rates and generational breakdown: Trust & Will 2026 Estate Planning Report; will-ownership survey methodology variance: Gallup; Caring.com
- Intestate succession and court-decided guardianship for minor children: LegalZoom; Trust & Will
- Financial power of attorney, healthcare power of attorney, advance directives, and HIPAA authorization, how they differ: CaringInfo; American Academy of Estate Planning Attorneys
- DIY, online, and attorney will costs: Ethos; Trust & Will Guide
- Witness requirements, self-proving affidavits, and holographic wills by state: Cornell Legal Information Institute; Holographic will requirements survey
- Utah will execution requirements, Utah Code § 75-2-502, and Utah's holographic will rule: Utah State Legislature; Utah Legal Services
- State bar lawyer referral services and legal aid income eligibility: State Bar of California (representative example)

Barter & Local Trade Systems

The Economic & Financial chapter's Barter Negotiation and Skill Valuation items cover trading fairly and valuing skills directly. This guide goes deeper: what real historical barter and local-currency systems reveal about how trade actually organizes itself when normal money breaks down, and where they tend to fail.

What a real economy without functioning money looks like

Economist R.A. Radford was a prisoner of war during World War II, and his 1945 paper on the camp's internal economy is one of the most cited real-world studies of emergent trade. Cigarettes became the camp's currency, not by decree, but because they were divisible, widely wanted, and reasonably durable. A camp "shop" ran fixed prices, and an informal notice board (the "Exchange and Mart") let prices move with supply and demand in real time. The economy showed real inflation and deflation tracking Red Cross parcel shipments, hoarding of higher-quality cigarette brands (a real-world case of Gresham's Law, "bad money drives out good"), and, most tellingly, a paper-scrip currency the camp tried introducing (the "Bully Mark") collapsed when trust in it broke down, while the cigarette-based commodity currency kept working because cigarettes had value on their own, not just as a symbol of value.

The lesson that carries forward

A trade good that has real, independent use value survives a trust collapse in a way a symbolic currency (paper, a ledger entry, a promise) doesn't. This is the same logic behind stocking broadly recognized, high-demand barter goods rather than relying only on cash.

Local currencies and time-banking: real systems, and why most declined

System	How it worked	What happened to it
Ithaca HOURS (Ithaca, NY, founded 1991)	A local paper currency, 1 HOUR equal to \$10, meant to keep spending circulating locally	Grew to real circulation (tens of thousands of dollars, hundreds of participating businesses at its peak) but declined after its founder stepped back and consumer credit cards became more convenient; effectively inactive by the mid-2010s despite a 2019 attempt to revive it digitally
TimeBanks (TimeBanks.org, founded by Edgar Cahn)	Hour-for-hour credit for any task, regardless of the task's market value	Still active in various local forms; Japan's Fureai Kippu program applies the same model specifically to elder care and has over 300 participating nonprofit organizations
LETS (Local Exchange Trading Systems, originated Comox Valley, BC, 1983)	A mutual-credit ledger system with no physical currency at all, credits and debits tracked centrally	Grew to roughly 350 networks and 30,000 members in the UK by 1995, then declined, partly from being slow to move online, and partly the same founder-dependency pattern as Ithaca HOURS

The common thread in both declines: a local currency or trade network tends to depend heavily on one or two committed organizers, and struggles to survive their departure or a more convenient mainstream alternative appearing. A durable barter or trade system needs more than one person who understands and maintains it.

What real economic collapses show about barter

- **Weimar Germany, 1923:** during the hyperinflation, professionals like doctors were sometimes paid directly in firewood or potatoes rather than a currency losing value by the hour.
- **Post-WWII Germany, 1945-1948:** cigarettes again became a de facto currency, with a single cigarette trading for roughly 15-20 Reichsmarks on the black market, evidence this pattern isn't unique to a POW camp.
- **Argentina, 2001 economic collapse:** barter clubs ("clubes de trueque") grew to an estimated 4-7 million participants at their peak, organized around a credit unit called a "crédito." The system eventually collapsed from its own internal over-issuance of créditos, effectively an internal hyperinflation, and some organizers were later arrested for fraud.

WARNING

A barter or credit system needs the same discipline as real money

Argentina's collapse is the clearest warning: any credit-based trade system (time-based, crédito-based, or otherwise) needs real limits on how much credit gets issued, or it can inflate itself into worthlessness exactly the way a currency does. This isn't a reason to avoid trade networks, but a reason to keep them small, transparent, and disciplined rather than assuming a barter system is automatically immune to inflation just because it isn't official money.

The tax rules still apply

Bartering is taxable income in the U.S. regardless of whether any cash changes hands; the IRS treats the fair market value of goods or services received in trade the same as if you'd been paid in dollars (IRS Topic 420).

A few practical distinctions matter:

- Organized barter exchanges are required to file Form 1099-B for their members' transactions.
- An informal trade rises to a reporting requirement (Form 1099-NEC) when a business pays \$600 or more to the same person in a year, a threshold rising to \$2,000 starting January 1, 2026 under the One Big Beautiful Bill Act.
- Casual, informal neighbor-to-neighbor bartering, the IRS's own example is a babysitting co-op, is explicitly exempted from the exchange-reporting regime, though it's technically still taxable income if it rises to the level of a trade or business.

Sources

- R.A. Radford, "The Economic Organisation of a P.O.W. Camp," *Economica*, 1945
- Ithaca HOURS history and circulation figures: Donella Meadows Institute; contemporary local-currency research literature
- TimeBanks.org; Fureai Kippu program documentation (Japan)
- LETS origin and UK network figures: Michael Linton, LETSystem documentation; UK local-currency research literature
- Weimar Germany and post-WWII German "cigarette economy": historical economic literature on both hyperinflation periods
- Argentina 2001 "clubes de trueque": contemporary reporting and post-collapse economic analysis
- Barter tax treatment: IRS Topic 420, Bartering Income; 1099-NEC reporting threshold change under the One Big Beautiful Bill Act

Land Navigation Without GPS

The Transportation chapter's Tier 3 Land Navigation item names dead-reckoning and terrain-reading as a genuinely different skill from following a paper map on existing roads. This is that skill: orienting a map and compass correctly, counting distance by pace, reading terrain features, and knowing which natural-navigation folklore actually holds up.

Orienting a map and compass

A baseplate compass (a flat, clear rectangle with a rotating dial) is the right starting tool, not a military lensatic compass; it's simpler to learn on and does everything a beginner needs.

1. Lay the compass baseplate along a north-south reference line on the map, either the map's own border (which runs true north-south) or a printed grid line.
2. Rotate the dial so its orienting lines match that same north-south line, with north on the dial pointing to the top of the map.
3. Holding the map and compass together as one rigid unit, turn your own body until the red end of the magnetic needle falls inside the dial's orienting arrow, a step commonly called "red in the shed." You're rotating map and compass together, not the compass alone while the map stays put.
4. The map is now oriented to match the real terrain around you: features on your left on the map are on your left in the field.

Don't skip declination, and know which direction to correct

A compass points to magnetic north, not true north, and the gap between them (declination) varies by location and shifts slowly over time. Look up the current declination for your area with NOAA's declination calculator, then either dial that correction into an adjustable-declination compass once and forget it, or manually add/subtract it every time you take a bearing. The rule for which direction: "east is least, west is best," an east declination gets subtracted from a true (map) bearing to get a magnetic (compass) bearing, a west declination gets added. Skipping this step, or getting the direction backward, is a common beginner error that gets worse the farther you travel.

Taking and following a bearing

Orienting the map tells you which way is which; taking a bearing is how you actually walk from where you are to a specific point you can see on the map but maybe not in front of you.

1. Lay the compass baseplate's edge along the straight line connecting your current position to your destination on the map, with the baseplate's direction-of-travel arrow pointing toward the destination, not back toward you.
2. Holding the baseplate still, rotate the dial until its orienting lines and arrow align with the map's own north-south lines, north on the dial matching north on the map.
3. Read the bearing in degrees where the dial meets the fixed index line on the baseplate, then apply your declination correction from the note above.
4. Hold the compass flat in front of you and turn your whole body until the needle boxes inside the orienting arrow again, the same "red in the shed" check as before. The direction-of-travel arrow now points the way to walk.
5. Pick a landmark in that exact direction, a distinct tree, rock, or terrain feature, and walk to it rather than staring at the compass the whole way; re-check your bearing once you reach it and pick the next landmark. This is what actually keeps you on line over distance.

Watch it: REI, "How to Use a Compass: Compass/Map Navigation".

Finding your own position first: resection

Taking a bearing assumes you already know where you are on the map. When you're not sure, resection finds that starting point using terrain you can actually see:

1. Identify two or three recognizable features around you that you can also find on the map, a peak, a tower, a distinct bend in a ridge or river.
2. Take a magnetic bearing to each one with your compass, correcting for declination the same way as above.
3. Convert each bearing to its back azimuth (add 180 degrees if the bearing is under 180, subtract 180 if it's over).
4. From each identified feature's position on the map, draw a line running in the direction of its back azimuth.
5. Where the lines cross is your position. Two features can work, but three lines forming a small triangle rather than a single clean intersection is a useful accuracy check, your real position is inside that triangle.

A basic fixed compass like the Suunto A-10 NH (roughly \$24) is enough to learn on. A compass with an adjustable declination ring and mirror sighting, like the Silva Ranger 2.0 (roughly \$75), removes the manual-

correction step and aims more precisely, worth the upgrade once the basics are solid.

Pace counting: measuring distance without a GPS

Pace counting turns your own stride into an odometer, walk a known distance, count your steps, and you have a personal conversion factor for judging distance in the field.

WARNING

Two different counting conventions exist, know which one you're using

Scouting America's method counts a "pace" as one complete stride cycle, both feet, i.e. count only every time your *same* foot (say, your right) touches down, which typically comes out to roughly 62-75 counted paces per 100 meters on flat ground. The U.S. Army's FM 3-25.26 instead counts every single step, which roughly doubles that to around 120-130 per 100 meters. Neither is wrong, but mixing them mid-plan will throw your distance estimate off by half or double. Pick the double-step (Scouting) convention as the simpler default, and just be consistent.

To find your own count: measure out a known 100-meter (or 100-yard) stretch, walk it naturally at a normal pace several times, and average your count. Terrain changes your count, uphill, deep snow, and heavy brush all shorten your stride, so a serious navigator keeps separate counts for flat ground versus rough terrain. A simple pace-counting bead string (or just knots on a cord, moved one per 100 meters) keeps track without doing mental math while walking.

Reading terrain, not just the map

Certain terrain features are useful specifically because they're hard to miss, which makes them reliable navigation aids even with an imprecise pace count or a rough bearing.

Feature	What it means for navigation
Handrail	A linear feature, a stream, ridge, or fence line, that you deliberately follow alongside rather than trying to walk a precise bearing
Catching feature	A large, unmistakable feature (a road, river, or ridgeline) beyond your destination that tells you you've gone too far if you reach it
Saddle	A low point between two higher points on a ridge, often the easiest place to cross
Draw	A small valley feature that channels water downhill, usually easier walking than the surrounding slopes but can dead-end or steepen
Ridge	High ground connecting peaks; generally easier, more open walking than valley bottoms

Plan a route around these features deliberately: pick a handrail to walk beside, and set a catching feature past your destination so you know when to stop even if your bearing was slightly off. This terrain vocabulary comes from the Army's FM 3-25.26 land navigation manual, chapter 11.

Natural navigation: what actually works, and what's folklore

A lot of natural-navigation advice repeated online is exaggerated or flatly wrong. Some of it deserves the opposite correction, it's more reliable than its reputation suggests.

Method	Verdict
Moss grows on the north side of trees	Unreliable. Moss grows wherever it's damp and shaded, which depends on local tree cover, slope, and microclimate, not a consistent compass direction.
Shadow-stick method (track a stick's shadow tip to find east-west)	Genuinely one of the more reliable natural-navigation methods, usable year-round at most latitudes. Accuracy actually depends on time of day, not season: it's most accurate within about 2 hours of local solar noon, and error grows well beyond that, worst near sunrise and sunset.
Using a watch as a compass (point hour hand at sun, bisect to 12)	Works roughly, but has a documented error of about 15 degrees during Daylight Saving Time since the method assumes standard time. Correct for it by using the 1 o'clock mark instead of 12 while DST is in effect, or mentally subtract an hour from the watch first.
Navigating by Polaris (the North Star)	More accurate than its casual reputation suggests: Polaris currently sits roughly 0.5-0.65 degrees from true celestial north (slowly shrinking toward a minimum around the year 2100). The real risk is misidentifying which star is Polaris in the first place, not the star itself being imprecise.
Following a stream or watching bird flight lines to find civilization	An oversold heuristic. Streams don't reliably lead to people, and bird flight patterns are not a dependable directional signal.

Sources

- Map and compass technique, declination, terrain association vocabulary (handrail, catching feature, saddle, draw, ridge): U.S. Army FM 3-25.26, Map Reading and Land Navigation, Chapter 11
- Declination lookup: NOAA National Centers for Environmental Information
- Pace-counting convention (double-step method): Scouting America, Orienteering merit badge
- Polaris accuracy and natural navigation method reliability: U.S. Army FM 3-25.26; standard celestial navigation references
- Compass bearing procedure and declination correction mnemonic: REI Expert Advice; REI Expert Advice
- Resection technique: U.S. Army FM 3-25.26, Chapter 11
- Shadow-stick method accuracy and solar-noon timing: Salt & Prepper
- Watch-compass Daylight Saving Time correction: NITE Watches
- Current Polaris offset from celestial north: EarthSky

Basic Bicycle Maintenance & Repair

The Transportation chapter's Tier 2 names a bicycle as a genuinely practical fuel-free backup, but only if it stays rideable. Unlike a car, a bike is DIY-friendly enough that almost anyone can learn the handful of repairs that keep it running: fixing a flat, keeping the chain lubricated, and knowing when a shifting problem is dirt, not damage.

Fixing a flat: patch it or replace the tube

1. Flip the bike upside down (or use a stand). For a rim-brake bike, open the brake caliper's own quick-release first so the tire can clear the pads. If the wheel uses a quick-release skewer, pull the lever straight outward, away from the wheel, until it swings a full 180 degrees into the open position, most levers are stamped "Open"/"Close" to confirm you're reading it right; only loosen the adjusting nut on the far side if the wheel still won't clear the dropouts. For a rear wheel specifically, shift to the smallest rear cog first, then pull the derailleur body backward to slacken the chain before lifting the wheel out, guiding it down past the chain and derailleur cage as it comes free.
2. Work a tire lever under the tire's edge, hook the other end on a spoke to hold it up, then work a second lever around the rim until one whole side of the tire is off.
3. Pull the tube out and find the leak: re-inflate it slightly and listen or feel for escaping air, or submerge sections in water and watch for bubbles.
4. Check the inside of the tire itself for whatever caused the puncture (a thorn, a sliver of glass or wire) before putting a new or patched tube back in; skip this and the same object punctures the next tube too.
5. Work the tube into the tire and the bead back onto the rim mostly by hand; only use a lever as a last resort, and never a screwdriver or knife, which can puncture the tube you just installed. Inflate to low pressure first and check both sides of the tire for a visible, even line just above the rim (the bead seated correctly) before inflating the rest of the way; an uneven line usually means the tube is pinched under the bead somewhere.

Two different kinds of stick-on patches exist, and using the wrong procedure for the one you have is a real way to fail a repair. A **glueless patch** works as written: lightly scuff the area around the hole so the adhesive bonds, peel the backing, then press the patch on firmly and hold it for a minute. A traditional **rubber-cement patch kit** works differently: scuff the area the same way, apply a thin, even layer of the cement from the kit, then wait for it to dry until tacky, not press the patch onto wet cement, before applying the patch. Treat a patch as a get-you-home fix rather than a permanent one, though a properly applied patch can last a long time in practice. Replacing the tube outright is faster and more reliable when time matters, which is

why carrying at least one correctly-sized spare tube is worth more than carrying only patches. Match the new tube's diameter and width numbers to what's printed on the tire's sidewall before buying spares.

Before you can add air at all, know which of the two incompatible valve types your bike uses: a narrow, threaded **Presta** valve needs the small knurled nut at its tip unscrewed (counterclockwise) before a pump will move air, then closed again after; a wider **Schrader** valve, the same type used on car tires, just needs the cap off. Check which one your bike uses before buying a pump or inflator, some pump heads only fit one type. Inflate to the PSI (or BAR) range printed on the tire's own sidewall, not a single fixed number: road tires typically run 100-140 psi, hybrid/urban tires 60-80 psi, and mountain bike tires 30-50 psi, with heavier riders running toward the top of the range and the rear tire commonly a few psi higher than the front.

Chain care: the maintenance that prevents most other problems

Clean and re-lubricate the chain roughly every 100 to 150 miles of riding, after any wet or muddy ride regardless of mileage, or as soon as it starts sounding gritty or dry, whichever comes first. Wipe the chain down with a rag and a degreaser to pull off built-up grime, let it dry, then apply lubricant drop by drop so it reaches each link, and wipe away the excess. Excess lube left on the outside of the chain doesn't help it run smoother; it just collects more dirt, which is the opposite of the goal.

Shifting problems: usually dirt, not damage

Most shifting complaints come from a dirty drivetrain, a stretched or gunked-up cable, or a derailleur knocked slightly out of adjustment, not a broken part. Brush caked grease and grit off the derailleur's small jockey wheels and give the derailleur's pivot points a light touch of lubricant, without over-oiling them the same way the chain shouldn't be over-oiled. Clean the whole drivetrain (chain, cassette, chainrings) before assuming a shifting issue needs a real mechanical fix; a surprising share of "broken derailleur" complaints resolve with nothing more than a proper cleaning.

Riding while hauling cargo

A loaded bike, whether carrying panniers, a trailer, or a bag of supplies, handles differently than an empty one: it's slower to turn, needs more distance to stop, and is less stable at low speed, especially over the first few rides while getting used to the new balance. Practice riding loaded on a familiar, low-traffic route before relying on it for a real trip, the same reasoning this manual applies to breaking in evacuation footwear or testing a rucksack under real weight.

Quick Reference

Task	Interval / trigger	Note
Chain lube	Every 100–150 miles, or after wet rides	Wipe excess off; too much lube attracts dirt
Chain/drivetrain cleaning	Every 2–3 lube cycles	Degreaser + rag; resolves most shifting complaints
Tire check	Before every real-use ride	Check for embedded debris after any flat
Spare tube fit check	Before storing as emergency backup	Match diameter/width printed on the tire sidewall

A basic repair kit:

Item	Purpose	Note
Tire levers (2-3)	Removing the tire from the rim	Plastic is fine; keep a spare, they do snap
Patch kit	Emergency/get-home fix	Check the glue hasn't dried out before relying on it
Spare tube(s)	Fast, reliable fix	Correct size for your specific tire
Mini pump or CO2 inflator	Re-inflating after a repair	A pump never runs out; CO2 is faster but finite
Chain lube + rag	Routine maintenance	A dedicated bike lube, not household oil
Multi-tool	Minor adjustments on the road	Covers 4mm, 5mm, and 6mm hex/Allen, the sizes used on most stem, seatpost, and brake/derailleur mounting bolts, plus a Phillips or flat screwdriver bit

TIP

Dust a stored spare tube with talcum powder before it goes in the kit

A bare rubber tube left folded up for months tends to stick to itself, which makes it harder to unfold and seat correctly when you actually need it. A light dusting of talcum or baby powder inside a sealed

ziplock bag keeps the rubber from bonding to itself and doubles as a light lubricant that makes the tube easier to work into the tire during the actual repair.

Sources

- Flat repair and tube replacement steps: REI Expert Advice; GearJunkie
- Chain lubrication interval and technique: We Love Cycling; BigRing Cyclery
- Derailleur/shifting troubleshooting basics: REI Expert Advice
- Wheel removal (quick-release lever direction, rear-wheel derailleur/chain step) and tire/tube reinstallation: Park Tool; Park Tool
- Presta vs. Schrader valve types and inflation technique: BikeRadar
- Tire pressure ranges by bike type: REI Expert Advice
- Glueless vs. rubber-cement patch procedure: Park Tool
- Talcum/baby powder for storing a spare inner tube: Bike Noob

Securing Your Home Against Earthquake Damage

The Shelter & Structural Safety chapter lists "Hazard Hunting" as a Tier 1 skill and the shopping list has line items for seismic straps and furniture anchors, but the actual technique has never been written down. FEMA's own data is the reason this matters: falling and shifting objects, not building collapse, is the leading cause of earthquake injury. This guide is how to actually anchor the things in your home.

Everything below depends on finding your studs first

Anchoring hardware, screws, L-brackets, straps, only works if it bites into a wall stud. A screw into drywall or plaster alone will pull straight out under real earthquake force; it isn't a weaker version of a proper anchor, it's decoration that fails when it matters. Studs are typically spaced 16 inches apart, center to center, in most home construction.

To actually use a stud finder: hold it flat against the wall and start it over a spot you're confident is hollow, between where you expect two studs to be, so it calibrates against empty wall rather than a stud. Sweep it horizontally at a slow, steady pace, roughly an inch per second, and keep your other hand off the wall while you do, touching the wall can throw off the reading. When it signals a stud, sweep back over that spot from the other direction to find both edges of it, then mark the midpoint between them as the stud's actual center. If you don't have a stud finder, the knock test works as a backup: tap along the wall and listen for the sound to change from hollow to solid.

Where to start if you can only do one thing

Every item below is worth doing, but they're not equally urgent. Ranked by the actual consequence of skipping it:

1. **The water heater.** A 400+ pound water heater that topples doesn't just make a mess, it can sever its own gas and water connections, creating a fire and flood risk at the same time, in the same moment you're least able to respond to either.
2. **Heavy furniture near beds and exits.** A bookcase or dresser that falls onto a bed, or blocks a doorway, turns a manageable earthquake into a trapped or injured household member.
3. **Everything else on this page:** shelf contents, cabinets, pictures, electronics. Real risks, but lower-consequence than the first two.

Water heater and furnace strapping

Spec	Requirement
Number of straps	At least 2: one in the upper third of the tank, one in the lower third
Lower strap position	At least 4 inches above the water heater's own control panel/gas valve
Strap material	Metal strapping at least 22-gauge steel and 5/8 inch wide, or plumber's tape that fully encircles the tank, not nylon
Anchor hardware	1/4-inch (minimum) lag bolts, at least 1.5 inches of thread penetration into the stud, with a large flat washer between the lag screw and the strap
Gas and water lines	Flexible connectors, not rigid pipe, so the connection can flex slightly with the tank instead of shearing

This isn't just good practice, it's Utah's actual adopted building code (based on the International Residential Code) for exactly this reason: the Wasatch Fault makes water heater strapping a code requirement here, not an optional upgrade. Two straps covers most residential tanks, but the exact cutoff for needing a third strap at mid-height varies by tank size and local jurisdiction; check your specific tank's manufacturer instructions or your local building code rather than assuming two is always enough.

Anchoring furniture: bookcases, dressers, and tall pieces

1. Locate the studs behind where the furniture sits (see above).
2. Use metal L-brackets with screws through the top or back of the piece, or nylon safety straps, either works; what matters is that the hardware reaches a stud, not just the furniture's own backing. Use wood screws long enough to penetrate at least 2 inches into the stud itself, and once installed, pull-test both ends, at the wall and at the furniture, to confirm there's no slack and nothing shifts before trusting the anchor.
3. **Before anchoring through the back of a bookcase**, confirm the back panel is actually solid and securely attached to the sides, top, and bottom. A thin, loosely stapled back panel will tear away from the rest of the piece under load, defeating the anchor.
4. Where two pieces of furniture sit next to each other, connect them to each other in addition to the wall; a linked pair is more stable than two independently anchored pieces.
5. Position anything heavy and unanchored, or anything you haven't gotten to yet, away from beds, sofas, and exit paths, so it can't fall on someone or block the way out.

TVs, electronics, and appliances

- Keep TVs, computers, and microwaves on lower shelves or furniture where practical; lower center of gravity means less energy in a fall.
- A TV needs two separate connections, not one: anchor the furniture itself to a wall stud first, then separately strap the TV to the furniture using the TV's own VESA mount points on the back. Pull-test both connections, at the wall and at the TV, before trusting either one.
- Strap a refrigerator to the wall the same way as a water heater, heavy-gauge strapping into studs, if it isn't already secured by cabinetry on both sides.
- Any gas appliance (range, dryer) should have a flexible connector, not a rigid line, for the same reason as the water heater above.

Keeping shelf and cabinet contents from becoming projectiles

- **Open shelves:** a thin restraint wire, wood dowel, or elastic guardrail across the front of each shelf keeps books and objects from sliding straight off during shaking.
- **Kitchen and bathroom cabinets:** an ordinary childproof latch is built to resist a toddler's grip, not the lateral force of shaking, and some release with the exact same pull motion an earthquake would apply to a swinging door. Use latches specifically sold for earthquake use, push-to-close positive-catch latches or dedicated seismic latches, installed with all the hardware the latch comes with.
- **Pictures and mirrors:** hang with closed hooks rather than open hooks, so the frame can't bounce free during shaking. For smaller or lighter items on shelves, museum putty or earthquake wax holds them in place without permanent hardware.
- **Ceiling fans and pendant lights:** turn off the circuit breaker for the fixture, not just the wall switch, and confirm it's actually dead with a non-contact voltage tester before touching any wiring. Support the fixture with a bracing wire secured to a ceiling joist, and confirm the fixture itself is mounted to a fan-rated electrical box or brace capable of holding at least 50 lbs, not just the drywall around a standard box.

This connects directly to the utility shutoff skill

A strapped water heater with flexible connectors is far less likely to need a gas shutoff in the first place, but knowing how to actually shut off gas, water, and electricity if something does break is a separate skill covered in full in Fire-Starting & Generator Safety. Both matter; this page prevents the damage, that one handles it if prevention wasn't enough.

Sources

- FLASH (Federal Alliance for Safe Homes), securing furniture, appliances, electronics, and belongings before an earthquake: FLASH; FLASH
- Water heater seismic strapping specification (strap placement, lag bolt size, thread penetration): Plumbing & Mechanical
- Utah Residential Code, water heater seismic bracing requirement (adopted 2021 IRC, Section P2801.8): UpCodes; ICC Digital Codes
- Earthquake Country Alliance, "Step 1: Secure Your Space": Earthquake Country Alliance
- Water heater strap material spec: California Seismic Safety Commission
- Stud finder calibration and sweep technique: Bob Vila
- CPSC Anchor It, furniture/TV two-point anchoring and pull-test method: CPSC; FEMA, screw stud-penetration spec: FEMA
- Seismic-rated cabinet latch requirements: FEMA
- Ceiling fan electrical safety and fan-rated box weight requirement: Fine Homebuilding

Basic Knots

Emergency Shelter Basics tells you to secure a tarp ridgeline with a trucker's hitch and stake it out with a taut-line hitch. Other guides across this site mention a clove hitch, a bowline, tying off a line. None of them actually teach the knot itself, they assume you already know it. This guide is that missing skill: seven real knots, with real illustrations and the actual steps, not just the name.

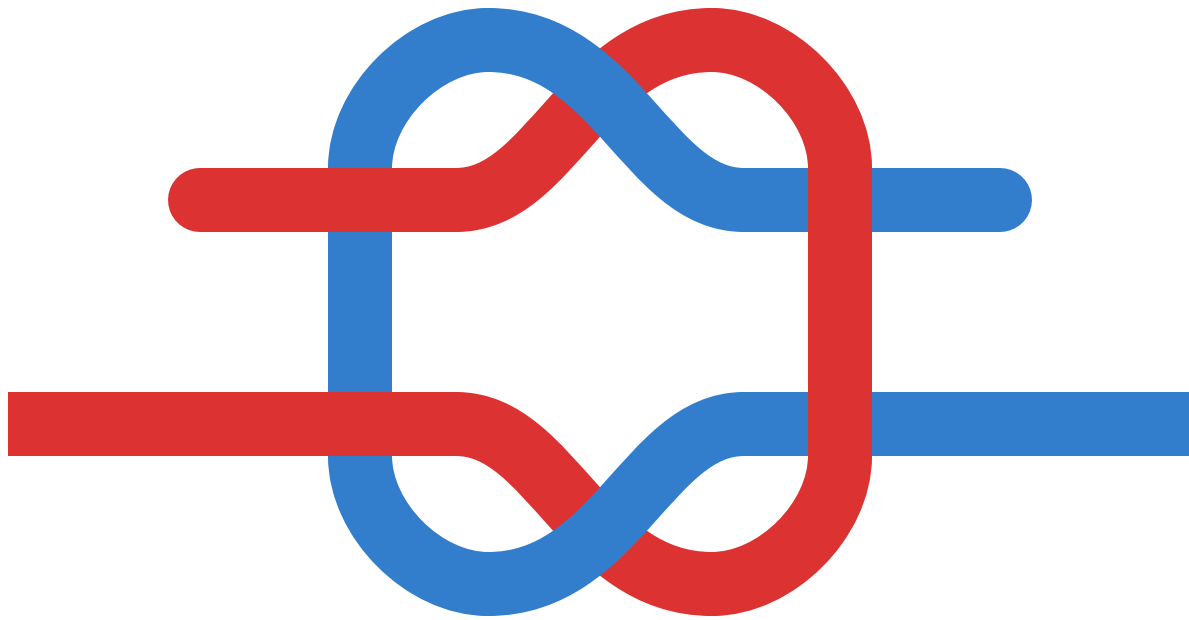
Practice on a real piece of rope before you need one of these for real

Every knot below is simple enough to learn from a picture and a few tries, but "I read the steps once" and "I can tie this in the dark, cold, with my hands shaking" are two different skills. Keep a 3-to-6-foot piece of rope or paracord somewhere you'll actually see it, and tie each of these a few times until your hands remember the pattern without you thinking through the steps.

Square knot (reef knot): binding, not joining

The knot most people already half-know from tying shoelaces or a bandage. It's for binding something closed, cinching a bundle, tying off a bandage, securing a rolled tarp, not for joining two ropes that will bear real load.

1. Hold one rope end in each hand.
2. Cross the right end over the left and tuck it under, then pull both ends to snug the first half.
3. Cross what's now the left end over the right and tuck it under.
4. Pull all four ends (two working ends, two standing ends) to tighten. Done correctly, the two loops that form lie flat and parallel; if they twist into an "S" shape instead, you've tied a granny knot, which slips far more easily, undo it and redo the second cross the other way.



Public domain, CountingPine, via Wikimedia Commons.

WARNING

Don't use a square knot to join two ropes under load

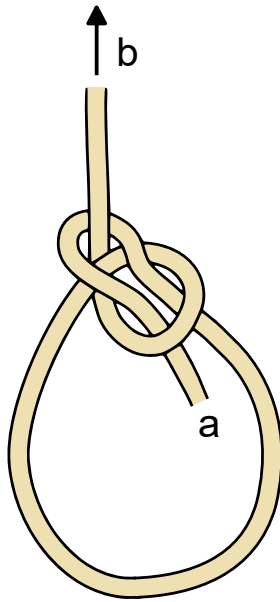
A square (or granny) knot can capsize and slip apart, especially with slippery synthetic rope, wet rope, or two ropes of different diameters, exactly the situation where failure matters most. Use a sheet bend to join two ropes that need to hold real weight.

Bowline: a fixed loop that won't tighten under load

The knot to reach for anytime you need a loop at the end of a rope that stays a fixed size no matter how hard it's pulled, a rescue loop, a loop around a post, the end of a line you're about to throw. Unlike a slip knot, the loop it makes cannot cinch down and choke.

1. Make a small loop in the rope a short distance from the end, the "hole," with the working end coming up through it.
2. Pass the working end up through that loop from underneath, the classic mnemonic: the rabbit comes up out of the hole.
3. Wrap the working end behind the standing part of the rope, around the "tree."
4. Bring the working end back down through the same small loop it started in, the rabbit goes back down the hole.

5. Pull the standing part and the loop's two strands separately to dress the knot, then pull hard on the standing part and the loop together to set it.



Original by Hella, derivative by Tescobar, CC BY-SA 3.0, via Wikimedia Commons.

WARNING

A bowline can work itself loose with no load on it at all

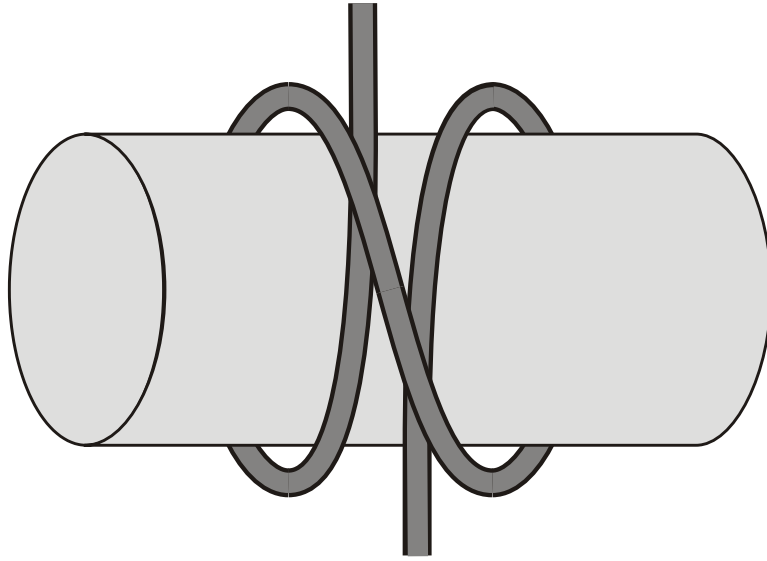
Unlike most knots, a bowline holds fine under steady load but can shake itself undone when the rope is repeatedly slack and jerked with nothing pulling on it, a real, documented weakness, not a myth. For anything safety-critical (a harness, a line someone might actually fall on), finish it with a stopper knot tied in the working end right against the loop, or ask someone at a real climbing or sailing course for the "Yosemite finish."

Clove hitch: quick, adjustable, not fully trustworthy alone

The fast way to start or end a lashing, or to tie a line to a post or pole when you'll want to adjust or untie it again soon. It's not a knot to trust alone for a load that could shift direction or go slack and snap tight again.

1. Wrap the working end around the pole or post once, crossing over itself to form an X on the front.
2. Wrap around the pole a second time, in the same direction, laying the new wrap just to one side of the X.

3. Tuck the working end under that second wrap, passing it through the X you formed in step 1.
4. Pull both ends to snug the hitch tight against the pole.



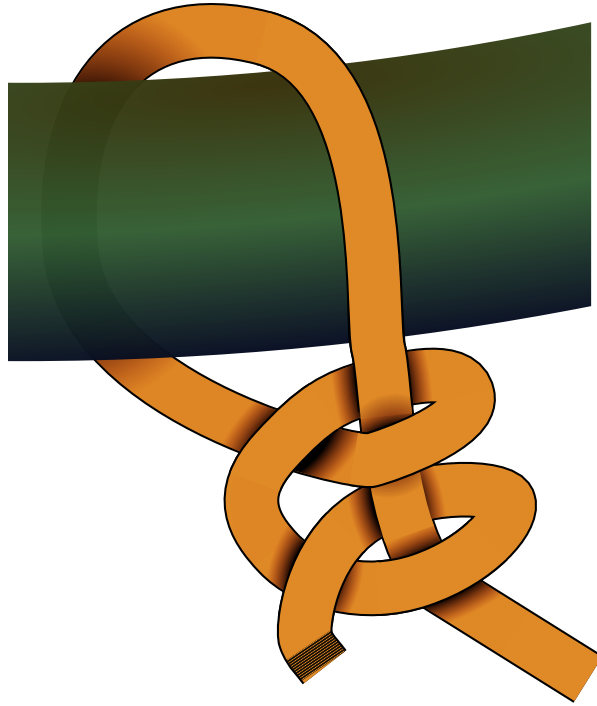
Original by Hella, modified by Luftpirat, CC BY-SA 3.0, via Wikimedia Commons.

For anything that needs to actually hold, a shelter ridgeline, a load you can't watch constantly, back a clove hitch up with a couple of half hitches on the working end, or use two half-hitches from the start instead.

Two half-hitches: securing a line end, plain and reliable

The plain, dependable way to tie a rope's end off to an anchor, a tent stake, a post, a tree, when you want it to actually stay tied. Less adjustable than a clove hitch, more trustworthy.

1. Pass the working end around the anchor.
2. Bring it up and over the standing part, then back through the loop that creates, that's one half-hitch.
3. Repeat the same wrap a second time, right next to the first, that's the second half-hitch.
4. Slide both hitches snug against the anchor and pull the standing part to set them.

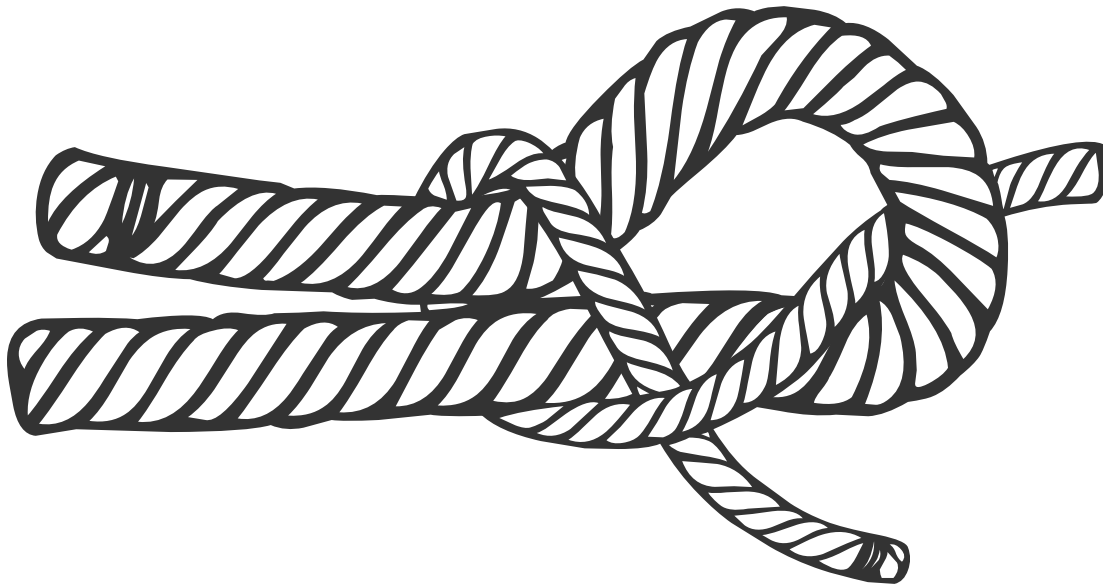


Sawims, public domain, via Wikimedia Commons.

Sheet bend: joining two ropes of different sizes

The real answer to "how do I tie two ropes together," especially when they're different diameters or materials, exactly the case a square knot fails at. A length of paracord to a length of clothesline, a thin guyline to a thicker ridgeline.

1. Form a bight (a U-shaped fold) in the end of the thicker rope and hold it.
2. Pass the working end of the thinner rope up through that bight.
3. Wrap the thinner rope's working end around behind the entire bight.
4. Tuck the working end under itself, where it first crossed the bight, so both working ends end up on the same side of the finished knot.
5. Pull the thicker rope's bight and the thinner rope's standing part apart to snug it tight.



Lucasbosch, CC BY-SA 3.0, via Wikimedia Commons.

WARNING

A sheet bend can shake loose with no load on it, same weakness as the bowline

If the joined ropes might go slack, tie a double sheet bend instead: identical, but wrap the thinner rope around the bight twice before tucking it, for real security when the size difference between the two ropes is large.

Taut-line hitch: an adjustable knot that grips under load and slides when it's slack

The knot Emergency Shelter Basics uses to stake out a tarp: it holds tension like a fixed knot but slides by hand to re-tension whenever the line stretches or a stake shifts, without ever having to retie it.

1. Wrap the working end around the anchor (a stake, a tree), then around the standing part of the line, moving toward the anchor, twice.
2. Wrap the working end around the standing part one more time, this wrap goes above the first two, closer to the load.
3. Pull the whole hitch snug. Under tension it grips; with the tension released, slide the whole knot along the standing line by hand to lengthen or shorten it, then pull tight again to lock it back in place.



Chris 73, CC BY-SA 3.0, via Wikimedia Commons.

Trucker's hitch: real mechanical advantage for pulling a line drum-tight

The knot that lets one person tension a ridgeline, a tarp, or a load on a roof rack tighter than they could ever pull by hand alone, the same hitch Emergency Shelter Basics uses to tension a tarp ridgeline between two trees.

1. Anchor one end of the line to a fixed point with a bowline or by tying off around it.
2. A few feet from the second anchor point, twist a loop into the standing part of the line, a simple slip loop works, though it can jam under real load; a directional figure-eight-on-a-bight is more secure and still easy to untie afterward.
3. Run the working end around the second anchor point and back through that loop.
4. Pull the working end to draw the line tight, the loop acts as a pulley, giving real (if friction-reduced) mechanical advantage over pulling the line by hand alone.
5. Holding the tension, secure the working end with two half-hitches around the taut lines just below the loop so it can't release.



Cobanyastigi, CC0 (public domain), via Wikimedia Commons.

Watch it: a full tying sequence is easier to follow in motion than in still steps; Animated Knots by Grog and most outdoor-retailer YouTube channels cover this exact hitch start to finish.

Write your own plan, in one sentence

Reading seven knots once isn't the same as your hands knowing any of them. Finish this sentence with your own real plan:

"This week, I will practice the taut-line hitch until I can tie both, five times each."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

Send them this page ›

Sources

- Square/reef knot vs. granny knot, and capsizing failure mode: Wikipedia

- Bowline tying steps and the "rabbit and the tree" mnemonic: NetKnots; loosening-when-slack weakness and the Yosemite finish: Wikipedia
 - Clove hitch tying methods and its need for backup under a shifting load: MasterClass; Wikipedia
 - Two half-hitches technique: Wikipedia
 - Sheet bend tying steps, working-ends-same-side requirement, and the double sheet bend for dissimilar rope sizes: Royal Museums Greenwich; Wikipedia
 - Taut-line hitch wrap sequence and slide-to-adjust mechanism: Wikipedia
 - Trucker's hitch construction, real-world mechanical advantage, and securing the working end: Animated Knots by Grog; Wikipedia
-

Working through this from Ready, Set, Ready? Head back to pick your next topic once this one's real.

DIY Assistive Equipment Fabrication

The Access & Functional Needs chapter's Tier 3 Assistive Technology Fabrication item calls this a real skill, best learned by working with an occupational therapist or assistive-tech specialist rather than improvised from scratch. This guide covers where that line actually falls: the real organizations that already build and give away assistive devices, simple builds reasonable to make yourself, and what genuinely needs a professional.

Where DIY stops and professional help starts

Occupational therapists and assistive-technology professionals draw a fairly consistent line: customizing or adapting an already-selected, low-risk aid is reasonable to do yourself, while anything load-bearing, structural, or involving custom seating or positioning needs a professional. A grab bar that isn't anchored into a wall stud, or a mobility device modification that changes how weight is distributed, isn't a place to improvise.

WARNING

Never DIY these

Anything load-bearing or structural (wheelchair frame modifications, custom seating, ramps meant to support a wheelchair's full weight) and anything that replaces a properly fitted medical device should go through a professional. Standard PVC pipe, in particular, is not rated as load-bearing and is not food-safe; treat it as a shaping and mounting material only, never a structural or ingestible-contact one.

Real organizations already doing this

Organization	What it does
e-NABLE	A volunteer network of roughly 200 chapters and 10,000+ members who 3D-print free upper-limb devices for people with partial hand or limb differences. Material cost typically runs \$25-50 per device, print time 12-16 hours. e-NABLE explicitly recommends working with a medical professional before and after fitting a device.
Makers Making Change (Neil Squire Society)	215+ open-source assistive device designs, with an estimated 30,000+ devices built by volunteer makers since the program launched in 2016.
AT3 Center / ATAP	The national umbrella organizations for assistive-technology reuse and state AT programs; a good starting point for finding a local device-lending or reuse program instead of building from scratch.

Thingiverse's assistive technology design groups are worth browsing too, but they're unmoderated and less vetted than e-NABLE or Makers Making Change; treat designs there with more scrutiny before printing and using one.

Simple builds reasonable to DIY

PVC pipe and fittings are the most common material for low-risk, non-structural adaptive builds, cheap, easy to cut and assemble with basic hand tools, and easy to reconfigure.

- 1. Reachers and grabbers:** use 1/2-inch PVC pipe, 2 to 3 feet long, as the shaft. Cut two identical jaw pieces from thin plywood or thick cardboard and mount them to cross like scissors at a fixed pivot point (a bolt through both pieces works as the fulcrum) near the shaft's business end. Run a non-stretching cord (paracord or strong string) from the jaws' non-gripping ends back down the shaft to a pull-handle; pulling the cord rotates the jaws closed. A rubber band stretched across the gripping ends provides the opposite tension, holding the jaws open by default so they close only when you actually pull.
- 2. Walker or wheelchair trays:** a flat panel mounted to a PVC frame that clips onto a walker or wheelchair for carrying items hands-free. Size the frame's tubing to slide snugly over or clamp around the walker/wheelchair's own frame tubing (measure its outer diameter first), and secure the connection with hose clamps sized to that diameter rather than PVC cement, so the tray can be removed later.
- 3. Switch mounts:** a PVC arm or frame that positions an adaptive switch (for a communication device or powered equipment) within reach of a specific range of motion.

4. **Key turners:** drill a hole through a short length of PVC or a wood dowel sized to hold a bolt, sandwich the key's head between the two halves (or a slotted holder cut to the key's thickness), and secure it with a bolt, nut, and washer rather than epoxy, so the turner can be swapped between keys. The added leverage from the handle length is what does the actual work for someone with reduced grip strength, not the fastening method.

Material	Use
PVC pipe and fittings	1/2-inch for shafts and handles (reachers, key turners); 3/4 to 1-inch for load-spreading frames like a walker tray. Cut with a PVC cutter or hacksaw and deburr the cut edge with sandpaper before use, a rough edge is uncomfortable to grip and can catch on clothing. Use PVC cement only for permanent joints; leave a friction-fit or clamped joint uncemented anywhere you'll need to adjust or disassemble it later.
Foam pipe insulation	Slip over a handle or grip point to build up diameter for easier grasping
Non-slip drawer liner	Wrap or line a grip surface, or place under an item to keep it from sliding
Stud finder	Critical before mounting anything to a wall, including a grab bar; never rely on drywall anchors alone for load-bearing hardware
Basic hand tools (PVC cutter or hacksaw, screwdriver, drill)	All that's needed for the builds above
FDM 3D printer (optional)	Opens up e-NABLE and Makers Making Change's open-source device library directly

A useful reference ceiling, even for improvised builds

The ADA's 1:12 maximum slope standard for wheelchair ramps (one inch of rise for every twelve inches of ramp length) is a reasonable benchmark to check any improvised ramp against, even outside a context where ADA compliance is legally required.

TIP

Sealant-filled inner tubes prevent the flat that strands a wheelchair user

For a wheelchair with pneumatic (air-filled) tires, a puncture is a mobility emergency, not just an inconvenience. A tire sealant made for this (injected through the valve after removing the valve core, then the tire fully inflated) seeks out and seals small punctures as they happen, before the tire even

goes flat. It's a preventive product, not a fabrication project, but it's cheap, doesn't require replacing the tire, and closes a real gap this guide's builds don't otherwise address.

Sources

- e-NABLE network size, device cost, and print time: e-NABLE
- Makers Making Change design library and device count: Makers Making Change
- National AT reuse infrastructure: AT3 Center; Association of Assistive Technology Act Programs (ATAP)
- PVC-based adaptive equipment builds: Equip2Adapt project documentation
- DIY-versus-professional scope of practice: American Occupational Therapy Association (AOTA) scope-of-practice guidance; RESNA wheelchair service provision guidelines
- ADA ramp slope standard: ADA.gov, 2010 ADA Standards for Accessible Design, §405
- DIY reacher/grabber cord-and-jaw mechanism: Engineer Fix; The Tech Interactive
- DIY key turner attachment approach: Thingiverse, Open Assistive Technology
- Tire sealant use in wheelchair pneumatic tires: Adventure Wheels

Home Accessibility Modifications

The Access & Functional Needs chapter names temporary ramps, wider doorways, and grab bars as practical modifications worth making, without covering how. This guide covers the real slope ratio a ramp needs to be usable, why a grab bar has to go into a stud and nothing else, and the cheap fix that solves most doorway-width problems before anyone reaches for a saw.

Building a temporary ramp

Slope is the number that actually matters, and it's expressed as a ratio of rise to length: 1 inch of vertical rise for every 12 inches of ramp length (a 1:12 slope) is the standard accessible ratio. A gentler 1:16 slope is easier to push a manual wheelchair up; 1:20 takes even less effort but needs more length and material to cover the same rise. A short, steep plywood ramp that technically bridges a single step but doesn't meet something close to 1:12 is usable by an able-bodied person carrying groceries and not much use to anyone who actually needs it.

Component	Typical spec	Note
Ramp surface	3/4" plywood	Full width of the ramp, edges secured with screws, not just nails
Stringers (side supports)	2x8 pressure-treated lumber	Cut to the exact slope angle; the ramp's actual skeleton
Cross joists	Every ~16 inches	Joist hangers and screws, not just nails, for real load-bearing strength
Handrail height	34–38 inches above ramp surface	Support posts no more than 6 ft apart, bolted (not just screwed) in place

Slope isn't the only spec that determines whether a ramp actually works. Build it at least 36 inches of clear width, narrower than that and a wheelchair's own width leaves no margin for error. Include a level landing at least as wide as the ramp and 60 inches long in the direction of travel at both the top and the bottom, and anywhere the ramp turns; a ramp that dumps straight onto a step or an uneven transition at the door creates exactly the hazard the ramp was built to remove. Add a curb or raised edge at least 2 inches high along both open sides wherever the drop-off exceeds about half an inch, without it a wheel can slide off the side, especially in the corner of a turn.

Check local permit requirements before building anything permanent; many jurisdictions allow a temporary plywood ramp without a permit but require one for a fixed structure, and the line between the two isn't always obvious.

Grab bars: the one rule that isn't optional

A grab bar has to be mounted into a wall stud, or into blocking installed behind the wall specifically for this purpose, never into drywall alone and never relying on drywall anchors or toggle bolts as the primary support. A properly stud-mounted bar needs to support real force, up to 250 pounds applied at any single point along the bar or its mounting hardware, and a bar backed only by drywall simply can't meet that even briefly, which turns a fall-prevention device into the cause of a fall the moment someone actually leans on it under real weight.

Standard mounting height is 33 to 36 inches from the finished floor to the top of the bar, at the toilet, in the shower, and at the tub; a vertical bar at a shower entry mounts with its bottom edge between 39 and 41 inches up. Buy a bar with a 1.25 to 1.5 inch diameter grip, thin enough that an average hand can actually wrap fully around it, and mount it with 1.5 inches of clearance from the wall so fingers have real room behind the bar rather than getting pinched against the tile. Use a stud finder before drilling, and if a stud doesn't land where the bar needs to go, install a section of solid blocking (a piece of lumber screwed between two studs) behind the wall first rather than compromising on anchor type.

WARNING

A grab bar in drywall is worse than no grab bar

Someone reaching for an installed grab bar assumes it will hold their full weight during a fall, exactly the moment a drywall-only mount fails. A missing grab bar at least doesn't create false confidence; a failed one can turn a stumble into a fall with someone already off-balance and reaching for support that isn't there.

Widening a doorway: try the cheap fix first

Standard doorways clear 32 inches with the door open, and many household wheelchairs fit through that, but tighter. Before cutting into a frame, try offset (also called swing-clear or Z-style) hinges: they shift the door's pivot point so the door swings completely clear of the opening instead of eating into it, typically gaining about an inch or two of usable clearance for a relatively small, inexpensive hardware swap that most people can install themselves. Removing the door entirely, or just removing its trim, is the next-cheapest option and can gain meaningful clearance without any structural work at all. Actually widening the frame is

a real carpentry project, worth doing for a permanent Tier 3-style modification, but not the first thing to reach for when the goal is a working fix now.

Quick Reference

Modification	Key number	Cheapest fix first
Ramp	1:12 slope minimum; 36" min. clear width; 60" landings	Plywood + pressure-treated stringers
Grab bar	33–36" height, 1.25–1.5" grip diameter; stud-mounted, rated to 250+ lb	Stud finder + blocking if needed, never drywall alone
Doorway	32" minimum clear width	Offset hinges before frame-widening

Full checklist:

- Ramp slope measured and built to at least 1:12, not just "close enough"
- Ramp surface and stringers rated for real, repeated load, not a one-time-use fix
- Every grab bar located over a stud (or blocking) with a stud finder before drilling
- Grab bar height confirmed against the 33-36" (or 39-41" vertical) standard
- Offset hinges tried before committing to frame-widening carpentry
- Local permit rules checked before any permanent structural modification

Sources

- Ramp slope ratios and construction: Family Handyman; BraunAbility
- Grab bar height, stud mounting, and weight rating: GrabBars.com; AccessibilityChecker.org
- Doorway width and offset hinges: Karman Healthcare; Age Fearless Academy
- Ramp minimum width, landing size, and edge protection: U.S. Access Board; AccessibilityChecker.org
- Grab bar grip diameter and wall clearance: GrabBars.com

Substance Withdrawal: What's Actually Dangerous

The Mental Health chapter's Tier 2 names increased substance use during the disillusionment phase as a real, well-documented pattern, not a moral failing. This guide covers what happens when access to that substance disappears anyway: which withdrawal is actually life-threatening, which only looks that way, and what to do without assuming medical care is reachable.

WARNING

Severity and danger are not the same thing, and the instinct here is backwards

Someone in opioid withdrawal looks far worse than someone in the first hours of alcohol withdrawal: doubled over, sweating, vomiting, miserable. It's the person who just looks shaky and anxious who needs closer attention. Alcohol and benzodiazepine withdrawal can escalate to seizures and a genuine medical emergency; opioid withdrawal, despite how it looks, rarely becomes life-threatening on its own.

Alcohol and benzodiazepines: the ones that can actually kill

Roughly 3–5% of people going through alcohol withdrawal progress to **delirium tremens** (DTs), its most severe form: severe confusion, hallucinations, dangerously elevated heart rate and blood pressure, and a real risk of prolonged seizures. Untreated, DTs carries a mortality rate as high as 37%; with real medical treatment, that drops to around 2%. That gap, not the withdrawal itself, is the entire reason this section exists.

Timeframe after the last drink	What typically happens
6–48 hours	Seizure risk window, peaking around 24 hours
48–72 hours	Delirium tremens onset, if it's going to happen
4–5 days	Peak DT intensity, when it occurs
Up to 8 days	Symptoms can persist even in a survived, treated case

Benzodiazepines (prescription anti-anxiety medications like diazepam or alprazolam) carry the same real seizure and delirium risk on withdrawal as alcohol does, for the same underlying reason, and the two are

frequently discussed together in clinical withdrawal guidance for exactly that reason.

Recognizing a real emergency

Any of these means get to real medical care immediately, regardless of tier: a seizure, severe confusion or disorientation, hallucinations (visual, auditory, or a crawling sensation on the skin), a dangerously fast heartbeat, or a high fever. This isn't something to manage at home past this point.

What clinicians actually use to judge severity

The CIWA-Ar is the real, standard 10-item scale hospitals use to score alcohol withdrawal severity, covering things like tremor, sweating, anxiety, and orientation. A score under 10 is mild; 11 to 15 is moderate; 16 or higher is severe and strongly indicates a real medical response is needed. This isn't a tool for self-diagnosis at home, but the categories it's built from are the same real signs worth watching for.

Opioids: severe, but rarely fatal on their own

Opioid withdrawal is genuinely miserable, nausea, vomiting, gooseflesh skin, and an intense crawling discomfort that can last around 10 days, but it's not usually life-threatening by itself the way alcohol or benzodiazepine withdrawal can be. The real risk with opioids runs the other direction: a return to use after a period of abstinence, when tolerance has already dropped, is what actually kills people, from an accidental overdose at what used to be a normal dose.

If a seizure actually happens

This is real, safely-taught first aid for the seizure itself, arranging emergency transport at the same time, not instead of it.

1. Clear away anything nearby they could strike, and put something soft (a folded jacket, a pillow) under their head.
2. Turn them onto their side, mouth toward the ground, so saliva or vomit doesn't block the airway.
3. **Never put anything in their mouth** and never try to hold them still; both cause real injury and don't stop the seizure.
4. Time it from start to finish. A seizure lasting 5 minutes or longer, or a second one starting before they've regained consciousness from the first, is its own emergency on top of the withdrawal itself.

5. Stay with them until they're fully alert; confusion for a while afterward is normal, but get to real care regardless of how quickly they seem to recover.

What supportive care can and can't do without medical backup

- **Can help:** hydration, a calm and safe environment, monitoring for the danger signs above, reassurance, and simply not leaving someone in moderate-to-severe withdrawal alone. Thiamine (vitamin B1), an over-the-counter supplement, is genuinely worth giving to anyone withdrawing from heavy, sustained alcohol use, it's low-risk and real medical guidance recommends it for exactly this population, to prevent a separate serious complication called Wernicke's encephalopathy. Give it before any sugary food or drink if you can, a large carbohydrate load in someone thiamine-deficient can actually trigger the complication it's meant to prevent.
- **Can't safely substitute for medical care:** managing a real seizure risk, administering benzodiazepines to treat someone else's withdrawal without training and real dosing knowledge, or assuming supportive care alone is enough once any real emergency sign above has appeared.

Tapering ahead of a predictable disruption

If a disruption to supply is foreseeable, evacuating ahead of a hurricane, a known pharmacy closure, a planned move, a gradual, deliberate reduction is real harm reduction and meaningfully safer than an abrupt stop. It's not universally safe to do without guidance, though: heavy daily drinkers, anyone with a prior withdrawal seizure, or anyone with a significant medical condition should be evaluated by a clinician before attempting any reduction plan, not guess at a schedule alone.

Real help

SAMHSA's National Helpline, **1-800-662-4357**, is free, confidential, available 24/7/365, and reachable as long as phone service is up, independent of whether local treatment facilities are open. It's a real referral and information line, not a hotline that requires an active crisis to call.

Sources

- Alcohol withdrawal timeline, delirium tremens risk, and mortality with and without treatment: StatPearls/NIH; Cleveland Clinic
- Opioid versus alcohol withdrawal, severity-versus-danger distinction: NorthStar; NJ Addiction Centers

- CIWA-Ar scale, items, and severity scoring: Clinical Institute Withdrawal Assessment for Alcohol; MDCalc
- Tapering safety and who shouldn't self-taper: Alina Lodge
- SAMHSA National Helpline: SAMHSA
- Seizure first aid technique and when it's an emergency: Epilepsy Foundation; Mayo Clinic Health System
- Thiamine supplementation in alcohol withdrawal and Wernicke's encephalopathy prevention: Alcohol Treatment Guidelines

Safety Planning When Home Isn't Safe

Every other guide on this site assumes home is the place you're trying to protect, and that everyone in the household is on the same side of the plan. For a household living with domestic violence or intimate partner violence, neither assumption holds: the danger is a person you live with, not a hazard outside, and a shared family communication plan or an obvious go-bag can be turned into a warning sign for an abuser rather than a safety measure. This guide is a different kind of planning, sourced directly to the organizations built specifically for it, not adapted from the rest of this manual.

If you're in immediate danger, call 911

Everything below is for planning ahead, before a crisis moment, or for situations where calling 911 isn't the safest immediate option. If you or someone else is in danger right now, call 911. This guide doesn't replace that judgment call, it's what to have in place before you need to make it.

The real hotline, and why it matters more than anything on this page

The **National Domestic Violence Hotline** is free, confidential, and available 24/7: call **1-800-799-7233**, text **START to 88788**, or chat at thehotline.org, in English, Spanish, and over 200 languages through interpretation services. Their advocates build a real, personalized safety plan with you, specific to your actual situation, your abuser's actual behavior, and your actual resources, which is something a general guide like this one genuinely cannot do. Their own interactive safety planning tool walks through this step by step. Everything below is a starting point for that conversation, not a substitute for it.

A go-bag that doesn't tip off an abuser

The core difference from every other go-bag on this site: it can't live somewhere obvious in your own home, and packing it can't look like packing.

- **Store it somewhere else entirely**, ideally at a trusted friend or neighbor's home, not next door, not a close mutual friend or family member an abuser would think to check first.
- **Pack it gradually, or keep a duplicate set** of documents and essentials rather than visibly emptying a drawer at once. Photocopies of documents work if the originals can't be removed without being noticed.

- **What actually goes in it:** cash, a spare debit or credit card, identification (driver's license, passport, Social Security card, green card or work permit if applicable), birth certificates for you and any children, a spare phone or a prepaid phone, a change of clothes, any daily medication, and a copy of any protective order already in place.

Know your way out before you need it

Identify which door, window, stairwell, or exit actually offers the fastest way out of your home, and mentally walk through it, the same rehearsal logic this site uses for every other emergency reflex, applied here to a very different kind of emergency.

Agree on a code word with a trusted friend, relative, or neighbor, one ordinary-sounding word or phrase you can say or text that means "call for help" or "come get me now" without an abuser who overhears or reads it realizing what it means.

Technology can be turned into surveillance

WARNING

Shared accounts and devices can reveal a safety plan before it's used

Location sharing on a shared phone plan, a shared cloud or email account, a smart-home app, or a car's own built-in tracking can all let an abuser see where you are or what you've been searching, sometimes without you realizing the feature is even on. If you suspect a device or account is being monitored, using it to research leaving or to contact help can itself be a risk. Where it's safe to do so, use a device the abuser doesn't have access to, a public library computer, a trusted friend's phone, and clear browser history afterward if you have to use a shared device. The National Network to End Domestic Violence's Safety Net Project covers this in real depth, specific to phones, apps, and smart-home devices, and is worth reading before you assume any device is safe to use for this.

Why the rest of this site's plan can work against you here

A family communication plan built for a storm or an earthquake assumes everyone benefits from everyone knowing the meeting point and the out-of-area contact. Here, that same information in the wrong hands is exactly what lets an abuser find you. Keep your own safety plan, your own contact, and your own meeting point separate and known only to people you trust, not shared as part of a household-wide plan the abuser is also part of.

Sources

- National Domestic Violence Hotline, contact methods and interactive safety planning tool: TheHotline.org; MNADV
- Go-bag contents, storage location, and gradual-packing guidance: Women Against Abuse; Illinois Legal Aid Online
- Escape route identification and code-word planning: Illinois Coalition Against Domestic Violence; Domestic Violence Crisis Center
- Technology-facilitated abuse and device/account safety: National Network to End Domestic Violence, Safety Net Project

Safely Re-Entering a Damaged Home

The Post-Disaster Recovery chapter puts re-entry safety first, "before" the claims process, since none of that matters if entering the structure itself causes an injury. This guide is the actual walkthrough: what to check outside first, the gas and electrical checks, the structural red flags that mean turn around, and the order to move through the house once it's safe to go in. For the insurance and claims process that comes after, see [Filing Claims After a Disaster](#).

Wait for official clearance first

Return only once local authorities have said it's safe to do so. After a significant event, especially an earthquake, trained inspectors may have posted an official placard on the building: **green** means inspected and safe to occupy without restriction, **yellow** means restricted or limited use only, **red** means no entry at all, full stop, regardless of how urgent it feels to get inside. If no placard is posted yet, that doesn't mean it's safe, it may just mean an inspector hasn't reached the property yet.

Before you go anywhere near the door: the exterior check

Walk around the outside of the property first. Damage visible from outside is often a sign of a bigger problem inside.

- Downed or damaged power lines. If you see one, don't step in any nearby puddle or standing water, stay well back, and report it to the power company rather than moving it yourself.
- The smell of gas, or a hissing or blowing sound. Don't investigate further, see the gas section below.
- Foundation cracks, walls that are out of plumb, a sagging roofline, or ground fissures.
- After a wildfire specifically: ash pits, charred trees, and hot embers, which can stay dangerously hot for days.

Don't enter if you see floodwaters, significant visible damage and debris, or if a structural inspector or contractor hasn't yet confirmed the building is sound.

Gas: leave immediately if you detect it

1. If you smell gas or hear a hissing or blowing sound, don't turn on lights, don't use a phone or anything electrical inside, and don't investigate the source.

2. Open a window if you can do so quickly and safely, then leave the property immediately.
3. Turn off the gas at the main valve from **outside** if you can do so safely; the exact shutoff steps are covered in Fire-Starting & Generator Safety.
4. Call the gas company or fire department only after you're a safe distance away.

Electrical hazards

If any wiring looks damaged, or anything electrical has been wet, turn off power at the main breaker or fuse box rather than risk it. Have a licensed electrician inspect the system before restoring power to a home that's had any water intrusion or visible wiring damage.

Structural red flags: turn around if you see these

Sign	Why it matters
Any indication of collapse or foundation movement	The structure may not be able to bear its own weight, let alone yours
Cracked chimney mortar	A fire and carbon monoxide hazard even if the rest of the home looks fine
Cracks in the roofline, structural beams, or foundation	Signs the building's load-bearing capacity has been compromised
"Stair-step" cracks in drywall, especially after an earthquake	A classic sign of structural shifting, not just cosmetic damage

Once it's genuinely safe to go in

- **Wear real PPE:** sturdy closed-toe boots, work gloves, and an N95 or better respirator.
- **Use a battery-powered flashlight, never a candle or open flame,** in case of an undetected gas leak.
- **Leave children with a relative or friend** for this first inspection; the site may genuinely be unsafe for them, and seeing the damage firsthand can be upsetting.

Move through the home in this rough order:

1. **Stairs and banisters:** test stability before putting your full weight on them.
2. **Windows and doors:** look for jamming or cracks radiating out from the corners, a sign of structural movement.

3. **Appliances:** check connections; anything that got wet needs to dry out completely before it's powered on.
4. **Attic:** check for smoke or fire damage, especially after a wildfire.
5. **Basement:** inspect for cracks that could indicate a structural problem, not just water damage.
6. Stay alert for objects that could fall from cabinets or shelving that shifted during the event.

Water, sewage, and mold

- Turn off the main water valve if any pipes are visibly damaged.
- Don't flush any toilet until you've confirmed the sewage line itself is intact; flushing into a broken line can back up into the house.
- Assume tap water is unsafe to drink until local authorities confirm otherwise, even if it looks clear; see Water Purification if you need to treat it yourself in the meantime.
- If a basement or crawlspace is flooded, pump it out gradually, roughly **one-third of the water per day**, rather than all at once. Removing floodwater too fast can let outside groundwater pressure push against an unsupported foundation and cause it to crack or collapse.
- Watch for a musty smell in the days after, an early sign of mold growth in wet drywall, carpet, or insulation.

TIP

Race the 24-48 hour window, not just watch for the smell afterward

Mold can start growing within 24 to 48 hours of anything getting wet, so the actual goal is getting materials fully dry inside that window, not waiting to notice a musty smell later. Run fans and a dehumidifier, open doors and windows if outdoor air is drier than inside, and keep going until indoor humidity is at or below 50%. It's only a guideline, not a guarantee either way, but it's the practical target worth aiming for while you're already in cleanup mode.

Document before you clean anything up

Take photos and video of every damaged area before repairs or cleanup begin, and separate debris into yard waste, building materials, and regular trash as you go. This is the exact evidence the claims process depends on; see Filing Claims After a Disaster for what happens next.

Sources

- American Red Cross, checking a home's structural elements and utilities after a disaster: Red Cross; Red Cross
- American Red Cross, checking a home after a fire: Red Cross
- FLASH (Federal Alliance for Safe Homes), how to inspect, clean up, and re-enter a home after a disaster (exterior check, utility shutoffs, structural red flags, room-by-room order, floodwater pump-out rate): FLASH
- CDC, safety guidelines after an earthquake: CDC
- Mold growth timeline (24-48 hours) and CDC/EPA drying and humidity guidance: Palm Build Restoration

Household Trash & Pet Waste Disposal

The Sanitation & Hygiene chapter names garbage containment in one line, and the pet chapter names pet-waste composting in one line. Human waste already has its own real how-to in Bathroom & Hygiene Without Running Water; this guide is the how-to for the other two waste streams that stop being routine once collection service does: household garbage and pet waste.

Household garbage

Left alone, accumulating trash attracts pests and starts smelling within days, and both problems compound the longer collection is out. Sort it as you generate it rather than waiting; separating a week's worth of mixed trash after the fact is a much worse job.

- **Wet or food-contaminated waste** (food scraps, anything soiled) is the most urgent, and there's a real clock on it: fly eggs laid on exposed or poorly-sealed waste can hatch into maggots in as little as 8 to 24 hours in warm weather, and within roughly 72 hours even in cooler conditions. Double-bag it and keep it in a leak-resistant, tight-lidded container, ideally outside, away from the living space, until it can actually leave the property, and don't let it sit unsealed overnight.
- **Dry, non-organic waste** (packaging, paper, plastic) can wait considerably longer. Crush or smash it down to conserve storage space, don't let empty boxes and containers take up volume they don't need to.
- **Burnable items**, if local rules allow it, can be burned outdoors as a last resort for volume you can't otherwise store, but only certain materials are actually safe to burn: dry paper, cardboard, untreated and unpainted wood, and yard debris are fine. Never burn treated, painted, or pressure-treated wood (CCA-treated lumber releases arsenic when burned), particleboard, rubber, foam, or vinyl, these produce dioxins at ground level, a worse outcome for anyone nearby than just bagging the plastic instead. Pick a safe, cleared spot, never burn on a windy day, and stay with the fire the entire time. Check restrictions before lighting anything: call both your local fire department (for burn permits and fire-safety rules) and your county or regional air quality district (for air-quality permits and any active burn ban), most jurisdictions require clearing both, not just one.

WARNING

Flies, mosquitoes, and rodents aren't just a nuisance, they're mechanical disease carriers

A fly that lands on exposed garbage or waste and then on food carries whatever pathogen it picked up along with it, one of the actual mechanisms behind disaster-related outbreaks. The good news: proper refuse sanitation alone does roughly 90% of the work of fly control and 65% of rat control, so the containment steps above are already most of the job. What actually pest-proofs a container is the container itself: a galvanized steel can with a deep-drawn, water-resistant lid is real animal resistance, plastic lids flex and crack under a raccoon's weight in a way steel doesn't; add a bungee cord or a locking lid strap sized to the can's diameter (commonly 12 to 24 inches) if raccoons or other wildlife are actually prying lids in your area. Keep storage containers away from the house itself, and check them daily. For mosquitoes specifically, empty or remove anything that collects standing water after rain, buckets, tarps, tire ruts, old containers; a single container left standing for about a week is enough for a new generation to hatch.

Pet waste

Dog and cat waste carries its own disease risk, roundworms and other parasites, and in cats, the toxoplasmosis parasite, which is a real hazard for anyone pregnant or immunocompromised in the household (the same population this site's water-budget guidance already flags for a higher personal ration). That risk is exactly why it can't go into a food-crop compost pile the way some other organic waste can.

If anyone pregnant is in the household, they shouldn't handle cat waste at all

The CDC's specific recommendation for toxoplasmosis is that pregnant individuals avoid handling cat litter or cat waste entirely, hand it off to someone else in the household. If no one else can do it, wear disposable gloves for the task and wash hands thoroughly afterward, every time, not just when visibly soiled.

- **Bag and trash it**, the simplest option: scoop into a bag, tie it off, and add it to the same non-organic waste stream above rather than the wet-waste stream, since it doesn't decompose the same way food scraps do.
- **Or bury it**, if bagging isn't practical long-term: dig a hole **6 to 8 inches deep**, at least **200 feet** from any water source, the same distance this site's own human-waste guidance uses. Never bury it near a vegetable garden or any food-growing area; ornamental, non-food areas of the yard only.
- **Or install an in-ground pet waste digester**, a real, commercially available product (functions like a miniature septic tank: enzymes and bacteria break waste down into liquid that percolates into the soil). Site it the same distance from wells and water sources as a septic system, check local rules on that setback, and expect reduced performance in heavy clay soil or in freezing conditions.

- **Never** add pet waste to a compost pile intended for food-crop soil, even one that's otherwise well-managed. The pathogens involved routinely survive typical home composting temperatures.

Is a pet-waste compost bin or digester even legal?

Generally, yes, on your own property, for non-food-crop use. There's no state law banning pet-waste composting or digesters; what actually exists is local ordinances (setback distances from wells, similar to septic rules) and the fact that most municipal yard-waste collection programs won't accept pet waste, a program-acceptance rule, not a ban on having a bin. The strong "never put it in food-crop compost" guidance throughout this page is a health recommendation, not a legal one, though it's every bit as important to follow.

WARNING

Pyrolysis/biochar: a real advanced option, not a backyard shortcut

Heating waste to a sustained high temperature without oxygen, pyrolysis, does destroy the pathogens that survive normal composting, including the toxoplasmosis parasite in cat waste, and produces biochar, a usable soil amendment. This is genuine, actively used sanitation technology (the same principle behind commercial fecal-sludge treatment systems), not a fringe idea. But it only works if the equipment actually holds that temperature through the whole load: a backyard burn barrel or an improvised setup runs cooler in spots, and cool spots are exactly where hardy pathogens survive. If you own or build purpose-built pyrolysis equipment with a way to verify sustained temperature, this is a legitimate path for both pet waste and, per the manual's Tier 3 guidance, human waste. Without that verification, stick to bagging, burial, or the standard humanure method above, don't treat an improvised setup as equivalent to real pyrolysis.

WARNING

A method that works for human waste but not this: alkaline (lime) treatment

The manual's human-waste guidance covers hydrated lime treatment (raising pH above 12 for a couple hours) as a real, fast pathogen-kill method. Don't extend that to pet waste without caution: research on inactivating the toxoplasmosis parasite specifically shows most standard chemical treatments, including common disinfectants, don't reliably kill it; heat is the method with real evidence behind it for cat waste. Until better evidence exists for lime against this specific parasite, treat pyrolysis, not lime, as the validated option for pet waste.

Sources

- Be Ready Utah, garbage and trash disposal during an emergency (separating waste streams, burning guidance, pest-proof storage): Be Ready Utah
- EPA, pet waste management and water-quality risk: EPA
- Sanitation as the primary method of fly and rodent control (the 90%/65% figures), CDC: CDC
- Mosquito breeding in standing water and source-reduction guidance: Northern Nevada Public Health
- Leave No Trace, pet waste burial depth (6-8 inches) and distance from water: cited via American Kennel Club
- Roundworm and toxoplasmosis risk from pet waste: EPA
- Fly egg hatching timeframe under warm conditions: University of Florida IFAS
- Pest-resistant galvanized steel container and locking-lid strap design: Behrens Manufacturing; BearSaver / Bearicuda
- Toxic combustion products from burning treated wood and synthetic materials: EPA; Wisconsin Department of Health Services
- Burn-permit and air-quality-district approval requirements: Larimer County; San Diego Air Pollution Control District
- CDC, toxoplasmosis prevention guidance for pregnant individuals: CDC
- Pyrolysis of fecal sludge, pathogen destruction and biochar output: Faecal sludge pyrolysis as a circular economic approach, Environment, Development and Sustainability; Biochar as a novel technology for treatment of onsite domestic wastewater, Frontiers
- In-ground pet waste digester mechanism and siting: Doggie Dooley
- Toxoplasma gondii oocyst resistance to standard chemical disinfectants: Techniques for inactivating Toxoplasma gondii oocysts, systematic review; Chemical inactivation of Toxoplasma gondii oocysts in water, PubMed

Death, Burial & Body Disposition

The Sanitation & Hygiene chapter's Tier 4 already debunks the biggest myth here (a body doesn't spread disease the way people assume) and stresses documentation. This guide is the practical layer underneath that: the legal paperwork that still applies, how to actually preserve a body without embalming, and the real rules around burial when a funeral home isn't reachable. The Act of Thriving names this directly as the one endpoint eldercare planning doesn't cover; this is that answer.

The paperwork still applies, even when normal life doesn't

A death certificate is required everywhere in the US, and someone has to sign it: the treating physician for an expected, natural death, or a coroner or medical examiner for a death that's sudden, violent, unattended, or where the person hadn't seen a doctor recently (the specific window varies by state, commonly around 20 days). Without a funeral home acting as the go-between, you'd typically present the case directly to the deceased's doctor, the coroner, or the medical examiner, whichever applies, to get the certificate completed. A **burial-transit permit** is also required before moving a body from where they died, obtained through the same office.

Northern Utah note: Utah's specific requirements

Utah Code § 26-2-13 requires the death certificate to be filed with the Utah Department of Health and Human Services within 5 days of death. A burial-transit permit is required before moving the remains anywhere. If burying on private land, the state's own guidance is to draw a map of the property showing the exact burial location and file it with the property deed, so the location stays known to future owners, heirs, and title searches, not just the people who were there.

Basic care of the body in the first few hours

Rigor mortis, the stiffening of the muscles, sets in roughly 2 to 4 hours after death and makes repositioning far harder once it does. Do this early, while the body is still supple:

- Gently close the eyelids by holding them down for a short time; if they don't stay closed on their own, a small weight (a folded cloth or a small bag of rice) placed over each lid for a while holds them shut.

- Close the mouth by gently elevating the head (a rolled towel under the chin works) or by wrapping a soft cloth or bandage under the chin and around the top of the head; this can be removed once rigor has set the position.
- Straighten the limbs and position the body as you want it to remain, arms at the sides or folded over the torso, while it's still easy to move. Once rigor sets in, forcing a limb into a different position risks real tissue damage rather than just discomfort.

Preserving a body if burial or cremation can't happen right away

Without embalming or refrigeration, real decomposition sets in within about 24 hours in a warm climate. Dry ice is the practical substitute: start cooling within 4–6 hours of death if possible, and get the body down to and held at 34–40°F. Done correctly, this preserves a body for roughly **3 to 5 days**, enough time to complete the paperwork above and arrange burial or cremation.

What	Detail
Dry ice quantity	Roughly 16 lbs per day for an adult body
Replacement interval	Every 1–3 days as it sublimates
Placement	Under and around the torso, wrapped so it doesn't contact skin directly
Before burial	Remove all dry ice first; it sublimates into gas and shouldn't go into the ground with the body

WARNING

Dry ice is a real carbon dioxide hazard, not just a cold pack

Dry ice releases CO2 as it sublimates, which can build up to dangerous concentrations in a small or sealed room. Keep windows open or the room otherwise ventilated the entire time it's in use, and never store or use it in a low-lying, enclosed space where heavier CO2 can pool.

Home burial: real, but genuinely state- and county-dependent

Roughly 30 states allow home burial in some form, but two separate layers of law apply, and both matter. **State law** decides whether a family can legally handle the death, permits, and burial at all without a funeral director, Indiana, for example, effectively requires burial in a licensed cemetery, while Texas, Vermont,

Colorado, Montana, Maine, Oregon, and Washington are cited as some of the more clearly permissive states. **Local zoning**, a separate layer even in a permissive state, governs the specific parcel: setback distance from a neighbor's property, minimum burial depth (commonly 3–5 feet), and distance from any water source, since a shallow or poorly sited grave is a real groundwater contamination risk, not just a formality. Check your specific state and county before assuming either layer is settled by the other.

WARNING**Document the location, or the burial itself becomes the family's next problem**

An unrecorded burial site is a real, recurring problem for the next generation: heirs who don't know a grave is there, a future sale that surfaces remains during construction, a title search with no record of what the land actually contains. Map it and file that map with the property deed, exactly as Utah's own guidance above describes, regardless of which state you're in.

What doesn't need to be feared

The common assumption that unburied bodies cause epidemics is largely a myth the World Health Organization and the Red Cross have specifically and repeatedly corrected: someone who died from trauma, drowning, or the disaster itself doesn't generally carry organisms that pose a public health risk, and survivors moving through the same area are a bigger disease vector than the deceased are. The real exception is a death from a communicable disease already spreading through the community, where standard precautions genuinely do matter. What actually causes lasting harm in the historical record isn't disease, it's undocumented, rushed mass burial: grieving families who never get closure, and estates, insurance claims, and legal processes that stall for years without a death record to point to.

Grief, and coordinating beyond your own household

The mechanics above are only part of this. See the Mental Health chapter's grief-support guidance for the part that isn't paperwork, and if a community structure already exists, coordinate through it rather than improvising alone, exactly as this chapter's own Tier 4 guidance on handling a death recommends: consistent documentation practice across every household matters more than any one family's choices in isolation.

Sources

- Death certificate signing authority, physician versus coroner/medical examiner: College of American Pathologists; home funeral death-certificate process: Nolo
- Home burial legality by state, the state-law versus local-zoning distinction: Funeral.com; National Home Funeral Alliance
- Body cooling technique, dry ice quantity, timeline, and CO2 ventilation safety: My Mortuary Cooler; Peaceful Passage at Home
- Utah death certificate filing deadline (Utah Code § 26-2-13), burial-transit permit, and recording a private burial site: Nolo; LegalClarity
- WHO and Red Cross guidance correcting the dead-bodies-cause-epidemics myth: World Health Organization and International Committee of the Red Cross, management of dead bodies after disasters (field guidance)
- Basic body care and positioning before rigor mortis: Peaceful Passage at Home; Titan Casket

Composting Toilets: Humanure, Vermicomposting & Incineration

The Bathroom & Hygiene Without Running Water skill guide covers the short-term bucket toilet: a liner, cover material, and temporary sealed storage. This guide picks up where that stops, the Sanitation & Hygiene addendum's Stage 3 goal of a real, permanent, no-power sanitation system: the actual science behind safely composting human waste long-term, plus vermicomposting, incineration, and pyrolysis as real alternatives.

The real mechanism: heat or time, not just a pile of waste

Thermophilic (hot) composting works because sustained heat kills pathogens directly. In an active pile that reaches 131–150°F, *E. coli* and salmonella die within 1–4 hours. Roundworm eggs, the most heat-resistant pathogen commonly found in human waste, need far longer: 1–2 months of sustained heat at that same temperature.

WARNING

A pile that never gets hot isn't automatically unsafe, it just needs time instead of heat

Most backyard humanure setups never reach true, sustained thermophilic temperature, and that's fine as long as it's treated honestly: given enough time, roughly 12 months minimum for cold composting, pathogen load drops to safe levels on its own. If the finished compost will ever touch a food crop, that minimum doubles to 24 months, the WHO, EPA, and every credible composting-toilet guideline agree on this figure. Skipping the cure time because the pile "looks like dirt" is the single most common real mistake.

The actual chemistry: why sawdust cover material isn't just for odor

Composting needs a carbon-to-nitrogen ratio of roughly 25:1 to 30:1 to work efficiently. Raw human waste alone is far too nitrogen-rich, about 6–10:1, which is exactly why a cover material matters: fine hardwood sawdust runs 300–500:1, so a consistent layer after each use is doing real chemistry, correcting the ratio toward the range that actually composts, not just masking smell. A persistent odor problem is a real diagnostic signal that the ratio is off, or the pile is too wet with too little air, not a sign that composting toilets are inherently unpleasant.

Element	Spec	Why
Cover material amount	A handful to a cupful after each use, enough to fully bury what's underneath and leave no waste visible	About one 20-liter bucket of sawdust per week for two adults and a child; too little leaves odor and flies, too much just runs out the supply faster than necessary
Cover material	Fine hardwood sawdust, wood shavings, or chopped straw (under 3–4 inches)	High carbon content corrects raw waste's nitrogen-heavy ratio toward the 25:1–30:1 target
Bin design	Sealed, above-ground container, isolated from soil and water contact	Contains waste safely while decomposition happens, and keeps it inaccessible to children or animals
Cure period	12 months minimum; 24 months if output will touch food-crop soil	Matches WHO/EPA guidance for pathogen die-off without relying on sustained heat

A real system needs at least two bins in rotation, ideally three: one actively receiving material from the toilet bucket, one resting and curing untouched, and a third fully finished and ready to use, so a bin is never both being filled and being counted toward its cure clock at the same time. When a toilet bucket fills, its contents get dumped directly into the active compost bin and immediately covered with a layer of the same carbon material, not left exposed; this is the actual mechanical link between the short-term bucket system and the long-term pile, and it's worth practicing the transfer before relying on it.

Size matters more than most instructions mention: a pile smaller than roughly 3 feet on each side (about a cubic yard) simply can't hold enough of its own heat to reach or sustain thermophilic temperature, regardless of what's in it, so an undersized bin will default to the slower cold-composting timeline no matter how well the carbon ratio is managed. And "reaches 131–150°F" isn't a guess to make by touch: check it with a long-stem compost thermometer with an 18 to 24 inch probe, inserted to roughly the center of the pile's depth, left in place for a minute or two before reading, and checked in the morning before the sun's own heat can skew the number. If attempting the hot-composting route, turn the pile every 1 to 2 days, moving cooler material from the outer edges into the hot core; a pile left untouched develops cool pockets at its margins that never reach a pathogen-killing temperature even while the center does.

Vermicomposting: a real pretreatment step, not a standalone finish line

Eisenia fetida, commonly called red wigglers, are the species used for this specifically; they process waste quickly and tolerate the conditions involved better than other earthworm species. Real research backs a genuine pathogen-reduction effect, including eliminating up to 99% of fungal pathogens found in test material. The honest limit: vermicomposting is a pretreatment step that meaningfully reduces pathogen

load, not a substitute for the same hot-composting or cure-time rules above, and the same food-crop caution still applies to its output.

A working bin needs real numbers too: roughly 1 to 2 pounds of worms per square foot of bin surface area, a bedding layer (shredded cardboard or coco coir works) a few inches deep kept damp but not soaked, like a wrung-out sponge, and a bin with drainage and airflow rather than a sealed, airtight container.

Incinerating toilets: the no-composting alternative

An incinerating toilet burns waste to sterile ash after each use rather than composting it at all, the most hands-off option in terms of ongoing management, at the cost of a real, continuous fuel or power dependency.

Type	Unit cost	Per-use operating cost
Electric	\$2,000– \$4,500	Electricity cost varies by local rate and unit
Propane	\$2,500– \$4,800	~0.25–0.35 gallons of propane per cycle, roughly \$0.63–\$1.23 at typical current prices

Weigh this against generator or solar/battery capacity if considering the electric version for a real Tier 3 plan; it's a real, continuous draw, not a one-time equipment cost.

These units aren't plug-and-use: every incinerating toilet needs dedicated exhaust venting, typically a 3 to 4 inch pipe routed to the roof or an exterior wall and terminating at least 24 inches above the roofline, never vented into an attic or crawlspace. Skipping proper venting causes indoor odor at best and a real fume or overheating hazard at worst. Ash left behind after each burn is sterile and can go into regular household trash or be used as a soil amendment in small amounts; let it cool fully before handling either way.

Pyrolysis and biochar: faster than composting, but only with real equipment

Pyrolysis heats waste in a sealed, oxygen-free chamber, a retort, to roughly 930–1,200°F (500–650°C), destroying pathogens in minutes rather than the months a cold-composting cure needs, while cutting the waste's volume by about 90% and leaving behind biochar, a stable, carbon-rich material with real, documented use as a soil amendment. This is genuine, actively studied sanitation technology, not a fringe idea, and the output is credibly described in the research as pathogen-free when the process actually runs at temperature.

The gap between that and a backyard burn barrel is the entire point: real pyrolysis depends on the chamber staying sealed against outside air and holding true temperature evenly throughout the load, exactly what a gasketed, refractory-lined retort is built to do and an open or improvised burn setup can't reliably guarantee. A cooler pocket in an uneven burn can leave hardy pathogens, roundworm eggs among them, alive in material that looks fully processed. Treat this as a real upgrade path once you own or build equipment that actually verifies sustained temperature throughout the chamber, not a shortcut around the aging method above with whatever's already on hand.

Check before installing anything permanent

Utah's onsite wastewater rules (Utah Admin. Code R317-4) explicitly cover composting toilets, but a permanent installation, as opposed to a temporary bucket-toilet setup, is the kind of thing worth a call to your local health department before building, not after. NSF/ANSI Standard 41 is the real, recognized certification standard for a manufactured composting toilet unit if buying one rather than building from scratch.

Sources

- Joseph Jenkins' Humanure Handbook, the original documented methodology: Humanure Handbook
- Pathogen die-off temperatures and times, and 12/24-month cure guidance: The Off-Grid Workshop
- Carbon-to-nitrogen ratio math and cover material specs: Coconino County; NSF/ANSI 41 requirements: NSF
- Vermicomposting species, bin stocking density, and pathogen-reduction research: Red Worm Composting; National Library of Medicine; Urban Worm Company
- Incinerating toilet costs, operating specs, and venting requirements: Septic Tank Hub; Cinderella Eco; Incinerator Toilet Venting Guide
- Minimum pile size for thermophilic heat, and measuring pile temperature: Permies; Grow Your Pantry
- Bin rotation, cover-material amount per use, and turning frequency: Humanure Handbook; Appropedia; Compost Check
- Pyrolysis temperature, retort design, and biochar output: University of Colorado (Sol-Char toilet research); Waste and Biomass Valorization
- Utah onsite wastewater regulations: Cornell Legal Information Institute

Soap Making: Lye & Oils

The Sanitation & Hygiene chapter's Tier 3 guidance calls for soap-making as the skill that produces an effectively unlimited hygiene supply once stocked soap runs out. This guide covers the actual chemistry and the real safety practice behind it: three real methods, why the fat-to-lye ratio has to be calculated, not guessed, how to handle lye without getting hurt, and how to make your own lye from wood ash once buying it isn't an option either.

Three real methods, and which one actually teaches the skill

"Soap making" covers three genuinely different processes, and only one of them is the self-sufficiency skill this chapter actually needs. Melt-and-pour starts from a pre-made soap base, already saponified by the manufacturer, that you melt and customize with color or scent; there's no lye handling and no cure time, which makes it the easiest and safest onramp, but it's still a manufactured input with a supply chain behind it, the same dependency this manual is trying to build away from. Cold process mixes fat and lye at a low temperature, 86–122°F; saponification finishes over the next 24 to 48 hours inside the mold, and the bar needs 4 to 6 weeks of curing after that before it's ready to use. Hot process cooks the same reaction with added heat, finishing saponification in a few hours so the soap is usable almost immediately, at the cost of less control over how the finished bar looks.

Cold and hot process are the real skill: both start from raw fat and lye, the two inputs a household can actually produce or stockpile without depending on a soap manufacturer. Melt-and-pour is worth knowing as a genuine first project, especially for introducing kids to the craft without lye in the room, but treat it as practice for handling a mold and fragrance, not as the skill this chapter is asking for.

The chemistry that makes the ratio non-negotiable

Soap is the product of saponification: a reaction between a fat (a triglyceride) and lye that produces soap and glycerin. Every fat has its own saponification value, the exact amount of lye it takes to fully convert that specific fat to soap, and the value is different for every fat because their fatty-acid profiles differ. Guess the ratio instead of calculating it and there are two ways to get it wrong in opposite directions: too much lye leaves unreacted lye in the finished bar, genuinely harsh and irritating on skin; too little leaves unreacted fat, a soft, greasy bar that spoils faster.

Fat	Approx. SAP value (g NaOH per g fat)	Note
Lard or tallow	0.14	The traditional base fat; widely available from a household already raising or processing livestock
Coconut oil	0.19	Produces a harder, more cleansing bar; used as a smaller fraction of a recipe, not the whole thing, since it's drying at high percentages
Olive oil	0.135	Produces a mild, gentle bar; the base of traditional Castile soap

These numbers are approximate and vary by source, growing conditions, and processing method. Run every real recipe through a lye calculator, SoapCalc is the standard, free one, rather than hand-calculating or reusing a ratio from memory; enter the exact fats and weights in the actual recipe and let it do the math. Set a superfat, sometimes called a lye discount, of 3 to 8 percent: intentionally leaving that percentage of fat unreacted is the real margin of safety against a lye-heavy bar, not an optional refinement.

Weigh every ingredient in grams on a digital kitchen scale, never measure by volume with cups or spoons. Fat density and lye density both vary enough that a volume measurement can throw off the whole ratio the calculator just worked out; the entire safety margin this section describes assumes weighed ingredients.

Handling lye safely

Lye, sodium hydroxide, is genuinely corrosive: it causes severe chemical burns on contact with skin, and worse damage to eyes, where it can destroy tissue before the pain even registers clearly enough to react. Treat every batch with real PPE: splash-proof goggles that seal around the eyes, not regular glasses; nitrile or rubber gloves that cover the wrist, not latex, which lye degrades; and long sleeves and pants, since a single droplet on bare skin can scar in seconds. Mix lye only in a well-ventilated space, outdoors or with real airflow, since the fumes released when lye first dissolves in water are sharp and genuinely irritating to breathe.

Mix lye only in heavy-duty HDPE plastic (labeled #2) or stainless steel, never aluminum, tin, or a thin or flimsy plastic container. Lye reacts with aluminum to release hydrogen gas, genuinely flammable and potentially explosive in enough quantity, while also eating through the metal itself.

A typical starting ratio is about 38 percent water relative to the total oil weight, which works out to a lye concentration (lye weight divided by lye-plus-water weight) of roughly 30 to 33 percent; SoapCalc will calculate the exact water amount for a given recipe, but that's the range a real batch should land in.

Dissolving lye in water is a strongly exothermic reaction: the solution can spike to around 200°F within a minute or two of mixing, so let it sit somewhere safe for 1 to 3 hours, or set the container in a cold water bath, until both the lye solution and the oils are down in the 100–130°F range before combining them.

Combining while the lye solution is still near 200°F risks container failure and a real burn hazard, not just a lower-quality bar.

WARNING**Lye into water, never water into lye**

Remember it as SNOW: sodium hydroxide over water. Always add the lye to the water, slowly, stirring as you go. Adding water to lye instead can trigger a violent, near-instant exothermic reaction that splashes caustic solution out of the container, a real, documented cause of serious injury. If lye contacts skin, flush immediately with cool running water for a full 15 to 20 minutes; never use vinegar to neutralize it, since the acid-base reaction between vinegar and lye releases its own heat and can worsen the burn. For eye contact, remove contact lenses and flush continuously with water for at least 20 minutes while arranging emergency care immediately. If swallowed, do not induce vomiting; call Poison Control (1-800-222-1222) or seek emergency care right away.

Store any lye that isn't used immediately in its original container or another airtight HDPE container, clearly labeled, somewhere cool and dry below 85°F, and locked away from children, pets, and other chemicals. Never store it in a metal container: lye pulls moisture out of the air over time, and that moisture reacts with bare metal.

Combining and reaching trace: how you know when to pour

Once the lye solution and oils are both in the 100–130°F range, combine them and mix, alternating short pulses of a stick blender with periods of hand-stirring, rather than running the blender continuously. What you're watching for is called trace: the point where the oil and lye solution have emulsified into a smooth, thickened batter that leaves a visible trail on the surface when drizzled from the blender or a spoon. Thin trace looks like a light pudding and is the earliest usable stage, medium trace holds a visible trail longer, and thick trace holds its own shape when mounded. Watch for false trace too: solid fats or butters that were still slightly cool can make a batch look thickened before it's actually emulsified; if in doubt, keep pulsing a little longer rather than pouring early.

Have the mold ready before you reach trace, not after: line a wooden or silicone mold with parchment paper or freezer paper if it isn't already silicone, sized to the batch's total volume. Pour at your target trace stage, tap the filled mold on the counter a few times to release trapped air bubbles, and cover it loosely for the first 24 to 48 hours while saponification finishes.

Going deeper: making your own lye from wood ash

Store-bought lye is itself a supply-chain dependency, which is exactly why the traditional method matters for a real Tier 3 or Tier 4 plan: leaching hardwood ash through water produces potassium hydroxide, a real, historically used lye. Oak, maple, and hickory ash work best, since hardwoods concentrate more potassium than softwoods do. Screen the ash through a colander to remove unburned chunks.

Build the leaching barrel itself with a few real drainage holes drilled in the bottom of a wood or food-grade plastic barrel, a layer of pebbles over those holes, then 2 to 3 inches of straw over the pebbles to keep ash from washing through, then fill the rest with the sifted ash. Elevate the whole barrel 3 to 4 feet up on blocks or a simple frame, positioned over a lye-safe collection bucket underneath. Pour hot water through slowly rather than cold, hot water draws more potassium out of the ash, at a rough working ratio of 10 cups of ash per gallon of lye water produced. Run the collected liquid back through the same ash a second time rather than using it straight off the first pass; a first pass typically comes out weak, roughly one quart of usable-strength lye per gallon of ash run through, and the second pass concentrates it closer to soap-making strength.

The traditional strength test is a fresh egg or a chicken feather: if it floats with about a thumbnail's-width above the surface, or the feather actually dissolves, the lye is concentrated enough to make soap. This is a real, functional field test, but it isn't a substitute for knowing the actual concentration the way a bought lye's labeled purity does.

Wood-ash lye doesn't drop into a store-bought recipe's ratio

A recipe calculated for pure, known-concentration sodium hydroxide from a lye calculator assumes a specific strength. Wood-ash lye's concentration varies by wood species, burn temperature, and how much water was run through the ash, so it won't match that calculation. Traditional wood-ash soap recipes lean on generations of practiced judgment (the float test, the eventual feel of the finished soap) rather than a precise calculated ratio; treat your first several batches as calibration, made in small quantities, not a batch-sized bet.

Curing: why a fresh bar isn't a finished one

A cold-process bar is chemically finished saponifying within a few days, but it isn't ready to use. Over 4 to 6 weeks of curing, the bar loses roughly 20 percent of its water content through evaporation, which is what turns a soft, tacky bar into a hard one that lasts. The same period lets pH drop by roughly a full point, commonly from around 11 to under 10, meaningfully reducing how harsh the bar feels on skin. Skipping the

cure isn't dangerous the way skipping lye safety is, but a bar used at one week will be softer, shorter-lived, and noticeably harsher than the same bar used at six.

Quick Reference

Method	Lye handling	Time to usable	Best for
Melt-and-pour	None (pre-saponified)	Under an hour	First projects, kids, learning molds and fragrance
Hot process	Full lye safety practice required	Same day to a few days	Faster turnaround; the real self-sufficiency skill
Cold process	Full lye safety practice required	4–6 weeks (cure time)	Traditional method; most control over final bar

Full checklist:

- Real recipe run through a lye calculator (SoapCalc or equivalent) before every batch, not calculated by hand or reused from memory
- Every ingredient weighed in grams on a digital scale, never measured by volume
- Superfat set to 3–8 percent
- HDPE plastic or stainless steel mixing container on hand, never aluminum or tin
- Splash goggles, nitrile/rubber gloves past the wrist, and long sleeves on hand and used every time
- Well-ventilated space confirmed before mixing lye
- SNOW rule (lye into water) understood by everyone handling it
- Cool running water available at the workspace for immediate flushing
- Lye solution and oils both cooled to 100–130°F before combining
- Mold lined and ready before mixing starts, not after reaching trace
- Leftover lye stored labeled, airtight, and locked away from children and pets
- At least one practice batch made and fully cured before treating this as a reliable hygiene-supply source
- If pursuing wood-ash lye: hardwood ash sourced, leaching setup built, and the float/feather strength test understood before batching

Sources

- Saponification, superfat, and cold vs. hot process mechanics: School of Natural Skincare; Sea Witch Botanicals

- SAP values and lye calculator: SoapCalc Oil Chart
- Lye safety, PPE, SNOW rule, and first aid: Learn Soap Making; Certified Lye; CDC/ATSDR Medical Management Guidelines
- Mixing container material (aluminum reacts with lye) and lye storage: Certified Lye; SoapIndex
- Lye-water concentration and ratio: The Nova Studio; Classic Bells
- Lye-solution reaction heat and cooling before combining: Nature's Garden; Brambleberry
- Reaching trace, thin/medium/thick stages, and false trace: Soap Queen; Learn Soap Making
- Wood-ash leaching barrel construction and re-leaching to concentrate: Soap Legacy; Wood Work Science
- Wood-ash lye leaching method and strength testing: Soap Legacy; Soapy Stuff
- Melt-and-pour process: Soap Guild
- Curing time, water loss, and pH change: PetalMade

Greywater Disposal Basics

The Sanitation & Hygiene chapter's addendum calls for a real greywater plan once a no-power, no-sewer sanitation setup is running, but the manual itself doesn't cover the technique. This guide covers which household water actually counts as greywater, the simple underground disposal method that keeps it from becoming a contamination or mosquito problem, and which soaps are actually safe to use with it.

Not all wastewater is the same

Greywater is the relatively lightly contaminated water from bathroom sinks, showers, tubs, and clothes washers. Toilet waste is blackwater and needs the dedicated treatment covered elsewhere in this chapter, not this guide. Less obviously, kitchen sink water is also effectively blackwater: it carries emulsified fats that clog soil pores and food particles that attract flies and rodents, the same vector problem this chapter's waste-management guidance exists to prevent. Route kitchen water to the same disposal system as toilet waste, not the lighter greywater system this guide describes.

Why greywater can't just run onto the surface

Greywater carries real pathogens, from skin, trace fecal contamination in shower and laundry water, and general household bacteria, even though the concentration is far lower than blackwater. Left standing on open ground, it also breeds mosquitoes and can carry contamination toward a well, garden bed, or neighboring property. The fix isn't complicated: get it below the surface and let soil do the filtering work, rather than letting it pool or run off visibly.

The mulch basin: the simplest system that actually works

A mulch basin is a shallow depression, dug below grade, filled with coarse woodchips or bark and connected to a greywater outlet by a short length of pipe. A single basin is commonly dug 2 to 4 feet across and 6 to 18 inches deep, and one basin of that size can handle roughly 40 to 80 gallons of greywater a week, in clay soil, figure on about 1 square foot of basin per gallon discharged per day; sandier, faster-draining soil needs less. The water disperses into the mulch layer and soaks down into the soil beneath, rather than pooling on top; the coarse organic material supports the aerobic bacteria that do the actual pathogen breakdown, and it also controls odor. Run the outlet pipe (1-inch inside diameter is standard for a washing machine line) into

the basin and keep it covered by at least 2 inches of mulch, rock, or soil, an exposed outlet just creates a wet, visible pool right at the pipe's end instead of dispersing the water properly. Because most of that biological activity happens near the surface, a well-built mulch basin can process greywater more effectively than a much larger and more complex system.

Site the basin at least 10 feet from the house's foundation and any property line, and at least 50-100 feet from any well (check your specific local health department's setback, since these vary by jurisdiction and soil type), well downhill or away from any spring or garden bed growing food that gets eaten raw, and never let outflow reach standing water or a shared water source. Rotate between two basins if the household is generating meaningful volume day after day, giving each one a rest period to fully drain and re-aerate.

WARNING**Never spray or pour greywater directly onto food crops eaten raw**

Subsurface dispersal into a mulch basin or drip line is the safe method; watering vegetable leaves or root crops directly with greywater risks depositing pathogens onto food that won't be cooked before eating. Water ornamental plants, trees, or fully cooked-crop gardens this way instead, or route it well clear of any food garden entirely.

Which soaps are actually safe for this

Not every soap or detergent is greywater-compatible. Look for biodegradable, phosphate-free, low-sodium, pH-neutral products; a simple liquid castile soap (olive oil, coconut oil, water, and potassium hydroxide) is a reliable, widely available option. Avoid anything containing bleach or chlorine, borax, petroleum distillates, or products marketed with "whitener," "softener," or "enzymatic" claims, since these either damage soil structure over repeated use or interfere with the bacterial breakdown the system depends on.

Pathogens don't linger forever in healthy soil

Under normal aerobic conditions, pathogens in dispersed greywater degrade to safe levels within roughly three days. This is exactly why the mulch basin's aerobic, well-drained design matters: a waterlogged or anaerobic basin doesn't break contamination down nearly as fast, another reason to keep the system draining freely rather than overloading a single basin.

Quick Reference

Source	Treat as	Note
Bathroom sink, shower, tub	Greywater	Route to mulch basin or subsurface disposal
Clothes washer	Greywater	Use a greywater-safe detergent (see above)
Kitchen sink	Blackwater	Route with toilet waste; fats and food scraps attract vectors
Toilet	Blackwater	Covered by this chapter's bucket-toilet/composting guidance

Full checklist:

- Kitchen sink water routed with blackwater, not treated as light greywater
- Mulch basin sited well away from the foundation, any well or water source, and any raw-eaten food garden
- Basin filled with coarse woodchips or bark, not left as a bare pit
- A second basin ready to rotate into if the first needs a rest/drain period
- Soap and detergent checked against the greywater-safe list before it becomes the household default
- No greywater ever sprayed or poured directly onto raw-eaten crops

Sources

- Mulch basin design and function: Teaspoon Dwellings; Water Wise Group
- Kitchen water as blackwater and vector risk: UC ANR (Alameda County)
- Safe soap and detergent selection: Water Wise Group; Harvesting Rainwater (Brad Lancaster)
- Pathogen die-off timing in soil: National Library of Medicine
- Mulch basin dimensions, weekly capacity, and outlet pipe spec: Greywater Action; Santa Cruz County Environmental Health
- Foundation, property-line, and well setback distances: UpCodes; Permit Sonoma

Home Lockdown & Barricading Basics

The Security & Self-Defense chapter's Lockdown skill and the Shelter & Structural Safety chapter's Barricading skill are two halves of the same real problem: securing a home fast, and reinforcing it well. This guide covers both, since a rapid lockdown routine and the physical reinforcement behind it work together, not separately.

The lockdown routine: practiced, not improvised

Speed is what actually matters in a lockdown, more than any single piece of hardware. A routine worked out and physically walked through in advance, not figured out for the first time under stress, is what makes the difference. Move through the same sequence every time: lock every door and window starting with the most likely entry points, close blinds and curtains so the inside isn't visible from outside, turn off interior lights that would silhouette anyone moving past a window, and move away from doors and windows once the space is secured. Silence phones so a call or notification doesn't reveal your location, and stay quiet.

Time yourself running this as a drill under normal conditions. A household that has never practiced the full sequence reliably takes several times longer under real stress than a household that has, and every extra minute is a minute the routine isn't providing the protection it's meant to.

Reinforcing the door: the upgrade that actually stops a kick-in

Most residential door frames fail at the strike plate, the small metal plate the deadbolt bolt extends into, because factory-installed strike plates are usually held by two short screws that barely reach the door jamb itself, not the wall stud behind it. A kick concentrates force exactly there. The fix is inexpensive and doesn't require a locksmith: replace the factory strike plate with a heavy-duty, elongated plate secured with four to six screws, and use 3-inch (or longer) screws that bite into the actual wall stud, not just the thin jamb wood. To actually install it, hold the new plate in place over the existing mortise and score its outline into the jamb with a utility knife, then chisel out the mortise deeper and, for an elongated plate, longer than the factory one, checking the plate sits flush with the jamb surface rather than proud of it. Drill pilot holes for all four to six screws before driving them, this keeps the jamb wood from splitting and lets the longer screws go in straight and reach the stud behind it. This single change is one of the highest-leverage, lowest-cost security upgrades a household can make.

For additional reinforcement, a jamb reinforcement bar, a flat steel bar roughly 12 inches long installed along the inside edge of the door frame under the trim molding, spreads impact force across the stud rather

than concentrating it at one point. A door bar or floor-to-doorknob brace adds a physical barrier that holds even if the lock itself is defeated: the bar's yoke hooks under the doorknob while its padded foot rests on the floor at roughly a 25-degree angle, about 12 to 18 inches out from the door for a standard 36-inch-high knob, and a light tap seats the foot's rubber pad against the floor to tension it snug, not forced tight. A barricade that secures both the top and bottom of the door provides more resistance than a single point of contact. None of these replace each other; a reinforced strike plate, a solid deadbolt, and a physical bar or brace work as layers, not substitutes.

WARNING**Reinforce the frame, not just the door**

A steel security door mounted in a weak, unreinforced frame still fails at the frame. The jamb and the stud behind it are what actually resist a kick; upgrading the door itself without upgrading what it's mounted into skips the part that matters most.

TIP**A rubber door wedge covers you where you can't install anything**

Everything above assumes a door you own and can modify. A cheap rubber door wedge, driven under the door from the inside, adds real friction against a rented apartment, a hotel or Airbnb room, or a connecting door you have no other control over. It's a light deterrent, not a lock, carpet reduces how well it grips, but it's inexpensive, packs flat in a bag, and it's the one option here that needs no tools and no landlord's permission.

Windows: the entry point most households ignore

A meaningful share of break-ins happen through a ground-floor window, not a door, because standard glass can be defeated quietly and quickly with far less effort than a reinforced door. Security window film is a transparent adhesive layer that doesn't stop glass from cracking but holds the shattered pieces together, turning what would be a near-instant break into a process that can take a minute or more of sustained, loud effort, which is often enough to make an intruder move on. Security bars are a more visible, more absolute option, best reserved for genuinely vulnerable windows like basement or ground-floor openings not otherwise overlooked; sliding windows and doors can also be fitted with a simple track-mounted bar or dowel that prevents the sash from being forced open, cheaper and less visually intrusive than full bars.

Quick Reference

Weak point	Fix	Relative cost
Short-screw strike plate	Elongated plate, 4-6 screws, 3"+ length into the stud	Low
Unreinforced door frame	Steel jamb reinforcement bar behind the trim	Low-moderate
Door held by lock alone	Floor-to-knob brace or top-and-bottom barricade	Low-moderate
Standard window glass	Security film (holds shattered glass together)	Moderate
Vulnerable basement/ground window	Security bars or track-mounted sash bar	Moderate

Full checklist:

- Full lockdown sequence written down and physically walked through as a timed drill
- Strike plates upgraded to elongated, multi-screw plates with screws long enough to reach the stud
- Jamb reinforcement bar and/or door brace installed on primary entry doors
- Ground-floor and basement windows identified and fitted with film or bars as appropriate
- Sliding windows/doors fitted with a track bar or dowel
- Blinds/curtains and interior light plan included as part of the routine, not an afterthought

Sources

- Strike plate and door frame reinforcement: Barry Bros Security; Armor Concepts
- Door bars and barricade systems: Premier Body Armor
- Lockdown sequence and principles: NIH Office of Research Services; Oregon State University
- Window security film and bars: Vivint; SecurityMan
- Strike plate mortise-chiseling and pilot-hole installation technique: Silver Eagle Locksmith
- Floor-to-doorknob security bar angle and setup: Master Lock; Brinks
- Rubber door wedge effectiveness as a supplementary, tool-free option: Off Grid Survival

Go-Bags & 72-Hour Kits

A pre-packed kit of essentials, ready to grab, so a household isn't scrambling to gather things during an actual emergency. This guide isn't tied to one manual chapter, because a real kit is really just Water & Food, Medical Care, and a few other chapters, repacked into one bag instead of spread across the house.

Same kit, different names

"Go-bag" and "72-hour kit" describe the same core idea, and the contents below work for either. The difference is emphasis, not substance:

- **72-hour kit** is the term most familiar in Utah specifically, taught for decades through LDS Church emergency-preparedness lessons and the state's own "Be Ready Utah" campaign. It anchors to a fixed duration: the classic emergency-management baseline that a household should be able to get through the first three days on its own before outside help reliably arrives. Even Be Ready Utah's own current guidance has moved past a strict three-day window, now recommending "three days, five days, or longer" and treating the exact "72-hour" figure as somewhat dated, though the name has stuck around in everyday use.
- **Go-bag** is the more nationally-used term, and it emphasizes grab-and-go speed and portability over any fixed time window. It's also used more loosely: this site's own Document Go-Bag guide is a go-bag too, just a narrower one scoped to paperwork alone, not the full kit below.

Two related terms worth knowing, since they show up elsewhere and aren't quite the same thing: a **bug-out bag** implies leaving home entirely for an extended stay somewhere else, so it's typically bigger and more self-sufficient than the kit below. A **get-home bag** is kept in the car or at work, sized only to get you home from wherever you happen to be, not to shelter you once you're there.

What actually goes in it

Category	What to pack	Notes
Water	1 gallon/person/day, at least 3 days	See Water Purification for making more once the kit runs dry
Food	3-5 days, non-perishable, no-cook or minimal-prep	Rotate it into your regular pantry use so it's never actually expired when you need it
Health	First aid kit, a few days of any prescription meds, spare glasses or contacts, basic OTC medication	See Medical Kits: What Actually Goes in Each One for exactly what belongs in this bag's kit, and First Aid Basics for how to use it
Light & power	Flashlight or headlamp, extra batteries, a NOAA weather radio, phone charger or power bank	See Family Communication Plan & Emergency Radio
Tools	Multitool, whistle, dust mask, duct tape, plastic sheeting, a wrench or pliers for utility shutoff, manual can opener	The whistle and mask are the two items households most often skip
Warmth & clothing	A full change of clothes, sturdy closed-toe shoes, an emergency blanket or lightweight sleeping bag	Broken-in, not brand new; see Physical Readiness
Sanitation	Wet wipes, a couple of small garbage bags, hand sanitizer, a little toilet paper	Doesn't need to be a full kit, just enough to get through a few days
Documents & cash	Copies of ID, insurance, and medical records; small-bill cash	The real version of this belongs in its own fireproof kit; see Document Go-Bag & Digital Backup and Financial Preparedness Basics
Household-specific	Infant formula or diapers, pet food and a leash, backup power for a medical device	See Pet Evacuation Basics and Backup Power for Medical Equipment

Size it to how it'll actually be carried

One go-bag per person for personal items (clothes, meds, documents), plus a shared household bag or tote for the bulkier items that don't need duplicating, water jugs, tools, a larger first aid kit. If there's any real chance of walking with it, the bag itself matters: a properly fitted backpack that carries weight on the hips,

not a plastic tote or a bag that was never actually tried on loaded. See Physical Readiness for what a well-fitted pack actually looks like.

Keep a separate, smaller version in each vehicle too, sized as a get-home bag rather than a full kit: your car is one of the more likely places to actually be stranded away from home, and a kit that only lives in the garage closet doesn't help there.

Check it twice a year, not once and done

Water and food need rotating, batteries corrode, kids outgrow clothing and shoe sizes, and prescriptions expire. Pair the check with something already on the calendar, a clock change, a birthday, so it actually happens instead of becoming the thing that was "ready" three years ago.

Sources

- Ready.gov, "Build A Kit": Ready.gov
- Be Ready Utah, "Get a Kit: Family": Be Ready Utah

Using AI to Plan Your Preparedness

An AI assistant can't stock your pantry or test your water filter. What it's genuinely useful for is the part every chapter on this site asks you to do yourself first: figuring out where your household actually stands and what to do about it next. This guide isn't tied to one manual chapter, because it applies to all fifteen equally.

Want this already built instead of building it yourself?

AI Prep Coach is a ready-to-paste version of this exact approach: one prompt that interviews you across all 15 categories and builds a full plan by actually browsing this site's live pages. The prompts below are for narrower, one-off asks, budget priority, a scenario walkthrough, meal planning from an exact pantry, once you already have a plan, or if you'd rather write your own instead of using a pre-built one.

What this is actually good for

Every category in this manual starts with the same kind of work: turn a vague situation into a specific list, turn a fixed budget into a priority order, turn "we should probably do something about this" into an actual plan. That's exactly the kind of task an AI assistant is good at, not because it knows your household, but because it's fast at organizing information once you give it the specifics. It replaces the blank page you'd otherwise be staring at before you start, not the hands-on skill, the professional advice, or the primary sources this manual cites throughout.

Where to find it: any general-purpose AI assistant works for this. The one you're already using is fine.

One trick works with all eight prompts below: paste in the link to the specific page on this site for your state or topic before you ask. Most AI assistants will read the page directly, which means the answer gets built on this site's own verified sourcing instead of the assistant's general, and possibly outdated, knowledge.

Eight prompts to start with

1. Household gap assessment

The same audit this site's own Tier structure assumes you've already done. Give it your real numbers, not a generic household. AI Prep Coach is the fuller, ready-made version of this exact idea, across all 15 categories instead of a single prompt; use the version below if you'd rather write your own or just want one quick pass.

"Here's my household: [ages, health needs, pets, vehicles, location]. Here's what we currently have stored: [list]. Compare this against a 2-week emergency supply standard and tell me our top 5 gaps, ranked by how fast each would become a real problem."

2. Budget-constrained shopping priority

Useful when the honest answer to "where do I even start" is "I have \$50, not \$500."

"I have \$50 to spend this month on emergency prep for a household of [size] with [specific needs]. What should I prioritize buying first, and why?"

3. Scenario walk-through

A cheap way to find the gap you wouldn't have thought to look for, before it finds you.

"Walk me hour-by-hour through what would actually happen in my house if we lost power for 72 hours in [month], given [household details]. Where would we run into trouble first?"

4. Family communication plan drafting

A starting draft for the same plan the Family Communication Plan guide walks through, including the out-of-town contact FEMA's own planning material recommends specifically because local phone lines can jam while long-distance calls and texts often still get through.

"Help me draft a wallet-card contact sheet for a family of [N], including an out-of-town contact, two meeting points, and each person's key medical info. Leave placeholders where I need to fill in real details myself."

5. Meal planning from what you actually have

Turns a pantry inventory into a real plan instead of a guess.

"Here's our current food storage inventory: [list]. Build a 14-day meal plan using only these items, accounting for [allergy or dietary need], and tell me what's missing to make it nutritionally complete."

6. Plain-language skill explainer

A supplement to a guide like this site's own, not a replacement for practicing the skill itself.

"Explain how to purify water using [method] in language a 14-year-old could follow, and tell me what could go wrong if a step is skipped."

7. Local law or hazard research, as a starting point

A first pass to figure out what to ask an official source, not a substitute for asking one.

"What are the current rainwater harvesting rules in [state]? Give me your best understanding, but flag anything I should double-check directly with [state agency], since laws change."

8. Multi-household coordination

Useful for extended family, not just the people under your own roof: aging parents, siblings scattered across town, a relative in another state.

"Help me draft a short, non-alarming message to my parents and siblings proposing we agree on an out-of-town relay contact and a check-in plan if a disaster hits our area."

What not to hand over

Describe it, don't paste it

Don't paste Social Security numbers, full account numbers, passwords, or exact medication and dosage details into a general-purpose AI chat. Describe things in relative terms instead, "a family member takes a daily heart medication" rather than naming the drug, the dose, and the pharmacy account. Consumer guidance on this is consistent: treat an AI chatbot the way you'd treat a stranger who's just offered to help you organize your files, useful for the organizing, not a safe place for anything you wouldn't hand a stranger directly.

Why you still have to check its work

AI assistants produce confident, fluent answers whether or not the underlying information is correct, a well-documented failure mode researchers call hallucination. Measured rates vary widely by model and topic, but the pattern is consistent across every study of it: a wrong answer reads exactly as convincingly as a right one. Nothing about how confident an answer sounds tells you whether it's accurate.

Treat it as a draft, the same way this site treats a single source

This site's own standard, stated on every state and skill page, is that a claim isn't trustworthy until it's checked against a primary source. Hold an AI assistant's answers to that same bar, especially anything with a real safety, legal, medical, or financial consequence. Ask it directly for its sources, and treat "you should verify this" as the correct answer, not a failure of the tool.

Three things AI specifically doesn't replace here: professional advice for anything medical, legal, or financial; official guidance from FEMA, Ready.gov, or your local emergency management agency, which this manual itself is built on; and hands-on practice. It can draft the water-purification steps; it can't tell you whether your actual filter works until you've actually run water through it.

Sources

- Out-of-town contact and family communication plan doctrine: Ready.gov; FEMA Family Emergency Communication Plan
- What not to share with an AI chatbot: AARP
- AI hallucination and verifying AI-generated answers: Forbes

Preparing Without Relying on Official Systems

This site's Filing Claims and financial guides assume a household that can call the police, file an insurance claim, and apply for FEMA aid without a second thought. That's not everyone's real situation: undocumented immigrants, mixed-status households, and anyone with a founded reason to be cautious around official channels face a genuinely different set of choices. This guide is those choices, stated directly rather than assumed away.

What FEMA aid actually covers, regardless of immigration status

Cash assistance through FEMA's Individuals and Households Program does require the applicant to be a U.S. citizen, non-citizen national, or "qualified alien" (a category that includes lawful permanent residents, refugees, asylees, and several other specific statuses). But that's only part of what's actually available, and the part that isn't cash-limited is broader than most people expect:

- **Non-cash emergency aid is available to everyone, regardless of citizenship or immigration status.** Crisis counseling, disaster legal services, disaster case management, emergency food assistance, shelter, and emergency medical care are all real, in-kind programs FEMA and partner organizations provide without an immigration-status requirement.
- **Mixed-status households can still access cash assistance.** A parent can apply for FEMA's Individuals and Households Program on behalf of a minor child who is a U.S. citizen or qualified alien, living in the same household, without providing information about the parent's own immigration status or signing anything regarding it.

Receiving disaster relief does not affect a 'public charge' determination

Federal disaster assistance under the Stafford Act, which is what FEMA's individual assistance program operates under, along with other short-term, in-kind emergency disaster relief, is explicitly excluded from public charge consideration. This has been a source of real, harmful confusion that keeps eligible households from applying out of fear it will hurt a future immigration case. Public charge policy has changed between administrations before and could again; if this is a live concern for your situation, a real immigration attorney (see below) can confirm the current rule rather than you relying on this page alone.

Where to find it: apply at disasterassistance.gov or 1-800-621-3362; see Filing Claims After a Disaster for the full application process once you've confirmed what you're eligible for.

Real legal help that doesn't start with your immigration status

ImmigrationLawHelp.org is a free, national directory of more than 1,000 nonprofit immigration legal service providers across all 50 states, searchable by zip code, with no cost and no requirement to disclose anything before finding a real local option. Every organization listed either has BIA-recognized accreditation or attorneys on staff, not a directory of unvetted listings. This is the first call to make before a disaster, not during one, so you already know who to contact when something happens.

Alternatives to a system built around insurance and bank accounts

Cash, barter, and community reciprocity all work without a credit check, a Social Security number, or a bank account behind them. See Barter & Local Trade Systems for what actually holds up when normal financial systems aren't accessible, and keep a real cash reserve for exactly this reason; see Financial Preparedness Basics.

Community networks that don't gate on documentation

Mutual Aid Hub, covered in full in Finding Your Local Prep Community, is built around informal, community-organized mutual aid specifically, not a government or insurance-adjacent program, and most local mutual aid networks exist precisely to fill the gap for anyone official systems don't reach. Community-based organizations, immigrant resource centers, and faith communities in your own area are often the fastest, least bureaucratic path to real help after a disaster, faster than a federal application in many cases, and worth identifying before you need them, the same logic behind this site's own "pick one real connection" advice throughout.

Sources

- FEMA citizenship and immigration status eligibility for disaster assistance, non-cash aid availability regardless of status, and mixed-status household applications: FEMA; FEMA
- Public charge exclusion for Stafford Act disaster assistance and other emergency in-kind relief: DHS; USCIS
- ImmigrationLawHelp.org, national free/low-cost immigration legal aid directory: ImmigrationLawHelp.org
- Disaster relief guidance for immigrant communities: National Immigration Law Center; Texas Law Help

Finding Your Local Prep Community

Tier 4 of this manual is "Thriving," the point where preparedness stops being a household project and starts depending on the people around you. This guide is the "who to actually contact" layer behind that idea: real organizations, most of them already active in your area, that you can join rather than invent from scratch.

Start at the neighborhood level

Map Your Neighborhood (MYN)

A structured, 9-step program for organizing your literal block before anything happens: a meeting where neighbors identify who has useful skills or equipment, who'd need help first (older adults, anyone with a mobility or medical need), and what to do in the first 60 minutes after a disaster. Originated by Washington State's Emergency Management Division and endorsed by the American Red Cross; many counties and cities elsewhere have adopted it directly.

Where to find it: contact your local county or city emergency management office and ask whether they run MYN training and can supply the meeting materials; Washington's Military Department hosts the original program if your area hasn't adopted a version of its own.

CERT (Community Emergency Response Team)

Already covered in depth on this site: free, hands-on disaster-response training run locally in nearly every state.

Where to find it: your state's page in By State lists the specific program and local structure for where you live.

The official channel most people never hear about

Local Emergency Planning Committee (LEPC)

Federally mandated in every county under the Emergency Planning and Community Right-to-Know Act (EPCRA), an LEPC brings together local officials, businesses, and community members to plan for chemical

and hazmat emergencies specifically and to keep residents informed about what's stored nearby.

Membership and meetings are usually open to the public.

Where to find it: your state's Emergency Response Commission (SERC) maintains the list of LEPCs; EPA's EPCRA page explains the structure and links to state SERCs.

Volunteer networks that already coordinate at scale

National VOAD and your State/Territory VOAD

Voluntary Organizations Active in Disaster is the umbrella that coordinates disaster-focused nonprofits, the Red Cross, Salvation Army, and dozens of others, so relief efforts don't collide or duplicate. Every state and territory has its own VOAD chapter.

Where to find it: nvoad.org's State/Territory VOAD directory.

American Red Cross

Already cited throughout this site as a source; also a real place to volunteer directly, disaster preparedness education, home fire safety visits, and instructor roles teaching the same skills covered in this manual.

Where to find it: redcross.org's Disaster Preparedness Volunteer page routes to your local chapter.

Team Rubicon

A veteran-led, secular disaster response organization active nationally, from wildfire response to long-term recovery operations.

Where to find it: teamrubiconusa.org.

Join the communication network, not just the radio

ARES / RACES

The Family Communication Plan guide mentions ARES/RACES as a reason to consider ham radio over GMRS, access to organized emergency communication nets, but doesn't cover actually joining one. The Amateur Radio Emergency Service (ARES) is open to any licensed amateur radio operator; the Radio Amateur Civil

Emergency Service (RACES) registers through local civil defense. Both plug you into a real, organized network that activates when normal communication fails.

Where to find it: for ARES, identify your local Emergency Coordinator or contact your ARRL Section Manager and file form FSD-98; for RACES, contact your local civil defense office or Emergency Operations Center directly.

Faith-based disaster response

Several religious organizations run disaster response networks large enough to matter at a regional scale, open to volunteers regardless of the survivors they're helping.

Southern Baptist Disaster Relief

The third-largest disaster response network in the country by most counts: mass feeding, flood/wind/fire cleanup, water purification, and rebuild work, run through trained volunteers from local churches.

Where to find it: sendrelief.org/southern-baptist-disaster-relief.

Church World Service

A cooperative ministry of 37 Christian denominations coordinating both U.S. disaster response and longer-term recovery support through local interfaith groups.

Where to find it: cwsglobal.org/learn/disasters.

A real, distinct structure specific to this manual's own region

Along the Wasatch Front specifically, The Church of Jesus Christ of Latter-day Saints maintains an official emergency preparedness and welfare structure built into every ward and stake (its local congregation units), including published planning guides, a member skills/equipment inventory, and a list of members who'd need help first, the same categories Map Your Neighborhood covers, run through existing local leadership rather than a separate program to join. This is specific to members of that faith community and coordinated through a member's own ward or stake leadership, not a general public program the way the others on this page are, but it's a genuinely significant, well-documented structure in this exact region and worth knowing about for what it is.

Where to find it: members can start with their own ward or stake leadership; the Church's own Emergency Preparedness manual is published publicly.

Grassroots and informal

Mutual Aid Hub

A searchable directory of informal local mutual aid groups, community-organized and typically less bureaucratic than the programs above. A useful complement to the more official channels, not a replacement for them.

Where to find it: mutualaidhub.org.

Pick one

The same rule that applies everywhere else in this manual applies here: one real connection beats six half-considered ones. If your neighborhood has no organization at all, Map Your Neighborhood is the fastest way to create one. If you want a recognized skill credential alongside the connections, CERT does both at once. If you already have a radio, ARES turns it from a household tool into a community one. Pick the one that matches where you already are, not the one that sounds most impressive.

Whichever you pick, put the actual arrangement in writing once you've made one, even an informal one with two neighbors. The Mutual Aid Agreement is a real, printable template for exactly that: who brings what, what's owed back, and a simple way to settle a disagreement, before you're relying on a memory of a conversation instead of something you both signed.

Sources

- Map Your Neighborhood program structure and materials: Washington State Military Department, Emergency Management Division
- Local Emergency Planning Committees and EPCRA: EPA
- National VOAD and State/Territory VOAD directory: nvoad.org
- American Red Cross disaster preparedness volunteering: redcross.org
- Team Rubicon: teamrubiconusa.org
- ARES membership and RACES registration: ARRL ARES/RACES FAQ
- Southern Baptist Disaster Relief: Send Relief
- Church World Service disaster response: cwsglobal.org

- The Church of Jesus Christ of Latter-day Saints, ward/stake emergency preparedness structure:
churchofjesuschrist.org
- Mutual Aid Hub: mutualaidhub.org