SKILL GUIDE · FOOD

Calorie Planning for Your Food Supply

The 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.

These three tiers are the USDA's own dietary-guideline categories, built for planning a general population's day-to-day intake, not for genuinely heavy, sustained manual labor: hand-digging, felling and splitting wood all day, or extended construction and rebuilding work, the kind of daily output this book's Fitness chapter and a real Tier 3 homesteading plan both assume eventually. That's a different, higher bracket: documented occupational data puts construction-level labor at roughly **3,500 kcal/day**, and genuinely extreme sustained exertion, wildland firefighting shifts, military field operations, as high as **6,000 to 7,000 kcal/day**. Very few households need to plan for the extreme end by default, but a household actually running a farm, felling trees, or rebuilding a structure by hand for weeks should budget closer to 3,500 to 4,500 kcal/day per adult doing that work, not the Active tier's roughly 3,000 kcal ceiling.

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)	~800–1,100 kcal/lb	A full meal at roughly 1,200–1,250 kcal, but the meal itself weighs only 18–26 oz (1.1–1.6 lb) depending on menu, not the 3+ lb people often assume; denser than a canned good, but still well short of a dry staple's density
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, and by weight they're genuinely denser than a canned good, an individual meal packs roughly 1,200–1,250 kcal into just 18–26 oz, not the 3-plus pounds people often assume. They still fall well short of a dry staple's density, though, 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

The math behind this is two steps: find the household's daily total, then multiply by the number of days you're planning for. A child's calories scale at roughly 80% of the same activity tier's adult figure.

Worksheet: fill in your own household. Each row multiplies straight across to a subtotal, so the only addition left is the last row.

	Count	× Days	× Kcal rate	= Kcal total
Adults			1,800 sedentary 2,200 moderate 2,600 active	
Children (ages 4-13)			1,440 sedentary 1,760 moderate 2,080 active	
Total			Add the two rows above	

In dry-staple pounds as a sanity check, not a real menu: total ÷ 1,700 kcal/lb.

Worked example: for 2 adults and 2 children, moderately active (2,200 kcal/adult, 1,760 kcal/child), planning 14 days. Adults row: 2 × 14 × 2,200 = **61,600 kcal**. Children row: 2 × 14 × 1,760 = **49,280 kcal**. Total: 61,600 + 49,280 = **110,880 kcal** for the period. In dry-staple pounds: 110,880 ÷ 1,700 ≈ **65 lbs**.

The child figures above are 80% of the adult rate in the same column, 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.

Enter your own 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 run the same math instantly and see the same estimate for MREs and freeze-dried entrees too.

Adults

0

Children (roughly ages 4–13)

0

Household activity level

Some physical work (moderately active)

Days

14

Calculate

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.

Write your own plan, in one sentence

A pantry that looks full and a pantry that actually hits your household's calorie target aren't the same thing. Finish this sentence with your own real plan:

"The next time *I buy food storage* , I will actually *check calorie density per pound before I check the price* ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

Send them this page ›

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Sealing Bulk Food for Long-Term Storage

Preparing's 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.

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.

WARNING

Never use this method on anything above about 10% moisture, that's a real botulism risk, not just a spoilage one

An oxygen absorber creates exactly the low-oxygen environment *Clostridium botulinum*, the bacteria behind botulism, needs to grow, the same organism Food Preservation centers its entire canning safety case around. Dry staples like rice, beans, and pasta are safe because they're dry enough that nothing can grow regardless of oxygen level; anything with meaningfully more moisture than that turns the same sealed bag into the exact anaerobic environment the bacteria favors. That specifically rules out home-dehydrated fruit, vegetables, and jerky unless it's verified fully dry (commercial freeze-dried food is a different, genuinely low-moisture product and is fine), brown rice (its bran layer's oil content is a rancidity problem on top of the moisture one), and anything with visible moisture or a soft,

pliable texture rather than a hard, brittle one. When genuinely unsure whether something is dry enough, don't seal it this way.

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 worksheet below uses a flat **2,000 kcal per person per day** as a simple, conservative floor, not a personalized target: see Calorie Planning for Your Food Supply for the real activity-tiered numbers (1,800 sedentary, 2,200 moderately active, 2,600 active), nothing here contradicts that guide. Use 2,000 for a quick sanity check, then swap in the tier that actually matches your household, especially anyone doing hard physical labor, before treating the result as a real plan. Add up the calories in what you've stored, nutrition labels list servings per container and calories per serving, then divide by the household's daily need.

Fill in your own numbers. Each line combines with the one above it; a rule marks a line that's an answer rather than another number to add in.

	_____		people in the household
×	_____	kcal	calories per person, per day (2,000 is a conservative floor, see Calorie Planning for tiered numbers)
=	_____	kcal/day	**daily need**
	_____	kcal	total calories stored (servings per container × calories per serving, added up)
÷	_____	kcal/day	daily need, from above
=	_____	days	**days covered**

Worked example: a household of 4 at the 2,000 kcal/person/day floor needs 4 × 2,000 = **8,000 kcal/day**. A stock totaling 168,000 kcal covers 168,000 ÷ 8,000 = **21 days**.

Enter your own numbers below to run the same math instantly.

People in the household

e.g. 4

Calories per person, per day

2000

2,000 is a conservative floor, not a personalized target; see Calorie Planning for Your Food Supply for activity-tiered numbers (1,800 sedentary, 2,200 moderately active, 2,600 active). Raise it for children, larger adults, pregnancy, or hard physical labor.

Total calories stored

e.g. 168000

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.

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, an impulse sealer typically takes 10–30 seconds and signals ready with a light, while an iron or straightener needs a few minutes to reach its target temperature. 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 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.

WARNING

Moldy grain, corn, or nuts aren't just spoiled, they can carry aflatoxin

Aflatoxin is a liver carcinogen, and cooking does not destroy it once it's there. Discard any visibly moldy, discolored, or shriveled grain or nuts entirely; don't cut out the moldy-looking portion and keep the rest, the toxin spreads past what's visible. The real defense is the moisture and sealing standard already covered above: aflatoxin needs mold growth to form in the first place, and correctly dried, oxygen-absorber-sealed grain doesn't support that growth.

Write your own plan, in one sentence

Buying the Mylar and the food is the easy part; sealing it correctly is what decides whether it's still good in five years. Finish this sentence with your own real plan:

"The next time *I seal a batch of bulk staples* , I will actually

check every seal again within 24 hours, not just assume it worked ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

Food Preservation: Canning, Dehydrating & Smoking

Preparing's 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 25 of the 77 attendees with confirmed botulism, per the CDC's own outbreak report, the largest U.S.

botulism outbreak in nearly 40 years; 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
Home freeze-dryer	A countertop appliance (Harvest Right is the common consumer brand) that freezes food, then pulls a vacuum to sublimate the ice directly to vapor, skipping liquid water entirely; see the cost note below

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. It's also a real equipment investment, not an impulse buy: a small unit runs roughly $2,000–$2,500, draws 900–2,000 watts depending on size, and takes 20 to 40 hours per batch, unattended, from frozen to fully dry. High-fat or high-sugar foods, butter, peanut butter, chocolate, honey, jam, don't freeze-dry well regardless of equipment; the fat or sugar blocks the sublimation the process depends on. Worth it for a household that expects to run it regularly and already has the freezer space; canning and dehydrating equipment cost a fraction as much for occasional use.

- **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.

Write your own plan, in one sentence

Done wrong, this can produce food that looks and tastes completely normal while being genuinely dangerous. Finish this sentence with your own real plan:

"The next time *I can a low-acid food* , I will actually

use a pressure canner and a real tested recipe, not a water bath and a guess ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

Send them this page ›

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SKILL GUIDE · FOOD

What to Grow: Crop Selection & Seed Saving

Preparing's 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 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 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.

Write your own plan, in one sentence

Hybrid seed is a real dead end after one generation; open-pollinated is the only choice that actually closes the loop. Finish this sentence with your own real plan:

"The next time *I buy seed for next season* , I will actually

check that it's labeled open-pollinated, not just heirloom or non-GMO ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

Food Safety After a Power Outage

The 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.

Prepared infant formula follows the same 4-hour rule

Opened or prepared formula stored in the refrigerator falls under the exact same danger-zone rule as meat, dairy, and leftovers: throw it away if the power has been off 4 hours or more, or if the fridge reads above 40°F, per the CDC's own infant-feeding-in-emergencies guidance. If there's no working refrigerator at all, the safer approach is to prepare a fresh bottle for each feeding rather than trying to store prepared formula for later.

WARNING

Listeria is a separate, year-round risk, not just an outage-specific one

Pregnant women, adults over 65, and anyone immunocompromised face this risk every day, regardless of whether the power is on. Listeria often causes no symptoms in the person carrying it, but it can trigger miscarriage, stillbirth, or a dangerous newborn infection. Avoid soft cheeses made from unpasteurized milk (feta, Brie, Camembert, blue-veined, and Mexican-style cheeses) and raw milk itself, unless the label confirms pasteurization. If you're in one of these higher-risk groups, reheat deli meat and deli-case cheese to 165°F before eating; Listeria can persist on deli equipment and display cases themselves, not only in the food as sold.

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.**

WARNING

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 CO_2 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 Food.

Write your own plan, in one sentence

The order you eat things in decides how much of your food actually survives the outage. Finish this sentence with your own real plan:

"The next time *the power goes out* , I will actually

check the fridge thermometer before I open the freezer door at all ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

Solar Cooking: Box, Panel & Parabolic

The 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.



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Solarbroman, CC BY-SA 4.0, via Wikimedia Commons.

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 (CooKit-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 CooKit 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 held for about 6 minutes kills the pathogens that matter, including Giardia, Cryptosporidium, and the bacteria and viruses behind cholera and typhoid) 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.

Write your own plan, in one sentence

A solar cooker is the one backup cooking method that keeps working even if every stored fuel runs out. Finish this sentence with your own real plan:

"The next time *I have a sunny weekend afternoon* , I will actually *build a box cooker and actually cook a real meal in it once* ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

Building a Walipini: The Underground Greenhouse

Preparing's 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-19 insulated wall (the common fiberglass-batt rating for a 2x6-framed 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.



Aerin Aichi, CC BY 2.0, via Wikimedia Commons.

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 $3,500–10,000 for a 10×20 ft (200 sq ft) structure, $3,000–8,000 in glazing and construction plus professional excavation ($500–2,000 depending on soil and access). Budget for the real version, not the headline number.

WARNING

An unsupported 6-8 foot pit is a real cave-in risk, not just a big hole

OSHA requires sloping, benching, shoring, or another protective system for any trench or excavation deeper than 5 feet, and even shallower excavations can collapse without warning; a caving wall of soil is heavy enough to crush or suffocate someone in seconds, one of the most consistent causes of death on real construction sites and DIY digs alike. A walipini's 6–8 foot pit is deep enough to fall squarely in that danger zone. Slope the excavation's walls back at a safe angle for your soil type (loose or previously disturbed soil needs a shallower, wider slope than dense clay does) rather than digging straight down, keep the excavated spoil pile at least 2 feet back from the edge so its weight doesn't destabilize the wall, and never enter an unsupported vertical-walled pit this deep to work. If the soil doesn't allow a safe slope within the space available, temporary shoring or a trench box, not a steeper wall, is the correct fix.

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 walls back at a safe angle for your soil as covered above rather than digging straight down, and 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.



Aerin Aichi, CC BY 2.0, via Wikimedia Commons.

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.

Write your own plan, in one sentence

A walipini is a real structural project, not a weekend dig; the site conditions decide whether it works at all. Finish this sentence with your own real plan:

"The next time *I'm seriously considering a walipini* , I will actually *check my local water table depth before digging a single shovelful* ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

Building a Food Forest

Preparing's Food chapter's Tier 3 Greenhouse / Season Extension item and 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.

WARNING

Some standard 'guild' nitrogen fixers are seriously invasive; check before you plant

Autumn olive is one of the most commonly recommended nitrogen-fixing shrubs in permaculture plant lists, and it's also one of the most damaging woody invasives in North America: banned for sale in Massachusetts, restricted as noxious in Minnesota, and ranked a severe threat in Tennessee and Kentucky, among other states. A plant showing up on a permaculture guild list is not the same thing as a plant that's safe to introduce on your own land. Goumi and sea buckthorn fix nitrogen through the same bacterial mechanism without autumn olive's invasive track record, and are the standard substitutes. Before adding any nitrogen-fixing shrub or tree to a design, check it against your own state department of agriculture's noxious-weed list, not just the permaculture source that recommended it.

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.

Write your own plan, in one sentence

Guessing at sun, water, and wind is how a canopy tree ends up shading the exact bed that needed full sun. Finish this sentence with your own real plan:

"The next time *it rains hard* , I will actually

walk the site afterward and map where the water actually pools and drains ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

Improvised Cold Storage: Root Cellars & Evaporative Cooling

The 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.

WARNING

A walk-in cellar's excavation is deep enough to be a real cave-in risk

Once footing depth is added to the 4-foot minimum floor depth, a walk-in cellar excavation commonly reaches or exceeds the point where an unsupported vertical wall of soil can collapse without warning, heavy enough to crush or suffocate someone. OSHA requires sloping, benching, shoring, or another protective system for any excavation deeper than 5 feet, and shallower digs can still cave in. Slope the excavation walls back at a safe angle for the soil type rather than digging straight down, and treat this as real excavation work, not an oversized garden hole, the same caution this site's walipini guide gives for the same reason.

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.



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The traditional zero-structure option: a potato clamp

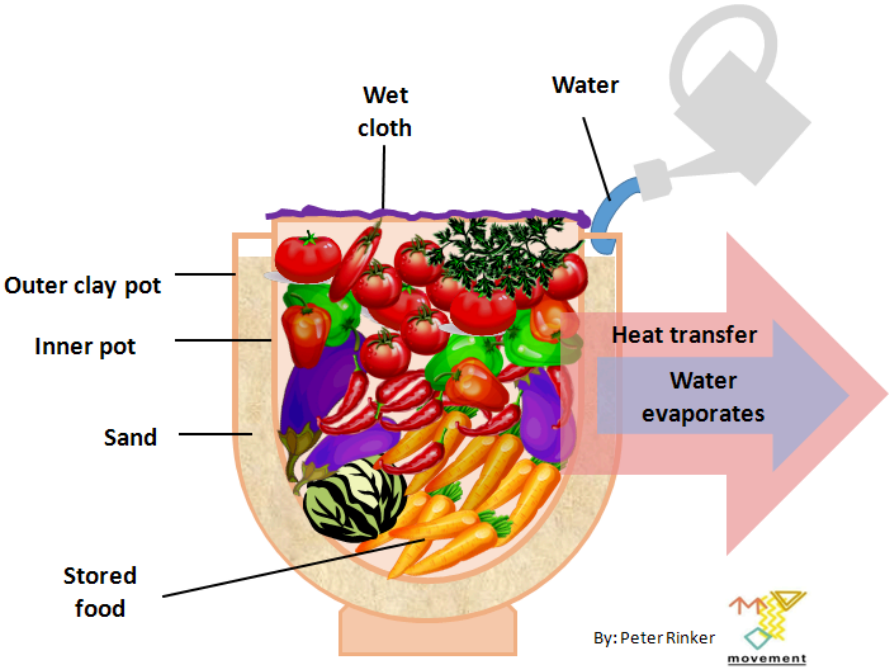
For a large one-time harvest with no cellar at all, a **clamp**, an outdoor mound, is a real, centuries-old method that saw wide use again during WWII food rationing. Lay 6–8 inches of straw on bare soil, pile produce on top as steeply as it will hold (roughly 32–40 inches high), cover with another 6–8 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.



David Wright, CC BY-SA 2.0, via Wikimedia Commons.

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.



Peter Rinker, CC BY-SA 3.0, via Wikimedia Commons.



Peter Rinker, CC BY-SA 3.0, via Wikimedia Commons.

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.

Write your own plan, in one sentence

A harvest with nowhere cold to go is a harvest that rots. Finish this sentence with your own real plan:

"The next time *I have a free weekend before harvest season* , I will actually

build the buried trash can version instead of just reading about it ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

Hunting, Trapping & Field Dressing Basics

Preparing's 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 skip by accident, and it's the reason a reader who jumps straight from opening the cavity to reaching into the chest 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. Wash hands afterward with soap and water, not a strong bleach solution, which is harsh enough to injure skin. Knives and other equipment are a different story: in an area with chronic wasting disease (CWD) in the local herd, soak them in a 40% bleach solution for a full 5 minutes, the concentration and time actually shown to inactivate CWD prions on stainless steel, since ordinary washing doesn't touch them. 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 prion risk.

WARNING

Tularemia is a real risk specific to rabbits, hares, and rodents

Tularemia ("rabbit fever") spreads through handling an infected animal, exactly what a snare or foothold trap most often catches, not just through a bite. It causes fever, chills, headache, and either a skin ulcer or swollen lymph nodes within about 3–5 days of exposure. Gloves and eye protection during skinning, thorough hand washing afterward, and cooking rabbit meat to at least 160°F all reduce the risk; freezing does not kill it. Tell a doctor about the exposure if a fever develops afterward: tularemia responds well to antibiotics but shares symptoms with other illnesses, so the hunting history is what points a clinician toward the right test.

WARNING

Hunting or trapping feral hogs carries a separate risk: brucellosis and leptospirosis

Both spread through contact with blood, body fluids, or urine-contaminated water. Symptoms (fever, joint and muscle pain, headache) can take anywhere from a week to six months to appear, so connect a late flu-like illness back to the hunt when talking to a doctor. Eye protection, rubber gloves, and footwear you can disinfect matter here specifically; disinfect gear afterward with a 10% bleach solution (1 cup bleach to 9 cups water), and keep dogs away from a raw hog carcass, since they can catch it from the carcass and pass it to you. Freezing, smoking, drying, and pickling do not kill either bacterium; only thorough cooking does.

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.

Trichinosis is a risk specific to bear and wild boar, far less so deer, and current CDC guidance sets wild game's safe cooking temperature at 165°F, not the 160°F long associated with commercial pork; check with a meat thermometer rather than trusting color or texture, since Trichinella in wild game doesn't reliably look different from safe meat. Freezing, which reliably kills the Trichinella species found in commercial pork, does not reliably kill the freeze-resistant species found in wild game; cooking is the only dependable safeguard.

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
- Tularemia, brucellosis, and leptospirosis signs known from memory, and gear disinfection (bleach solution) ready before a hog or rabbit harvest
- Wild game cooked to 165°F (not pork's 160°F), verified with a thermometer, not color

Write your own plan, in one sentence

Hunter education is something to earn now, while the normal licensing system still works, not after. Finish this sentence with your own real plan:

"The next time *registration opens for the hunter education course* , I will actually *sign up instead of telling myself I'll get to it later* ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

Send them this page ›

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SKILL GUIDE · FOOD

Fishing: Lines, Traps & Legal Basics

Preparing's Food chapter names hunting and trapping as the headline wild-protein skill, but fishing is the lower-barrier option sitting right next to it: no certification course, no firearm, and far less physical risk than field dressing large game. This guide covers the licensing step almost everyone skips, how active fishing compares to the "set and forget" methods, and the handling and consumption risks most fishing advice leaves out entirely.

Get licensed before you wet a line

Every U.S. state requires a fishing license for recreational fishing. The narrow exceptions are state-specific: a landowner fishing their own private pond is sometimes exempt, and most states run a handful of free fishing days a year, but neither is something to count on as a real-world plan. A resident annual license averages around $25 nationwide, with the actual price varying by state from roughly $12 to over $50. That license fee isn't just a formality: it funds the state wildlife agency that sets the catch limits, size limits, and season dates covering everything else in this guide. Buy it now, while the normal system still works, the same logic the Hunting, Trapping & Field Dressing Basics guide uses for hunter education.

Active fishing: the lowest skill floor

A simple rod-and-reel combo, 20–30 lb test line, a handful of hooks, split-shot weights, and a bobber covers most freshwater fishing. In unfamiliar water, bait fished near the bottom, worms, nightcrawlers, or cut bait, outperforms lures for a beginner; lures reward reading the water and the fish's behavior, a skill that takes time to build, while bait fishes itself once it's in the right depth and spot.

A cane pole or a simple handline, line wound around a stick or a spool with no reel at all, costs almost nothing and trades casting distance for simplicity. It's a reasonable backup to keep around in case a rod or reel breaks, not a first choice, but worth knowing how to rig on short notice.

Passive lines: letting one person run many hooks

Trotlines, limb lines, and jug lines all do the same basic job: they let one person fish far more hooks at once than a rod and reel ever could, at the cost of checking them on a schedule instead of watching them in real time. A trotline is a heavy line strung between two anchors with multiple baited hooks hanging below it. A limb line is a single baited hook tied to a branch overhanging the water. A jug line is a baited hook suspended from a floating jug that drifts or anchors in place.

These methods are heavily regulated, and the rules vary sharply by state, both in how often a line has to be checked and in what has to be written on it:

- **Missouri** requires an anchored jug line to be checked at least once every 24 hours, with the anchor heavy enough that wind, current, or a hooked fish can't move the jug; an unanchored jug line in a stream must be personally attended at all times. Every jug must be tagged with the owner's full name and address (or state conservation number).
- **Arkansas** caps limb lines, yo-yos, and similar devices at 25 per person, limits each limb line to two hooks, and requires lines to be run and the catch removed at least once every 24 hours; a line left unbaited for 24 hours or more has to come down. Every device needs the owner's name and address on it.
- **Virginia** requires every trotline, jugline, or limbline to be permanently marked with the owner's name, address, and phone number, and checked at least once a day; when not in use, lines have to come off the water entirely, not just go unbaited.

Confirm your own state's hook-count limits, check-interval rules, and labeling requirements before setting any unattended line. These numbers change state to state and year to year, and "I didn't know" isn't a defense a conservation officer accepts.

Fish traps: the least hands-on method

A wire or mesh funnel trap, baited and sunk, catches fish with no hook and no line involved at all, which also means nothing is left suffering on a hook between checks. It's the most inconsistently regulated passive method on this list, and the inconsistency runs in a specific direction: most states that allow traps restrict them to bait-size fish, not food fish.

Georgia, Maryland, and Indiana all allow minnow traps for collecting bait, with real limits attached (Georgia caps it at 50 nongame fish per day across no more than 2 traps per person, and any game fish caught has to go back in the water immediately; Indiana allows unlimited minnows and crayfish but explicitly bans keeping sunfish, bass, catfish, or pike from a trap; Maryland limits a recreational angler to one trap, checked daily). Arkansas goes further and bans wire, box, and basket fish traps

outright, regardless of what you intend to do with the catch. Don't assume a store-bought minnow trap is legal for table-size fish in your state; in most places, it isn't.

Higher-skill methods

Fly fishing reaches fish and water that bait fishing often can't, but it comes with a real learning curve: casting technique and fly selection both take practice before they become reliable, not something to count on cold in an emergency.

Cast netting, where it's legal, can take baitfish, and in some states rough fish, by the dozen in a single throw. Many states restrict cast nets to baitfish only or ban them outright for game species, so check the specific rule before relying on one as a food-gathering method rather than a bait-gathering one.

Noodling: worth knowing the word, not worth the plan

Noodling means reaching bare-handed into an underwater den to pull out a catfish by hand. It's legal in roughly half the states, including Arkansas, Georgia, and several others, and flatly illegal and actively enforced as poaching in others, Missouri among them, where conservation agents have pulled over a hundred illegal noodling containers from a single lake. Where it's legal, it's still not a method to build a food plan around: documented injuries include broken fingers, a catfish's sharp pectoral spine puncturing the chest cavity, and drowning, since a hooked den can pull a person underwater before they're able to let go. Know the word. Don't make it part of the plan.

Cleaning and storage

Clean a fish promptly: gut it and remove the gills as soon as practical, then keep it cold or iced until it's cooked. Fish sit in the same 40–140°F bacterial danger zone as any other meat, and the clock starts the moment the fish comes out of the water, not when you get around to cleaning it.

WARNING

Fish-handling cuts are a real infection risk, not just a nuisance

Cleaning fish with any cut or scrape on your hands is a genuine infection risk, not a minor one. A cut exposed to warm water that starts spreading redness, pain, or fever needs urgent care: Vibrio vulnificus, a bacterium present in warm coastal and brackish water and on raw seafood, can turn serious within hours, and roughly 1 in 5 infections are fatal. Less urgent but still real:

a slow-growing nodule that shows up weeks after a cut can be Mycobacterium marinum ("fish tank granuloma") or erysipeloid, both treatable but easy for a clinician to misdiagnose if they don't know about the fish exposure. Wear gloves when cleaning fish, especially with any open cut on your hands, and mention the fish exposure to a doctor if a wound isn't healing the way it should.

Freshwater fish can carry Diphyllobothrium, the fish tapeworm, if eaten raw or undercooked. Cooking to 145°F kills it. If freezing instead of cooking, the real FDA standard is holding the fish at -4°F for a full 7 days, noticeably colder and longer than a typical overnight home freezer cycle; the faster options (-31°F until solid, then held cold for 15 to 24 hours) need equipment most households don't have. Salting, smoking, and pickling do not reliably kill it.

WARNING

Scombroid poisoning is a chemical risk, not an infection, and cooking doesn't fix it

Tuna, mackerel, and other members of the Scombridae family carry a separate risk unrelated to every pathogen above: histamine that forms as the fish spoils, even mildly. Symptoms, facial flushing, a burning or peppery taste, headache, and sometimes a rash, start within 10 to 60 minutes and are easy to mistake for an allergic reaction. The critical difference from everything else in this guide: cooking does NOT destroy histamine once it's formed. The only real prevention is keeping the fish at or below 40°F continuously from the moment it's caught to the moment it's cooked, with no warm gap in between.

Check your state's fish consumption advisory before eating wild-caught fish regularly

Mercury and PCB contamination varies by waterbody and species, and most states publish or update a fish consumption advisory annually as new testing comes in, often with stricter limits for pregnant women and young children. A fish that's perfectly legal to catch isn't automatically safe to eat in any quantity; check the current advisory for the specific water you're fishing, not just a general rule of thumb.

Quick Reference

Method	Skill floor	Key regulatory note
Rod & reel (bait)	Lowest; works in unfamiliar water	License required; standard catch/size limits apply
Cane pole / handline	Lowest; good backup if gear breaks	Same license and limits as rod & reel
Trotline / limb line / jug line	Low; lets one person run many hooks	Check interval and labeling rules vary sharply by state (24–48 hrs typical)
Fish trap	Low; no hook or line to tend	Often bait-size fish only; some states ban outright (Arkansas)
Fly fishing	Moderate; real casting/fly-selection curve	Standard license and limits
Cast net	Moderate; one throw, many fish	Often baitfish-only; game-species use frequently restricted
Noodling	High physical risk, not skill	Legal in roughly half of states; poaching charge in others (e.g., Missouri)

Full checklist:

- Resident fishing license obtained and current
- State's check-interval, hook-count, and labeling rules confirmed before setting any trotline, limb line, or jug line
- State's fish-trap rules confirmed; don't assume a bait-size trap is legal for food fish
- Rod/reel setup (20–30 lb test, hooks, split shot, bobber) plus a backup handline or cane pole
- Gloves on hand for cleaning fish, especially with any cut or scrape present
- 145°F cooking target, or the full -4°F/7-day freezing standard, known before eating freshwater fish raw or undercooked
- 40°F-or-below cold chain understood as the only real defense against scombroid poisoning in tuna, mackerel, and similar species
- Current state fish consumption advisory checked for the specific water being fished

Write your own plan, in one sentence

A license and a confirmed set of state rules are something to have before the need is real, not after. Finish this sentence with your own real plan:

"The next time *I'm at the store or online for license renewal* , I will actually

buy this year's license and check the current trotline rules instead of assuming last year's still apply

."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

Foraging Wild Edibles Basics

The 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

WARNING

Water hemlock: North America's most acutely toxic plant

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 (leaflets arranged in pairs along a central stem, like a fern frond) 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.

WARNING

Poison hemlock: the real tell against wild carrot

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.

WARNING

Death camas: the bulb that kills people who skip the smell test

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.

Plants 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.

A second plant belongs on this short list for the same reason: broadleaf plantain (*Plantago major*), not the banana, is one of the most commonly recommended first plants for a new forager precisely because it has no reported dangerous look-alikes and grows almost everywhere disturbed soil exists, lawns, sidewalk cracks, trailsides, not just wild habitat. Identify it by its broad, oval leaves growing in a low rosette with prominent parallel veins running the length of each leaf from base to tip, and a distinctive leafless, pencil-like flower spike rising straight up from the center. Young leaves are the most palatable; older leaves toughen and are better cooked than eaten raw.

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)	None known: 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)
Broadleaf plantain	None known: no reported dangerous look-alike	Broad oval leaves in a low rosette with parallel veins base to tip, and a leafless, pencil-like flower spike; grows almost everywhere, not just wild habitat

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

Write your own plan, in one sentence

A partial match to a picture is exactly how people die from water hemlock and death camas. Finish this sentence with your own real plan:

"The next time *I think I've found a wild edible* , I will actually

confirm it against a real field guide or an experienced forager before I taste anything

."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

Backyard Poultry & Small Livestock Basics

Preparing's 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, plus meat rabbits, the other real small-livestock option, which need a fraction of a chicken coop's footprint and reach slaughter weight in weeks, not months.

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 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.

WARNING

Highly pathogenic avian influenza (bird flu) spreads fast and survives on clothing and equipment

Watch for sudden deaths with no warning, lethargy, a drop in egg production or soft and misshapen eggs, a swollen or discolored comb and wattles, breathing trouble, or stumbling; report sick birds immediately to your state veterinarian or USDA (1-866-536-7593) rather

than treating it yourself. It spreads through direct bird-to-bird contact and through contaminated clothing, shoes, and equipment carried in from outside, not only direct contact. Keep wild birds and rodents out of the coop, isolate any new or returning bird for 30 days before it joins the flock, and change shoes and wash hands before handling your flock after being anywhere wild waterfowl have been. Properly cooked eggs and meat (165°F) stay safe to eat either way; the real risk is handling and flock-to-flock spread, not the food itself.

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.

Wash hands after handling birds, eggs, or coop bedding, before eating or touching your face. *Salmonella* and *Campylobacter* spread through droppings and dust in the coop itself, not only through undercooked meat and eggs.

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.

Rabbits: the other small-livestock option

Rabbits solve a different problem than chickens do: not the B12 gap (rabbit meat is a real protein source but doesn't carry the same egg-based B12 case above), but speed and footprint. A meat rabbit reaches slaughter weight in 8 to 12 weeks at 3 to 4 lb live weight (roughly 2 to 2.5 lb dressed), against a chicken's much longer runway to real meat production. A single doe kept bred can realistically produce around 36 fryers a year, a lot of meat from an animal that needs a fraction of a chicken coop's space.

Element	Minimum	Note
Cage per rabbit	3 sq ft	A breeding doe needs more: a 30" × 7' grow-out cage comfortably houses her and a litter through weaning
Gestation	~30 days	Among the shortest of any common livestock
Rebreeding	4–6 weeks after kindling	Faster rebreeding means more litters a year, at the cost of more strain on the doe
Feed	16–18% protein pellets	Rabbits convert roughly 20% of dietary protein into edible meat, among the most feed-efficient livestock available at small scale

WARNING

Rabbits die of heat far more easily than chickens do

A rabbit is at real risk of heatstroke once ambient temperature climbs past about 85°F, and a body temperature above roughly 105°F is a genuine emergency: seizures, organ damage, and death can follow. Shade, airflow, and a way to cool the hutch (a frozen water bottle pressed

against the cage, misting the surrounding air) matter more for rabbits than for almost any other backyard animal, especially in a summer power outage when a fan or evaporative cooler isn't running.

Check the local ordinance the same way you would for chickens, not as an afterthought. Rabbits are usually regulated under the same "small livestock" category as poultry, sometimes with an even lower per-property cap, not exempted from it; assuming rabbits fly under the radar because they're smaller and quieter is a real mistake.

One genuine bonus: rabbit manure is a "cold" manure, low enough in nitrogen and salts that it can go straight onto garden beds without composting first, unlike most animal manure, which will burn tender plants if applied fresh. It also out-performs chicken manure on nitrogen, phosphorus, and potassium content. For a household also running a food forest or raised beds, that's a real, direct link between the rabbit hutch and the garden with no extra step in between.

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
Rabbits above 85°F need active cooling	Heatstroke is a real, fast risk for rabbits in a way it isn't for chickens
Avian flu signs known, biosecurity practiced daily	Spreads fast and survives on clothing and equipment, not just bird-to-bird contact

Write your own plan, in one sentence

A five-minute phone call before building anything avoids a coop you have to tear down later. Finish this sentence with your own real plan:

"The next time *I'm ready to order coop materials* , I will actually *call the local ordinance office first instead of assuming it's fine* ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

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	¼–½ 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	¼–½ 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	½–1 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

Four 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
Squash vine borer	A different, often more destructive squash pest than the squash bug above: a day-flying moth that looks more like a wasp lays eggs at the base of the stem, and its cream-colored larva tunnels inside, leaving a small hole oozing moist, sawdust-like frass (insect droppings) near the crown. A plant that wilts suddenly and severely, rather than gradually, usually already has a borer inside the stem	Wrap the base of young stems in foil or a self-adhesive bandage to block egg-laying before it happens; row cover works too, but only on ground that didn't grow squash the previous year, since adults overwinter in the soil and would emerge trapped underneath it. If a borer's already inside, slit the stem lengthwise near the entry hole, pick the larva out, then mound moist soil over the wound so the stem can re-root

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.

Write your own plan, in one sentence

A finger pushed into the soil tells you more than a watering schedule ever will. Finish this sentence with your own real plan:

"The next time *I'm about to water the garden* , I will actually *check 2 inches down first instead of watering on autopilot* ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

Send them this page ›

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SKILL GUIDE · FOOD

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 two to three times the width of the container for a potted one, the same ratio either way. 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 (insect droppings) 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	Cut at least 8-12 inches below the visible damage, into clean wood a year or more old, since the bacteria travels ahead of what's visibly infected; disinfect pruning tools between every single cut with rubbing alcohol or a bleach solution, not just between trees. Prune during dry weather if at all possible, wind and rain are how the bacteria actually spreads from an infected cut to the next one. 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.

Write your own plan, in one sentence

Dormant-season pruning is a narrow window, and skipping a year shows up in fruit quality for years after. Finish this sentence with your own real plan:

"The next time *late January comes around* , I will actually

get out and prune the dormant wood instead of letting the window pass ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

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.

WARNING

The pest risk here isn't what gets in, it's what thrives once it does

A sunken pit actually keeps most outdoor pests out entirely; the real problem is the opposite direction. Field mice specifically seek out a warm, sheltered winter structure exactly like a walipini, and once one finds a way in, it finds the same stable temperature and complete absence of predators that make the space so good for growing crops, with a tray of tender seedlings as an easy meal. A mouse can wipe out an entire succession-planting tray overnight, precisely the technique this guide's own calendar depends on. Seal any real gap around the door, vents, or where the outlet or ventilation pipes pass through the structure, and keep a snap trap or two inside through the winter months as a standing precaution rather than a reaction to damage already found.

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.

Write your own plan, in one sentence

Humidity thresholds aren't guessable by feel, and condensation is what actually triggers fungal disease. Finish this sentence with your own real plan:

"The next time *I start my first succession round* , I will actually

hang a real hygrometer at plant height instead of guessing by feel ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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Sources

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SKILL GUIDE · FOOD

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.

Fish feed is its own hidden dependency, the same way electricity is

A bag of commercial fish feed is easy to overlook as a supply that could run out, the same blind spot electricity has in this guide's own framing below. Tilapia genuinely help here: they digest plant matter well, and duckweed, grown right in the system or a companion tub, is a real, self-renewing feed source once established. Black soldier fly larvae (see Backyard Poultry & Small Livestock Basics for how to raise them) are a strong protein supplement on top of that, and can replace up to about half of a commercial feed's protein content in published feeding trials. Kitchen scraps round it out. None of this replaces commercial feed's balanced formulation for maximum growth, but it's a real answer to "what do the fish eat if the feed store closes," not a gap this guide leaves open.

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.

Size your equipment

Three separate scaling decisions come up across these systems: how big an air pump for a DWC bucket, how big a heater for an aquaponics tank, and how much grow light for your growing area. Fill in whichever apply to your own setup.

Air pump (DWC)

gal bucket water volume

× _____ L/min per gal pump rate: 1 minimum, 2 for better oxygenation

= _____ L/min **minimum pump rating needed**

Tank heater (aquaponics)

_____ gal fish tank volume

× _____ W/gal heater rate: 3 minimum, 5 for faster heat-up or a colder space

= _____ W **heater wattage needed**

Grow light

Crop stage	W/sq ft	Your sq ft	= Watts needed
Seedlings	20-30		
Leafy greens and herbs	25-35		
Fruiting crops (tomatoes, peppers)	35-50		

Worked example: a 4-gallon DWC bucket needs a 4-8 L/min pump. A 30-gallon aquaponics tank needs a 90-150W heater. A 10 sq ft leafy-greens growing area needs 250-350W of LED (25-35 W/sq ft).

Fill in whichever setups apply below to run the numbers instantly.

Air pump

Bucket water volume (gal)

e.g. 4

Tank heater

Fish tank volume (gal)

e.g. 30

Grow light

Crop stage

Seedlings (20-30 W/sq ft)

Growing area (sq ft)

e.g. 10

Calculate

Write your own plan, in one sentence

Dissolved oxygen can crash within an hour once the pump stops. Finish this sentence with your own real plan:

"The next time *I set up my first DWC bucket or tank* , I will actually

have a battery backup air pump ready before I need it, not after an outage starts ."

Know someone this guide would actually help? Being the person who's ready includes being the person who says something.

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SKILL GUIDE · FOOD

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.

Sunchokes cause real digestive discomfort the first time, cook around it

Sunchokes carry a higher percentage of inulin, a fiber humans can't digest directly, than almost any other vegetable; gut bacteria ferment what reaches the lower intestine instead, which is where the well-known gas and bloating come from. It's not a sign anything's wrong with the tubers. Two real fixes cut it down a lot: boil them with a splash of lemon juice or vinegar, which breaks inulin down into sugars the body can actually absorb, and let freshly harvested tubers sit in storage for a few weeks before eating a large helping, since inulin content drops the longer they're stored. Don't judge the crop by a first meal of raw or plain-boiled, freshly dug sunchokes.

Rhubarb's one real safety note

Only the stalks are edible.

WARNING

Rhubarb leaves are toxic, not just inedible

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.

Write your own plan, in one sentence

Asparagus gives you nothing the first year no matter when you plant it, which is exactly why the clock should start now. Finish this sentence with your own real plan:

"The next time *I have a free weekend this spring* , I will actually *plant the asparagus crowns instead of waiting for a better time* ."

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Sources

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SKILL GUIDE · FOOD

Regenerative Agriculture: Cover Crops, No-Till & Composting

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.

WARNING

Manure or hay from an unknown source can carry a herbicide that survives composting entirely

Picloram, clopyralid, and aminopyralid, herbicides commonly sprayed on pasture and hayfields, pass straight through a grazing animal's gut and stay active in its manure; hay or straw from a treated field carries the same residue. None of that breaks down in a normal compost pile the way other contaminants do: it can stay active for months, and field reports put some cases at three to four years, especially in a pile that never fully finished breaking down. The result looks and smells like perfectly good, finished compost right up until it stunts, curls, or kills sensitive broadleaf crops, tomatoes, beans, peas, potatoes, and peppers among them, the same crops most worth growing. Before trusting manure, hay, or straw from a source you don't know, run a real bioassay: mix a sample with clean potting soil at roughly 2 parts sample to 1 part soil, plant a few bean or pea seeds in it alongside identical seeds in plain clean soil, and compare growth after two to three weeks. Curled, twisted, or stunted growth against a normal-looking control means don't use that batch.

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.

Write your own plan, in one sentence

A bed left bare over winter is fertility you'll have to buy back later instead of rebuilding for free. Finish this sentence with your own real plan:

"The next time *harvest wraps up this fall* , I will actually *sow a cover crop by the real cutoff instead of leaving the bed bare* ."

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

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- 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
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SKILL GUIDE · FOOD

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.

WARNING

Don't grow microgreens from a general garden seed packet

Many seeds sold for outdoor planting are treated with a fungicide (thiram, captan, and metalaxyl are common ones), usually dyed pink, blue, or purple as a visual warning that they're not for consumption. That treatment matters far more here than it would in a garden

bed: microgreens are harvested just 7–14 days after germination, in a warm, moist environment that actually favors chemical absorption into the young seedling, with none of the months a normal crop has for residue to break down before harvest. Buy seed sold specifically for sprouting or microgreens production instead; it's untreated and handled under food-safety standards a general garden seed packet isn't.

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.

Write your own plan, in one sentence

Seven to fourteen days is short enough to actually test, not just read about. Finish this sentence with your own real plan:

"The next time *I want to test my food security setup* , I will actually

grow a tray of microgreens start to finish and time how long it really takes ."

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

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- 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

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