SKILL GUIDE · WATER & FOOD

Water Purification

Five methods for making questionable water safe to drink, with the exact steps, ratios, and times behind each one. This is the hands-on skill the Water & Food chapter and its addendum both assume you'll go build; this guide is where you build it. To confirm a source or a finished batch is actually safe rather than assuming it, see Water Testing: Strips, Labs & Field Methods.

The core principle: clarify, then disinfect

Every method below works better, and some barely work at all, on clear water. Cloudy or turbid water isn't just harder to look at: suspended particles use up chemical disinfectant before it can reach pathogens, block UV light from reaching microorganisms, and can physically shield bacteria from a filter's contact time. If your water isn't already clear, clarify it before you disinfect it, not instead of disinfecting it.

- **Let it settle.** Sand and silt sink on their own. Pour water into a container and let it sit undisturbed for a few hours, then draw off the clear water from the top without disturbing the sediment at the bottom.
- **Speed it up with alum.** Stir ¼ teaspoon of alum powder into a quart of cloudy water for a few minutes, then let it sit. The suspended particles clump together and settle faster than they would on their own. *Where to find it:* sold as food-grade "pickling alum" in a grocery store's spice or canning aisle, or from any online retailer.
- **Pour it through cloth.** A clean cloth, paper towel, or coffee filter catches visible particles in one pass. This is the fastest option when you don't have time to wait for settling.

None of these three steps disinfect the water on their own. They just get it clear enough for one of the five real methods below to actually work.

Which method, when

Situation	Best method	Why
Clear tap water under a boil-water notice	Boiling or bleach	Fastest options; no special gear needed
Cloudy stream, pond, or floodwater	Clarify first, then boil or filter (0.1 micron or finer)	Bacteria and protozoa risk; an unclarified filter clogs fast
Suspected sewage contamination (flooded municipal line, backed-up septic)	Boiling, or a 0.01 micron / “purifier”-rated filter, or chemical disinfection	Standard 0.1 micron filters do not remove viruses
Treating many gallons for a household over several days	Bleach or chlorine dioxide tablets	Scales cheaply; no filter cartridge to wear out
No fuel, no chemicals, full sun, water already looks clear	Solar disinfection (SODIS)	Free, but slow and the least certain of the four
Clear water, want a fast, chemical-free treatment and have charged batteries	UV pen sterilizer	Treats a liter in under 2 minutes; depends entirely on battery power and clear water

Method 1: Boiling

The surest method against biological contamination, bacteria, viruses, and parasites alike. It does **not** remove chemical or heavy-metal contamination, so it's the wrong tool if you suspect a fuel spill or industrial runoff rather than a pathogen problem.

1. Clarify the water first if it's cloudy (see above).
2. Bring it to a **rolling boil**, vigorous, full bubbling across the whole surface, not just a few bubbles at the bottom of the pot.
3. Keep it at a rolling boil for **1 minute**. Above 6,500 feet elevation (much of the Wasatch Front's higher canyons and mountain valleys), extend that to **3 minutes**, since water boils at a lower temperature at altitude.
4. Let it cool before drinking. If the flat taste bothers you, pour the water between two clean containers a few times to reintroduce air, or add a pinch of salt per quart.

You need: a heat source and a pot. Nothing else.

Mixing infant formula with this water

Water boiled per the steps above and cooled is safe to mix with powdered formula for most infants. If the baby is under 2 months old, was born prematurely, or has a weakened immune system, use an extra precaution against Cronobacter, a bacterium that particularly threatens high-risk infants: mix the powder with water that's still hot, at least 158°F, rather than fully cooled water, then cool the prepared bottle before feeding.

Method 2: Chemical disinfection (bleach)

Use **plain, unscented household bleach only**, 5–9% sodium hypochlorite, with no added scents, dyes, or "color safe" formulations. Bleach is effective against bacteria and viruses but is less reliable against Cryptosporidium, a parasite resistant to chlorine at these concentrations; if you suspect Cryptosporidium specifically (common in water contaminated by livestock or wildlife feces), boiling or filtration is the better choice.

Bleach concentration	Dose per gallon of clear water	If water is cloudy, colored, or very cold
6% sodium hypochlorite	8 drops	Double the dose
8.25% sodium hypochlorite	6 drops	Double the dose

1. Clarify the water first if it's cloudy.
2. Add bleach at the dose above for your bottle's concentration, printed on the label.
3. Stir and let it stand for **30 minutes**.
4. The water should have a faint chlorine smell. If it doesn't, repeat the dose and let it stand another 15 minutes before drinking.

Where to find it: any grocery, big-box, or hardware store carries it. The plain, unscented version of a major brand like Clorox Regular is the standard example; check the label for 5–9% sodium hypochlorite and confirm there's no added scent, dye, or "color safe" formulation.

Stored bleach loses strength, plan to rotate it

Sodium hypochlorite degrades on the shelf, losing roughly 10-20% of its available chlorine per year even unopened, faster in a hot garage or shed than in a cool closet (ideally 50-70°F). A bottle that's a couple years old may no longer disinfect reliably at the doses above even though it still smells like bleach. Replace stored bleach intended for water treatment roughly once a year, write the purchase date on the bottle, and don't count on a bottle of unknown age as your only disinfection method.

Alternatives to bleach

Chlorine dioxide tablets (follow the package instructions exactly) are more effective against Cryptosporidium than bleach and pack well in a kit; Potable Aqua Chlorine Dioxide and Katadyn Micropur MP1 are both EPA-registered chlorine dioxide products effective against bacteria, viruses, Giardia, and Cryptosporidium, sold at outdoor retailers, pharmacies, and online. Not every "purification tablet" on the shelf is chlorine dioxide, though: Aquatabs, for example, uses a different active ingredient and isn't rated against that same full range of pathogens, so check the active ingredient on the label rather than the word "purification." Iodine works but shouldn't be used by anyone who is pregnant, has a thyroid condition, or is relying on it for more than a few weeks at a time.

Method 3: Filtration

Filters work by physically straining out organisms, so the pore size (measured in microns) determines what actually gets removed:

- **0.1 micron** removes bacteria and protozoa (Giardia, Cryptosporidium). This covers most portable backpacking and emergency filters.
- **0.01 micron**, often marketed as a "purifier" rather than a "filter", also removes viruses. So does reverse osmosis.

Look for **NSF/ANSI P231** certification specifically if you want a filter rated for untreated, potentially unsafe water (the standard built for travel and emergency use, requiring demonstrated bacteria, virus, and protozoan cyst reduction). NSF/ANSI 53 covers contaminant reduction in already-treated water and isn't the same guarantee; NSF/ANSI 58 covers reverse osmosis systems specifically.

Where to find it: outdoor and camping retailers, general retailers, and pharmacies all carry portable filters, but marketing language on the box isn't the same as certification. NSF maintains its own searchable database of currently certified products; it's worth checking a specific model there before relying on it. The

gap between "meets the standard" and "is certified to the standard" is real: as of this writing, LifeStraw's Go line carries third-party NSF P231 certification, while Sawyer's popular MINI filter is marketed as meeting that same protocol's requirements without holding the formal certification itself. That's not a verdict on either product; it's the exact reason to check the database yourself rather than trust the packaging.

1. Pre-filter cloudy water through cloth first; this single step is the biggest thing you can do to keep a filter from clogging mid-use.
2. Follow the manufacturer's flow procedure exactly; most portable filters are designed to be primed and used a specific way.
3. Dry and store the filter per its instructions between uses. A damp filter left in a bag is exactly the environment mold and bacteria grow in.

Watch it: LifeStraw, "How to Use Your LifeStraw Personal Water Filter".

A 0.1 micron filter is not enough on its own if you suspect viruses

Standard portable filters don't catch viruses; they're too small to be physically strained out at that pore size. If the water source might carry human sewage, a flooded municipal system or a compromised septic line, pair a 0.1 micron filter with boiling or chemical disinfection, or use a 0.01 micron purifier instead.

Method 4: Solar disinfection (SODIS)

A World Health Organization–recognized method that needs no fuel and no chemicals, at the cost of being the slowest and least certain option here. It only works on water that's already reasonably clear; if you can't read text held behind the container, the water is too cloudy for this method.

1. Use a clean, clear (colorless, not tinted) plastic PET bottle, the kind most bottled water comes in, with the label removed. Check the small recycling triangle on the bottle's bottom for a "1" or "PET"/"PETE" inside it to confirm the plastic type; skip any bottle that's scratched, cloudy, or brown/green tinted, since those all block the UV light this method depends on.
2. Fill it about three-quarters full, cap it, and shake it for about 20 seconds to add oxygen, which helps the disinfection process.
3. Fill the rest of the way and cap it again.
4. Lay it on a reflective surface (a metal roof, foil, light-colored pavement) in direct, unobstructed sun for **6 hours** on a clear or up-to-half-cloudy day, or **2 full days** if it's mostly overcast. If the water is already above 122°F (50°C), 1 hour is enough.

You need: sun, and a clear plastic bottle. That's it, which is exactly why it's worth knowing even though it's a backup method, not a first choice.

Method 5: UV pen sterilizers

A UV pen (SteriPEN is the best-known brand) is a battery-powered wand that uses UV-C light to disable the DNA of bacteria, viruses, and protozoa so they can't reproduce or make you sick, without heat, chemicals, or a filter cartridge. Independent lab testing contracted by manufacturers has found devices in this category meet EPA microbiological water purifier requirements, at least 99.9% reduction of bacteria, viruses, and protozoa including Giardia and Cryptosporidium.

1. Clarify the water first if it's cloudy. This matters even more here than with other methods: suspended particles block UV light from reaching organisms and can physically shield them from exposure, so UV pens are only reliable in already-clear water.
2. Fill a wide-mouth bottle or container with the water to be treated.
3. Insert the lamp end into the water per the device's instructions and stir continuously for the rated time, typically **48 seconds for half a liter or about 90 seconds for a full liter**.
4. Most devices signal success (usually a light or symbol) when the full treatment time completes without interruption; if it's interrupted, start over.

Where to find it: outdoor and camping retailers and online sell UV pens, SteriPEN is the longest-established brand. **Carry spare batteries** (or keep a rechargeable model topped off), since the entire method fails the moment the battery dies, and cold temperatures reduce battery life faster than at room temperature. Like other methods here, it doesn't remove chemical contamination or improve bad taste, only clarify and disinfect first.

Watch it: Tentworld, "Steripen Ultra UV Water Purifier Demonstration & Review".

What doesn't work

Common myths, and why they're wrong

Freezing does not purify water. Giardia and Cryptosporidium both survive freezing and reactivate once the water thaws; chemical contaminants are entirely unaffected by temperature. Freezing is a storage tool, not a treatment method.

Alcohol, including high-proof liquor, does not purify water. Even a strong vodka isn't concentrated enough to reliably kill the bacteria and parasites that cause waterborne illness, and it adds a dehydration risk on top of whatever contamination was already there.

Taste, smell, and clarity are not reliable safety indicators. Water that looks and tastes completely normal can still carry a dangerous pathogen load. Treat based on the source and situation, not on how the water presents.

None of these five methods work on a harmful algal bloom

Every method above is built to handle biological pathogens, bacteria, viruses, and protozoa. A harmful algal bloom (cyanobacteria) is a different problem entirely, and boiling it doesn't help: it doesn't remove the toxin, and can actually concentrate it as water boils away while the toxin stays behind. This isn't hypothetical here: Utah Lake and the Jordan River both get recurring bloom advisories. If a water source has a visible bloom (thick green/blue-green scum, paint-like streaks) or an active health advisory, don't try to treat it with any method on this page; use a different source entirely, and never let pets drink from it either.

Before you need it

The Water & Food addendum's own Stage 2 goal is to actually treat a batch of water with bleach at the correct dose and separately with a filter you own, timed, without instructions in front of you, and its Stage 4 goal is owning at least two independent treatment methods so a single point of failure doesn't leave you without safe water. Reading this guide once isn't the same as being able to do it under pressure. Pick two methods, and actually practice them before you need them for real.

Write your own plan, in one sentence

Reading this once isn't the same as being able to do it under pressure. Finish this sentence with your own real plan:

"The next time *I do my seasonal water rotation* , I will actually practice *the bleach method, timed* ."

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

- CDC, "Make Water Safe During an Emergency" and Yellow Book water disinfection guidance: CDC; CDC Yellow Book
- EPA, "Emergency Disinfection of Drinking Water": EPA
- World Health Organization / SODIS Reference Centre, solar water disinfection protocol: SODIS.ch
- NSF International, filter and purifier certification standards (P231, 53, 58) and certified product search: NSF; certified products database
- LifeStraw and Sawyer NSF P231 certification status: Water Filter Guru
- EPA registration and active-ingredient comparison for chlorine dioxide water purification tablets: SectionHiker
- UV pen sterilizer effectiveness, EPA purifier requirements, treatment times, and clear-water dependency: InspectAPedia; CleverHiker
- CDC, infant formula preparation in emergencies and Cronobacter precautions for high-risk infants: CDC
- EPA, harmful algal blooms and cyanotoxins in drinking water (boiling does not remove them): EPA
- Utah Division of Water Quality, harmful algal bloom advisories for Utah Lake and the Jordan River: Utah DEQ
- Sodium hypochlorite shelf life and degradation rate: Solenis; Alliance Chemical
- PET bottle identification and SODIS bottle-selection requirements: Akvopedia; Eawag/Sandec

Working through this from Ready, Set, Ready? Head back to pick your next topic once this one's real.