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# Water Sovereignty

## 1. Potability

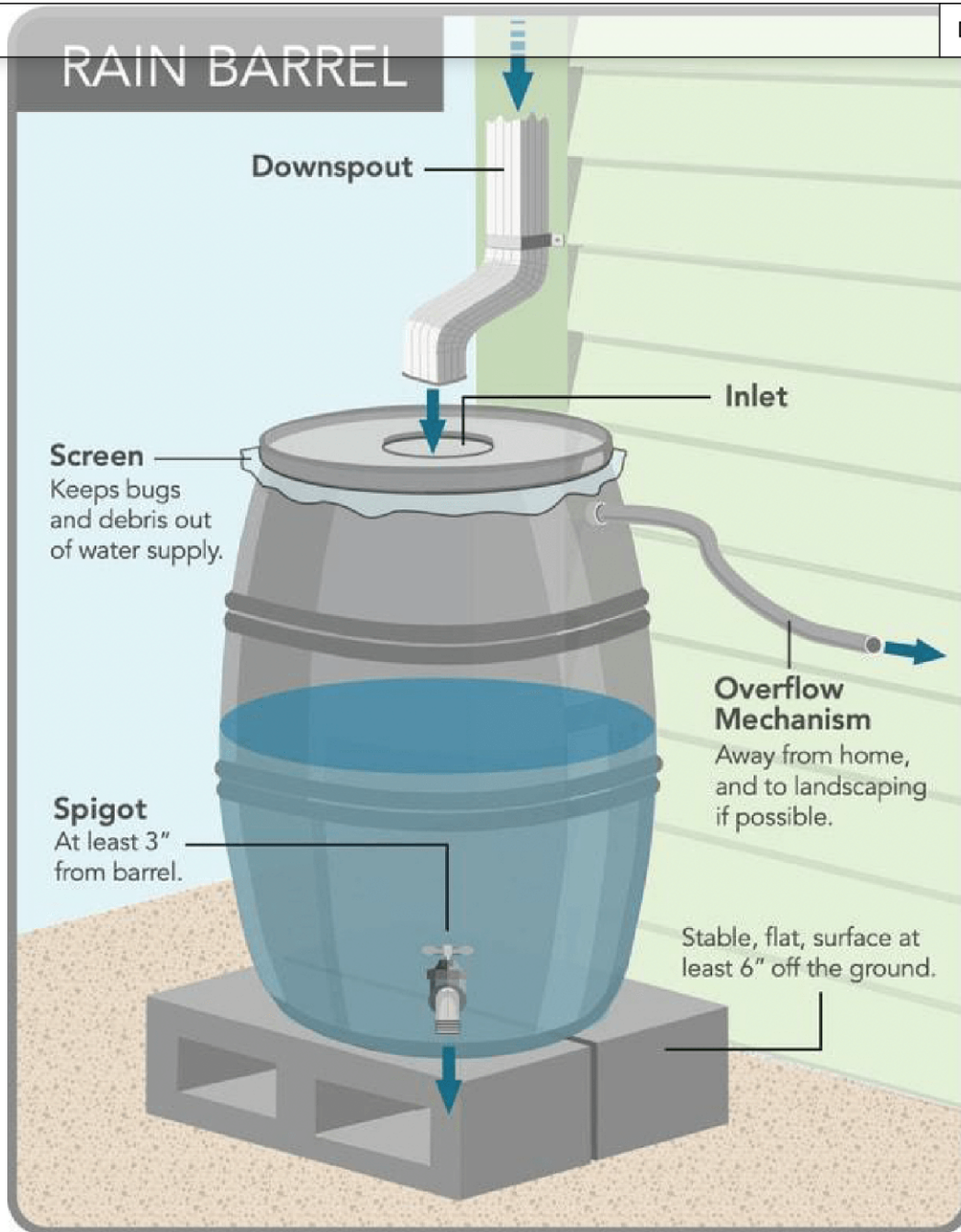
This is a reminder that collected water must be screened, settled, filtered, and disinfected before being considered potable (*or drinkable*). Please refer to the section on Purification when considering collecting water for drinking, washing, cooking, etc.

- **Screening:** Passing collected water through mesh filters to prevent large debris and solids from being collected with the water. This not only helps keep the water clean but also helps prevent damage or blockages of your collection systems.
- **Settling:** Sediment will settle to the bottom of a vessel, forming sludge or slurry at the base. Before being considered potable, collected water must first be allowed to settle in a vessel, then skimmed, pumped or siphoned from above the settlement layer. Settled sediment is a primary reason to regularly empty and clean vessels used for water storage. Best to do so before any rainy season, every 6-12 months.
- **Filtering:** Most filtering methods help prevent smaller sediment and particles from being included in drinking water. Others will help filter germs and chemicals from being included in your drinking water. We will include multiple examples of both.
- **Disinfecting:** Kills germs, bacteria, viruses, and parasites. Boiling is the most effective method, though chemical disinfectants are also available. Adding 8 drops of 6% bleach or 6 drops of 8.25% (*the two most common household bleach concentrations*) will disinfect a gallon of water.

## 2. Collection

To begin, collection of rainwater or other forms of water may or may not be legal in your area. Learn the local regulations and laws but regardless, attempt to keep collection methods out of sight of roads. Attention is best avoided, regardless of legality. If it must face the road, attempt to camouflage. Potted plants, lattices, trash bins, etc. will do, so long as the collection vessel is not in plain sight.

### a. Rain Barrels



A 1,000 ft<sup>2</sup> roof can collect 300 gallons of water for just a half inch of rain. Depending on the intended use of the water, this can be utilized without much alteration. Your roof will need gutters and a downspout, leading to a barrel. Viola, you have stored water for your crops and yard. Ideally, somewhere between roof and barrel is a leaf filter and a lid on your barrel to keep critters out, but this is truly all that's needed for water collection for watering plants.

Asbestos was commonly used in roofing tiles in the 1980's. Please do not collect rain water from roof built in the 80's. If unsure, contact a professional. Rain barrels can be set up without use of a roof, and other methods of water collection are in this guide.

Before setting up a barrel think: **Will I want it elevated? Will I want a hose attached?**

#### **Raise the barrel**

Best to do this step before the barrel has been filled. Water gets heavy fast, a 55 gal bucket weighs about 500lbs full. Do not attempt to lift a full barrel of water. Ensure that whatever you plan to use to stand the barrel on can withstand the weight of a full barrel, both the structure and the ground it sits on, ensuring the structure won't sink into soft earth.



Attaching a hose to the bottom of the barrel will allow gravity to do the work of moving the water you. As long as the head of the hose remains physically below the top of the water level, water will flow. Raising the barrel will affect how high you can hold your hose. This will make a big difference. If you connect a drip or seep watering system, this will ensure it will work until the last drop in the bucket.

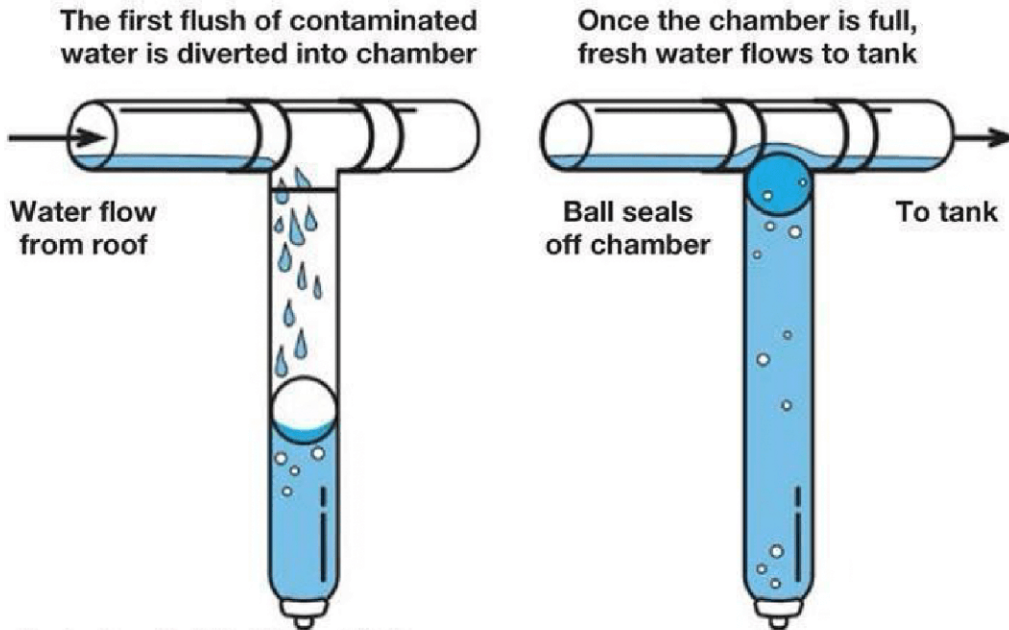
### Leaf Filters



You want to reduce the leaves and debris that enter your rain barrel. This requires filters that are accessible enough to be cleaned at least seasonally. You can have multiple layers of filters, but you want at least one larger mesh guard, higher in the flow path for catching leaves and sticks, as well as a finer mesh lower in the flow for catching smaller debris.

These filters can be on the gutters themselves and the barrel lid in order to remain accessible. Additionally, a filter can be added to the downspout. These can be found at hardware stores but can also be done at home with small difficulty. The easiest (*but not the best*) way to do so would be to make a cut in the downspout. Secure mesh to the upper opening of the bottom piece. Flare the top piece so the bottom piece can fit inside, continuing the path as it was before the cut, and secure the pieces back together with small sheet metal screws. This should result in a bisected downspout that, with the removal of a few screws, the mesh filter can be brushed off and put back in place.

### First Flush



Courtesy Innovative Water Solutions LLC (2)

A first flush system is highly valuable if you intend to use captured water for drinking, washing, cooking, etc. It's also helpful for garden plants, though not mandatory. What we intend with a "first flush" system is to allow the roof to be cleaned by the rain in the first few minutes of downpour before collecting. We will later go into other methods of filtering that can be used instead of, or preferably in conjunction with the first flush system.

Assuming your roof is decently clean, you'll want around 10 Liters or 2 ½ gallons worth of rain to pass through per 100 ft<sup>2</sup> before you begin collecting. For instance, If you have a 1000 ft<sup>2</sup> roof, but you only collect from the back half, your first flush system will need to accommodate 12 ½ gallons. If your roof is perfect, you can cut that in half. If it's the worst anyone's ever seen, quadruple it. Use discernment and speak with everyone who will use this water.

Integrating first flush will take some more work than just filtering. Essentially, your downspout will feed directly into a PVC pipe running almost parallel to the ground, with enough tilt that water will not pool and cause mildew. This will run to a T fitting that will have your flush system down and your clean water continuing on to your barrel.

The flush storage will need to be watertight from the T fitting, so make sure you're planning ahead. A section of large PVC can be used. In the previous example, collecting from half of a 1000 ft<sup>2</sup> roof, 9ft of 6in PVC will hold approx. 12 ½ gallons. Inside this section of pipe must be a hollow ball that will seal the connection to the T when the 12 ½ gallons has been filled, while still allowing water flow through the rest of the system. This will seal the "first flush" from the now clean water running through the system. On the bottom end of this section of pipe, must be a valve to empty this after each large rain, or whenever you think your roof needs another flush. If you are using a first flush instead of filters, you should have a larger opening in order to remove leaves/debris.

**Again, water gets heavy fast, ensure this system is well secured.** 9 ft of 6 in pipe full of water weighs over 100lbs.

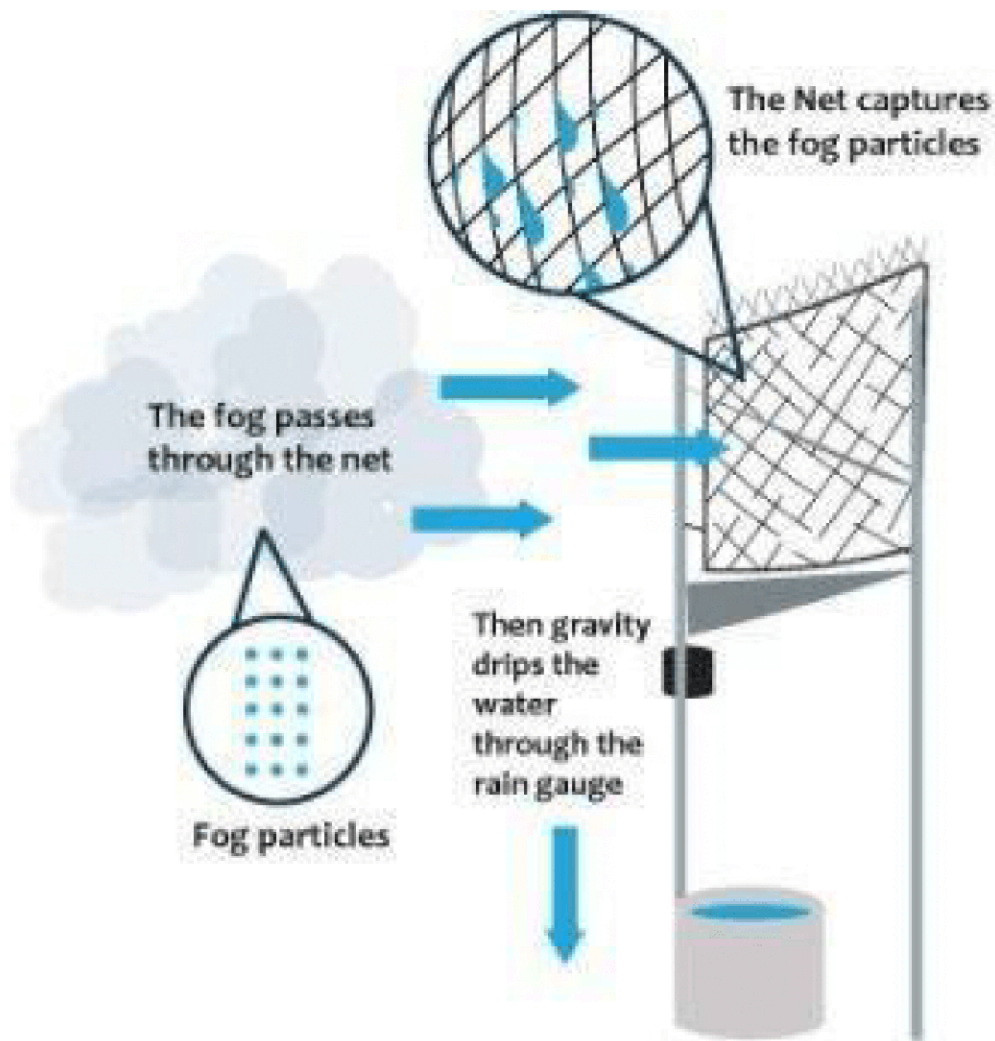
This is one way the first flush system can be implemented. Depending on your existing systems and property layout, you may find a different way to flush your roof or decide it isn't worth it.



## b. Condensation Traps:

These traps come in many forms such as: Fog nets, dew traps, transpiration traps, and solar stills. Solar stills will be covered in the purification section, as it works best when you already have collected, unfiltered water. The other forms of condensation traps, if clean materials are used, can collect already potable water from natural condensation. Depending on collection method, cleanliness of materials, and local levels of pollution, it is advisable to still disinfect or even filter this collected water.

### Fog Nets



Using a fine mesh or breathable fabric, find a location with consistent fog (*high elevation or near a body of water*) and secure it in the air with sturdy poles or branches. The fabric will collect moisture from the air and drip downwards, so angle the net to maximize exposure and minimize drip area, so you only need one collection point. Monitor the trap, adjust for efficiency (*catch more wind*) and clean when needed. Fine mesh like mosquito netting can be left to drip but thicker fabrics may need to be wrung out or used with other purification methods like the solar still.

### Dew Traps



In areas that acquire dew, or condensation on the grass and plants in the mornings, you can lay tarp, or fabrics to collect this moisture. A tarp will need to be folded and the condensation poured into a bowl or other collection method. Fabrics will again need to be wrung out. These should be collected in the mornings before the sun evaporates what you've collected. Depending on the cleanliness of your tarp/ fabric, this water can be considered filtered, but should still be disinfected.

### Transpiration Traps (*plant trap*)

Using a clear plastic bag, secure it around green foliage, like a tree branch. Close off the mouth of the bag with a rubber band, hair tie, Velcro strap, etc. After a few hours, the bag should acquire condensation inside. While setting up, be aware of how you will need to remove the bag and/or water.

## 3. Purification

When storing water for later use, it's common to screen the water being collected then allowing it to settle in storage containers, then filtering and disinfecting before use. When collecting for immediate use, filtration and disinfection take priority.

Screening and Settling are essentially preemptive measures that will allow your filtration and disinfection methods to last longer.

### a. Screening

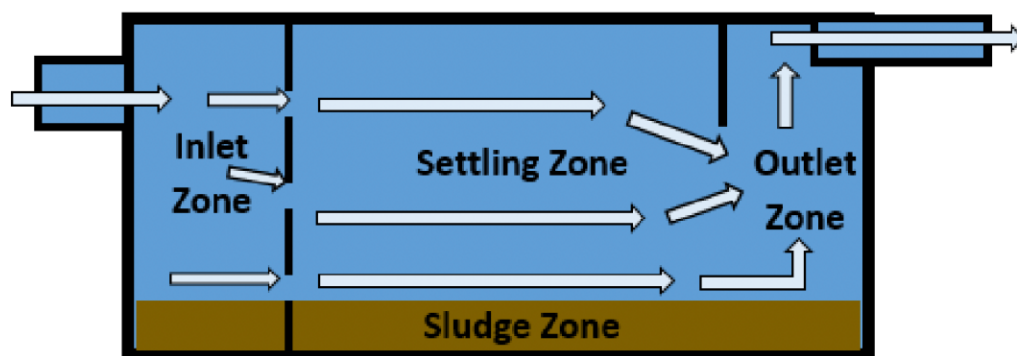
Mesh filters on your gutters is a method of screening. This is the preemptive removal of debris before storage. Anytime you have the opportunity to do so, you should. This can look like cleaning your traps, stills, and mesh filters, or even skimming debris from your storage containers.

#### First flush

*(Please refer to rain barrels collection method for a quick guide.)*

A first flush system is technically screening, washing the collection method before collection. Your roof collects dirt, dust, leaves, and all kinds of muck from the surrounding environment that you don't want to sit in your storage containers.

### b. Settling





Allowing water to be stored in containers where sediment can settle to the bottom is useful to help preserve your filtration devices. The less of that sediment that passes through a filter, the longer it will last. When pulling water from these containers, you should take from above the settlement line. You should clean your containers every 6-12 months, or when the settlement line rises too close to your collection point (*where the hose attaches*). If it is rising faster than that you may need to clean your collection system, or increase your first flush capacity.

### c. Filtration

Certain disinfection methods allow you to skip this step, namely distillation. But it isn't always feasible to distill a large amount of water for use.

If you want drinkable water, the earlier you start the better. If you have the ability to acquire a commercial filtration system, you can learn how to replace or refresh its filters. If you can connect one to your houses infrastructure, you can learn to maintain a pressurized system for if/when the water and power get cut off. This is a general guide and will focus on independent and DIY methods of filtration, that can be used without system integration. Remember to work together, utilize what you have to do what you can. Before attempting to innovate your filtration systems, ensure you can still have drinkable water if it doesn't work out. Expand and duplicate systems instead of replacing them. Redundancy is key.

**⚠ Remember to DISINFECT, you do not have drinkable water after this step.**

#### Charcoal filters

Both charcoal and activated charcoal can be purchased from hardware stores. Making your own is a time consuming and arduous task. Do not use common BBQ briquettes to make activated charcoal as they contain additives that will change the reaction.

First, how to make activated charcoal: charcoal is made from hardwood or fibrous plant material like coconut shells burned with little or no oxygen. This can be labor intensive and time consuming, so it is best to do large batches as a community. Chop hardwood or fibrous plants to fit into a metal container (*oil drum*) and build a bonfire around the container to burn for 3-5 hours and **DO NOT SEAL**. A 55gal drum full of hardwood requires 5 hours. Let cool overnight. Charcoal is useful on its own, store in a cool dry place.

To activate charcoal you will need:

- calcium chloride a.k.a. pickle crisp, or lemon juice in equal amounts
- a glass jar or non aluminum mixing pot with lid
- water and measuring cup
- cheesecloth or clean white sheet (no detergents or scents)
- cookie sheet or flat pan
- finished storage container (*airtight jar*)
- eye protection

Instructions:

1. Crush charcoal into a powder.
2. Make a 1 to 3 solution with calcium chloride and water. 1 part calcium chloride 3 parts water. This reaction produces HEAT, if mixing in jar, release pressure periodically.



3. In glass or non aluminum bowl/ jar, make a paste with the solution and powdered charcoal, slowly adding solution until paste is spreadable, drain leftover solution.

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4. Let dry for 24 hours.
5. Spread on white sheet or cheesecloth. Rinse with water (you can collect this and run it through a coffee filter to collect carbon you would've lost).
6. Move carbon from sheet (*and coffee filter*) to cookie sheet.
7. Bake at 250 F for 30 minutes or until all moisture is gone.
8. Cool and break apart to store in airtight jar.

Activated charcoal doesn't "go bad" but will become less effective while exposed to air. Stored in an airtight jar, the effectiveness will not diminish. In plastic, it can remain effective for 1 to 3 years.

### **Bucket method**

This method can be used with any container, ranging in sizes from plastic water bottles to 100 gallon containers.

#### **Materials:**

- (2) plastic bucket (*food safe preferred*)
- drill (*~1/4in bit*)
- activated charcoal
- fine sand
- fine gravel
- clean cloth/coffee filters
- scissors

Clean all materials before assembling (*charcoal, gravel, and sand should be rinsed*).

#### **Instructions:**

1. Using the drill, create holes in the bottom of one bucket for drainage.
2. Place a layer of clean cloth or coffee filters in the bottom of the bucket with holes.
3. Add a layer of charcoal, followed by a layer of sand, and then a layer of fine gravel.
4. A second plastic bucket can be used to place pressure on the sand, this will improve durability.

Re-make your filter at least once a year or when taste becomes affected. Some sources recommend as early as 3 months.

### **Ceramic filters**

Ceramic clay, when dried, will filter water. Form a cone shape with ceramic clay and allow to dry completely, use a coffee filter as well as any filter materials you have from the bucket method (*gravel, sand, charcoal*) in layers to help filter. Replace fillers as needed, clean the ceramic regularly, and boil it periodically to disinfect.

Any size ceramic will filter water, a disk can be added to a bucket method filter, or a large ceramic pot can be suspended in your containers to catch the water before it is filtered into the larger container.

### **Bio-filter**



Certain plants can be used to filter water. Aquatic plants such as water hyacinth, water lettuce, a duckweed work well or bog plants like cattails, reeds, and rushes. Different plants will have different growing methods and will require different upkeep and planting methods. If added to your containment system, can increase the quality of your water. *Not a substitute for filtration.*

## d. Disinfection

### Boiling

The most effective and simple method of disinfection, bringing water to a rolling boil for at least 2 minutes and up to 10 will kill most germs and microorganisms in you water, making it safe to drink. This will not remove contaminants or sediment, which is why it should be used in conjunction with filtration methods. Will not eliminate chemical contaminants.

### UV Disinfection (*sodis*)

Allowing water to sit under a UV lamp or in the sun can help kill certain microorganisms that won't be caught with filtration. You should have your water in a clear plastic bottle for this to work best. Will not eliminate chemical contaminants.

### Chemical Disinfectant

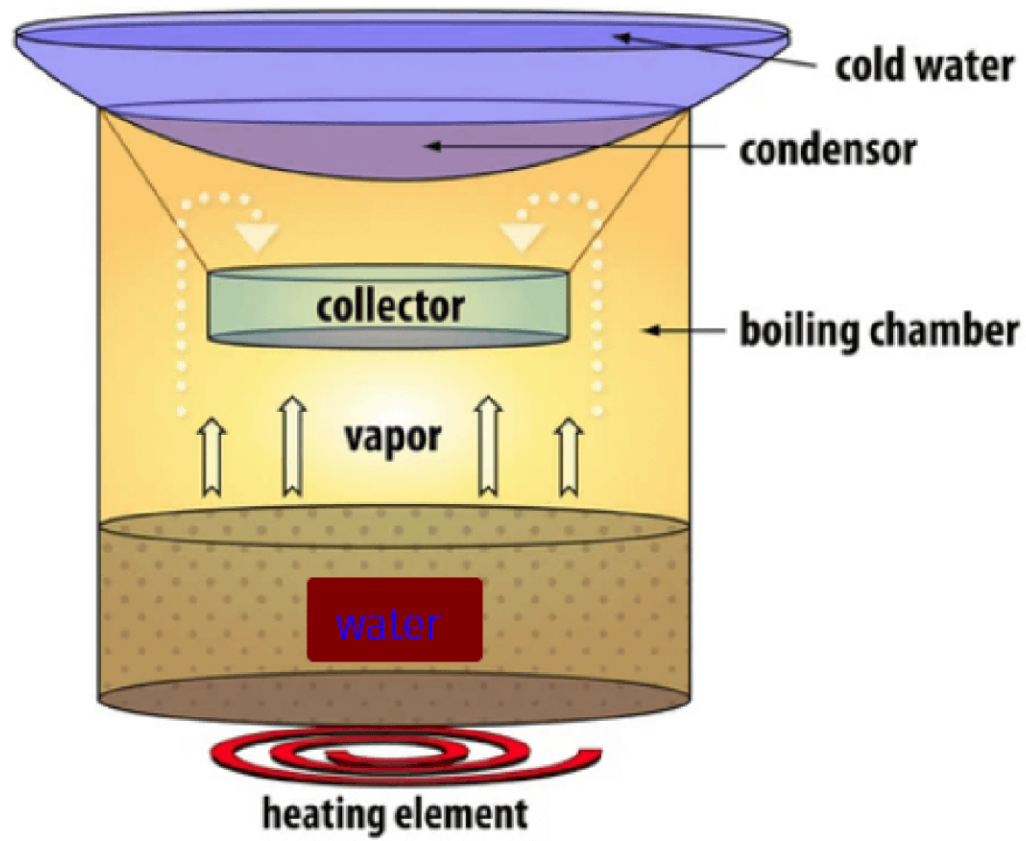
**⚠️** *Overusing bleach can be as harmful or more so than allowing certain contaminants to remain. Please be sure to have an accurate method to measure, such as an eyedropper from smaller containers.*

<i>Bleach either contains 6 or 8.25% sodium hypochlorite. Volume of Water</i>	Amount of 6% bleach to add	Amount of 8.25% bleach to add
1 quart/liter	2 drops	2 drops
1 gallon	8 drops	6 drops
2 gallons	16 drops (1/4 tsp)	12 drops (1/8 tsp)
3 gallons	1/3 tsp	1/4 tsp
4 gallons	2/3 tsp	1/2 tsp

Stir into water and allow to sit for 30 minutes. Water should have a slight chlorine odor. If it doesn't, repeat dosage and wait another 15 minutes. If chlorine taste is too strong, pour the water from one container to another clean container and let stand for a few hours before use.

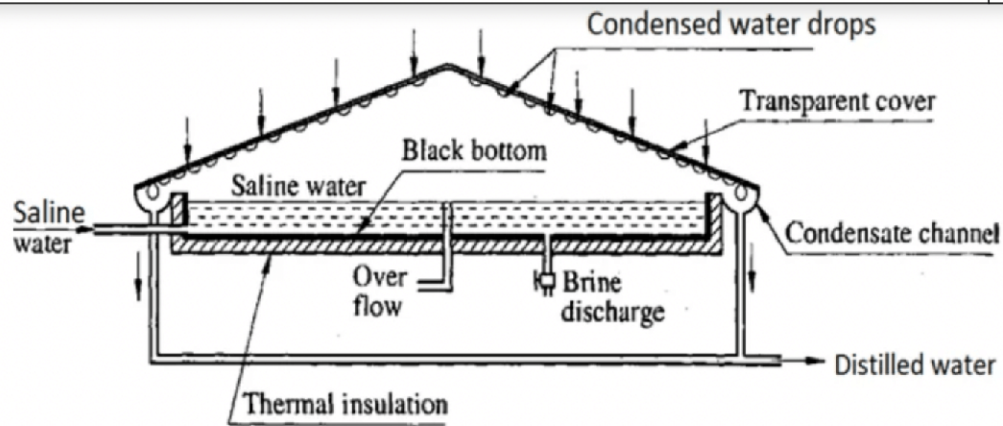
Common household iodine or tincture of iodine can be found in some first aid kits. 5 drops of 2% iodine for each liter of water will disinfect. Stir and let stand for 30 minutes.

### Distillation



A simple still can be made with a large pot with a lid and a smaller heat resistant container. Placing the smaller container in the center of your large pot to catch clean water, fill the pot with the water you want to purify. Don't fill over halfway up the smaller container, as you will get boil over. A small magnet can be used to help secure the smaller container if applicable. Cover the pot with the lid upside down to create a slope into the smaller container. Bring the water to a boil then reduce to a simmer. Place ice or a cool rag on top of the lid to help condense the moisture. Steam will be caught on the lid and roll down to fall into your smaller container. This water is now safe to drink.

### Solar Stills



A solar still uses the heat of the sun to evaporate unfiltered water and catching the condensation and allowing it to collect as filtered water. In order to do this you need a clear material to form a covering or roof for the dirty water. Common forms include using glass or clear plastic to form an A frame roof above the pool of unfiltered water, or using a sheet of plastic to form an inverted cone above the unfiltered water, placing a small stone or weight in the center of the sheet. For either method, choose an area with as much direct sunlight as possible.

First the concept of an A frame: You will need to hold water under the center of the A frame that will evaporate and rise to hit the glass. Condensation will then form on the glass of the A frame and roll downwards, where you will need to have something to catch the now filtered water. Note: when constructing the A frame, two rectangular pieces of glass or plastic are met on edge and angled outward, and two pieces of wood, plywood, or other material is cut to join these two and form a standing structure, much like an A frame house.

The inverted cone is best described if you imagine first a small hole dug in the ground. A bowl for our clean water will be set in the center, and our unfiltered water will go around it. This water can look like anything from moist soil, to vegetation, to damp cloth. Have the center of the hole raised so the bowl is raised. A clear plastic sheet is then suspended over the hole, secured on the edges and weighed down in the center. The unfiltered water will evaporate from the sun's heat, condense on the plastic sheet, roll down to the center and drip into the bowl. A long tube or "straw" can be run from the center collection bowl to outside the cone to drink from without having to reset the whole contraption.

***Depending on the cleanliness of your stills, this water is safe to drink.***

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