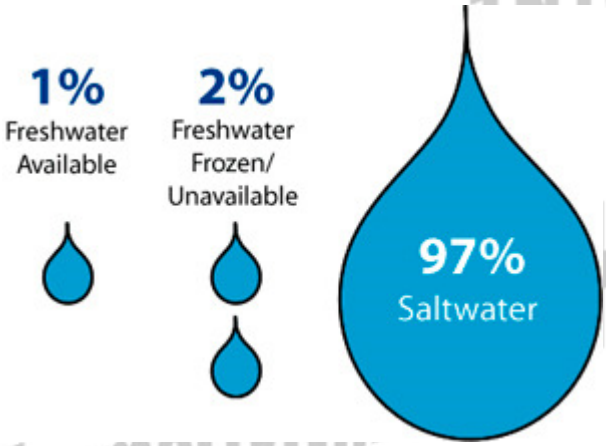
Water & Sanitation Preparedness

Water is one of those necessity to physical life things that we cannot ignore. Right up there with breathable air, nutritional food and protection from the elements (shelter, clothing, heat and cooling).

Water is distributed throughout our "spaceship", Earth, in the form of freshwater and salt water in the oceans. Our planet is often called the "blue planet" because when viewed from space it appears blue, which is caused by the reflection from the oceans which cover about 71% of the surface of the Earth. That means the ratio of salt water to fresh water on Earth is around 40 to 1.

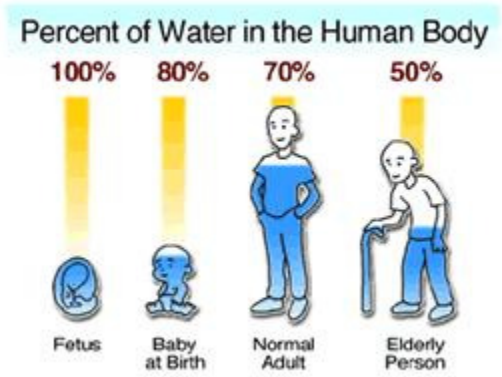


Even though almost three-quarters of the Earth's surface is covered with water, *less than 1% is freshwater and fit for human consumption.*

The human body is more than 60% water. Blood is 92% water, the brain and muscles are 75% water, and bones are about 22% water.

The amount of water lost from the body through urine, water vapor from the lungs, and through perspiration averages 2.5 liters per day. Water loss *must* be made up by fluids consumed, and by the water produced in the body as a result of metabolic processes.

The effects of dehydration on the body are dramatic. They range from thirst to stronger thirst, sleepiness, apathy, nausea, emotional instability, labored breathing and dizziness, delirium--and finally death. Infants, children, the elderly or physically ill persons are particularly susceptible to dehydration.



A human can survive for a month or more without eating food, but only a week or so without drinking water. A loss of only 10% to 22% body weight as water is fatal. Hence it's necessity to physical life status.

To be sure we are all on the same page when it comes to certain terms that will be used in this article, please check out the Glossary at the end ;-}

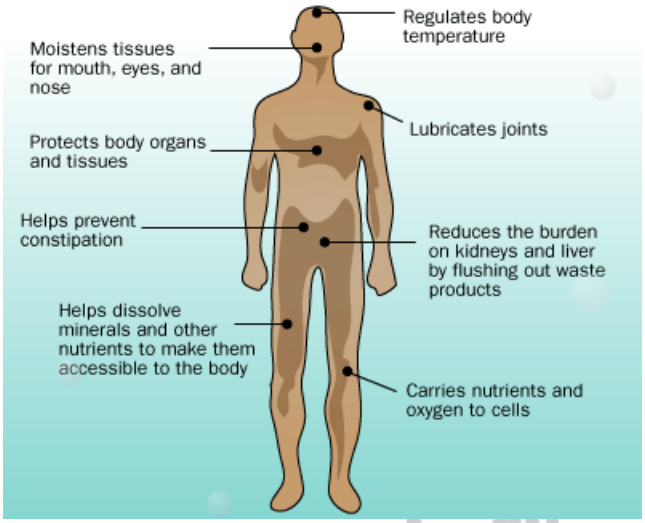
When Preppers discuss water needs, we need to consider ALL our water needs: drinking, personal hygiene & general washing (grey water), crops and irrigation, cooking, sanitation ("black" or waste water), conservation of water, purification of water and, if we have a long duration crisis on our list, where we can find additional water.





Tip: Preppers are big on the 5 gallon buckets with lids. Food Grade and non-food grade. This is because you can store all kinds of things in them and they shouldn't be too heavy to lift. Also you can make a non-food grade bucket food grade by purchasing rolls of the 5 gallon food grade plastic bags (cheaper than food grade buckets) to line the bucket and make it food grade. When you can get the buckets for free, purchasing these bags and lids is still less than the cost of a food grade bucket and lid purchased new.

Waters Effects On The Body



Let's take a closer look at our water needs first:

We already know that water is a necessity to life, but ***how much do we need to survive****?*

- General Rule with hygiene: MINIMUM is 1 Gallon per person per day for drinking and sanitation
- Human General Average: MINIMUM of 2 liters or 8 cups per day to maintain efficiency
  - About one quart of water is needed daily for every 50 pounds of body weight
  - Children require about 4-6 cups of fluid per day on average

Factors that Determine the Water Needs for adults, children and (some) pets:

- *Age* - Children may need more water
- *Weight* - The heavier a human or pet is, usually means they need more water to sustain themselves.
- *Activity* - The less active one is; the less water they can get away with.
- *Health* - A female that is pregnant or nursing needs more water than one that is not; someone who is ill could need more water. A medical emergency might require additional water.
- *Climate* - If you live in a warm weather climate, more water may be necessary. In very hot temperatures, water needs can double.
- *Dogs & Cats* - *Dry pet food* will require *more* water for the pet than wet pet food.

This means a normally active person needs to drink at least two quarts of water each day, but that amount can vary. Children, nursing mothers and ill people may need more, and during summer you should double the amount of water stored. You will also need additional water for food preparation and hygiene. An adequate supply of water for pets should also be included.

Whereas a quart of water or other fluid daily will sustain life, according to the *Department of Defense and the Office of Civil Defense*, it is recommended that a gallon of water per day per person be stored for food preparation and drinking. A gallon provides added comfort and accommodates increased fluid needs at higher altitudes or warm climates. *An additional one-half to 1 gallon per day* is recommended for bathing and hygiene, and to wash dishes. ***So the DoD says 2 gallons per person per day!***

How much water should be stored?

The rule of thumb is to store at least one gallon per person per day for at *minimum 3 days*, with the *recommendation of 10 days* to be really prepared.

That's 2 quarts for drinking and 2 quarts for food preparation and sanitation per day, per person *at minimum*.

A family of four should store a minimum of 12 gallons of water.

Do the Math

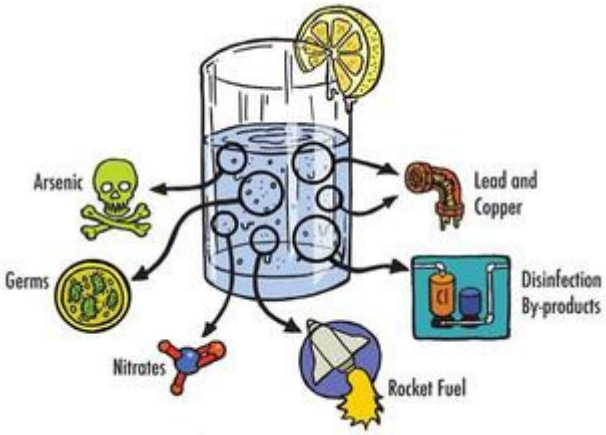
- 1 Gallon of Water = a little over 8 pounds
- Water for 1 person for 3 days = about 24 pounds
- Water for 1 person for two weeks (14) days = a little over 116 pounds
- Water for 1 person for 30 days = about 240 pounds

No matter how you look at it that is a lot of water, a lot of weight and a lot of storage space that is needed for just a two week supply for an individual, yet alone an entire family and pets.

Hint: Keep waterless anti-bacterial hand gel and or wet wipes to reduce hygiene water needs.

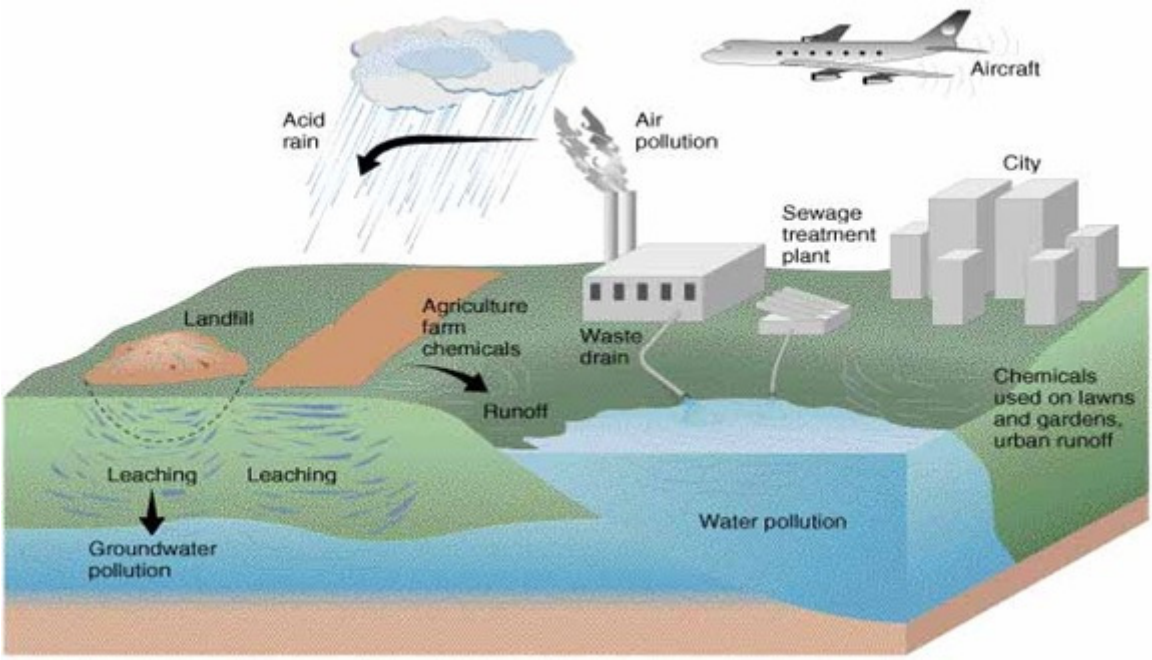
The survival quantity of 1 gallon per person per day – is just that – the bare, very basic, best case MINIMUM!

Warning: If there is a crisis on your list that can take out electricity city wide or larger, *you will lose water*. This means that even if you do NOT have any long duration crisis on your crisis list - you still need to think about water at the very least.



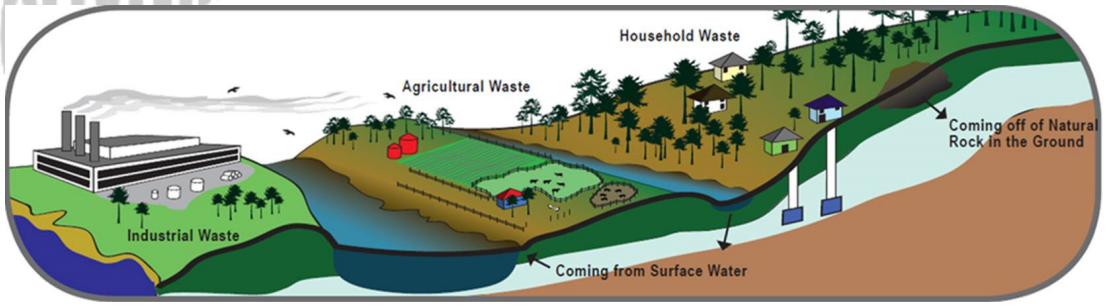
Contaminants

Water contamination or pollution is any chemical, physical or biological change in the quality of water that has a harmful effect on *any* living thing that drinks or uses or lives (in) it. When humans drink polluted water it often has serious effects on their health. Water pollution can also make water unsuited for the desired use.



Water contaminants can come from a number of sources and are called many different things. Even rain water has acquired some contaminants as it passes through the atmosphere (acid rain) and then when traveling off a roof into its collection barrel. A disaster such as a flood or an earthquake, may contaminate water when sewage systems are damaged or when there are breaks in the water lines. If there is a minimum of a city-wide power failure, water treatment plants shut down and contaminants can be passed into the system. When power comes back, the water now traveling through the contaminated pipes will become contaminated itself.

Unfortunately, water contamination is usually caused by human activities. There are two sorts of sources, point and nonpoint sources. Point sources discharge pollutants at specific locations through pipelines or sewers into the surface water. Nonpoint sources are sources that cannot be traced to a single site of discharge.



(NC Department of Health and Human Services, 2011)

Examples of Point Sources are: factories, sewage treatment plants, underground mines, oil wells, oil tankers and agriculture.

Examples of Nonpoint Sources are: acid deposition from the air, traffic, pollutants that are spread through rivers and pollutants that enter the water through groundwater. Nonpoint pollution is hard to control because the perpetrators cannot be traced.

There are several **Classes of Water Contaminants:**

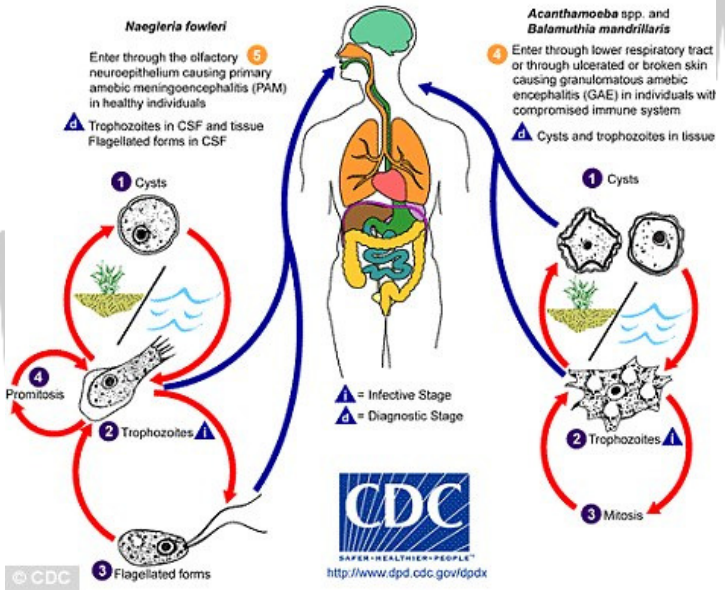
Contaminant Class	**Definition**
Disease-causing Agents	These are bacteria, viruses, protozoa and parasitic worms that enter sewage systems and untreated waste.
Oxygen-demanding Wastes	These are wastes that can be decomposed by oxygen-requiring bacteria. When large populations of decomposing bacteria are converting these wastes it can deplete oxygen levels in the water. This causes other organisms in the water, such as fish, to die.
Water-soluble Inorganic Contaminants	Such as acids, salts and toxic metals. Large quantities of these compounds will make water unfit to drink and will cause the death of aquatic life.
Nutrients	These are water-soluble nitrates and phosphates that cause excessive growth of algae and other water plants, which deplete the water's oxygen supply. This kills fish and, when found in drinking water, can kill young children.
Organic Compounds	Such as oil, plastics and pesticides, which are harmful to humans and all plants and animals in the water.
Suspended Sediment	These cause the depletion in the water's light absorption and the particles spread dangerous compounds such as pesticides through the water.
Water-soluble Radioactive Compounds	Can cause cancer, birth defects and genetic damage.

Then there are things like:

Heat Pollution	In most manufacturing processes a lot of heat originates that must be released into the environment, because it is waste heat. The cheapest way to do this is to withdraw nearby surface water, pass it through the plant, and return the heated water to the body of surface water. The heat that is released in the water has negative effects on all life in the receiving surface water. This is the kind of pollution that is commonly known as heat pollution or thermal pollution. The warmer water decreases the solubility of oxygen in the water and it also causes water organisms to breathe faster. Many water organisms will then die from oxygen shortages, or they become more susceptible to diseases.
Eutrophication	Eutrophication means natural nutrient enrichment of streams and lakes. The enrichment is often increased by human activities, such as agriculture (manure addition). Over time, lakes then become eutrophic due to an increase in nutrients. Eutrophication is mainly caused by an increase in nitrate and phosphate levels and has a negative influence on water life. This is because, due to the enrichment, water plants such as algae will grow extensively. As a result the water will absorb less light and certain aerobic bacteria will become more active. These bacteria deplete oxygen levels even further, so that only anaerobic bacteria can be active. This makes life in the water impossible for fish and other organisms.
Acid Rain	Typical rainwater has a pH of about 5 to 6. This means that it is naturally a neutral, slightly acidic liquid. During precipitation rainwater dissolves gasses such as carbon

	dioxide and oxygen. The industry now emits great amounts of acidifying gasses, such as sulphuric oxides and carbon monoxide. These gasses also dissolve in rainwater. This causes a change in pH of the precipitation – the pH of rain will fall to a value of or below 4. When a substance has a pH of below 6.5, it is acid. The lower the pH, the more acid the substance is. That is why rain with a lower pH, due to dissolved industrial emissions, is called acid rain.
Rotten Egg Smell	When water is enriched with nutrients, eventually anaerobic bacteria, which do not need oxygen to practice their functions, will become highly active. These bacteria produce certain gasses during their activities. One of these gases is hydrogen sulphide. This compounds smells like rotten eggs. When water smells like rotten eggs we can conclude that there is hydrogen present, due to a shortage of oxygen in the specific water.
White Deposit on water fixtures (faucets, sinks, showers stalls)	Water contains many compounds. A few of these compounds are calcium and carbonate. Carbonate works as a buffer in water and is thus a very important component. When calcium reacts with carbonate a solid substance is formed, that is called lime. This lime is what causes the white deposit on showers and bathroom walls and is commonly known as lime deposit. It can be removed by using a specially suited cleaning agent.

So water contaminates come from a multitude of sources, some natural and too many are human induced. Just living our lives creates contaminates that can leach into water, from taking care of our homes and yards, driving our vehicles, to doing our job at work.



Here is a list of the most likely contaminants:

Acids and Alkalies	The natural buffering system of a water source is exhausted by the discharge of acids and alkalies. Aquatic life is affected by the wide swings in pH as well as the destruction of bicarbonate alkalinity levels.
Bacteria - (for example, Campylobacter, Salmonella, Shigella, E. coli)	Potential health effects from ingestion of water contaminated with bacteria are: • Gastrointestinal illness (for example, diarrhea, vomiting, cramps). Sources of bacteria in drinking water are: • Human and animal fecal waste. Methods that may remove some or all of bacteria from drinking water are: • Boiling (Rolling boil for 1 minute) has a very high effectiveness in killing bacteria; • Filtration has a moderate effectiveness in removing bacteria when using an absolute less than or equal to 0.3 micron filter; • Disinfection with iodine or chlorine has a high effectiveness in killing bacteria;

	• Disinfection with chlorine dioxide has a high effectiveness in killing bacteria; • Combination filtration and disinfection has a very high effectiveness in removing and killing bacteria when used with iodine, chlorine, or chlorine dioxide and an absolute less than or equal to 0.3 micron filter (NSF Standard 53 or 58 rated "cyst reduction / removal" filter).
Chemical	If your water supply has become contaminated by pesticides, fertilizers, herbicides, or petroleum and its additives, mine tailings or other chemicals, *disinfecting the water will not correct those unsafe conditions* ** Boiling, filtering, or chemically treating water can remove or kill microorganisms, but it will not remove chemical toxins. This is also the case when using a solar still.
Metals & Heavy Metals	Certain metals are toxic and affect industrial, agricultural, and municipal users of the water source. Metals can cause product quality problems for industrial users. Large quantities of discharged salts necessitate expensive removal by downstream industries using the receiving stream for boiler makeup water. For many metals and Heavy Metals, *disinfecting the water will not correct those unsafe conditions.* ** Do NOT boil water to attempt to reduce Lead. Boiling water increases lead concentration. Always use water from the cold tap for preparing baby formula, cooking, and drinking. Flush pipes first by running the water before using it. Allow the water to run until it's cold. If you have high lead levels in your tap water, talk to your health care provider about alternatives to using boiled water in baby formula.
Organic Compounds	The amount of organic material that can be discharged safely is defined by the effect of the material on the dissolved oxygen level in the water. Organisms in the water use the organic matter as a food source. In a biochemical reaction, dissolved oxygen is consumed as the end products of water and carbon dioxide are formed. Atmospheric oxygen can replenish the dissolved oxygen supply, but only at a slow rate. When the organic load causes oxygen consumption to exceed this resupply, the dissolved oxygen level drops, leading to the death of fish and other aquatic life. Under extreme conditions, when the dissolved oxygen concentration reaches zero, the water may turn black and produce foul odors, such as the "rotten egg" smell of hydrogen sulfide. Organic compounds are normally measured as chemical oxygen demand (COD) or biochemical oxygen demand (BOD).
Protozoa - Cryptosporidium	Potential health effects from ingestion of water contaminated with Cryptosporidium are: • Gastrointestinal illness (for example, diarrhea, vomiting, cramps). Sources of Cryptosporidium in drinking water are: • Human and animal fecal waste. Methods that may remove some or all of Cryptosporidium from drinking water are: • Boiling (Rolling boil for 1 minute) has a very high effectiveness in killing Cryptosporidium; • Filtration has a high effectiveness in removing Cryptosporidium when using an absolute less than or equal to 1 micron filter (NSF Standard 53 or 58 rated "cyst reduction / removal" filter); • Disinfection with iodine or chlorine is not effective in killing Cryptosporidium; • Disinfection with chlorine dioxide has a low to moderate effectiveness in killing Cryptosporidium; • Combination filtration and disinfection has a very high effectiveness in removing and killing Cryptosporidium when used with chlorine dioxide and an absolute less than or equal to 1 micron filter (NSF Standard 53 or 58 rated "cyst reduction / removal" filter).
Protozoa - Giardia intestinalis (also known as Giardia lamblia)	Potential health effects from ingestion of water contaminated with Giardia are: • Gastrointestinal illness (for example, diarrhea, vomiting, cramps). Sources of Giardia in drinking water are: • Human and animal fecal waste. Methods that may remove some or all of Giardia from drinking water are: • Boiling (Rolling boil for 1 minute) has a very high effectiveness in killing Giardia;

	• Filtration has a high effectiveness in removing Giardia when using an absolute less than or equal to 1 micron filter (NSF Standard 53 or 58 rated "cyst reduction / removal" filter); • Disinfection with iodine or chlorine has a low to moderate effectiveness in killing Giardia; • Disinfection with chlorine dioxide has a high effectiveness in killing Giardia; • Combination filtration and disinfection has a very high effectiveness in removing and killing Giardia when used with chlorine dioxide and an absolute less than or equal to 1 micron filter (NSF Standard 53 or 58 rated "cyst reduction / removal" filter).
Nutrients	*Nitrogen and Phosphorus* are essential to the growth of plants and other organisms. • *Nitrogen compounds can have the same effect on a water source as carbon-containing organic compounds*. Certain organisms use nitrogen as a food source and consume oxygen. ** Do NOT boil water to attempt to reduce Nitrates. Boiling water contaminated with nitrates increases its concentration and potential risk. If you are concerned about nitrates, talk to your health care provider about alternatives to boiling water for baby formula. • *Phosphorus* is a concern because of algae blooms that occur in surface waters due to its presence. During the day, algae produce oxygen through photosynthesis, but at night they consume oxygen.
Particulates	The term "Particulates" refers to particles of rust, dirt, sand, and sediment found in drinking water. Water that contains Particulates is typically cloudy, and as you might expect, tastes and smells "dirty". By themselves, Particulates are not known to cause any adverse health effects, but they can sometimes carry other harmful organic, inorganic, and microbiological contaminants through the drinking water system. In general, better filters will remove finer particles. Each filter's ability to remove particulates is measured against a certain "particulate class", or particle size. Class I - 0.5 to 1 micron Class II - 1 to 5 microns Class III - 5 to 15 microns Where one micron is one millionth of a meter or approximately 1/25,000 of an inch. For example, if a filter is rated to remove "95.1% of Particulates (Class II)", that just means that it will remove 95.1% of all particles that are between 1 and 5 microns in size.
Sediment	Sediment is nothing more than dirt and rocks that settle on the bottom of lakes, rivers, and streams. Dredging, floods, or even bottom-feeding fish can sometimes stir sediment back into the water, and cause turbidity. Sediment doesn't cause any adverse health effects, but like particulates, sediment can carry other harmful organic, inorganic, and microbiological contaminants. Sediment is removed to some extent by all of the filters we sell. In general, better filters will remove finer sediment.
Viruses - (for example, enterovirus, hepatitis A, norovirus, rotavirus)	Potential health effects from ingestion of water contaminated with viruses are: • Gastrointestinal illness (for example, diarrhea, vomiting, cramps), hepatitis, meningitis. Sources of viruses in drinking water are: • Human and animal fecal waste. Methods that may remove some or all of viruses from drinking water are: • Boiling (Rolling boil for 1 minute minimum) has a very high effectiveness in killing viruses; • Filtration is not effective in removing viruses; • Disinfection with iodine or chlorine has a high effectiveness in killing viruses; • Disinfection with chlorine dioxide has a high effectiveness in killing viruses; • Disinfection has a high effectiveness in killing viruses when used with iodine, chlorine, or chlorine dioxide.
2,4-D	2,4-D is a herbicide used to control broad-leaf weeds in crops like wheat and corn, and on pasture and rangelands. It's also used to control woody plants along roadsides, railways, and powerlines. Like other herbicides, 2,4-D enters surface-water as a result of runoff, and enters underground-water by leaching - that's when water from rain, irrigation, or other sources flows through the soil, dissolves the chemicals in it, and carries them down into the groundwater that supplies wells and springs. Short-term exposure to 2,4-D can cause damage to the nervous system, while long-term exposure can cause damage to the liver and kidneys.
Alachlor	Alachlor is a herbicide used to control annual grasses and broadleaf weeds in crops like corn, sorghum, and soybeans. Like other herbicides, Alachlor enters surface-water as a result of runoff,

	and enters underground-water by leaching - that's when water from rain, irrigation, or other sources flows through the soil, dissolves the chemicals in it, and carries them down into the groundwater that supplies wells and springs. Short-term exposure to Alachlor can cause slight skin and eye irritation, while long-term exposure can cause damage to the liver, kidneys, spleen, lining of the nose & eyelids, and cancer.
Asbestos	Asbestos is a very durable, heat resistant Mineral Fiber found in a variety of building materials like insulation, floor & ceiling tiles, roofing, exterior siding, and fireproof boards. It can also be found in some appliances including toasters, broilers, slow cookers, waffle irons, dishwashers, and refrigerators.
Atrazine	Atrazine is a herbicide used to control broadleaf and grassy weeds. Like other herbicides, Atrazine enters surface-water as a result of runoff, and enters underground-water by leaching - that's when water from rain, irrigation, or other sources flows through the soil, dissolves the chemicals in it, and carries them down into the groundwater that supplies wells and springs. Short-term exposure to Atrazine can cause: • Congestion of the heart, lungs, and kidneys • Low blood pressure • Muscle spasms • Weight loss • Damage to the adrenal glands Long-term exposure to Atrazine can cause weight loss, cardiovascular damage, retinal & muscle degeneration, and cancer.
Benzene	Benzene is a chemical compound used in the manufacture of plastics, rubber, resins, and synthetic fabrics like nylon and polyester. It is also used as a solvent in the printing, paint, and dry cleaning industries. Short-term exposure to Benzene can cause temporary nervous system disorders, immune system depression, and Anemia. Long-term exposure can cause chromosome aberrations and cancer.
Carbofuran	Carbofuran is an insecticide used to control beetles, nematodes, and rootworm on crops like alfalfa, rice, corn, grapes, etc. Like other insecticides, Carbofuran enters surface-water as a result of runoff, and enters underground-water by leaching - that's when water from rain, irrigation, or other sources flows through the soil, dissolves the chemicals in it, and carries them down into the groundwater that supplies wells and springs. Short-term exposure to Carbofuran can cause: • Headaches • Sweating • Nausea • Diarrhea • Chest pains • Blurred vision • Anxiety • Muscular weakness Long-term exposure to Carbofuran can cause damage to the nervous and reproductive systems.
Chlorine	Chlorine is a chemical element - you may remember it from high school chemistry as atomic number 17 from the periodic table. Chlorine has been used by water treatment plants in the U.S. since the early 1900's because it is a very powerful disinfectant. It kills deadly germs and microorganisms that might otherwise cause life-threatening waterborne diseases such as cholera, typhoid, and dysentery. So, Chlorine is a good thing... as long as you don't mind the bad taste and odor that comes along with it - remember the last time you swam at the neighborhood pool? The good news is that your refrigerator filter will remove the Chlorine just before you drink the water. It's the best of both worlds really... your drinking water is safe AND tasty!
Chlorobenzene	Chlorobenzene is a chemical compound with an almond-like smell. Chlorobenzene is used in the manufacture of chemicals & insecticides, and as a solvent for adhesives, drugs, rubber, paints, and dry-cleaning. Short-term exposure to Chlorobenzene can impair the function of the liver and kidneys, while long-term exposure can cause liver, kidney, and central nervous system damage.
Cyst	A cyst is the survivable form that parasites take on when they leave the host (you, me, your dog, etc...). The parasite goes dormant and grows a thick covering like an egg which allows it to

	survive in water or soil for long periods of time. The covering even allows it to survive the chlorine-based disinfectants typically used by the water treatment industry. The most common types of cyst that cause disease in humans are Giardia and Cryptosporidium. These intestinal parasite cysts "hatch" when ingested by humans and cause intestinal disease. The diseases are not life threatening if treated, but can be dangerous to people with weakened immune systems. Symptoms Include: • Diarrhea • Abdominal cramping • Nausea • Vomiting • Fever • Headache • Loss of appetite
Dichlorobenzene	Dichlorobenzene is a colorless organic compound with a pleasant, aromatic odor. Dichlorobenzene is used in the manufacture of agricultural chemicals & herbicides, and as a solvent for things like wax, gum, resin, wood preservatives, and paints. It's also found in some insecticides, dyes, coolants, deodorizers, and degreasers. Long-term exposure to Dichlorobenzene can cause nervous system damage, as well as damage to the liver, kidneys, and blood cells.
Endrin	Endrin is an insecticide used to control insects, rodents, and birds on field crops such as cotton, corn, sugarcane, rice, cereals, and ornamentals. Like other insecticides, Endrin enters surface-water as a result of runoff, and enters underground-water by leaching - that's when water from rain, irrigation, or other sources flows through the soil, dissolves the chemicals in it, and carries them down into the groundwater that supplies wells and springs. Short-term exposure to Endrin can cause tremors, difficulty breathing, mental confusion, and convulsions, while long-term exposure can cause liver damage.
Ethylbenzene	Ethylbenzene is a chemical compound with an gasoline-like smell. Ethylbenzene is primarily used to make the chemical compound Styrene, which is used in the manufacture of a variety of plastics. Ethylbenzene is also used as a solvent, and to make some rubber and plastic wraps. Short-term exposure to Ethylbenzene can cause drowsiness, fatigue, headaches, and mild eye and respiratory irritation. Long-term exposure can cause central nervous system damage, as well as damage to the liver, kidneys, and eyes.
Fluoride	Fluoride is the common name for a group of chemical compounds containing the element Fluorine. In the US, Fluoride is added to things like toothpaste, mouth-rinse, and drinking water because studies show that it helps strengthen tooth enamel. Fluoride is only removed by reverse-osmosis filters.
Hardness	If you've ever washed your hands at a friends house and you just can't get the soap to lather up, then you've experienced "hard water". Hardness is the measure of the mineral content of water, and hard water typically contains excessive amounts of dissolved Calcium, Magnesium, Bicarbonates, and Sulfates. Hard water shouldn't pose any health concerns, but it can sometimes make drinks like coffee and tea taste bitter.
Lead	Lead, symbol Pb (for the Latin word Plumbum) from the periodic table, is extremely toxic to humans. Unfortunately, the toxicity of Lead wasn't truly understood until it had been used for many, many years in things like paint, solder, water pipes, brass plumbing fixtures, gasoline, and pottery. In fact, 75% of the houses built before 1978 contained lead based paint, and before 1987 the solder used for plumbing typically contained 50% lead. Contact with water slowly corrodes the inside walls of the pipes & fittings, as well as the solder used to connect them. As this happens, the dissolved metals flow through the pipes and out through the faucet. The health effects of lead exposure are most severe for infants and children. For them, exposure to high levels of lead in drinking water can result in delays in physical and mental development, learning disorders, behavioral problems, and reduced attention span. Lead can also cause abnormal fetal development in pregnant women. For adults, exposure can cause damage to the kidneys, central nervous system, and brain, as well as high blood pressure.
Lindane	Lindane is an insecticide used on pets, livestock, fruits, vegetables, cotton, wool, tobacco, and various other plants & trees. It's also used as a wood preservative, and for treating head lice & scabies on humans. Like other insecticides, Lindane enters surface-water as a result of runoff, and enters underground-water by leaching - that's when water from rain, irrigation, or other

	sources flows through the soil, dissolves the chemicals in it, and carries them down into the groundwater that supplies wells and springs. Short-term exposure to Lindane can cause high body temperature and pulmonary edema, while long-term exposure can cause damage to the liver and kidneys.
Mercury	Mercury is a shiny, silver-gray, liquid metal named after the closest planet to the Sun. Symbol Hg (for the Latin word hydrargyrum which means "liquid silver"), Mercury is used in things like thermometers, barometers, fluorescent lamps, and batteries. Mercury has also been used since the early 1800's in dental fillings, commonly known as Amalgam - an alloy containing Mercury, Silver, Tin, and Copper. Exposure to Mercury can cause neurological & kidney damage.
MTBE	Methyl Tertiary Butyl Ether, or MTBE, is a volatile, flammable, colorless liquid that smells a bit like turpentine, and dissolves easily in water. MTBE has been used in low levels since 1979 to increase the octane level in gasoline - which helps reduce engine damage caused by premature combustion, or "knocking". In 1992, levels of MTBE were raised significantly as a result of the Clean Air Act - since MTBE also increases the oxygen content, and helps the gasoline burn more completely. MTBE enters underground-water primarily as a result of leaking fuel storage tanks and pipelines.
Nitrates / Nitrites	Nitrates and Nitrites are simply chemical compounds containg Nitrogen and Oxygen. To be more specific, a Nitrate is 1 Nitrogen atom and 3 Oxygen atoms, while a Nitrite is 1 Nitrogen atom and 2 Oxygen atoms. Seems harmless enough, right? Well, the problem is that excessive amounts of Nitrates and Nitrites in the body can reduce the bloods ability to carry oxygen. They can also combine with protiens found in some foods & medicines to form Nitrosamine - a substance which has been shown to cause cancer. Nitrates are most troublesome to infants... particularly once they've been ingested and the body converts them to Nitrites - where they reduce the oxygen-carrying capacity of the infants blood. If untreated, the so-called "blue baby" disease is very serious, and can be fatal. Long-term exposure can cause hemorrhaging of the spleen, and diuresis - excessive formation of urine.
Radiation	Radioactive substances are introduced from the atmosphere or are washed out of soils and rocks. Both natural radioactive isotopes, such as 40K, 222Rn, 226Ra, and 238U, and artificial isotopes arising from nuclear explosions, mainly 90Sr, 90Y, and 137Cs, can be present in water. The content of natural radioactive substances in water depends on the origin of the substances and varies considerably. Artificial radioactive substances enter water together with precipitates from the atmosphere. Thus, as a result of the testing of nuclear weapons, the concentration of 90Sr in natural water increased steadily until 1968, reaching 10 picocuries per liter in some cases. Another major source of artificial radioactive substances is the water discharged from plants that produce nuclear fuel. Note: The radiation is nano in size and clings to larger particles. If you filter the larger particles that have been contaminated by radiation then you filter the radiation.
Simazine	Simazine is a pre-emergent herbicide used to control broad-leaf and grassy weeds on crops like corn, asparagus, beans, oranges, and artichokes. Like other herbicides, Simazine can enter surface-water as a result of runoff, and underground-water by leaching - that's when water from rain, irrigation, or other sources flows through the soil, dissolves the chemicals in it, and carries them down into the groundwater that supplies wells and springs. Short-term exposure to Simazine can cause changes in the blood, and weight loss, while long-term exposure can cause tremors, cancer, mutation of the genes, and damage to the testicles, liver, kidneys, and thyroid.
Solids	Solids discharged with a waste stream may settle immediately at the discharge point or may remain suspended in the water. Settled solids cover the bottom-dwelling organisms, causing disruptions in population and building a reservoir of oxygen-consuming materials. Suspended solids increase the turbidity of the water, thereby inhibiting light transmittance. Deprived of a light source, photosynthetic organisms die. Some solids can coat fish gills and cause suffocation.
Terrorism	If this occurs it will likely be biological or some form of poison. Recent fears of terrorist attack have changed public perception about the need for emergency preparedness. Finding alternative sources of water is difficult and purifying the water is time consuming under the best circumstances. Preparing an adequate stock of safe drinking water takes only a small amount of effort and money and can insure your family is ready for most emergencies.

Tetrachloroethylene	Tetrachloroethylene is a chemical compound used mainly in aerosol dry-cleaning products and metal degreasers, and to a lesser extent in rubber coatings, solvent soaps, printing inks, adhesives, sealants, polishes, lubricants, and pesticides. Long-term exposure to Tetrachloroethylene can cause liver problems and may increase the risk of getting some types of cancer.
Toxaphene	Toxaphene is an insecticide used on cotton, vegetables, livestock, and poultry. In the past, it was also used to kill unwanted fish in some lakes. Like other insecticides, Toxaphene enters surface-water as a result of runoff, and enters underground-water by leaching - that's when water from rain, irrigation, or other sources flows through the soil, dissolves the chemicals in it, and carries them down into the groundwater that supplies wells and springs. Short-term exposure to Toxaphene can cause restlessness, hyperexcitability, tremors, spasms, and convulsions. Long-term exposure can cause degeneration of the liver and kidneys, damage to the central nervous system, suppression of the immune system, and cancer.
TTHM (Total TriHaloMethanes)	Trihalomethanes (TTHM or THM) are the by-products of the water disinfection process. Typically, disinfectants like Chlorine react with the naturally occurring organic matter in the water they are disinfecting. This process produces things like Chloroform, Dibromochloromethane, Bromodichloromethane, and Bromoform. Fortunately, the health risks of TTHMs are very small compared with the risks of inadequately disinfected water.
Turbidity	Turbidity is a measure of how clear the water is. Water with a lot of suspended solids, appears murky, and has a high level of Turbidity. Suspended solids can be anything from microscopic floating plants like Phytoplankton, to clays and silts, or even sediment that's been stirred back into the water by dredging, floods, or bottom-feeding fish like carp. These suspended solids can sometimes carry toxic organic contaminants, pesticides, and heavy metals like cadmium, mercury, and lead.
VOC (Volatile Organic Compounds)	Volatile Organic Compounds (VOC's) are organic compounds are chemicals that contain carbon and are found in all living things and easily become vapors or gases. Along with carbon, they contain elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulfur or nitrogen. VOC's can be trapped in the air and water VOCs include chemicals that are both man-made and naturally occurring. The VOCs we're most likely to be exposed to come in the form of pesticides, herbicides, or insecticides that enter the water supply as a result of runoff. Other VOCs enter the water supply through the disposal of industrial waste. VOC's can include things like total trihalomethanes (TTHM), a by-product of the chlorination process, gasoline, benzene, formaldehyde, solvents such as toluene and xylene, styrene, and perchloroethylene (or tetrachloroethylene), the main solvent used in dry cleaning.

Contaminants Exceeding Health Guidelines

Contaminant	Average/ Maximum Result	Health Limit Exceeded	Legal Limit Exceeded	TESTING HISTORY (○–Tested ○–Detected ○–Over Health Guidelines ●–Over Legal Limit*) 04 05 06 07 08 09
Chloroform	50.67 ppb 91.93 ppb	Yes 5.7 ppb	Yes 80 ppb	
Total trihalomethanes (TTHMs)	57.95 ppb 99.5 ppb	Yes 9.8 ppb	Yes 80 ppb	
Dichloroacetic acid	19.46 ppb 23.4 ppb	Yes MCLG: 0 ppb	No 60 ppb	
Total haloacetic acids (HAAs)	39.2 ppb 50.38 ppb	Yes 0.7 ppb	No 60 ppb	
Bromodichloromethane	7.34 ppb 9.83 ppb	Yes MCLG: 0 ppb	No 80 ppb	
Dibromochloromethane	0.58 ppb 2.2 ppb	Yes 0.4 ppb	No 80 ppb	
Lead (total)	1.16 ppb 2.5 ppb	Yes MCLG: 0 ppb	No	
Trichloroacetic acid	16.88 ppb 27.63 ppb	Yes 20 ppb	No 60 ppb	

NOTE: Each dot in the above graph represents one month.

* Water utilities are noted as exceeding the legal limit if any test is above the maximum contaminant level (MCL). Most MCLs are based on annual averages so exceeding the MCL for one test does not necessarily indicate that the system is out of compliance.

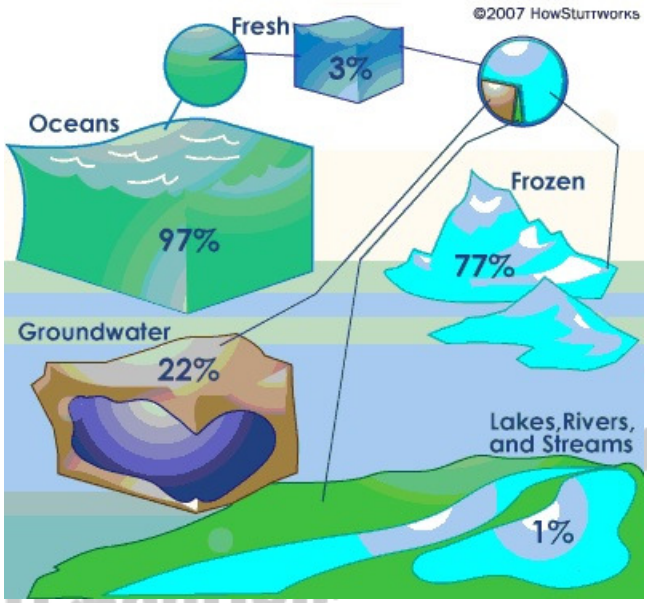
Most of these contaminants are removed by municipal water treatment plants, however if you have a well or are using emergency water sources, you need to be aware of these contaminants and how to get rid of them to make the water "safe".

According to the USGS, "***Safe Water*** *means water that will not harm you if you come in contact with it. The most common use of this term applies to drinking water, but it could also apply to water for swimming or other uses. To be safe, the water must have sufficiently low concentrations of harmful contaminants. The list of harmful contaminants includes bacteria, viruses, pesticides, petroleum products, some metals and metalloids, strong acids, and many more substances*."

In comparison to other countries and activities, drinking U.S. public tap water, or any of the bottled waters, or water from most domestic wells, is safe. In most of the U.S. waters are filtered and treated to kill microbes and keep contaminants at "safe" levels by municipal water treatment plants.

It is important to keep in mind that water can be safe for one person and may be unsafe for another. If your immune system is weak, you are a young child or an elderly person, or you are pregnant or a nursing mother, you are more susceptible to contaminants in drinking water than the rest of the population.

We will cover Water Disinfection and Purification a little latter in this article.



Water Sources

A water source is any place where water for drinking, cooking and cleaning can be obtained with minimum fuss. Some of these sources are "natural" or occur in nature and some do not. Since all water contains some impurities, disinfection or purification is needed no matter what the water source.

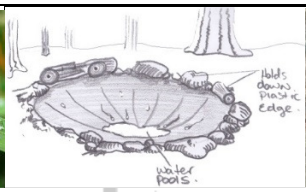
Outdoor Sources

Signs of Water	• Birds flying low and fast are usually heading toward a water source. • Birds flying from water are usually full and will often fly from branch to branch; fluttering and zig-zaging. • Bees build their hives near a water source to help cool the hive so the combs do not melt. • When you find converging game trails, following them, in the direction of the arrow that they make where they meet, will lead to water. • Look underneath any man made objects you may come across such as a sheet of iron or the like, it may have been placed there on purpose to cover the entrance of a well or bore. This is common practice amongst locals in arid places. • In arid areas, particularly in the western and south-western United States, rainwater collectors called "guzzlers" may be found. These are designed to gather precipitation and feed it into a holding tank where it

remains until it is either consumed by thirsty animals or eventually evaporates.

- Even though water is not visible on the surface of the ground, it may still be present in the soil in sufficient quantity to be collected. Locate low lying areas where water is most likely to have accumulated and dig down until damp layers of soil are found. Over time, water may seep into the hole where it can be collected.
- If no indicators of sub-surface water are present, dig a hole in the outside bend of a dry river bed or where there is some plant life (avoid dryer, brownish looking plants and areas) in a shaded or low-lying area.



Morning Dew

Unless there is some kind of serious air pollution present, morning dew does NOT need to be purified.

1 Spread out your tarp or tent's rain fly the night before.
2 Dew will collect on the surface of these overnight.
3 In the morning gather the ends of the tarp making a pool at the bottom of the tarp for dew collection. Carefully unwrap the tarp and collect the water at the bottom.
4 You can also use items of clothing to absorb dew.
5 Once the clothing is wet wring out the moisture into your mouth or water bottle.


Plants that Contain or Trap Water

Certain plants can trap or contain water
Collect water from plants that trap it
For plants that contain water, like the barrel cactus, understand that there isn't much quantity in any one plant, it will take quite a few to get enough water; cut off the top and mash the pulp to drink

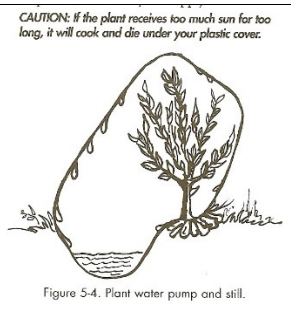
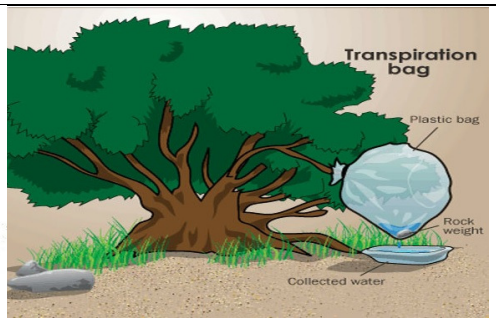
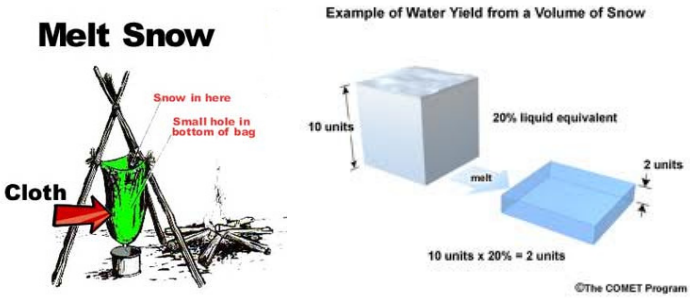
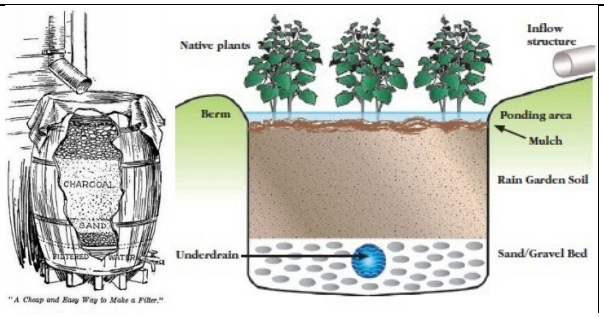



Figure 5-4. Plant water pump and still.


Plant/Tree Transpiration

Tie a piece of plastic or put a plastic bag over a section of bush or tree branch

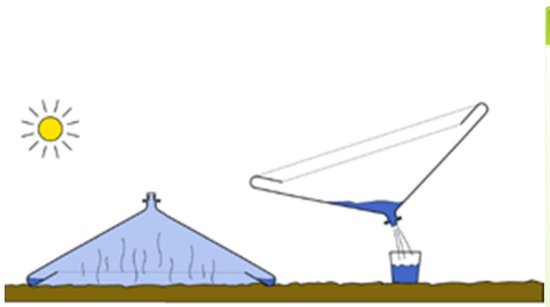
	Leave the bag on overnight The natural transpiration of the plant will produce water
Ponds and lakes	 If you are using an outdoor water source, avoid collecting water with floating material, an odor, or dark color. To purify water collected from outdoor sources, both filtration and boiling is required before drinking the water. Be aware that chlorine is not effective or only somewhat effective in controlling *Cryptosporidium* and *Giardia* found in surface water. Boiling is usually the best way to remove these two pathogens. Another method uses filters labeled as "absolute one micron filters," or those labeled as certified by an American National Standards Institute (ANSI) - accredited organization to ANSI/NSF Standard 53 for "Cyst Removal".
Rain (or Snow) Water Harvesting	 Unless there is some serious air pollution, snow, when melted is a good source of water and usually doesn't need to be purified. Do NOT EAT Snow! This can speed up hyperthermia, the lowering of the body's core temperature and lead to death. Let the snow melt and if it is cold out, try to warm it up a bit before drinking. Rain or melting snow dripping from the gutters or downspouts of a house can be collected in containers such as a barrel or plastic tank with a lid. If this water is to be used for drinking, brushing teeth, cooking or growing food, it should be purified. For irrigation the water should at least be filtered of solids. An old sheet or pantyhose lining the barrel spigot should do.
	

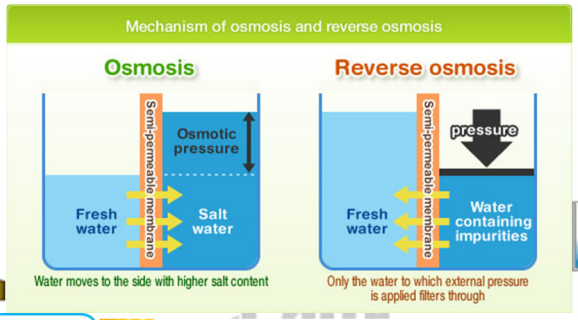
Rain Water

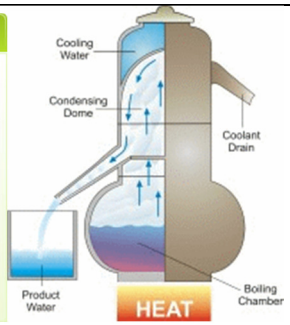
Out in the woods, unless there is serious air pollution present, rain water does NOT need to be purified. This is about wilderness rain water.

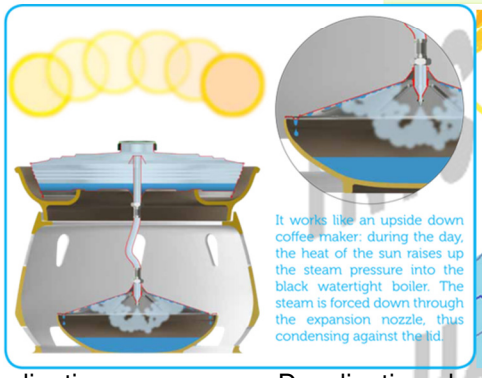
1 Use a tarp, your coat, a poncho, or a tent's rain fly to collect and store water.
2 If water is running down a rock face you can lie a rope along one of the veins where the water is running.
3 Use the end of the rope to guide the water into your water bottle.

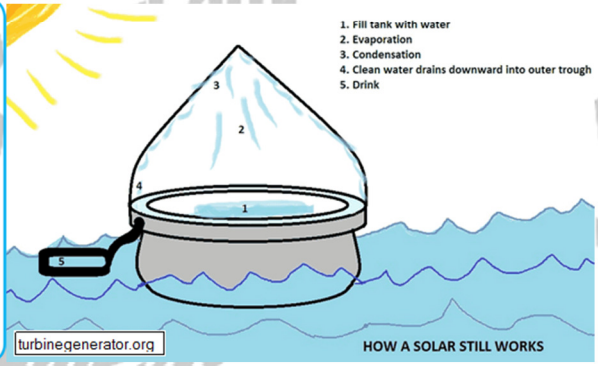
Even if the water is only dripping you'll soon have gallons of clean water.











Salt Water Desalination

Desalination, desalinization, and desalinisation refer to any of several processes that remove some amount of salt and other minerals from saline water. More generally, desalination may also refer to the removal of salts and minerals, as in soil desalination.

Salt water is desalinated to produce fresh water suitable for human consumption or irrigation. One potential byproduct of desalination is salt. Desalination is used on many seagoing ships and submarines. Most of the modern interest in desalination is focused on developing cost-effective ways of providing fresh water for human use. Along with recycled wastewater, this is one of the few rainfall-independent water sources.

Due to relatively high energy consumption, the costs of desalinating sea water are generally higher than the alternatives (fresh water from rivers or groundwater, water recycling and water conservation), but alternatives are not always available.

Here are the USGS parameters for saline water in "parts per million" (ppm):

- Fresh water - Less than 1,000 ppm
- Slightly saline water - From 1,000 ppm to 3,000 ppm
- Moderately saline water - From 3,000 ppm to 10,000 ppm
- Highly saline water - From 10,000 ppm to 35,000 ppm

By the way, ocean water contains about 35,000 ppm of salt.

Some Simple Steps To Desalinate Water (courtesy of http://www.wikihow.com/Desalinate-Water):

1. Fill a large bowl or other large container with salt water. If you are without bowls or buckets, you may need to dig a shallow depression and line it with plastic or leaves to prevent the water from seeping out.
2. Place a smaller container in the center of the larger bowl.
3. Place a piece of plastic over the large container. The plastic should be large enough that you can tie it down and that the plastic can sag a little. If you are using a bowl, use a rubber band or string to keep the plastic in place. If you have dug a hole, use rocks to hold down the plastic.
4. Place a small rock or marble in the center of the plastic cover, directly over the smaller container. Allow the plastic to sag a little so it is pointed to the center of the smaller container.
5. Set the water still in a sunny location for a few hours. The sun will cause the water to evaporate, and it will try to rise as steam. It will condense on the plastic covering and leave the salt behind in the larger container. The condensation will form as drops on the plastic and naturally roll towards the smaller container, eventually falling into it.
6. Remove the plastic covering after a few hours, and remove the smaller container. This will contain the purified water.
7. Dispose of the remaining salt water carefully. It is highly concentrated and may cause damage to plants or animals.

(See a how-to video @ http://www.youtube.com/watch?feature=player_embedded&v=U1MMIs2N264)

Spring & Seep Water

If you are using an outdoor water source, avoid collecting water with floating material, an odor, or dark color.

To purify water collected from outdoor sources, both filtration and boiling is required before drinking the water.

Be aware that chlorine is not effective or only somewhat effective in controlling *Cryptosporidium* and *Giardia* found in surface water.

Boiling is usually the best way to remove these two pathogens.

Another method uses filters labeled as “absolute one micron filters,” or those labeled as certified by an American National Standards Institute (ANSI) - accredited organization to ANSI/NSF Standard 53 for “Cyst Removal”.

If you are in the wilderness and can hike to the top of a stream or areas where the water is coming from the ground or out of a rock, this usually does not need purification. Although even back in the 70’s we did purify.

Streams, rivers and other moving bodies of fresh water

If you are using an outdoor water source, avoid collecting water with floating material, an odor, or dark color.

To purify water collected from outdoor sources, both filtration and boiling is required before drinking the water.

Be aware that chlorine is not effective or only somewhat effective in controlling *Cryptosporidium* and *Giardia* found in surface water.

Boiling is usually the best way to remove these two pathogens.

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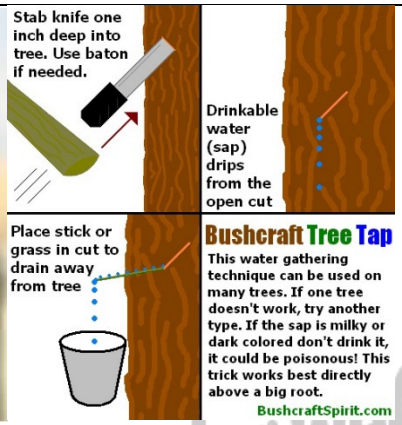


Tapping Trees in Early Spring (February until March)

Hardwood trees send up gallons of sugary sap in preparation for Spring, this is suitable for drinking and doesn’t need to be purified.

1 To tap the tree make a small hole with the tip of your knife
2 insert a wood spile to guide the watery sap.
3 Collect the water into your cup or canteen.
4 Once you’ve collected enough water seal the hole.

Wet Earth Water Extraction

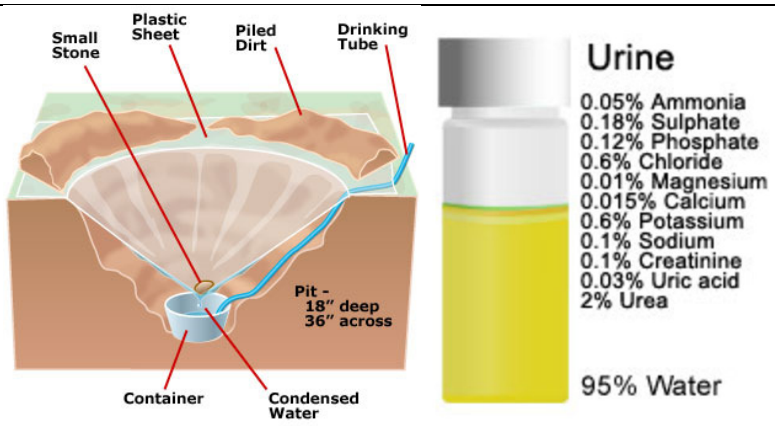
There is some debate on if this water needs to be purified or not. When we were out in the wilderness, we still purified since we didn’t know what animal had been by and peed recently ;-}

If you are urban, suburban or rural (farming/ranching country) I would purify.

No matter what, one needs to remove all solids so you end up with clear water. If you are in an area that has a lot of water in the soil you can extract it using this method.

1 You will need a long drinking tube and a shovel.
2 Dig a deep hole in the ground.
3 Add a layer of dry grass on the bottom of the hole.
4 Place the end of your drinking straw on top of the pile of dry grass.
5 Add another layer of dry grass and cover whole thing with the wet soil you removed.

	6 Let the water filter through the grass and drink it from the tube or collect it to filter and then drink.



Distill Urine before drinking

Urine	A very last resort. In dire emergencies it is possible to drink your own urine up to twice in succession before it becomes toxic. This is because it is essentially sterile. If you are sick I wouldn't recommend it at all!

Emergency Water Sources around the home:

Canned Goods — Canned Goods such as Tuna, canned vegetables, beans and fruit all contain liquids that can be drained.

Commode (Toilet) Tank — As long as you do NOT use chemicals in your commode tank (not bowl) you can use this water as an emergency water option:

1. Scoop the water out of your toilet storage, or reserve tank
2. Boil the water for 3 to 5 minutes or add a couple of drops of bleach to each gallon to purify it.
3. If using bleach, stir or shake the water to mix the bleach in
4. Allow it to sit for 30 minutes before drinking it.



Hot Water Heater

Use the water reserve in your hot water heater**.** Most heaters hold 30 to 60 gallons. As long as the plumbing and hot water heater have not been submerged by flood waters, do the following:

1 Turn off the electricity or gas to the water heater to prevent the heater from operating without water and turn off the water intake valve.
2 Let the water heater cool before draining it from the heater so it does not scald you.
3 Start the water flowing by opening the drain at the bottom of the tank and turning on a hot-water faucet.
4 Discard the first few gallons if they contain rust or sediment.
5 Once water has been drained into clean, sanitized containers, add 5-7 drops of chlorine bleach* per gallon of water, and stir or shake the solution to mix it. Let it set 30 minutes before use.
6 Do not turn on the gas or electricity when the tank is empty.

Sidebar: Hot Water Heater Safety
Tankless hot water heaters have a more precise temperature than pressurized tanked hot water heaters, however this little safety tip will work for both: Turn on your shower, when you get the temperature that you desire, collect some in a class, jar or bowl that has a candy thermometer in it, set the tankless hot water heater temperature to about 5-10 degrees lower than that temperature.

Sidebar: Hot Water Heater Economy
On demand tankless hot water heaters use less energy (electricity, propane or natural gas) than pressurized hot water heaters. Some Preppers will install both, having the tankless system feeding the pressurized hot water heater instead of cold water. This too will utilize less energy than a standalone pressurized system will use as the pressurized system will have pre-heated water feeding it.





Ice Cube Trays, bottles, etc.

Ice that you have frozen in your freezer(s) can be used as water.
Empty ice cube trays or automatic catchment bins into a bowl or pitcher where you can allow the ice to melt.

If you have frozen blocks, bags or bottles in your freezer, take these out for thawing as needed.

Sidebar: Economy
Keeping jugs and blocks of ice in your freezer will not only reduce the energy used by the freezer, but they will help keep the items in the freezer frozen and cold longer without the use of energy.



Swimming Pool

Use your swimming pool (not spas or hot tubs) as an emergency water supply. Always keep your pool water purified and keep a cover on the pool so it is ready for emergency water use.

Boil the water or purify it with bleach before you drink it.

Note: Most experts agree that water from a Hot Tub is NOT recommended. Because of the heat, human activity and chemicals added to the water in a hot tub, it has the potential to contain way more bacteria and viruses.

If used it is best to boil, treat with iodine and filter before use.

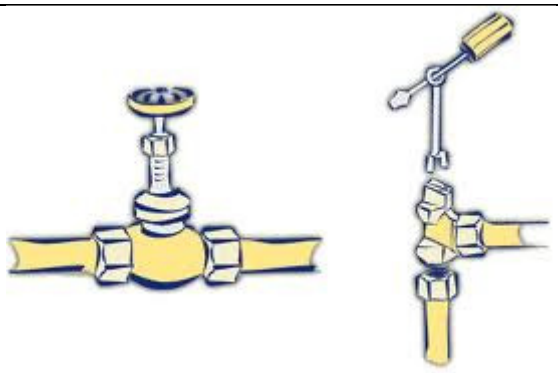

Water Bed

Waterbeds hold up to 400 gallons of water, but some water beds contain toxic chemicals that are not fully removed by purifiers. Use the water in your water bed only as a last resort as the water in your bed could contain chemical toxins that leached into the water from the mattress.

However if you plan to have the waterbed as an emergency water source**,** Do not add algicides or other additives (with the exception of chlorine bleach) and do the following annually:

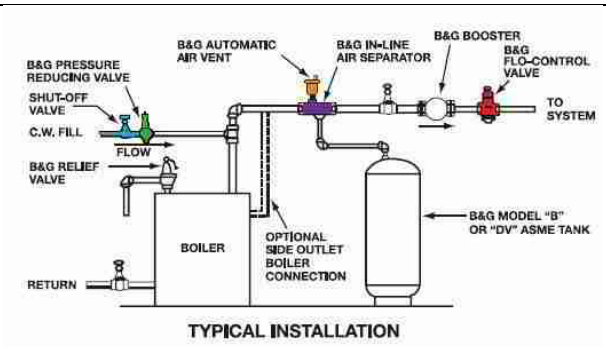
1 Drain your water bed annually.
2 Replace the old water with fresh water and add approximately two (2) ounces (1/4 cup) of bleach per 120 gallons of water or 1 1/2 cups of bleach to an average 400 gallon water bed.

If and when this water is used as an emergency source:
1 Drain the water
2 Boil it and bleach the water you remove from a water bed to kill any possible bacteria, using normal bleach purification procedures.



Water Pipe Shut Off

Be sure you know where your water shut off valve is.

	The local water utility company can come and locate it for you at no charge. Locate the water shut-off valve before an emergency so that you are not caught off guard. Many community water systems require a proprietary tool to shut the water intake to a home off, be sure you have one. As soon as you hear of a power outage or suspected upcoming contamination issue with public or well water; shut off the incoming water to your home. This is to prevent the contamination from entering your home if it has not already done so.
	 TYPICAL INSTALLATION
Water Pipe Bleeding	This option can be used as long as there has been *no warning that the public or well water may be contaminated or the plumbing has NOT be submerged by flood waters*: Once the incoming water to your home has been shut off; 1 Let air into the plumbing by turning on the faucet in your house at the highest level. A small amount of water will trickle out. 2 Open a faucet in the lowest level of your house--the basement if you have a faucet there, or the kitchen sink otherwise. 3 Drain the water into storage containers

Ok we have covered what "purified" vs "pure" water is, now let's get onto Disinfection and Purification.

Harmful Contaminants	SolarBag	UV Sterilizers	Carbon Filters	Treatment Tablets
Bacteria	●	●	◒	●
Viruses	●	●	X	●
Protozoa	●	●	●	●
Pesticides	●	X	◒	X
Herbicides	●	X	◒	X
Petrochemicals	●	X	◒	X
Pharmaceuticals	●	X	◒	X
Arsenic	●	X	X	X
Lead	●	X	X	X
Mercury	●	X	X	X

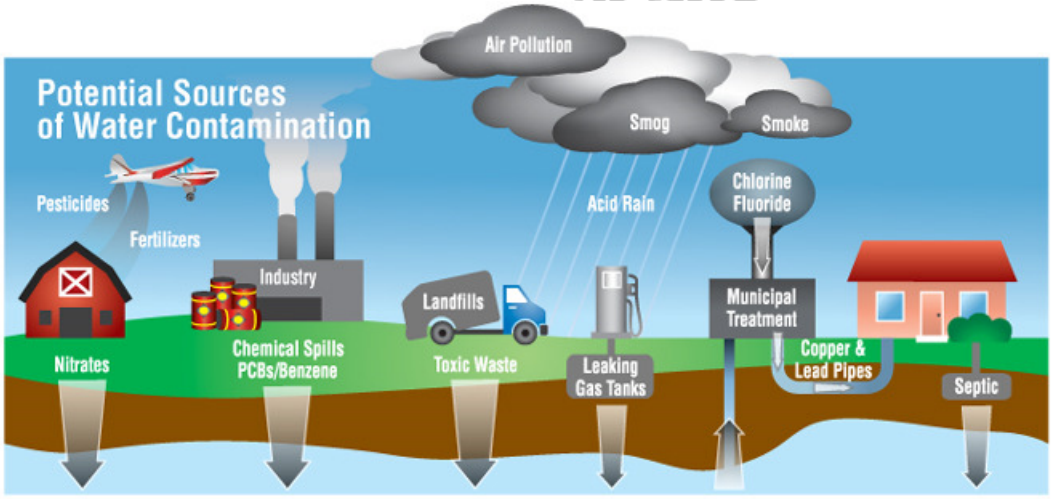
Disinfection

Detoxification

Water Disinfection and Purification

A technical definition of "pure water" would refer to water containing only hydrogen and oxygen molecules. Such "pure" water does NOT occur naturally anywhere in the world!

All water contains some impurities, or elements of different chemical compounds than merely hydrogen and water (Binnie et al, 2002). As water passes through streams, rivers and lakes, it carries mineral sediments with it.



Ground water, the source for most municipal water systems, contains remnants of pesticides, herbicides, and industrial waste. Water generally carries several bacteria and viruses and other particulate matter, which have originated either naturally or through man-made sources. Hence, it becomes necessary to treat water before using it for drinking, irrigation, or other purposes. This "treatment" is called Water Purification or Disinfecting.

Now understand that the water industry is a bit confused about the meanings and differences between water purifiers and water filters. Many industries use the two terms interchangeably to describe the same end result – water free of harmful impurities and contaminates and to date, our government hasn't passed any "truth in labeling" laws regarding this confusion. **So here are the technical definitions of the terms: Purification/Disinfection and Filtration.**

Purification or Disinfection	Filtration
Water purification describes the elimination of chemical contaminants and microbes from your water supply.	Filtration of water can be done by various types of filters, some solid or solid to the naked eye, some are granular, some are powder, and others are paper or cloth.

This can done by irradiating the water with UV light, adding a disinfectant such as chlorine or changing the chemical composition of the water using a water ionizer.

These “filters” can be a sand or gravel pit to cartridge types.

Water filtration systems can remove particles and some chemical contaminants by binding them in ion exchange systems or using activate charcoal.

However most filtration units are not designed to remove microbes such as bacteria from the water. These units are not "purifiers" in the strict meaning of the word.

The extremely fine filters that can remove microbes, bacteria and other super small pollutants are expensive and will fill-up or clog very quickly if used for everyday water filtration.

Any water-treatment method designated as a "purifier" will, in most cases, rid water of all the threats listed below.

Some contaminants and their size in microns

Contaminant	Size
Giardia lamblia, Single-cell parasite	Tiny, 8 to 12 microns
Cryptosporidium parvum, Single-cell parasite	Tiny, 4 to 6 microns
Bacteria (salmonella - E.coli)	Very tiny, 0.2 to 4 microns
Bacteria (Vibrio cholerae, Yersinia entercolitica, Leptospira interrogans and many others)	Very tiny, 0.1 to 10 microns
Viruses (hepatitis A, rotavirus, enterovirus, norovirus)	Exceptionally tiny, .004 to 0.1 microns (Generally, only a few filters, such as ultrafilters and reverse osmosis, have holes small enough to assure removal of all viruses. However, viruses can be killed using a disinfectant.)

From http://www.epa.gov/safewater/faq/pdfs/fs_healthseries_filtration.pdf page 6

Ok we have covered a little about the characteristics of water, where drinking water comes from, where to find emergency drinking water and what “purified” vs “pure” water is; so now let’s cover the differences between “filtering” and “purifying” water, along with various methods to do both.

First off some filters *can* purify water and some cannot. Most purification is multi-stage and commonly utilizes multiple methods for treating the water to make it disinfected or free enough of harmful pathogens to drink.

Water Filtration and Basic POU Filter Types and Technologies

There are hundreds of brands of home water filters and they all rely on a small number technologies to remove contaminants. This doesn't mean that any one filter technology is as good as another. Plus some brands use a combination of filter technology, while other brands rely on just one. Therefor filter systems vary widely in quality and what contaminants it will remove from the filtered water.

To ensure that a filter removes a particular contaminant, verify that it is certified for that contaminant by a reputable, independent agency. For example, some carbon filters can remove chloramine but others cannot.

> Some filters are labeled "NSF certified." NSF is a reputable product evaluation company, however its certifications are not all the same. It may certify that a filter will improve water's taste and odor but not necessarily guarantee that it will remove any specific contaminants. Read the fine print.
>
> Some 3rd Party product evaluation companies, like EWG for its Filter Buyers Guide recommend filters that have been certified by the California Department of Public Health and/or NSF to reduce one or more common drinking water contaminants.

Most of the top recommended "purifiers" for water filter systems use *filtration methods such as activated carbon, kinetic degradation fluxion (KDF), adsorption and particulate filtration*.

Water systems that use these types of filtration media and are *more than one stage of filtration*, will remove the *most* contaminants while leaving in the natural occurring minerals in the water.

Remember it is the *Pore Size* of a filter that determines how well it removes harmful particulate contaminants like asbestos, parasitic cysts, and bacteria.

Common microorganisms and the filter size needed:

Organism	Examples	General Size	Filter Type	Particle Size Rating
Protozoa	*Giardia, Cryptosporidium*	5 microns or larger	Water filter	1.0–4.0 microns
Bacteria	*Cholera, E. coli, Salmonella*	0.2–0.5 microns	Microfilter	0.2–1.0 microns
Viruses	*Hepatitis A, rotavirus, Norwalk virus*	0.004 microns	Water purifier	to 0.004 microns

Use the following guidelines to determine if filtration equipment is adequate to use with microbiologically contaminated water:

Filtration Equipment	Safe on Microbiologically Contaminated Water?
Carbon Filter	No
Ceramic Filter	Some – but only if rated for bacteriological protection
Deionization Filter	No
Faucet Mount Filter	No
Pitcher Filter	No
Reverse Osmosis	No
Steam Distiller	Yes – but requires electricity
UV Sterilizer	Yes – but requires electricity

Technology Types		Removal		Amount of Water		Cost ($US)	Ease of Use	
		Bio.	Org.	Flowrate	Lifespan	Unit	Set-Up	Maint.
Ceramic Filters	Disk	Y	N	1-10 L/hr	5 years.	$3.50	Easy	Monthly
	Candle	Y	N	1 L/hr	6-12 months	$2.25	Easy	Monthly
Biofilm Filters	Biosand	Y	N	60 L/hr	Indefinate	$12-$30	Mod.	Sporadic
	JAL	Y	N	30 L/hr	Indefinate	$10-$15	Easy	Sporadic
Sand Filter		Y	N	200 L/day	Variable	$50.00	Easy	Weekly
UV Radiation	SODIS	Y	N	1 L/bottle	Indefinate	$0.00	Easy	Regular
	Lamps	Y	N	>1 L/min.	1 yr/bulb	$10-$100	Mod.	Regular
Chemical	SWS	Y	N	N/A	Variable	Variable	Easy	None
	PUR	Y	N	10 L/sachet	N/A	.10¢/sachet	Easy	None
Moringa Seeds		Y	N	N/A	Variable	$0.00	Mod.	N/A
Sari Cloth		Y	N	Variable	Limited	$0.00	Easy	None

Basic Filter Technologies

Adsorption / Activated Carbon	When a substance is attached to a surface is is called adsorption, is this case the substance is attached to the internal surface of active carbon. (When a substance is absorbed in a different medium it is called *absorption*. When a gas is taken in a solution it is called absorption.) Adsorption is a process where a solid is used for removing a soluble substance from the water. In this process active carbon is the solid. Activated carbon is produced specifically so as to achieve a very big internal surface (between 500 - 1500 m2/g). This big internal surface makes active carbon ideal for adsorption. The GAC version is mostly used in water treatment, it can adsorb a rather large number of soluble substances. (for a complete list see http://www.lenntech.com/library/adsorption/adsorption.htm)
Carbon/Activated Carbon	Activated carbon chemically bonds with and removes some contaminants in water filtered through it. Active carbon comes in two primary variations: Powder Activated Carbon (PAC) and Granular Activated Carbon (GAC). Carbon filters vary greatly in effectiveness: Some just remove chlorine and improve taste and odor, while others remove a wide range of contaminants including asbestos, lead, mercury and volatile organic compounds (VOCs). However, activated carbon cannot effectively remove common “inorganic” pollutants such as arsenic, fluoride, hexavalent chromium, nitrate and perchlorate. Generally, carbon filters come in two forms, carbon block and granulated activated carbon.
Carbon Block	Solid Block, Activated Carbon filters have very small carbon particles bonded into a tightly packed matrix, shaped into blocks, with uniform pores, typically between 0.5 and 1.0 micron, and can reliably remove small particulate contaminants.

	They are typically more effective than granulated activated carbon filters because they have more surface area. Their effectiveness depends in part on how quickly water flows through.
Carbon/Activated Carbon, Granulated (GAC)	These filters contain fine grains of activated carbon. They are typically less effective than carbon block filters because they have a smaller surface area of activated carbon. Their effectiveness also depends on how quickly water flows through.
Ceramic	Ceramic filters have very small holes throughout the material that block solid contaminants such as cysts and sediments. They do not remove chemical contaminants.
Deionization	These filters use an ion exchange process that removes mineral salts and other electrically charged molecules (ions) from water. The process cannot remove non-ionic contaminants (including trihalomethanes and other common volatile organic compounds) or microorganisms. EWG's water filter guide does not include any filters based on this technology.
Distillation	This technology heats water enough to vaporize it and then condenses the steam back into water. The process removes minerals, many bacteria and viruses and chemicals that have a higher boiling point than water. It cannot remove chlorine, trihalomethanes or volatile organic chemicals (VOCs). EWG's water filter guide does not include any filters based on this technology.
Fibredyne block	This is a proprietary type of carbon block filter that claims to have a higher sediment holding capacity than other carbon block filters.
Ion Exchange	This technology passes water over a resin that replaces undesirable ions with others that are more desirable. One common application is water softening, which replaces calcium and magnesium with sodium. The resin must be periodically "recharged" with replacement ions.
Mechanical Filters	Like ceramic filters, these filters are riddled with small holes that remove contaminants such as cysts and sediments. They are often used in conjunction with other kinds of technologies, but sometimes are used alone. They cannot remove chemical contaminants.
Ozone	Ozone kills bacteria and other microorganisms and is often used in conjunction with other filtering technologies. It is not effective in removing chemical contaminants.
Reverse Osmosis (RO)	This process pushes water through a semi-permeable membrane that blocks particles larger than water molecules. Reverse osmosis can remove many contaminants not removed by activated carbon, including arsenic, fluoride, hexavalent chromium, nitrates and perchlorate. However, reverse osmosis does not remove chlorine, trihalomethanes or volatile organic chemicals (VOCs). Many reverse osmosis systems include an activated carbon component than can remove these other contaminants. Quality can vary

	tremendously in both the membrane system and the carbon filter typically used with it. Consumers should also be aware that reverse osmosis filters use 3-to-20 times more water than they produce. Because they waste quite a bit of water, they are best used for drinking and cooking water only.
Ultraviolet (UV)	These systems use ultraviolet light to kill bacteria and other microorganisms. They cannot remove chemical contaminants.
Water Softeners	These devices typically use an ion exchange process to lower levels of calcium and magnesium (which can build up in plumbing and fixtures) as well barium and certain forms of radium. They do not remove most other contaminants. Since water softeners usually replace calcium and magnesium with sodium, treated water typically has high sodium content. Some people may be advised by their physicians to avoid softened water. For the same reason, it is also not recommended for watering plants and gardens.

Basic Filter Devices

Faucet mounted	Faucet-mounted filters attach directly to the end of the faucet. Most can be pivoted to an "on" or "off" position, allowing you to collect filtered water for drinking and cooking. This filter style typically uses an activated carbon filter that can remove contaminants and improve taste and odor. Models vary, but many reduce chlorine, lead, mercury and (less frequently) disinfection byproducts.
Handheld water filters	Designed for backcountry travel are more correctly called "microfilters." They are more exacting than household tap "filters" by removing very fine particles down to 0.4 microns in size. However, they do not trap super-fine particles as well as industrial-grade "ultrafiltration" and "nanofiltration" methods.
KDF	Kinetic Degradation Fluxion (KDF) process media are high-purity copper-zinc granules that reduce contaminants in water using an oxidation/reduction (redox) reaction. They are used in pretreatment, primary treatment and wastewater treatment applications in order to extend system life and to reduce heavy metal contamination, chlorine and hydrogen sulfide. KDF Media is usually of 4 grades, each with a specific purpose: • KDF 55 granules: designed for removing or reducing chlorine and soluble heavy metals • KDF 85 granules: used to remove or reduce iron and hydrogen sulfide from water supplies • KDF-F fine mesh granules: can be incorporated into carbon blocks and other matrixes • KDF-C coarse mesh granules: are used for removal or reduction of soluble heavy metals and chlorine.

Microfilters	Physically separate protozoa and bacteria from water by pushing water through an internal "filtering media" — a ceramic cartridge or a cluster of hollow-fiber tubes. These media look solid to the eye, but they contain microscopic pores (typically 0.2 to 0.4 microns) that water can penetrate, but protozoa, cysts and bacteria cannot. Microbiologists call this process "size exclusion." The filtering media basically acts as a microscopic colander that strains bugs out of the water. Viruses, however, are tiny enough to slip through even these pores. Because the risk of viral contamination in North American wilderness waters is considered low, filters are quite sufficient for most domestic backcountry travel. But in less developed international locales where surface water is exposed to all manner of human and animal activity (such as remote villages, primitive farming communities and heavily concentrated population centers), treating water with a purifier is a must.
On-counter	On-Counter filters typically sit on the counter, with a line connecting directly to the faucet. A diverter value allows you to switch between filtered and unfiltered water. You collect filtered water from an extra spout or faucet on the filter unit. Models use a range of technologies, including activated carbon and reverse osmosis. Effectiveness varies widely between models, but many on-counter filters will reduce a wide array of contaminants.
Pitcher/Large dispenser	Pitchers or large dispensers are typically fitted with an activated carbon filter that can remove contaminants and improve taste and odor. Models vary, but many reduce chlorine, lead, mercury and (less frequently) disinfection byproducts. This filter style works well for filtering drinking water and can be stored in the refrigerator.
Pump or gravity-based devices	Commonly called "filters", reliably sift out protozoa, cysts and bacteria *but are not effective against miniscule viruses.*
Under-sink	Under-Sink filters are mounted underneath the kitchen sink, where they are fitted to the water supply line. Some models have a separate spout or faucet for water collection. Models use a range of technologies, including activated carbon to reverse osmosis. Effectiveness varies widely between models, but many under-sink filters will reduce a wide array of contaminants.

	Technology / Characteristics	Activated Carbon	Ion Exchange	UV Devices	Chlorine + Silverions	Hollowfiber	Katadyn Filtermedium ViruPur	Katadyn Glassfiber 0.3 Micron	Katadyn Ceramic 0.2 Micron
	Effective against protozoa (e.g. Giardia)	✗	✗	✓	✓	✓	✓	✓	✓
	Effective against bacteria	✗	✗	✓	✓	✓	✓	✓	✓
	Effective against viruses	✗	✗	✓	✓	✗	✓	✗	✗
Use outdoors	Suitable for clear surface water without suspended solids	✗	✗	✓	✓	✓	✓	✓	✓
Use outdoors	Suitable for slightly turbid surface water	✗	✗	✗	✗	✓	✓	✓	✓
Use outdoors	Suitable for turbid and extremely turbid surface water	✗	✗	✗	✗	✗	✗	✗	✓
Use outdoors	Makes the water clear (particles will be removed)	✗	✗	✗	✗	✓	✓	✓	✓
Use indoors (hotels or the like)	Suitable for questionable tap water	✗	✗	✓	✓	✓	✓	✓	✓
Use indoors (hotels or the like)	Suitable for safe tap water (drinking water quality)	✓	✓	✓	✓	✓	✓	✓	✓
Use indoors (hotels or the like)	Reduces chemicals and improves the taste of the water (chlorine)	✓	✓	✗	✗	✗	✓	✓	✗
Use indoors (hotels or the like)	Requires batteries	✗	✗	✓	✗	✗	✗	✗	✗
	Range of products								

Basic POU Filter Types and Technologies:

Treatment Device	What It Does To Water	Treatment Limitations
Activated Carbon Filter (includes mixed media that remove heavy metals)	Adsorbs organic contaminants that cause taste and odor problems. Some designs remove chlorination byproducts; Some types remove cleaning solvents and pesticides.	Is efficient in removing metals such as lead and copper Does not remove nitrate, bacteria or dissolved minerals
Distillation Unit	Removes nitrates, bacteria, sodium, hardness, dissolved solids, most organic compounds, heavy metals, and radionuclides Kills bacteria	Does not remove some volatile organic contaminants, certain pesticides and volatile solvents Bacteria may recolonize on the cooling coils during inactive periods
Ion Exchange Unit (with activated alumina)	Removes minerals, particularly calcium and magnesium that make water “hard” Some designs remove radium and	If water has oxidized iron or iron bacteria, the ion-exchange resin will become coated or clogged and lose its softening ability

	barium Removes fluoride	
Reverse Osmosis Unit (with carbon)	Removes nitrates, sodium, other dissolved inorganics and organic compounds Removes foul tastes, smells or colors May also reduce the level of some pesticides, dioxins and chloroform and petrochemicals	Does not remove all inorganic and organic contaminants
From *Water on Tap: What You Need to Know* 2009 @ http://water.epa.gov/drink/guide/upload/book_waterontap_full.pdf		

For more detailed information on filter pore size, contaminate removal and purification methods see *Comparison of Drinking Water Treatment Methods* @ http://www.cyber-nook.com/water/Solutions.html#treatment Clicking on a table thumbnail takes you to:
Benefits, Limitations and Costs of various POU water treatment methods table @ http://www.everythingyoualwayswantedtoknow.com/watertreatment/treatment-table.html and *Drinking Water Contaminant Removal Table* http://www.cyber-nook.com/water/WaterTreatment.htm#chart and *Water Problem Table Identify Common Water Contaminants by Their Sensory Clues* @ http://www.cyber-nook.com/water/TasteOdor.htm#top and *Water Needs and Costs online Calculator* @ http://www.cyber-nook.com/chart/default.asp?Usage=5&Years=4

Water purification systems, such as ***Reverse Osmosis*** *(R.O.)* and ***Distillation***, do remove many contaminants from water (including fluoride) but they *do not remove all harmful contaminants*, such as chlorine and chloramines, volatile organic chemicals (VOCs), pharmaceuticals, and many others that are removed through a high-quality filtration system. In addition, water purification systems (R.O. and distillation) *also remove the minerals from water. Drinking demineralized water is not the healthiest option for long-term use*, according to many health advocates, associations, as well as a study conducted by the World Health Organization (WHO).

Other types of water purification technologies, such as ***ozone*** and ***ultraviolet***, are *not* effective enough *to be used alone*. However, they are beneficial when used in conjunction with other water filtration methods, such as with carbon block and KDF media.

Boiling water is one of the oldest forms of water purification. However keep in mind that different contaminates need different temperatures to ensure neutralization and some contaminates like *Nitrates and Lead should never, ever be boiled out*. This is on top of the fact a "rolling boil" can occur at different temperatures, usually lower than actual boiling (100°C or 212° F at 1 atmosphere of pressure ie sea level) temperatures when at higher altitudes.

Any filter that can remove the micro to nano-sized pathogens and result with any remotely timely disinfected water, are usually mechanical systems that require pressurized water, such as the various ***pump filters***.

This next table is the result of about 3-5 months of research; at the library, EPA and CDC inquiries, university libraries and online searches. I also went through all my books on backpacking, camping and self-reliance. I plugged the info into a table that will be quick and easy as a reference.

Now, not all of the methods listed are true "purification" methods (hence the quotes), however when a water treatment method was used interchangeably with purification, I put it in the table.

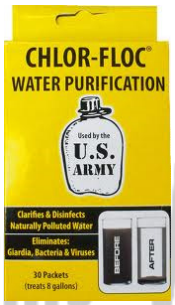
Basic Advantages/Disadvantages of POS "Purification" Methods:

Method	Pro's	Con's
Boiling 	The least expensive and most effective solution is boiling. Boiling will kill bacteria, parasites, and viruses. Many people advise bringing water to a hard boil for 5 minutes, and perhaps longer at higher elevation. According to the Wilderness Medical Society, water temperatures above 160 F (70 C) kill all pathogens within 30 minutes and above 185 F (85 C) within a few minutes. So in the time it takes for the water to reach the boiling point (212 F or 100 C) from 160 F (70 C), all pathogens will be killed, even at high altitude. To be extra safe, let the water boil rapidly for one minute, especially at higher altitudes since water boils at a lower temperature. Boiling is often used with a course fabric filter and chemical treatment (chlorine or iodine).	Fuel Time to boil Time to cool down Never ever boil water if you suspect Nitrates or Lead: Boiling water contaminated with nitrates or lead increases its concentration and potential risk. If you are concerned about nitrates, talk to your health care provider about alternatives to boiling water for baby formula.
		

Chemical	Lightweight and easy to pack. Easy to use. Inexpensive.
	
	Common chemicals used: Chlorine and Iodine
	* Iodine
	  * tablets
	  * crystals
	  * tincture of iodine
	* Sodium Chlorite / Chlorine Dioxide
	* Potassium Permanganate
	* Chlor-floc
		As a method of water purification, any type of chemical disinfection is far from ideal.
		They may take 15 to 30 minutes to disinfect the water (perhaps longer in very cold water) and they do not remove any sediments.
		Cryptosporidium is very resistant to this type of purification, so it is questionable how much longer this will be effective as our water sources become more contaminated.
		will not kill parasites
		One of the main problems with using iodine or chlorine is the taste they give the water.
		If using iodine, one effective method for reducing the taste of the iodine is to add vitamin C to neutralize it, but only after the treatment itself has been completed.
		Some parasites may not be killed using this method.
		Purification capability can be reduced by several factors:
		* Temperature of the water
		* Clarity of water
		* Tablet expiration date

<table>
<tr><th>Method</th><th>Pro's</th><th>Con's</th></tr>
<tr><td></td><td></td><td>Tablets take a long time to treat the water (up to four hours in some instances!) and the chemical taste is not pleasant.
Interestingly, if you do the maths it's clear that tablets, although cheap, do not work out cheaper for long-term use</td></tr>
<tr><td>Chemical – bleach
 

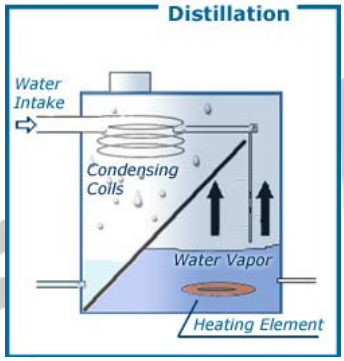
<table>
<tr><th colspan="3">Water Purification Chart</th></tr>
<tr><th></th><th colspan="2">Amount of Bleach</th></tr>
<tr><th>Amount of Water</th><th>Clear Water</th><th>Cloudy Water</th></tr>
<tr><td>1 Quart</td><td>2 drops</td><td>4 drops</td></tr>
<tr><td>1 Gallon</td><td>8 drops</td><td>16 drops</td></tr>
<tr><td>5 Gallons</td><td>1/2 teaspoon</td><td>1 teaspoon</td></tr>
</table></td><td>Use a non-scented, household chlorine bleach that contains a chlorine compound to disinfect water. Do not use non-chlorine bleach to disinfect water. Typically, household chlorine bleaches will be 5.25% available chlorine.
Follow the procedure written on the label. When the necessary procedure is not given, find the percentage of available chlorine on the label and use the information in the following table as a guide. (Remember, 1/8 teaspoon and 8 drops are about the same quantity.)
<table>
<tr><th>Available Chlorine</th><th>Drops per Quart / Gallon of Clear Water</th><th>Drops per Liter of Clear Water</th></tr>
<tr><td>1%</td><td>10 per Quart
40 per Gallon</td><td>10 per Liter</td></tr>
<tr><td>4-6%</td><td>2 per Quart
8 per Gallon
(1/8 teaspoon)</td><td>2 per Liter</td></tr>
<tr><td>7-10%</td><td>1 per Quart
4 per Gallon</td><td>1 per Liter</td></tr>
</table>
(If the strength of the bleach is unknown, add ten drops per quart or liter of filtered and settled water. Double the amount of chlorine for cloudy, murky or colored water or water that is extremely cold.)
Mix the treated water thoroughly and allow it to stand, preferably covered, for 30 minutes. The water should have a slight chlorine odor. If not, repeat the dosage and allow the water to stand for an additional 15 minutes. If the treated water has too strong a chlorine taste, allow the water to stand exposed to the air for a few hours or pour it from one clean container to another several times.</td><td>will not kill parasites
Takes time
Adds a chemical taste
You'll smell it (unless you can let it sit for a long time, ie overnight, so the smell can dissipate).
Bleach has a shelf life to remain effective bottles should be replaced every three months to ensure that the bleach is at full strength. When chlorine is in liquid form it degrades and becomes useless within a few years (and quicker if it is stored in the heat).</td></tr>
<tr><td>Chemical - BROMINE</td><td>used in pools and spas, doesn't smell or taste as bad</td><td>doesn't kill bacteria very well</td></tr>
<tr><td>Chemical - Calcium Hypochlorite</td><td>This chemical, sometimes called pool shock, can be purchased at any swimming pool store and is superior to bleach. (When chlorine is in liquid form it degrades and becomes useless within a few years and quicker if it is stored in the heat). The advantage of calcium hypochlorite is that it is in powder form and stores indefinitely.
It kills all kinds of micro organisms in the water while bleach kills most but not all organisms.
This chemical is extremely concentrated and will need to be diluted twice. The first step is to make the concentrated chlorine solution. Mix 5 milliliters (or 1 teaspoon) of Calcium Hypochlorite (78% grade powder) to 7.5 Liters (or 2 gallons) of water.
Do not drink this concentrated mix. It is still very concentrated and could kill you. It starts to deteriorate once it's in liquid form so don't mix up more than you can use in 6 months.</td><td>Time
It's an added chemical
Doesn't kill all organism contaminants.
Very dangerous in its concentrated form.</td></tr>
</table>

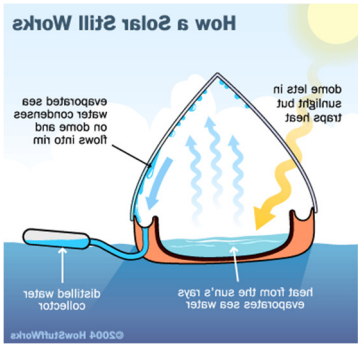
Method	Pro's	Con's
	Add 1 part solution for every 100 parts water. For a smaller batch mix 2 teaspoons concentrated liquid for every 1 quart (or liter) of water. Allow this mixture to sit for 30 minutes if the water is clear (If the water is not clear or murky allow it to sit for an hour). For larger batches add 1 cup of concentrate to every 6.25 gallons of water. Notes on finding 1/100 ratio starting from drips. 24 drips = 1/4 tsp. 96 drips = 1 tsp. 203 teaspoons per liter. 192 teaspoons in a quart. 2 tsp (or 10 ml) to every 1 liter of water fulfills the 1/100 ratio.	
Chemical - calcium hypochlorite granular	You can use granular calcium hypochlorite to disinfect water. Add and dissolve one heaping teaspoon of high-test granular calcium hypochlorite (approximately ¼ ounce) for each two gallons of water, or 5 milliliters (approximately 7 grams) per 7.5 liters of water. The mixture will produce a stock chlorine solution of approximately 500 milligrams per liter, since the calcium hypochlorite has available chlorine equal to 70 percent of its weight. To disinfect water, add the chlorine solution in the ratio of one part of chlorine solution to each 100 parts of water to be treated. This is roughly equal to adding 1 pint (16 ounces) of stock chlorine to each 12.5 gallons of water or (approximately ½ liter to 50 liters of water) to be disinfected.	It's a chemical Time Has an odor (To remove any objectionable chlorine odor, aerate the disinfected water by pouring it back and forth from one clean container to another.)
Chemical - Chlor-Floc Tablets 	Each 600 milligram tablet provides 1.4% available chlorine, and enough flocculating agent for the clarification and disinfection of 1 L (1.10 qts)of water from polluted sources at temperatures of 77 degrees F (25 degrees C). At 41 degrees F (5 C) two 600 milligram tablets will provide 2.8% available chlorine for the same purpose. Intended for the clarification and disinfection of polluted/suspended water, to make it bacteriologically safe for drinking.	Research: "Experiments examining the effectiveness of CHLOR-FLOC's disinfection component for viability of CryptosBoridium oocysts showed that the *disinfectant had very minimal capabilities to kill the encyst,.d organisms over the 20-minute contact time."* Source: dtic.mil *"The overall study results revealed that the CHLOR-FLOC system was not adequate to physically remove, or to provide adequate chemical disinfection of, Cryptosporidium oocysts to the required level of 99.9 percent reduction.* Water, Purification, CHLOR-FLOC tablets, Micro-organisms, Cryptosporidium, Klebseilla, Echovirus, Latex beads, Protozoan cysts, Bacteria, Disinfection, Coagulation." Source: oai.dtic.mil
Chemical - Chlorine	Chlorine in the form of bleach is used for disinfecting drinking water. CHLORINE is common, cheap, The amount of chlorine to be added depends on the concentration. Say for example, for 5% chlorine concentration, add 2 drops of the same per liter and vice versa. *Chlorine can be used by people with iodine allergies or restrictions* chlorine can "bleach" things, but it's not the same thing as what's in a bottle of bleach, which is sodium hypochlorite.	extremely toxic. It does not decrease physical or chemical contamination, it does increase colesterol formations, is a carcinogen, and causes heart disease Like iodine, treating with chlorine takes time, the length dependent on water temperature and sediment level. A major drawback, though, is that it takes FOUR hours of contact to be effective. So it's better not to run out of potable water before treating a new batch with chlorine.

Method	Pro's	Con's
		study has found out that chlorine is not effective against Giardia
Chemical - Chlorine bleach (sodium hypochlorite) 	Cheap. Commonly available in supermarket, pharmacies and convenient stores. Effective against bacteria and viruses. bacteria) that eventually builds up in the body. Unscented chlorine bleach can be used to eliminate some water impurities when you're camping. Commercial bleach such as laundry bleach purchased at a supermarket contain 3 to 6% sodium hypochlorite You can take an eye-dropper and add eight drops of bleach per gallon or 16 drops if the water is cloudy, but you'll want to stir the water well and allow it to stand for at least 30 minutes before drinking.	Initial chemical contamination in the water is not affected. Increases cholesterol formations. Carcinogenic in large amounts. May cause heart diseases because in the blood, chlorine reacts with calcium which causes it to become toxic and non soluble. Then it becomes plaque (breeding ground for bacteria) that eventually builds up in the body.
Chemical - Chlorine dioxide	Lightweight, compact, effective against Giardia and cryptosporidium (crypto). . Treatment with chlorine dioxide in liquid form such as Aquamira or Klearwater is more effective than iodine and adds less of a taste to the water. Aquamira comes in two separate bottles that have to be premixed, and has a shelf life of about 4 years.	Long wait time (20 minutes) – double that when water is cloudy or particularly cold; takes 30 minutes to kill Giardia and up to four hours for cryptosporidium.
Chemical - Chlorine Dioxide Tablets	Very simple, light, small and convenient. Just drop a tablet in a quart of water and wait. Chlorine dioxide tablets (found at REI under the brand name Micropur) meet EPA guidelines for effectiveness against harmful waterborne microorganisms, including viruses and hard-shelled Cryptosporidium.	Doesn't Filter Particles Limited to 30 Quarts Wait time is usually 30 minutes, but rises to 4 hours if Cryptosporidium is a known risk. Required wait time can frustrate thirsty users. The colder and/or dirtier the water, the longer the recommended dwell time. Some impact on taste may be noticeable. Not an ideal choice for murky or muddy water. Not always effective against Cryptosporidium due to the bug's egg like shell. When crypto is a serious concern (inquire locally), more reliable options are microfilters, UV light or boiling. Tips: Avoid wait time for chemical disinfection by prepping water at night for the next day's activity. Iodine is an alternate chemical treatment, but it is not effective against Cryptosporidium It is also not advised for use by people with thyroid conditions or pregnant women.
Chemical - Chlorine Pens – MSR MIOX Purifier	Combination of filter and chemical Compact & Small No Filters to replace Unlimited Uses	Requires Batteries & Salt Can leave chlorine taste

Method	Pro's	Con's
Chemical – Hydrogen Peroxide 	HYDROGEN PEROXIDE kills bacteria with oxygen, is chemically made and is very toxic. It is used in emergencies. What concentration of H_2O_2 hydrogen peroxide to use for drinking water disinfection? Health warning about drinking hydrogen peroxide http://inspectapedia.com/water/Drinking_Water_Purification5.htm Hydrogen peroxide (H_2O_2) sold as a topical disinfectant to reduce the chance of infection in minor scrapes, cuts, and burns, may also be used to purify water, and its odor will dissipate rapidly. Our page top photo shows typical drugstore hydrogen peroxide topical solution sold for home use as a disinfectant for cuts and abrasions. This hydrogen peroxide solution is found at 3% concentration. *How much hydrogen peroxide to add to drinking water?* We have not yet found an authoritative source that provides guidance on the concentration needed to disinfect drinking water. One of our readers spoke to a company that sells food grade 32 percent hydrogen peroxide. They recommend 1/8 of a cup per gallon but we do not know how they have determined this advice. Hydrogen peroxide vegetable soak Some websites describe use of 35% food grade H2O2 but without citing authoritative sources. "Vegetable Soak: (CLOROX substitute): Add 1/4 cup of 3% Hydrogen Peroxide into a gallon of Cold Water. Soak light Vegetables (Lettuce, etc.) 20 minutes, thicker skinned Vegetables (like Cucumbers) for 30 minutes. Drain and dry, (they keep LONGER too). If time is a Problem, you can spray the Vegetables with straight 3% Hydrogen Peroxide, let stand for a couple of minutes, rinse and dry." But is this treatment effective for just for Ecoli or also for Giardia? Some say thirty-five to fifty percent concentration being used but this is untested or quantified.	No quantified research on solution strength needed or results on the kinds of organisms, etc eliminated. NOT RECOMMENDED
Chemical – Iodine  	Lightweight, compact, effective against giardia, viruses and protozoa. Using ascorbic acid AFTER the water is disinfected with the iodine removes the bad taste that would otherwise make iodine a much less palatable option. Potable Aqua with PA Plus, there was no iodine taste in the water. There is perhaps a very slight taste difference between treated water and plain tap water, but it is difficult to discern. The treated water is pleasant to drink.	They may take 15 to 30 minutes to disinfect the water (perhaps longer in very cold water) and they do not remove any sediments. Water usually tastes bad (You can add a neutralizer to improve the taste). Not appealing to use with muddy water. Drink mixes can dilute effectiveness. Have to wait until chemicals work before drinking (often 30 minutes). Iodine tablets are not effective against cryptosporidium. *Do not use iodine to purify water for certain people:* • people who are allergic to iodine - possibly including people allergic to shellfish • people who have a thyroid disorder • people who are taking lithium (a medication)

Method	Pro's	Con's
		• women over fifty and women who are pregnant (without a doctor's advice) iodine in any form is limited in its ability to kill certain pathogens: "Cryptosporidium (a parasite that can cause diarrhea) and other coccidian parasites (e.g., Cyclospora, Toxoplasma) might not be killed by this method." [CDC] If the water is cloudy, any chemical disinfection may be less effective. You can reduce the cloudiness of water by allowing it to stand for a couple of hours, or by straining through a coffee filter or clean cotton cloth. Also a negative is the fact that iodine, in high enough dosage, is lethal.
Chemical – iodine, tincture of  Household Iodine (2%) — Amount of Water Needed 5 drops — 1 quart clear water 10 drops — 1 quart cloudy or murky water Let water stand for 30 minutes before consumption	Common household iodine from the medicine chest or first aid kit may be used to disinfect water. Add five drops of 2 percent U.S. or your country's approved Pharmacopeia tincture of iodine to each quart or liter of clear water. For cloudy water add ten drops and let the solution stand for at least 30 minutes.	Adds a chemical Taste time
Chemical - MIOX® systems (salt solutions)  	MIOX® systems use a salt solution to create mixed oxidants, primarily chlorine. high effectiveness in killing bacteria and viruses.	Adds a chemical Taste time Chlorine has a low to moderate effectiveness in killing Giardia Taste Time
Chemical - MSR Miox	Lightweight and easy to pack. Easy to use. Inexpensive. Another chemical method (the MSR Miox) is a proprietary treatment that uses a small electric current to create a chemical reaction called electrolysis to disinfect the water. high effectiveness in killing bacteria and viruses.	Adds a chemical Taste time Needs batteries. Chlorine has a low to moderate effectiveness in killing Giardia They may take 15 to 30 minutes to disinfect the water (perhaps longer in

Method	Pro's	Con's
		very cold water) and they do not remove any sediments. Water usually tastes bad (You can add a neutralizer to improve the taste). Not appealing to use with muddy water. Drink mixes can dilute effectiveness. Have to wait until chemicals work before drinking (often 30 minutes).
Chemical - Potassium Permanganate 	(Condy's Crystals or KMNO4) can be purchased at hardware stores. Sold as a water softener. Can be purchased in both powder and pill form (permitabs). This chemical compound has many uses from fire starting to water purification. Just a few crystals can treat a quart of water. (aproximately 0.01% solution) 1 gram per liter (3 - 4 crystals) This chemical can be found in some first aid kits. It kills micro-organisms through oxidizing the water.	Adds a chemical Taste time Adding this chemical will make the water slightly pink.
Chemical - Sodium Chlorite / Chlorine Dioxide tablets	These tablets essentially use chlorination as their method of purification. Sodium chlorite generate chlorine dioxide giving it the ability to treat water. Chlorination, as most know, is a common method of disinfecting water, and is commonly used by municipalities world-wide for this purpose. Chlorine destroys bacteria by destroying the cell walls of the bacterium/virus, killing the organism. Add one of these tablets to a quart of water. Allow it to sit for approximately 4 hours.	Adds a chemical Taste Time All tablets have a shelf life, check the date
Distillation 	Aside from desalinating water, the distillation process will reliably remove bacteria and viruses and dangerous heavy metals like lead, arsenic, and mercury. Reduces the heavy metals and fluoride in drinking water Kills any bacteria lurking the water *Distilled water systems bring water to boiling point, where water turns to vapor and is then condensed back into water in a separate chamber. It's a pretty involved mechanism.* Cost for home unit: $0.30- $0.60 cents per gallon Cost for gallon jugs from store: $0.89 cents – $1.29 per gallon	There are many problematic contaminants that are not removed from water because they vaporize at the same or lower temperature as water Removes minerals from the water Large and expensive to set up Not energy efficient they do not remove chlorine, chlorine byproducts, or VOCs. These chemicals, which have a lower boiling point than water, are the major contaminants of municipally treated water. Distillation, like reverse osmosis, provides mineral-free water that can be quite dangerous to the body's system when ingested, due to its acidity. Acidic drinking water strips bones and teeth of valuable and essential mineral constituents. Furthermore, distillation is an incredibly wasteful process. Typically, 80% of the water is discarded with the contaminants, leaving only one gallon of purified water for every five gallons treated. Long hours are required to attain a substantial amount of water. For example, it may take half an hour or longer to get 1 cup's worth (250ml / 8.5oz) of distilled water.

Method	Pro's	Con's
		A lot of electricity is used. For example, it may cost around 0.35 cents worth of electricity to produce 1 gallon / 4 liters of water, which adds up to about $21 per month for 2 gallons per day. Water cannot be distilled in the absence of electricity, making it completely unattainable should an emergency arise.
Distillation - Solar Still & Evaporation Methods 	Capable of distilling almost any tainted water including seawater. remove any chemicals or organic materials with higher boiling points than water. Such chemicals and organic materials with higher boiling points include bacteria, minerals, trace amounts of metals, many volatile organic chemicals (VOCs), and nitrate (Binnie et al, 2002). Drinkable water can be condensed from anything that has moisture. Easy to make and has low impact on the environment. All that is needed is a container to catch water and a large sheet of clear plastic. A clear plastic barrier like a plastic bag, ground cloth, or a plastic grocery sack is placed over the water source. The sun passes through the barrier and heats the source which then vaporizes, rises and then condenses on the underside of the plastic barrier. The moisture collected is drinking water.	Source materials that give off toxins like radiator fluids or fuels are not distillable. The distilling process is extremely slow and only small amounts can be collected daily. Wild salmonella reproduces quickly when stored in the dark, requiring 10 parts per million of hydrogen peroxide to solve the issue. it strips water of both dangerous and valuable mineral compounds.
Electrodialysis/Electrodialysis Reversal	Electrodialysis and electrodialysis reversal treatment systems use electricity and a series of membranes to separate salts from source water and to concentrate them into a solution for disposal. When electric current is applied to source water, chloride ions gravitate to the one end and sodium ions are drawn to the other. Moving in either direction, these minerals pass through stacks of membranes, which trap them in	Cost Needs electricity The waste product, which must be disposed of properly, may amount to some 30 percent of the total source water treated; 15 to 20 percent is more typical. The water produced by these treatments must also be treated for organic compounds (if they are a concern) and microbes—either before or after the electrodialysis process. Because source water does not physically pass through membranes in these systems, most organic contaminants are **not** removed. Source water for these systems must also be prefiltered, to reduce turbidity, Membranes are also kept clean by the periodic reversal of the system's polarity, which causes ion flow to occur in the opposite direction and reduces buildup. Electrodialysis and electrodialysis reversal systems require large amounts of energy to produce the constant current that drives purification and pumps water through the system.
Filtration	There is a difference between a water *filter* and a water *purifier.* Filters do not filter out viruses, but there are water purifiers, like the PUR Scout, that pass the water through both a filter and an iodine compound that kills any smaller organisms that have passed through the filter. These purifiers kill all microorganisms down to 0.004 microns; however,	Depends on the filter pore size Filters can get clogged Filters need to be replaced and can be costly Filters do not filter out viruses, Only filters that contain a chemical disinfectant matrix will be effective against some viruses.

Method	Pro's	Con's
	the filter should not be used by people who are allergic to iodine. you can consume the filtered water immediately. is no waiting for treatment, and unlike boiling, the water remains as cool and refreshing as the source. many of the cartridges (either paper or ceramic) contain charcoal to further "sweeten" the water. By forcing water through very tiny pores (say .2 microns), you can filter out many of the parasites, including Giardia. , water filters also extract from drinking water the chlorine-resistant protozoa *giardia* and *cryptosporidium* removes chlorine, chlorine byproducts, and VOCs from drinking water. Single media filters, typically constituting carbon or sand, absorb impurities from water, through both physical and chemical processes, as the water passes through the filter cartridge. Single media filters will generally remove undesirable tastes, colors, and odors from water as well as such chemicals as hydrogen sulfide, radon, chlorine, volatile organic compounds (VOCs), pesticides, and benzene (Ramstorp, 2003). Drinking water filters will also remove lead and other chemicals transferred from plumbing systems to water. Filtration is the only water purification process that will remove chlorine and chlorine byproducts from water. It is also the only water purification process that reliably and completely removes harmful pesticides from water. Single media filters will not remove mineral compounds from water. The true power of the filtration process lies in multimedia filtration technology. By using multimedia filters, select minerals can be retained in water while more harmful or useless minerals and chemicals can be removed. The magic of multimedia filters lies in their use of chemical processes, as well as physical processes for the removal of undesirable ground and surface water contents. As more media elements are added to the filter cartridge, the filter is able to remove more of the dangerous mineral contents. Multimedia filter cartridges can remove such harmful mineral deposits and chemical additives as arsenic and fluoride from drinking water. Though arsenic levels are generally low in most ground and surface water, the mineral can be deadly. Fluoride, while useful in maintaining healthy teeth, is a reactive and dangerous chemical that should be taken with care. *Sediment water filters* - remove dirt or debris. Very fine clay debris may pass through some sediment filters, requiring more sophisticated water treatment. A sediment filter or a granular or activated charcoal odor filter will improve the aesthetics of a water supply but it does not disinfect water contaminated with bacteria. *Iron removing water filters* - are intended to reduce the level of iron in a water supply. Many sediment filters are also capable of removing iron from drinking water.	heavier, bulkier, and more expensive than other solutions fairly slow process as it requires several stages of water purification. Depending upon the type of filter used, water filtration may be a less than ideal form of water purification. For example, granular filters do not utilize the chemical adsorption process, allowing several contaminants to pass through the filter media. Likewise, rapid water filters allot water inadequate contact time with the filter media, limiting the number of contaminants that may be removed. Solid block carbon filters solve both of these problems by using both adsorptive and slow filtration processes. Solid block carbon filters are absolutely the best and most effective water filters available.

Method	Pro's	Con's
	Odor water filters & charcoal water filters - typically constructed using activated charcoal, will remove odors, a limited amount of some chemicals, and may trap some bacteria but these are not water purifiers. Activated charcoal filters are a principal method used to remove general and specific organics from the drinking water supply A typical residential water treatment system handling water that contains bacteria will combine a chlorinator with a charcoal filter. the chlorinator treats the bacterial contamination and the charcoal filter post-processes the water to remove objectionable levels of chlorine. *Bacteriostatic water filters* - constructed using activated charcoal combined with silver that is released in ion form to help control bacterial growth in the filter *Ceramic water filters/purifiers* - use a ceramic cartridge through which water is filtered. Ceramic filters can remove bacteria, sediment, and often odors and other contaminants.	
Filtration - Carbon / Charcoal, Activated	Great for removing pesticides and chlorine Inexpensive Filters come in all shapes and sizes. Activated carbon filters are best suited for removing organic pollutants like insecticides, herbicides and PCB's. They can also remove many industrial chemicals and chlorine. Carbon water filters attract and trap carbon-based impurities, such as chlorine, that give water a bad taste. More activated carbon in the filter improves the quality of water and the lifetime of the cartridge. Electricity is not required Also called as carbon adsorption technique, activated carbon filtration, is one of the popular techniques used in household water purifiers charcoal filters are great at removing residual chlorine and odors in drinking water and can also remove sediment and even some pathogens. The U.S. EPA notes that solid-block charcoal filters can remove a wide range of water contaminants including • bacteria • chemicals • heavy metals • nitrates and nitrites • parasites • and with an additional filter step, fluoride	Does nothing against bacteria Not long-lasting Carbon filters provide a fertile breeding ground for bacteria. If water hasn't been treated with chlorine, ozone or some other bactericidal method before undergoing carbon filtration, any bacteria in the water will become trapped inside the filter and further contaminate the water that runs through it. Some manufacturers will claim that the problem can be taken care of by impregnating the carbon material with silver. Unfortunately, this doesn't work. The water must remain in contact with the silver for much longer than what actually occurs. Carbon filters also begin to lose their effectiveness over time. Many other chemicals like sodium and nitrate are not attracted to carbon at all so they pass right through. This means that an activated charcoal filter will remove certain impurities while ignoring others. It also means that, once all of the bonding sites are filled, an activated charcoal filter stops working. At that point you must replace the filter. Water at higher temperatures affects the performance of carbon filters. Carbon adsorption cannot remove heavy metals and dissolved solids in water. Effective when combined with other purification methods. **Watch out**: But charcoal can also serve as a pathogen growth media, and these filters can clog rapidly if the water supply is high in sediments. For this reason you'd place a charcoal filter, if needed, downstream from the sediment filter and downstream from a UV light or other disinfection system.

Method	Pro's	Con's
Filtration - Berkey Water Filter (black)	Bacteria is filtered to a 99.99999% and viruses to a 99.9999% level. Filters chlorine to undetectable levels Lead and other heavy metals are filtered up to 95%. When the black berkey filter is used in conjunction with the optional PF-2 filter, pretty much all undesirable contaminants are removed including fluoride. In fact, they filter water so well that they are rated by the EPA NSF/ANSI as water purifiers—purifiers greatly exceed water filtration standards. Minerals are not removed from the water The pores are so small that pathogenic bacteria, cysts, parasites, sediment and sedimentary minerals are not able to pass through them. The media formulation both "absorbs" some contaminates and "adsorbs" other contaminates. Heavy metals ions (mineral molecules) are extracted through an Ion exchange process where they are essentially electrically bonded to the media. The media used to extract the fluoride and arsenic is activated alumina. each water molecule can take several minutes to pass through the filter elements Outside of the filters and refilling, the system is low maintenance and no extra equipment or plumbing is required. Cost with black berkey filter: $.0.017 per gallon Cost with black berkey and flouride filter: $.07 per gallon	You must manually refill the chamber, though typically once a day Replacement filters can be expensive to remove fluoride from the water you must purchase a separate filter (black) You have to find somewhere on your counter to place it. The black filter system with multiple filters and ion exchange is expensive to initially purchase and then to replace the filters. If water is cloudy or visible dirty, it must be pre-filtered or the Berkley filters will clog.
Filtration – Cartridge Type	Water is passed through a filter cartridge that is usually contained in a plastic or metal canister. Both portable and permanently-installed water filters are widely available and form the most common water filter system found in residential installations where sediment, odors, or chlorine residue are a concern.	*Watch out:* most conventional cartridge-type water "filters" are not water *purifiers*. Only a filter that is certified to remove adequate levels of bacterial contamination are permitted to be sold as water "purifiers". Typically a filter that functions as a water purifier will be a ceramic device. *Watch out:* the functions performed by any cartridge type water filter depend on the material from which the cartridge is made. And many home water filter canisters will accept a variety of filter cartridge types intended for varying purposes. Be sure to read the properties of the filter cartridge you are buying and select a filter cartridge type that performs the functions required. For example a water filter designed to reduce sediment may work well for that purpose but may be ineffective at removing odors. And unless it is protected by a pre-filter or other means, a charcoal based water filter, good at removing odors, may become quickly clogged if it is used on a water supply high in sediment, or it may become contaminated if it is used on a water supply high in harmful bacteria. For these reasons you may find a cascade of types of water filters on some home water supply systems. Typically water will be treated to kill or remove

Method	Pro's	Con's
		bacteria, filtered for sediment, and finally, filtered for odors or taste
Filtration – Ceramic	Individual (1person) use ones are Inexpensive. Very easy to use. Removes all germs and bacteria from water. Works with both rain water and surface water. .Purifies about 2 liters per hour. Purifying filters use materials such as ceramic filters which have extremely fine pores to filter out harmful bacteria and protozoa. Examples of portable ceramic water filters include the Katadyn® ceramic water filter, Hiker Pro Micro Filter (also from Katadyn), and ExsStream ceramic water filter. Our portable, hand-operated pump-type water filters shown below include the Katadyn® Hiker microfilter (below left) and the Minworks® EX Microfilter. Some more recent single or multi-stage microfiber water filters have a very high gallon capacity and most models can simply be cleaned and re-used. • For example, The Katadyn *Combi filter* (www.rei.com) uses a combination of a silver-impregnated ceramic filter element and an activated-carbon cartridge to both filter and improve the taste of drinking water in a portable device intended for backpackers. *Portable water filters* all include a pump, usually a manual or hand pump, which forces water through a very fine ceramic filter cartridge, delivering a clean, if slow stream of potable drinking water. Some portable water filters include a container into which water is poured, then pumped out. *Note on Portable Water Filter Cartridge Types:* There are several types of filter cartridge designs, among which in our OPINION the most significant distinction is between fiberglass/paper/charcoal type filters and ceramic filters. The latter, ceramics, can be expected to have a longer use-life and can be cleaned and restored in the field. If you care, be sure to check the type of filter used in the specific model of portable water filter you are considering, as several manufacturers offer more than one filter type across their model line. Reduces asbestos fibers that may come from the degradation or breakdown of human-made products such as insulation, pipes, etc. Works against certain bacteria. Almost exactly like fiber filters which will provide only mechanical filtration. Again, go for pore sizes that are less than 1 micron. 0.5 micron if possible. Great against parasites and physical impurities Rust, dirt, parasites like Cryptosporidium and Giardia lamblia, and other impurities can be easily removed from drinking water	Not time efficient for purifying large quantities of water. If water is cloudy it should be pre-filtered to prolong the life of the ceramic filter. Replacement filters can be expensive Must be cleaned, can be repeatedly cleaned by simply scrubbing the outside of the ceramic material. Cannot remove arsenic from water. Whole house systems are expensive. Depending on pore size do not effect chemicals, bacteria or odors.
Filtration –Charcoal Filters with Chlorinators	Chlorine treatment water purification systems will also remove modest levels of sulphur, sulphur generating bacteria, and other odors.	If the water has a high level of sediment, pre-filtering may be necessary to avoid clogging the charcoal with debris. There is an operating cost as the charcoal filters need to be changed periodically.
Filtration – KDF / Copper-Zinc Systems	Effectively removes chlorine, heavy metals Another form of water filtration technology, being sold under the name KDF, uses granules of copper	Ineffective against pesticides and organic contaminants

Method	Pro's	Con's
	and zinc alloy to purify water. The copper and zinc molecules act like the different poles on a battery. As contaminated water passes through the granules, certain contaminants are drawn toward the zinc while others with a different charge migrate to the copper. Additional chemical reactions take place which release ozone and other compounds that kill bacteria and other organisms. KDF filtration effectively removes chlorine and its by-products, as well as heavy metals.	Copper and zinc filtration technology cannot remove pesticides and other organic contaminants. However, KDF systems usually incorporate precarbon block filters to make up for these shortfalls.
Filtration – Earth Filter	It is possible to make an earth filter using charcoal, sand, and grass. You will need a container like an old water bottle or birch tree bark folded into a cone. Add alternating layers of charcoal and sand with the grass on top. Filter the water through the container and into your collection cup.	Is not very trustworthy, use only as last resort. Diatomaceous Earth is expensive and must be backwashed daily.
Filtration – Faucet Water Filters	Faucet water filters give you a continuous flow of drinking water for even larger numbers of guests. They attach easily to the faucet, most without using any tools. Water is instantly filtered, making it convenient to have filtered water for drinking as well as cooking. This type of water filter fits onto the faucet and filters water with a carbon filter as it pours from the tap, reducing chlorine, sediment and a variety of minerals that can affect the pure taste. Many faucet-mounted water filters also reduce bacteria and lead. Most faucet filters let you bypass the filter for nondrinking water so you can preserve the life of the filter cartridge	You can only use the filter with cold water because hot water will cause the cartridge to deteriorate prematurely. Refill cartridges can be more expensive for faucet water filters than they are for water filter pitchers The kind and pore size of the filter will depend on what it removes and how well it does it.
Filtration - Fiber Filter	Sediment and muddiness is removed. Small organic particles that causes bad odors and taste may also be removed. These filters contain cellulose, rayon or some other material spun into a mesh with small pores. It is just like pouring water containing sand through a piece of cloth. Unlike slow sand filter, pressure is applied to force water through tightly wrapped fibers. There are many kinds of fiber filters in the market that comes in a variety of shapes and sizes from fine to coarse meshes. Go for fiber filters with micron ratings lower than 1 to efficiently trap particles.	The lower the micron ratings, the more often the filter must be changed. Anything that is dissolved in water like chlorine, lead and mercury is not removed. The kind and pore size of the filter will depend on what it removes and how well it does it.
Filtration – Bottles	Self Contained Filter and Bottle No Wait Time or Setup Fast Drinking Also, the stream of water is fairly small due to the fact it has to be squeezed through the filter. So if you're really thirsty, you can't "chug." There are many different types of filtration bottles on the market, varying in cost and number of refills before the filter should be considered worn out and the bottle discarded. Check with each manufacturer to get the details on what substances each filter will remove. I honestly don't recall what brand I had, but I know I used it for years and had no problems.	Pore size determines effectiveness and frequency of filter replacement Difficult for large quantities Average Filtering (but still safe) You pretty much have to submerge the bottle to fill it, so you may run into situations where you'll need to use a smaller cup to scoop or some other method to get the water from source to bottle. But this would be the case with just about any treatment method other than filtering through a tube.
Filtration – First Need	All models operate like standard pump filters, and the XL and Base Camp claim a pretty speedy flow	First Need canisters are not field cleanable.

Method	Pro's	Con's
	rate, roughly 1.9 liters per minute. (One liter per minute is considered a basic flow rate for pump filters.) Can withstand rough handling in luggage. The Trav-L Pure is a self-contained unit (no dangling hoses), but its flow rate is slower. Water is instantly drinkable with all models. With no chemical interaction, no taste is imparted to the water. The only pump devices that perform as chemical-free purifiers are found in the popular First Need series (XL, Trav-L Pure and Base Camp). First Need units feature a proprietary, carbon-treated filtering media, described as an electrostatically charged "structured matrix." Only its manufacturer (General Ecology) fully comprehends what's going on inside the First Need's tangled web of sci-fi fibers. (It's a combination of microfiltration and a process known as "adsorption," which causes suspended matter, such as viruses swimming in water, to adhere to a filtering material, all without chemicals.)	Pre-filters are available, but if you anticipate treating murky, muddy or silt-heavy water, a First Need canister potentially could plug up faster than you would like. After extended use, the ability of a First Need canister to capture viruses gradually diminishes.
Filtration - Charcoal / Carbon Filter, Granular Activated	Reduces chlorine, particles and improves the taste and odor of water. Water flow is reasonably maintained and is suitable for use as a whole house filter. Typical filter cartridge changes are done annually. Zero electricity is used. Zero water is wasted. Beneficial minerals such as calcium, magnesium and potassium that are dissolved in the water, stays in the water. Although activated charcoal granules are loose, they are an effective and valuable water treatment device. As long as a uniform flow rate is maintained and the filter is changed according to the manufacturer's specifications, optimal performance is achieved.	Water can flow around the granules without being treated as water flows where there is less resistance. Water can carve a channel where it may flow freely with little resistance, avoiding contact with the filtration medium. Pockets of contaminants can form around the granules that will result in a collapse, which contaminates the filtered flow of water, as the pressure changes. General pitcher filters containing active carbon granules have fairly large effective pore sizes of more than 20 microns. May potentially become breeding grounds for trapped bacteria when water flow is at a stop.
Filtration – Gravity	A hassle-free method for big groups. Gravity filters are quick and trap everything a pump model does, but handle larger volumes of water. Gravity filters are newly introduced and destined to become very popular with Venture Crews and large backpacking groups. Generally they work like this: fill a bag from any water source (two gallons or more), hang the bag in a tree, open a spigot and the water flows through the filter and into your water bottle (or cooking pot) at the rate of a half liter per minute. Easy and no pumping required. Several companies make gravity-operated "bag-type" water purifiers that clean water using a combination of one or more plastic bags, a filter, and plastic tubing. Reviews on the backpacking websites are generally very positive. The Katadyn Base Camp System only weighs 10 ounces (about the same as a pump filter) and doesn't take much room in your pack. It also uses the same filter as their pump filter products. The Platypus CleanStream filters four liters in less than three minutes; $90, platy.com. The lightweight bags pack small and are a snap to use (just hang	Unknown filtration specifics the Platypus™ "Cleanstream" gravity water filter is good for 1500 liters of water - but presumably less than that total quantity, possibly much less, for water that is very contaminated or plain dirty. Platypus points out that the Cleanstream water filter system is not suitable for use in freezing conditions.

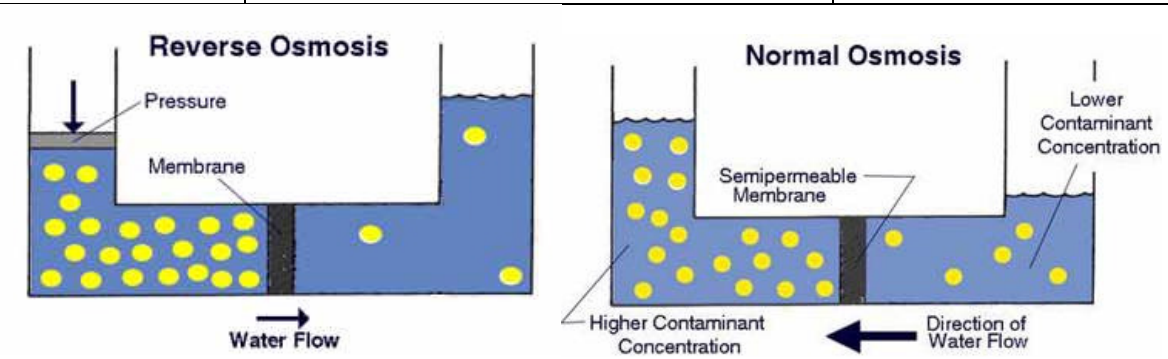
Method	Pro's	Con's
	from a tree, let water drip, and drink). the Platypus™ "Cleanstream" gravity water filter can produce water more rapidly and with less physical effort than a pump-type water filter. The Cleanstream by Platypus produces 4 liters of filtered water in about 2.5 minutes, and weighs 12.7 oz. This product filters particles down to 0.2 microns, small enough to remove nearly all bacteria and protozoa that may contaminate a water supply. The filter is good for 1500 liters of water	
Filtration – Hollow Fiber Memberane	More recent on the portable water filter market than ceramic and charcoal water filters are hollow-fiber membrane water filters that can be used as a drinking-straw type filter allowing drinking directly from a water source or as filters to fill a water bottle from a water source. The hollow-fiber water filter technology filters particles down to 0.1 micron and depending on the filter micron size rating, can remove 99.99999% of all bacteria such as salmonella, cholera and e.Coli, and removes 99.9999% of all protozoa such as giardia and cryptosporidium. – (retrieved 4/1/14 original source: http://www.rei.com/product/866577/sawyer-mini-water-filter) • LifeStraw Water Filter, www.rei.com $22. - 2 oz., 0.2 micron hollow-fiber filter removes 99.9999$ o bacteria, salmonella, cholera, E.coli, & 99.9% of protozoa including giardia & cryptosporidium • Platypus GravityWorks™ hollow fiber water filter, 2L ($110.) micron size not stated. • Sawyer Mini Water Filter, www.rei.com $25. - 2.0z, 0.1 micron size hollow-fiber filter removes 99.99999% of all bacteria such as salmonella, cholera and e.Coli, and removes 99.9999% of all protozoa such as giardia and cryptosporidium. The company also produces a higher capacity Sawyer Complete Water Filter system that can produce 2L of water in as little as 1.5 minutes. ($110.) In smaller size and at lower prices some of these units weigh only a couple of ounces and are very compact.	Unknown filtration specifics
Filtration – Ionic exchange water filters	Using a process that percolates water through special resins, ion exchange water filters soften hard water and de-ionize water, which many people believe has health benefits. Basically it exchanges sodium from salt for calcium or magnesium, using either glauconite (greensand), precipitated synthetic organic resins, or gel zeolite, thus softening the water. *Minerals, metals, chemicals or odors are not affected*, and the water is salty to drink Prolongs water heater Removes minerals, particularly calcium and magnesium that make water "hard" Some designs remove radium and barium Removes fluoride	This method does not remove organic contaminants. If water has oxidized iron or iron bacteria, the ion-exchange resin will become coated or clogged and lose its softening ability. Doesn't have any effect on water purity or your health "Ion exchange system" is a $100 phrase that refers to nothing more than a water softener. Softening hard water may improve your laundry and prolong the life of your hot water heater, but it won't do anything to prolong your life. Water softeners don't purify water.

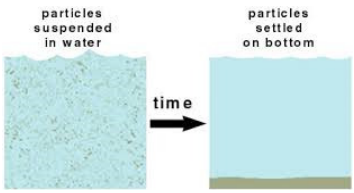
Method	Pro's	Con's
Filtration – Ionizer (Alkaline), Water and Filter Systems	These units include both filters and ionizing processes using electrolysis. The higher pH of the water and the alkalinity have been claimed to neutralize toxins in the body, helps to strengthen the bones and to boost the immune system. Alkaline water ionizers are installed at a sink, either as a countertop or under sink model, rather than as a whole house system. In addition to the drinking water benefits, these systems produce 5 different types of water that have a range of pH from very acidic water (for antibacterial and antiseptic uses) to very alkaline (highly effective, for removing oil-based pesticides and other chemicals from non-organic fruits and vegetables). These are just a few of the many uses of these pH waters. Water ionizers will also produce a "beauty water" (slightly acidic pH) which is an excellent toner for skin and can also be sprayed on hair to balance the pH. An electric ionizer can be connected very easily to your cold water tap and placed either under the sink or on your bench top. It is claimed by many, without scientific proof, that ionized and alkaline water is an antioxidant that reverses the process of oxidation within your body.	These water ionizer systems are more expensive than regular filtration systems Ionizers are only basic water filters and therefore not as effective as a purpose-designed drinking water filters. If you're concerned about the general quality of your water supply (and you should be), you'll need a home water filtration system, not an alkaline water ionizer. The units are expensive and the health benefit claims are not verified. Speak to some one who has a unit or study the reviews
Filtration – Magnetic		Magnetic water filters and purifiers are junk science and *are not* a reliable means of assuring safe drinking water.
Filtration – Microfiltration	Microfiltration membranes are created in several different designs. Spiral-wound membranes roll up many layers of flat membrane sheets around a central pipe that provides the water to be treated. Hollow fine-fiber configurations use a grouping of thousands of hollow tubes that are themselves constructed of membrane material. Microfilters, like ultrafilters, are normally found in a hollow fiber configuration. Because microfiltration membranes are a physical treatment technology, they are subject to physical limitations. Water that is filled with particulates or organic materials can clog membranes. Some water, particularly surface water, may need pretreatment before passing through a membrane system. These systems also produce small volumes of highly concentrated solution which requires disposal. Membranes are classified according to the size of the molecules that they are able to filter—Nominal Molecular Weight Cutoff or MWCO. Microfiltration has the highest MWCO, and thus, the largest pore size. Microfiltration employs pore sizes from .03 to ten microns (usually 0.1 to two microns) and is effective to MWCO sizes of 100,000 Daltons or more. It is often used to remove sand, silt, clay, algae, bacteria and Giardia and Cryptosporidium. Membranes are constructed of many different materials, which have their own pros and cons. Choosing the right membrane for conditions can be a challenge for water system managers	Mainly used for municipal water treatment plants. Compared to other kinds of membrane technologies, microfiltration is less commonly used today.

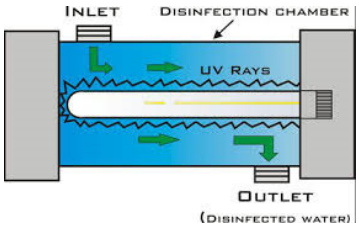
Method	Pro's	Con's
Filtration – Microfiltration, portable	remove contaminants from the water using a ceramic filter. By passing the fluid through the microporous membrane with pore sizes smaller than the contaminant we effectively remove pathogens	Pore size determines effectiveness and frequency of filter replacement
Filtration – MSR Pump Filter	Can make large quantities Fits onto Nalgene bottles Filters out particles	Longer Setup Time Can require maintenance Pore size determines effectiveness and frequency of filter replacement
Filtration – MSR Sweetwater Purifier System	Rugged construction is less susceptible to breakage. Needs no batteries. The filtration stage eliminates protozoa, cysts and bacteria; the chemical treatment is required only to deactivate viruses. This uses a 2-step approach: 1) mechanical filtration followed by 2) chemical treatment (drops of a chlorine solution). Some cautious wilderness land managers even advocate this 2-stage process as the most failsafe approach to backcountry water. MSR recommends filtering first, then applying the solution. Tips: Avoid wait time for chemical disinfection by prepping water at night for the next day's activity. Remember to take ample Sweetwater solution (packaged in 2-ounce bottles). Or teach yourself how to blend your own replacement solution using diluted liquid bleach.	Requires the physical effort of pumping; some people consider this slow and tiring. Treated water may project a slight chlorine taste. A modest wait time is involved after drops are added — MSR recommends 5 minutes to eliminate viruses. Extra-cautious souls may want to wait up to 30 minutes, particularly if the water is very cold. the Sweetwater solution is formulated to be effective only with the Sweetwater's borosilicate filtering medium. Pore size determines effectiveness and frequency of filter replacement As of this writing, the Transportation Security Administration prohibits pure liquid bleach or pool-strength chlorine in airline luggage. The Sweetwater solution contains 3.5% sodium hypochlorite (bleach, but in a highly diluted state). When traveling with the solution, the smart move, if possible, is to pack it in your checked luggage.
Filtration – Nanofiltration	Nanofiltration membranes are created in several different designs. Spiral-wound membranes roll up many layers of flat membrane sheets around a central pipe that provides the water to be treated. Hollow fine-fiber configurations use a grouping of thousands of hollow tubes that are themselves constructed of membrane material. Nanofilters, like reverse osmosis, are normally found in a spiral-wound arrangement. Nanofiltration is used to remove hardness, natural organic matter, and synthetic organic chemicals from water.	Used mostly by municipal water treatment plants Because membranes are a physical treatment, technology they are subject to physical limitations. Water that is filled with particulates or organic materials can clog membranes. Source water must always be treated prior to nanofiltration, so that particulates do not foul the membrane and limit its efficient. Waters high in iron, chlorine, and manganese may also require pretreatment. Even under ideal conditions, nanofiltration systems, like reverse osmosis systems, require regular membrane cleaning and periodic replacement. These systems also produce large volumes of concentrate, which requires disposal.
Filtration – PAPER or CLOTH	**PAPER or CLOTH** filters are disposable and filter to one micron	Does not have much capacity. Pore size determines effectiveness and frequency of filter replacement

Method	Pro's	Con's
Filtration – Paper or Polypropylene Water Filter Cartridges	Paper or Polypropylene Cartridge type water filter cartridges are designed for use in a residential water filter canister to remove sediment, silt, rust, or iron particles.	Paper, charcoal, or other water filter cartridges can be used in an emergency, however, *to pre-filter water* that is to be further treated with a disinfectant. Pore size determines effectiveness and frequency of filter replacement
Filtration - Pitcher Water Filters	Self Contained Filter and Bottle No Wait Time or Setup Fast Drinking Reduced chlorine in water Improved water flavor Low up-front costs Does not remove minerals from the water Because the pitchers can be put in the fridge, you can always have access to cold filtered water. Some water filter pitchers are small enough to be portable, and you can drink directly from them. Water filter pitchers and replacement filters are both very inexpensive. The most common type of water filter is the *water filter pitcher* that you fill with tap water and keep in the refrigerator or on the countertop, depending on the temperature you prefer. Water filter pitchers use replaceable *carbon filters* which trap sediment and reduce levels of chemicals, chlorine and other byproducts in your water. *These are fairly popular water filters that you can easily purchase in any grocery store. The filtration happens in the water pitchers and uses granulated activated charcoal to remove contaminants.* Cost: $0.13 – $0.34 per gallon	Difficult for large quantities Average Filtering (but still safe) The pitcher needs to be refilled frequently, and most water filter pitchers only hold enough water for two or three people. Pore size determines effectiveness and frequency of filter replacement The carbon filters is not solid, so it will not remove all contaminants Will not remove pesticides, herbicides, heavy metals, fluoride, or emerging contaminants Fairly small container for a family, must frequently refill water pitcher frequently Requires frequent replacement of cartridge, so may not be the most economical solution in the long-run despite up-front costs Unless you are making ice cubes the old fashioned way, you will not have ice made from filtered water.
Filtration –Silver Ceramic, Portable	Silver ceramic water filters are ceramic water filters which have been treated with colloidal silver - a step which increases filter effectiveness by killing bacteria in water passing through the system.	Watch out**:** take a look at the water treatment effectiveness discussion where COLLOIDAL SILVER is used. Pore size determines effectiveness and frequency of filter replacement
Filtration – Portable Water Filters	These filters are lightweight, compact, easy to use, and, depending on the manufacturer, are very effective at removing most water contaminants. These devices can be easily found in stores, and advances in design and technology make them an essential component of any well-prepared camper.	They can be expensive, will eventually clog up and fail to perform correctly, their effectiveness is largely dependent on the materials used in the filter media and pore size so may or may not eliminate the smallest bacteria and viruses.
Filtration – Pump	Removes sediment from the water. Provides clean water immediately They're easy to use, and a quick way to fill up and get clean water immediately when you're hiking in very small groups. Plus, they leave your water tasting fine, and don't allow pesky floating debris to get into your bottle. This method involves sucking water up through a device that strains harmful bacteria and protozoa and the occasional rogue twig or mayfly out of the water, and pumps clean, floater free water out the other end and into your bottle. There are two basic types of filters used with most pumps — membrane filters and depth filters.	Pore size determines effectiveness and frequency of filter replacement They can be slow. Expensive. Filters can clog or break. Hard work to filter water for a large group. Easy to contaminate the hoses. Bulky and heavy (11 ounces dry). Filtering requires pumping, adds weight to your pack, and is somewhat costly. *Note: If the intake hose on a water filter has been in contact with untreated water, consider the hose contaminated and keep it in a separate baggie. Once the*

Method	Pro's	Con's
	Membrane filters contain thin sheets with specifically and evenly-sized pores that prevent objects larger than the pores from passing through. These filters are fairly easy to clean but do clog more quickly than depth filters. One example is the Katadyn Hiker Pro Microfilter. . *Depth filters* contain thick, porous material such as carbon or ceramic to trap particles as water flows through. Activated carbon filters remove a range of organic chemicals and heavy metals, but the filters can be cracked if handled roughly, making them useless because untreated water can seep through the crack. These filters can be partially cleaned by back-washing. An example of a depth filter is the MSR MiniWorks EX Microfilter. There are many different types of water filters that treat the water by passing it through a very fine filter. Most Scout units have experience with pump filters from market leaders like MSR and Katadyn (although there are many brands). The pumps typically last two/three seasons, but the actual filters that go into the pumps typically have to be replaced every year. (Replacement filters can costs as much as the pump itself.) Backpackers have to find a suitable and comfortable spot, drop an intake hose into the water and place an outflow tube into the nalgene bottle (or anything else) and then pump (and pump and pump and pump). The hose going into the water is considered contaminated because it comes into direct contact with the water source. The tube going into the water bottle is considered clean and must be handled carefully. If the hose touches the tube (very possible when you are perched on a log fighting for balance while trying to unscrew the top of your water bottle as mosquitoes swarm around your head and arms) then both tubes are contaminated. To be extra careful, you then need to boil the tube or soak it in clean water with a few drops of bleach to sterilize it again. The same is true for water bottles that fall into the lake. A filter should be capable of straining out particles as small as 0.2 microns. Filters will also sift out sediments and convert cloudy water to clear water. Since filters work by mechanical means they can disinfect water immediately and are a convenient water treatment option. However, filters can become clogged or break. Therefore, a back-up treatment system is usually required. When treating water with a lot of sediment you can pre-treat the water by allowing it to settle and then straining it through a sieve such as a coffee filter or bandana. Cost: Good pumps cost roughly $70.00-90.00.	*hose is dry, it's no longer a concern.*
Filtration – Pump & Bottle – Lifesaver 4000	Self Contained Filter and Bottle Easy setup & usage Advanced filtering technology	Bulky Difficult for large quantities

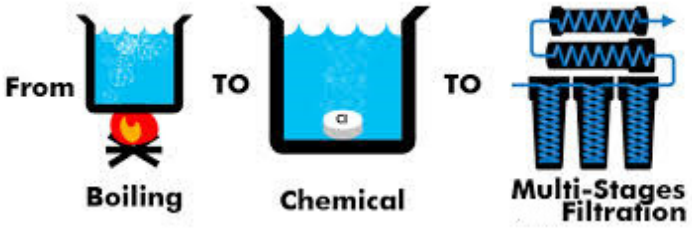
Method	Pro's	Con's
		
Filtration – Reverse Osmosis	uses a membrane with microscopic holes that require 4 to 8 times the volume of water processed to wash it in order to remove minerals and salt. Reverse osmosis will generally remove any molecular compounds smaller in size than water molecules. Reverse osmosis (RO) systems take advantage of the ability of water molecules to pass through a filter cellulose acetate semi-permeable membrane which at the same time keeps out many other (non-dissolved non-chemical) contaminants. "Semi permeable" means that the membrane is in effect an ultra fine filter whose openings pass water at a molecular level, leaving other larger molecules behind. Water pressure (usually at 40 psi or more) forces water molecules through the membrane, leaving behind certain water contaminants including bacteria and sediment. Water on the output side of the filter has been treated or purified, depending on the capacity of the particular RO system. Reverse osmosis (RO) water purifiers will remove nearly all water contaminants and also remove minerals from water leaving it soft. These systems do not discharge salt into the drain system, though they do discharge four gallons of waste water for every gallon of purified water produced. The semi-permeable membrane used in reverse osmosis contains tiny pores through which water can flow. The small pores of this membrane are restrictive to such organic compounds as salt and other natural minerals, which generally have a larger molecular composition than water. These pores are also restrictive to bacteria and disease-causing pathogens. Thus, reverse osmosis is incredibly effective at desalinating water and providing mineral-free water for use in photo or print shops. It is also effective at providing pathogen-free water. *There are different types of reverse osmosis systems. They typically differ based on the number of steps involved. The most comprehensive RO systems are 5-step systems. These 5 steps include filtration through micron filters, carbon filters, and water being pushed through a semi-permeable membrane. The last step that is often not included in home RO systems is treatment with Ultra-Violet light in order to kill bacteria and other organisms.* Cost for home unit: minimum of $0.15 – $0.97 per gallon Cost for gallon jugs from the store: $0.19 – $0.35 per gallon	Does not necessarily chemicals and bacteria. does not remove aesthetic contaminants such as dissolved chemicals, odors or bad tastes in the water supply unless it is mult-stage. So it needs to be preceded with a sediment filter to first remove large particulates and/or a charcoal filter to remove odors & residual chlorine. Does not remove pesticides, herbicides, and chlorine and as Chlorine passes through the membrane it can damage it removal of healthy, naturally occurring minerals in water (this can be unhealthy over long periods) Usually requires electricity Needs water pressure to work properly Although reverse osmosis does extract several contaminants from drinking water, its removal capabilities are not ideally suited to the challenges of the municipally treated water that the overwhelming majority of people receive. Municipal water contains such contaminants as chlorine and volatile organic chemicals (VOCs). Because these contaminants are physically smaller in size than water, the semi-permeable membrane cannot prohibit them from passing through with the water. Thus, they remain in drinking water. Reverse osmosis, by removing alkaline mineral constituents of water, produces acidic water. Acidic water can be dangerous to the body system, causing calcium and other essential minerals to be stripped from bones and teeth in order to neutralize its acidity. Trace elements of minerals were intended to be in water; their removal leaves tasteless, unhealthy drinking water. Reverse osmosis, although it is less wasteful than distillation, is still an incredibly inefficient process. On average, the reverse osmosis process wastes three gallons of water for every one gallon of purified water it produces. The storage tank requires regular cleaning to ensure the high quality of water stored.

Method	Pro's	Con's
	If you need to add a water softener to the mix or some other disinfecting filter for the finer contaminates, for a home unit that will increase the per gallon cost substantially.	Damaged membranes are hard to notice, thus it is not easy to tell if the system is still functioning properly. Synthetic membrane degrades when exposed to chloride and physical contaminants Systems can breed bacteria, requiring a carbon filter in between RO treatment and storage Does not work well with hard water Professional maintenance is needed
Filtration – Sediment filters 	Sediment filters and Iron filters to reduce red iron stains on fixtures & clothings; visible particles in the water supply are not only unpleasant but as we warned above, they can interfere with removal of pathogens from the water supply. For this reason it makes sense to place a sediment filter ahead of any other water treatment.	Does not purify water or remove remove aesthetic contaminants such as dissolved chemicals, odors or bad tastes in the water. This is a pre-treatment only.
Filtration – Sink Cartridge Type	It is not recommended to rely on the smaller store-bought filter cartridges that are simply attached to the tip of a kitchen sink faucet without clear documentation about just what that filter cartridge can remove from water, and how many of gallons of water it can process before it is exhausted. In contrast,CERAMIC FILTERS for water as well as some more recent single or multi-stage microfiber water filters have a very high gallon capacity and most models can simply be cleaned and re-used.	Pore size determines effectiveness and frequency of filter replacement *Watch out:* It would be unsafe to continue to "purify" water through an exhausted cartridge like filter.
Filtration - Carbon / Charcoal Filter, Solid Block Activated	Certain filters are designed to better reduce specific contaminants like arsenic, lead, mercury, etc. Much more effective and complete than granular activated carbon filters as surface area is larger and contact time is longer. Pore sizes of 0.5 micron and below is small enough to prevent trapped bacteria from multiplying. Totally independent of electricity and water pressure. Nutrient from minerals like calcium, magnesium and potassium remain in the water. Unlike granular activated charcoal, the carbon has been specially treated, compressed and bonded to form a uniform matrix. This combination of features provides the potential for greater adsorption of many different chemicals and greater particulate filtration than other types of purification methods. Effective pore sizes are usually below 1 micron. Just like any other filter cartridges, it will eventually become plugged and has to be changed according to manufacturer's specifications.	Soluble salt like nitrate and fluoride is not naturally reduced. Potentially harmful minerals like cadmium is not naturally reduced.
Filtration – SteriPEN	All SteriPEN models are small, simple to use and lightweight. No wait time is needed once water has been exposed to UV light. UV light imparts no taste to the water. The wand can be used to treat water (without ice) in individual drinking glasses, such as in hotel rooms. UV light is very effective against Cryptosporidium, the most treatment-resistant pest among protozoa and bacteria.	The quartz lamp could break. Batteries can run out. (The manufacturer recommends using lithium batteries.) Not effective in very dirty or gritty water unless it is prefiltered or clarified. Light must interact with organisms in order to be effective. Tips: If water has a high particulate content, use the SteriPEN's prefilter — a screw-

Method	Pro's	Con's
	This miniature light saber comes in multiple models. It uses ultraviolet light to deactivate the unseen cooties (viruses included) that could be lurking in water. Short-wave UV light (specifically, UVC, which transmits "germicidal" attributes) zaps, or "disrupts," their DNA, rendering them unable to reproduce and thus cause illness.	on cap for water bottles equipped with a 4-micron screen. The use of the prefilter is advised in any outdoor situation to keep water as particulate-free as possible. For speed and simplicity, bring a water bottle with threads that are compatible with the prefilter. If the water clarity is poor, give it a second or even a third dosage of UV light.
Filtration – Survival Filter Straws	Super small & light Easy to use Fast drinking There are several manufacturers of survival straws or emergency water filter systems. Examples include Aquamira and Lifestraw Information from Aquamira: "One unit will filter up to 20 gallons (75L) of water. Tests indicate that the Frontier Filter will remove 99.9% of Cryptosporidium and Giardia. The Frontier Emergency Water Filter System is also easy to operate, just attach and expand the straw, submerge the filter end into the water source, and drink through the straw." Article on the Lifestraw water filter: LifeStraw	Difficult for large quantities Average filtering (but still safe) Pore size determines effectiveness and frequency straw replacement Emergency single person use only
Filtration – Ultrafiltration (UF)	The size of the smallest virus and germ is more than 0.02 micron and hence UF method is effective in eliminating most particles, pathogens, microorganisms, and colloids above their rated size. Highly filtered water with less usage of energy. Ultra-Filtration is a type of membrane filtration, in which the water is forced against the membrane with several tiny pores. The pore size of ultra-filtration membranes range from 0.01 - 0.1 micrometers (1 micrometer is one millionth of a meter). This method of filtration removes dirt, suspended solids, bacteria, viruses, germs and their eggs, endotoxins and other pathogens, produces very pure water with low slit density.	Ultra- Filtration cannot remove any dissolved inorganic substances from water. To maintain a high pressure water flow, regular cleaning is required. Effective when preceded by carbon adsorption or when combined with other purification methods Used mostly by municipal water treatment plants
Filtration – Ultraviolet  	the proper UV light selection for water treatment is critical in the success of this approach. The UV light must have been properly selected to handle the volume and flow rate of the water supply where it is installed. If ultra violet light is not of sufficient capacity to treat water flowing past its bulb it will not be effective. Therefore it is important to follow the manufacturer's instructions when using the SteriPen UV light portable device. UV light will kill *Giardia trophozoites* but the real concern for drinking water is the *cysts*, since it is the cysts from stool that appear there. UV light for water disinfection where Giardia is present has, however, been successfully used in *combination* with chlorination as an approach to killing Giardia in water. An effective UV purifier kills 99.99% of harmful microbes. This method will not release any chemical compounds into the water	Murky water must be pre-filtered. if the water you are treating is visibly dirty or murky, there is a significant risk that the UV light will not penetrate and act on microorganisms in the water nearly as rapidly, and additional pre-filtering steps and/or extended treatment time may be necessary. Decreases the resistivity of water Will not remove any dissolved salts, particles, or ions from water. Uses electricity Requires professional maintenance UV Light & Giardia**:** Although the SteriPen producers describe this device as handling Giardia in water, not all sources agree that UV light will reliably and effectively kill cysts. -- [Dr. Omar Amin, of the Tempe AZ Parasitology Center]. Other treatment methods may

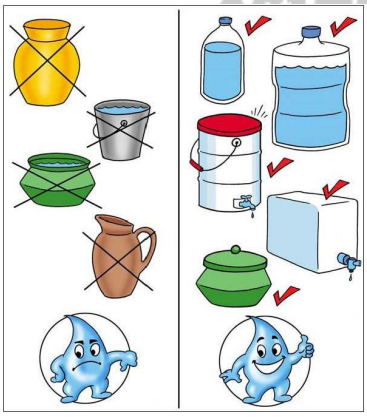
Method	Pro's	Con's
		be needed if Giardia is present in the water supply.
Filtration – Ultraviolet - Permanently-Installed on Private Well Water Systems	UV Lights are not filters. UV lights for drinking water treatment are installed in some properties as a means to kill bacteria in a water supply. We do not anticipate that UV light systems will be working in a disaster area, and we are doubtful that one can rely on this process for emergency drinking water purification: even if a UV light system is working, it will at kill bacteria and similar pathogens only. But if emergency generators or emergency electrical power are being provided to run a local water pump intended to provide drinking water, be sure that power is also provided to the UV light or to any other water treatment equipment that is installed in your location. UV light will kill *Giardia trophozoites* but the real concern for drinking water is the *cysts*, since it is the cysts from stool that appear there. UV light for water disinfection where Giardia is present has, however, been successfully used in *combination* with chlorination as an approach to killing Giardia in water.	Murky water must be pre-filtered. If the water you are treating is visibly dirty or murky, there is a significant risk that the UV light will not penetrate and act on microorganisms in the water nearly as rapidly, and additional pre-filtering steps and/or extended treatment time may be necessary. Decreases the resistivity of water Will not remove any dissolved salts, particles, or ions from water. Uses electricity Requires professional maintenance Websites that advertise use of UV light to kill giardia may be misleading. A UV light water treatment system will not remove chemical contaminants in a water supply. if the emergency event that has led to loss of power and water included a severe storm or flooding or other event that has sent ground water or flood waters into a private well, that water may be contaminated with chemicals or other ingredients that were never anticipated by water treatment equipment already installed at a building. Therefore even if you return a private well and water treatment equipment to operation, the water may not be safe to drink. Seek advice from local emergency management authorities before drinking water from any water source following an emergency, and to be safe, until you get an "OK" on using local water sources, you'll want to rely on suitable portable water purification methods.
Filtration – Under-counter	Under-counter water filters give you a large amount of filtered water for drinking or cooking. These water filters stay out of sight to keep your kitchen tidy. Generally, their cartridges need only to be changed twice a year. Under-counter water filters are attached to the cold water line underneath your sink. The filtered water is dispensed through a separate above-sink faucet.	Under-counter water filter systems require a bit more work to install, including changes to your plumbing fixtures. Pore size determines effectiveness and frequency of filter replacement
Grapefruit Seed Extract (GSE)	Grapefruit Seed Extract (or GSE) is a substance derived from the seeds, membranes, and the pulp of grapefruit. It's considered highly effective in fighting infection and promoting health. GSE is used as a purifier, antiseptic, and preservative, with some researchers claiming that its a superior antimicrobial to chlorine bleach, isopropyl alcohol, and colloidal silver. For water purification, the recommendation is to add 10 to 25 drops per gallon of water, then shake and let stand for several minutes. The water will have a bitter taste to it.	Not thoroughly studied or proven

Method	Pro's	Con's
		
Filtration – Membrane Treatment	Membrane technology is indeed an innovative method in which a semipermeable membrane is used for the removal of water impurities. There are two types of membrane water treatment methods, namely, pressure-driven (e.g. reverse osmosis) and electrically driven. In the former case, hydraulic pressure is used to drive the raw water across the membrane, whereas in the latter case, electric current is used to allow the movement of water through the membrane.	Expensive to install and maintain, particularly on a large scale Pore size determines effectiveness and frequency of filter replacement
Oxidation - Aeration	sprays water into the air to raise the oxygen content, to break down odors, and to balance the dissolved gases.	it takes space, is expensive, and picks up contaminants from the air
Oxidation – Electronic Purification and Dissolved Oxygen Generation	creates super oxygenated water in a dissolved state that lowers the surface tension of the water and effectively treats all three types of contamination: physical, chemical and biological.	Expensive, usually found in large municipal water treatment systems
Oxidation – Ozone (O3)	Kills bacteria including protozoa that form cysts, viruses, algae and parasites It also reduces odor problems and concentrations of iron, sulfur, manganese, and other dissolved chemicals. Ozone (O3) differs from normal oxygen in that it contains three atoms of oxygen instead of just two. This extra oxygen atom makes it highly unstable and reactive. When ozone gas bubbles through water, it quickly and very efficiently kills bacteria, viruses, algae and parasites. Not only is it thousands of times more potent than chlorine, it doesn't produce any harmful by-products like chlorine does. For these reasons it has become a viable method to treat water in swimming pools and spas. Uses highly charged oxygen molecules to kill microorganisms on contact, and to ozidize and flocculate iron, manganese and other dissolved minerals for post-filtration and backwashing.	Usually found in large municipal water treatment systems or for pools and spas Ineffective against heavy metals, minerals and pesticides Effectiveness dissipates quickly Produces trace amounts of a type of carcinogen called bromate. No disinfectant residual is left in the water. mild carcinogenic by-products and high cost of operation Prohibitively expensive and hard to come by in quantities for home use ozone has a very short "half-life." In other words, it dissipates almost instantly and offers no residual purifying power



Bottom Line: To be truly safe, it pays to use multiple "purification" methods.

- ✓ Filtering and Disinfecting or Purifying are two different animals.
- ✓ Filter or membrane pore size, along with surface area are key to what contaminants can be removed.
- ✓ For very cloudy water with large particulates, filter first through some kind of cloth (bandana, towel, cheese cloth, etc. The finer the weave the more it will filter out. Crush some charcoal on the cloth and you can take out even more contaminants.).
- ✓ Next treat any emergency water with either Chlorine (unscented household bleach) or Iodine.
- ✓ Then as long as you do not think there are any Nitrate or Lead contaminates, boil the water to be truly safe.
- ✓ And lastly, filter it through the finest pored, multi stage filter (ceramic with charcoal) you can afford.
- ✓ Remember that although Reverse Osmosis and Distillation will purify water of *most contaminants, but not ALL,* they also remove ALL minerals and metals, of which we do need some, and they are NOT recommended for long term water purification.



Water Storage

Preppers like to store water, along with other preparedness supplies, so they don't have to resort to any of the above "purification" methods too quickly. To do that we need containers to store the water in and like food items, any container will not do.

Water and food should be stored in Food Grade containers. There are basically **7 categories of plastic** and only four are food grade (1, 2, 4, 5):

1 **PETE:** Polyethylene terephthalate ethylene, used for soft drink, juice, water, detergent, cleaner and peanut butter containers.

2 **HDPE:** High density polyethylene, used in opaque plastic milk and water jugs, bleach, detergent and shampoo bottles, and some plastic bags.

3 **PVC or V:** Polyvinyl chloride, used for cling wrap, plastic squeeze bottles, cooking oil and peanut butter containers, and detergent and window cleaner bottles.

4 **LDPE:** Low density polyethylene, used in grocery store bags, most plastic wraps, Ziplock bags and some bottles.

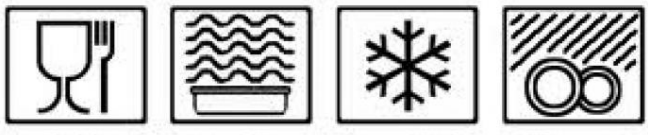
5 **PP:** Polypropylene, used in most Rubbermaid, deli soup, syrup and yogurt containers, straws and other clouded plastic containers, including baby bottles.

6 **PS:** Polystyrene, used in styrofoam food trays, egg cartons, disposable cups and bowls, carry-out containers and opaque plastic cutlery.

7 **Other:** This is a catch-all category for plastics that don't fit into the #1-6 categories. It includes polycarbonate, bio-based plastics, co-polyester, acrylic, polyamide and plastic mixtures like styrene-acrylonitrile resin (SAN). Number 7 plastics are used for a variety of products like baby bottles and "sippy" cups, baby food jars, 5-gallon water bottles, "sport" water bottles, plastic dinnerware and clear plastic cutlery.

I don't know about you but for me that is a lot to digest! Thank goodness that as with most things now-a-days, these often technical specifics have been reduced to symbols we can look for. Just don't confuse *Recycle* symbols with *Food Grade* symbols.

Food Grade Symbols



Cup & Fork indicates this plastic is safe for contact with food.

Radiation Waves indicates this plastic is safe for microwave.

Snowflake indicates this plastic is safe for use in the freezer.

Dishes in Water indicates this plastic is safe for dishwasher top rack.

Recycle Symbols

Another thing we need to keep in mind is that since 2000 any bottle of 2 liters or less containing liquid for human consumption must be made of a bio-degradable plastic. This means that the plastic bottle itself will have a shelf life.

<u>According to studies from Bingham Young University</u>: In 1-2 years the plastic decomposed enough to contaminate the water. Not enough to make a person sick, but the taste was bad and could not be "freshened" up. In 3-4 years, more than half of these bottles decomposed enough to leak. (Someone told me that this biodegradable plastic is utilized for all use-and-toss bottles that are 2 liters or less, as of this writing (12/2010), I have not verified this.) Aside from that you really don't want to have trash to hide if you are mobile for any reason and it is easier to crack or break plastic than it is metal; plus the new stainless steel containers don't leave that awful "canteen" taste in the water.

For more detailed information on these containers see Food & Water Storage Considerations @ http://weebly-file/2/2/5/0/22509786/food_and_water_storage_considerations_new_site.pdf

Understand that *water in and of itself never really goes bad.*

- It can get contaminated or polluted (a container that was not sterilized before filling can grow harmful bacteria) – yes
- It can absorb the taste of the container – yes
- Go bad when stored - NO

So whenever you see someone talk about rotating your water, they are generally talking about being on the safe side:

- That No contaminants have entered the container since it was filled or was already in the container when it was filled
- About the taste of water stored over long periods
- About the bottle itself degrading until its contents are contaminated or the container is leaking.

Storing Water in Plastic Soda Bottles

If you chose to use your own storage containers, *choose two-liter plastic soft drink bottles* – not plastic jugs or cardboard containers that have had milk or fruit juice in them.

Milk protein and fruit sugars cannot be adequately removed from these containers and provide an environment for bacterial growth when water is stored in them (they make great "water weights" for tarps and such though). Cardboard containers also leak easily and are not designed for long-term storage of liquids.

It is not wise to use glass freezer storage, as it is heavy and can break and some glass containers may break regardless of the air space provided for freezing.

Follow these steps to ensure safe drinking water:

- Thoroughly clean the bottles with dishwashing soap and water, and rinse completely so there is no residual soap.
- Sanitize the bottles by adding a solution of 1 teaspoon of non-scented liquid household chlorine bleach to a quart of water. Mix the sanitizing solution in the bottle so that it touches all surfaces. After sanitizing the bottle, thoroughly rinse out the sanitizing solution with clean water.
- Fill the bottle to the top with regular tap water. If the tap water has been commercially treated from a water utility with chlorine, you do not need to add anything else to the water to keep it clean. If the water you are using comes from a well or water source that is not treated with chlorine, add two drops of non-scented liquid household chlorine bleach to the water. Let the water stand for 30 minutes before using.
- A slight chlorine odor should be noticeable in the water, if not, add another dose of bleach and allow the water to stand another 15 minutes.
- Tightly close the container using the original cap. Be careful not to contaminate the cap by touching the inside of it with your finger. Place a date on the outside of the container so you can know when you filled it. Store in cool, dark place.

- Water can also be treated with water purification tablets that can be purchased at most sporting goods stores.
- Water that has not been commercially bottled should be replaced every six months, unless frozen.
- You can also store water for an extended period of time in the freezer. If you lose electricity, the frozen water will help keep foods in the freezer frozen until power is restored. Leave 2 to 3 inches of air space in the top of containers before freezing, to keep the container from breaking as water expands during freezing.

Tip: Chest Freezers will keep the enclosed items frozen longer than upright freezers during a power outage. They also tend to be cheaper to operate than uprights. (*Dah!* Cold air sinks, so when a chest freezer is opened, less cold air escapes than when an upright freezer is opened.)

A fantastic *Water Storage Calculator* can be found at http://www.thereadystore.com/water-storage

Water Storage Containers Recap

- Purchase *food grade* water storage containers online or from surplus or camping supplies stores.
- Choose from a wide selection of water containers, purifiers, filters, pouches, etc. Check out a bathtub bladder for emergency water storage, like WaterBOB @ http://www.waterbob.com/Welcome.do;jsessionid=6D92A2FF4397C279EDEFF8817F12313A
- Save, wash and sterilize *food grade* containers, or at least thoroughly clean the containers with dishwashing soap and water and rinse completely so there is no residual soap before filling with water.
- Freeze clean water in blocks or large ZipLoc bags in advance and store in your freezer
- Store water or food in a cool, low light, dry environment that is as insect and rodent proof/free as possible
- Avoid excessive conditions of temperature and humidity, as these can speed the deterioration of the plastic

Hygiene, Sanitation and Waste Water

In an emergency that takes out our normal infrastructures of water, grey water (from hygiene & cooking) and sanitation or "black water", we need to think of conserving our water for drinking, cooking and hygiene and what to do in place of normal toilets or commodes.

Personal Hygiene, Hand Washing, Dish Washing and Emergency Toilets

The most often referred to DIY projects for each of these scenarios comes from New Zealand Permaculture Emergency Response Group (http://www.composttoilets.co.nz/), out of Christchurch, New Zealand, that is referred to by several metropolitan areas and states on their preparedness sites.

- It is always wise to have a large box of disposable gloves in your emergency supplies. Use these often if in an emergency situation to reduce the need to wash your hands.

Personal Hygiene

If we stock up on "Wet Wipes" and waterless antibacterial hand gel we can get around most of the personal hygiene issues. We can use these items to wash our face, hands, arm pits and it we have enough, our entire bods too.

Hand washing is critical anytime – all the time! Use of hand sanitizer and disposable gloves and wipes will help you conserve your emergency water supply for essential hand washing.

The Two Bucket Hand Sink:

1 Collect two 5 gallon buckets with lids and handles.
2 String one up from a hook or tree branch
3 Make a hole in the bottom or bottom side of the bucket and be sure you have a cork or some other means to plug this hole.
4 String the second bucket under the first bucket to collect any water. Keep the lid on it when not in use to keeps bugs and such out.
5 Fill the top bucket with purified water.
6 You can hang a bottle of waterless hand gel, dish soap or bar soap nearby along with a sponge, wash rag and towel.

To use pull the cork/plug out, wash, put the cork/plug back and dry.

When the bottom bucket is full this can be used to wash dishes, clothing or to "flush" an emergency toilet.






Emergency Shower: The same method can be done with a steel tub that a human can stand in and a single 5 gallon bucket that has multiple holes (that can be plugged) in the bottom or has a tube with a "shower head" attached that can be clamped closed.
Hang the bucket of water over the steel tub
Step into the tub with your soap, pull the plugs, wet yourself, close the plug, wash quick, open the plug to rinse and re-plug when done
Dry off
Empty the steel tub water into your grey water tubs for further use later.

New Zealand Permaculture Emergency Response Group (http://www.composttoilets.co.nz/)

Tip: Make a soap pocket out of washcloths sewn together with a draw string to keep near your "sink" or "shower".

For those of you that are not DIY inclined you can always purchase collapsible disk pans and solar showers. To get an idea of the general pricing (unless there is a sale somewhere) see Campmor.com. Just remember that water weights about 8 pounds per gallon, so if you are hefting the thing to hang it up or put on an elevated platform, keep this weight in mind.

For teeth, there are really only three choices.

- Stock up on toothpaste and brushes
- Stock up on the all-in-one pocket sized single-use emergency toothbrushes
- Store baking soda and toothbrushes. Baking Soda can be purchased in bulk at most warehouse stores for a very cost effective price.

No matter which you decide on, only use ½ - 1 cup of water each time you brush your teeth. Keep a good speckled enamel mug for each member of your household, to use when brushing their teeth or shaving.

This water should then be saved with your washing dishes grey water or to be used for "flushing" your emergency commode.

But what about Feminine Hygiene? Well there are some good directions for DIY sanitary napkins and tampons found on the web. If you stock up on these supplies now, you should be ok. The same goes for condoms.

Some links to get you started on DIY Feminine Hygiene items:

Make Yourself An Emergency Maxi-Pad	http://jezebel.com/5812246/diy-pad-crisis
DIY Emergency Tampons Video	http://www.rookiemag.com/2013/03/sunday-video-diy-tampons/
How to Make a Substitute Sanitary Pad	http://www.wikihow.com/Make-a-Substitute-Sanitary-Pad

Tip: Copy the instructions from the link(s) you select into a Word document and then print it out. Store these instructions with your emergency feminine hygiene supplies or in your Emergency Documents Binder.






Dish Washing

When we wash dishes we should save our grey water to use for additional dish washing and for our emergency toilets. So having some 5 gallon buckets with lids handy is a plus.

To wash dishes and still conserve your purified water:

1 Have a large tea kettle or pot with lid that can go on an open flame.
2 Fill the kettle or pot with water and heat. If you cannot heat water use a black or dark heavy duty water proof plastic bag, fill it with water and place in the sun for a few hours.
3 Pour the heated water into either a small dishpan or 5 gallon bucket
4 Add 1/8 teaspoon (8 drops or about 0.75 milliliters) of household unscented liquid bleach to the 1 gallon (16 cups) heated water. (This disinfects as it rinses the dishes)
5 In another small dishpan or 5 gallon bucket add no more than a gallon of unheated water (You can heat this water too if you wish, but do NOT add any bleach).
6 Wash your dishes in the cool water
7 Rinse your dishes in the bleached hot water
8 Dry the dishes and put away for future use
9 Save this water for as many dishwashing chores as you can before dumping both water containers into your grey water containers(s).

Of course one can always purchase camping solar-showers, tubs, camp sinks and such for these hygiene tasks.

Commodes or Toilets are another matter.

If all that is going on is a "boil order" due to contaminants in the public or well water supply, you may not need to worry about this. *That's you MAY NOT have to worry about this!* However, if this is a flood or earthquake where the normal sewage and grey water infrastructures are not available, then you do need to worry about this – big time.

There are also 4 key items to remember when utilizing emergency sanitation, especially any kind that does not utilize chemicals.

- SEPARATE (urine and feces to optimally manage pathogens and volume): "Not mixing the urine and feces is a proven principle of ecological sanitation. In separating pee and poo, the twin-bucket toilet reduces disease risks and odor and makes the contents of each bucket easier to handle". The solution is to create two different buckets, one for pee and one for poo. This twin-bucket emergency toilet system will serve 3 – 4 people for 3 days.

- CONTAIN (safely contain excreta, making sure you have enough containers)
- COMPOST (manage your compost properly): See The Humanure Handbook 3rd Edition by Joseph Jenkins (the link for the PDF to download is in the Resources section or purchase the book.)
- WASH (remember hand hygiene; build a hand washing unit, like the Two Bucket Hand Sink mentioned earlier.)

Although there are several methods to consider, some DIY, some to purchase, the two most often referred to are continuing to use your Flush Toilet (without the flush) or the DIY Two Bucket Toilet from the New Zealand Permaculture Emergency Response Group (http://www.composttoilets.co.nz/), out of Christchurch, New Zealand. Both of these options are the cheapest to set up and take up the least amount of space while using little to no chemicals.

Your Flush Toilet

If you are in an area that can experience *severe flooding* it pays to *sandbag your toilets!*

Put a sandbag into and around the toilet bowls.

This will not prevent your home from being flooded, but it will prevent sewer waste from backing up into your home and will minimize the overall damage from that type of consequence.

If the water is out and you are stuck in your home, you can ***Continue To Use Your Commode*** by following a few simple steps:

Drain the water from the bowl

Line the inside of a toilet bowl with two heavy-duty plastic garbage bags.

Or you can use heavy-duty "Bio-Hazard" sanitation liners. These are often used in Hassock Portable Toilets and Portable Loos.

Place kitty litter, fireplace ashes, used charcoal, or sawdust into the bottom of the bags.

Or you can go expensive and add the chemicals used in chemical toilets to help reduce the smell and break down the waste.

After each use: Add a 1/4 cup of Bleach and then Close the inner bag to reduce smell.

OR You can also use the spoon with long handle to scoop to:
Add about a tablespoon of powdered, chlorinated lime on the waste. This helps to break down the waste.
And
Add about a tablespoon of borax on the waste. This helps to reduce odors.

At the end of each day, the double-bagged waste should be securely tied and removed to a protected location such as a garage, basement, outbuilding, and so on, until a safe disposal option is available.

The location should be at least 48' from any dwelling, water supply, animals, and garden. Dig a hole at least 18 inches deep and at least 48' downstream or away from any water source (Dogs can smell through dirt up to 16 inches and they will dig up human waste) Place the bag full of waste in the hole and bury. Mark the site for future removal if it becomes necessary.

Most states allow residents to dispose of the waste in a properly functioning public sewer, or septic system, or they may bury the waste on their own property.

During a declared emergency, most states allow these bags may be included with the regular garbage if a public announcement has been made that allows this method of disposal.

The **DIY** Christchurch **Two Bucket Toilet**

Since the orginal, there have been many “modifications”, some are good, some not so good. The basic system is just buckets and organic carbon material, no special chemicals.

These modifications have mostly added chemicals or components like, lime or kitty litter, even TP and wet wipes. Then stamped the outside of the buckets with fancy stenciling of Pee and Poo. Volia ! You have the Twin-Bucket Emergency Toilet for $50.00 dollars, when you can do it yourself for about $15-20.00.

If you are into paying for stuff you can get for half the price or for free, then go for it. Otherwise you can put one of these “kits” together for yourself for less dollars.

No matter which way you go, when complete or purchased these will take up the same amount of space in storage. When either "kit" is set up for emergency they will take up the same working space and require the same "maintenance and disposal" steps.

Toilet Components

- ✓ five-six gallon food grade buckets are needed for 3-4 people for 3 days – IF you <u>do not use liners</u> for the buckets. Try restaurants, bakeries and supermarkets for the freebies as they are not allowed to reuse them for food.

- ✓ Box of Heavy Duty Trash bags that can fit the buckets or heavy-duty "Bio-Hazard" sanitation liners, often sold for RV and boat portable toilets.

- ✓ Lids for the buckets. These may need to be purchased. Check out hardware stores for the cheapest lids.

- ✓ Toilet seat or two that fits the buckets. Either move the seat from one bucket to the other or purchase one for each bucket.




- ✓ Carbon material to cover the poo: A supply of sawdust, coffee husk chaff, finely shredded paper, pulverized dry leaves or peat moss, kitty litter, or coir fiber. About a gallon bag per day. The Boy Scouts recommend a 50# Bag of powdered, chlorinated lime, also referred to as calcium Hypochlorite or Bleaching Powder that can be found at pool supply stores and Borax found at your local grocery store






- ✓ Spoon with long handle


- ✓ Box of disposable gloves

- ✓ Toilet Paper

- ✓ Wet Wipes

- ✓ Waterless Hand Gel Soap



- ✓ Wash Rag & Towel
- ✓ Optional: sanitary napkins or diapers if needed

Using the Toilet

1. Mark the twin buckets "pee" and "poo" (or #1 and #2 or urine and feces, or yellow and brown, etc).
2. Also place a "pee" and "poo" sign above each bucket in case the label on the bucket gets damaged or covered.
3. Put buckets in a private space with carbon covering material nearby, along with a plastic scoop.
4. Line the buckets with 2 heavy duty bags, making sure you can still see the Pee & Poo signs.
5. Put in enough Kitty Litter to line the bottom of each bucket (about 1-2 cups).
6. Seal the lids on the buckets.
7. Place the seat between the two covered buckets so it can be moved from one to the other; or if you bought 2 seats, there is one for each.
8. Decide if you need to use the pee bucket or the poo bucket. The seat can be moved from one to the other unless you purchased one for each bucket.
9. Try not to mix pee and poo. This is important although it's understandable that there will be mistakes. The pee is the component that produces the bad smell in toilets that mix the two.

10. Pee

- After using the pee bucket, you can put the toilet paper in the poo bucket.
- Then remove the seat from the pee bucket and cover with a lid that closes well.

10. Poo

- After using the poo bucket, sprinkle as much carbon material as needed to completely cover the surface of the poo (around half a cup, depending). This eliminates odors and keeps flies away.
- Remove the seat and cover with a lid that closes well.
- A few sources said to leave the Poo bucket slightly open, ensuring it's not airtight; supposedly to give poo some air to dry out and reduce in volume a bit. I'll tell you from camping experience - *This Invites Bugs!*

11. Here the Boy Scouts say "After each use of the toilet, use the spoon with long handle to scoop about a tablespoon of borax on the waste in either bucket."
12. Make sure each bucket is covered after each use. Put all used TP into the poo bucket.

13. Have a "Hand Washing" station in the same area made of either Wet Wipes, Waterless Sanitizing Hand Gel or the Two Bucket Hand Washing Station discussed earlier.

Hygiene, Sanitation and Waste Water Supplies Recap

- Large box of disposable gloves
- Wet Wipes
- Waterless Hand Gel
- Toothpaste & Toothbrushes or Disposable single-use toothbrushes or (my favorite due to the multi-functionality of baking soda) Large box/bag of Baking Soda & Toothbrushes
- Rags or towels for DIY sanitary napkins
- 12 Five gallon buckets with lids (2 for hand washing, 2 for emergency toilet, 2 for dishwashing (or two small dishpans), 4 for water purification, 1 for a shower and 1 spare). These can be purchased or run by restaurants, supermarkets or bakeries and ask for their buckets, since FDA regulations prohibit them from re-using these food grade buckets and lids. If the restaurant doesn't have the lid, as long as the bucket is a standard food grade 5 gallon size, you can purchase replacement lids rather cheaply on the web or at most hardware stores.
- 1 steel tub that a human can stand in
- Household Bleach, unscented (bleach has a shelf life and must be rotated and if it gets too hot it can create a dangerous gas to humans, that under the right conditions can be explosive.)
- Water Treatment Iodine
- Charcoal (for water purification) 2 bags per day for a family of 4; more if you are going to cook with it or use it as surface catchment in a portable commode.
- Plastic Toilet Seat: The one sold by Quake Kare, Inc. fits the 5 gallon buckets securely (or purchase 2 if budget allows)
- Water Purifier device or two, Filters & spares
- Large Tea Kettle or pot with lid, that can go on open flame if need be or a black or dark heavy duty water proof plastic bag, fill it with water and place in the sun for a few hours to heat the water.
- Several bags of cat litter (The cheap stuff is great on an icy walk or drive and the little better stuff is good for any type of non-chemical emergency toilet.) and/or 3 gallons of carbon material like shredded paper, crushed or used charcoal, sawdust, fireplace ash or forest litter.
- Toilet paper (think along the lines of at least one roll per person in your household)
- Wash rag (enough for one per person in your household)
- Hand towel (at least one per person in your household)
- Bath towel (at least one per person in your household)
- Dish towel (one per meal, per day)

Preparedness Wisdom

Knowledge is useless without the skill to apply it.
Our SHTF life can never, ever, truly be as our everyday life, so stop trying to make it the same.
Preparedness can be as cheap or as expensive as one makes it.
99% of the crises one is likely to encounter will NOT be of the large scale or world altering type.
One cannot buy preparedness, one has to do it!
A family that prepares together, survives and thrives together.

"On a long enough time line, the survival rate for everyone drops to zero."
Chuck Palahniuk, Fight Club

"When making your choice in life, do not neglect to live."
Samuel Johnson

Glossary

Term	**Meaning**
Bacteria	Microscopic living organisms; some are helpful and some are harmful. "Good" bacteria aid in pollution control by consuming and breaking down organic matter and other pollutants in septic systems, sewage, oil spills, and soils. However, "bad" bacteria in soil, water, or air can cause human, animal, and plant health problems.
Biologically Contaminated	Water that contains microorganisms such as Giardia (a common microorganism that, if not killed, leads to intestinal disorders), bacteria, or viruses that can lead to infections
Channeling	Channeling is the use of channels that are nature or human-made. In terms of water processing, channeling is a function of most water filters that involves backwashing to clean the filter. In physical geography, a channel is a type of landform consisting of the outline of a path of relatively shallow and narrow body of fluid, most commonly the confine of a river, river delta or strait. Channels can be either natural or human-made. A channel is typically outlined in terms of its bed and banks.
Contaminant	Anything found in water (including microorganisms, minerals, metals, chemicals, radionuclides, etc.) which may be harmful to human, animal or environmental health. Science and technology is constantly discovering more potential contaminants in the water – such as pharmaceuticals and endocrine disrupters – including, at times, in water that has been centrally treated.
Disinfected Water	The removal of contaminants. There are various methods to perform this function.
Drinking Water	Drinking water or potable water is water safe enough to be consumed by humans or used with low risk of immediate or long term harm. In most developed countries, the water supplied to households, commerce and industry meets drinking water standards for that country. Typical uses (for other than potable purposes) include toilet flushing, washing and landscape irrigation. The word potable came into English from the Late Latin potabilis meaning drinkable. It is important to understand that only 1% of all municipal water is consumed by humans. The other 99% flushes toilets, waters lawns, and supports cleaning, commercial, and industrial processes.
EWG	The Environmental Working Group (EWG) is an American environmental organization that specializes in research and advocacy in the areas of toxic chemicals, agricultural subsidies, public lands, and corporate accountability. EWG is a non-profit organization (501(c)(3)) whose mission, according to their website, is "to use the power of public information to protect public health and the environment."

Term	**Meaning**
	Founded in 1993 by Ken Cook and Richard Wiles, EWG is headquartered in Washington, D.C. in the United States. A sister organization, the EWG Action Fund, is the lobbying arm (501(c)(4)) of the organization and was founded in 2002.
GAC	Granular Activated Charcoal (GAC) a type of filter have relatively large, and irregular sized pores (10 microns would probably be the minimum size to expect), so it is impossible to state with any certainty what size particles would be removed. Channeling can also dump unfiltered water into the output stream. *GAC only filters should never be relied on exclusively to provide protection from small particulate contaminants.*
Heavy metals	Metallic elements with high atomic weights, such as, mercury, chromium cadmium, arsenic, and lead. Even at low levels these metals can damage living things. They do not break down or decompose and tend to build up in plants, animals, and people causing health concerns.
Irradiated Water	To expose to or treat with radiation
Micron	Describes the minute size of many contaminates. One micron is one millionth of a meter or approximately 1/25,000 of an inch. For comparison, a human hair is about 70 microns thick. This directly relates to the *Pore Size of a Filter* which determines how well it removes harmful particulate contaminants like asbestos, parasitic cysts, and bacteria. Typically, water filters are rated by the smallest particle they can remove. Most filters can remove particles as small as 10 or 20 microns in size, but the best filters are able to remove particles smaller than 1 micron. Just remember, when it comes to removing particles, smaller is definitely better.
Microorganisms	Also called microbes. Very tiny life forms such as bacteria, algae, diatoms, parasites, plankton, and fungi. Some can cause disease.
MSR	Mountain Safety Research, or MSR, is an American corporation founded in 1969 by Larry Penberthy, located in Seattle, Washington and owned by Cascade Designs. The company was acquired by REI in 1981. MSR produces camping, hiking and mountaineering equipment such as portable stoves, water filters and tents, specializing in lightweight equipment. MSR designed and distributes snowshoes made of composite materials, lighter than earlier designs.
Nitrates	Plant nutrient and fertilizer that enters water supply sources from fertilizers, animal feed lots, manures, sewage, septic systems, industrial wastewaters, sanitary landfills, and garbage dumps.
NSF / NSF Certified	Founded as the *National Sanitation Foundation (NSF)* in the 1940's, as it expanded into global markets it became *NSF International*. They were and are a Public Health and Safety Organization. NSF provides third-party certification provides information to stakeholders that allows them to determine compliance to regulatory and purchase specifications, to apply risk management principles and to determine general suitability of products, systems and processes *NSF tests a multitude of consumer products and awards certifications on many factors, from US Code or Standards to safety and costs, to determine if a certification is meeting your primary needs on any product visit the site and look-up the requirements for that particular certification.*

Term	**Meaning**
	Their mission is to develop uniform, consensus-based national standards for their stakeholder countries; they bring together regulators, industry, consumers and public health experts. Their scientists, engineers and public health professionals test various products and methodologies aganst these standards or protocols; for the benefit of all stakeholders, namely the public, the business community and government agencies.
Pathogen	A specific causative agent (as a bacterium or virus) of disease
POE	Water Point of Entry (municipal water treatment plant)
POU	Water Point of Use (home, businesses, etc)
Protozoa	One-celled animals, usually microscopic, that are larger and more complex than bacteria. May cause disease.
Radiated Water	The radioactivity caused by the presence of radioactive substances
Radionuclides	Distinct radioactive particles coming from both natural sources and human activities. Can be very long lasting as soil or water pollutants.
Radon	A colorless, odorless naturally occurring radioactive gas formed by the breakdown or decay of radium or uranium in soil or rocks like granite. Radon is fairly soluble in water, so well water may contain radon.
Toxic Contamination	Water sources contain chemical contamination from pesticide runoffs, mine tailings, and so on.
Viruses	Submicroscopic disease-causing organisms that grow only inside living cells.
Water Purification	The technical term for water purification is disinfect. This is the removal of contaminants. There are various methods to perform this function.
Water Treatment	Treating water to remove odors, bad taste, organic and inorganic materials found in hard water, water softening or contaminates present in the raw or partly treated water. The objective of all water treatment procedures is to remove the contaminants or at least reduce their presence in raw water. Note: The term Water Treatment alone, *does NOT mean Disinfecting or Purifying* unless specifically stated by the manufacturer of the device. Most home water treatment systems have not been designed to treat turbid, contaminated drinking water.
Turbidity	Turbidity is a measure of how clear the water is. Water with a lot of suspended solids, appears murky, and has a high level of Turbidity. Suspended solids can be anything from microscopic floating plants like Phytoplankton, to clays and silts, or even sediment that's been stirred back into the water by dredging, floods, or bottom-feeding fish like carp. These suspended solids can sometimes carry toxic organic contaminants, pesticides, and heavy metals like cadmium, mercury, and lead.
Hardness	If you've ever washed your hands at a friends house and you just can't get the soap to lather up, then you've experienced "hard water". Hardness is the measure of the mineral content of water, and hard water typically contains excessive amounts of dissolved Calcium, Magnesium, Bicarbonates, and Sulfates. Hard water shouldn't pose any health concerns, but it can sometimes make drinks like coffee and tea taste bitter.
Filtration	Filtration is the removal of particulates, and thus some contaminants, by water flowing through a porous medium. Filtration is the most practical treatment process.

Term	Meaning
Microfiltration	Microfiltration is a membrane separation technique in which very fine particles or other suspended matters, with a particle size in the range of 0.1 to 1.5 microns, are separated from a liquid. It is capable of removing suspended solids, bacteria or other impurities. Microfiltration membranes have a nominal pore size of 0.2 microns.
Ultrafiltration	Ultrafiltration is a membrane separation technique in which very fine particles or other suspended matters, with a particle size in the range of 0.005 to 0.1 microns, are separated from a liquid. It is capable of removing salts, proteins and other impurities within its range. Ultrafiltration membranes have a nominal pore size of 0.0025 to 0.1 microns.
Nanofiltration	Nanofiltration is a membrane separation technique in which very fine particles or other suspended matters, with a particle size in the range of approximately 0.01 to 0.005 microns, are separated from a liquid. It is capable of removing viruses, pesticides and herbicides. 0.02
pH	pH is a measure of how acidic a liquid is. A liquid with a low pH is very acidic, while a high pH indicates alkalinity. Acidic water can be quite corrosive, leaching metals like Lead, Copper, Iron, and Zinc from the plumbing pipes and fixtures in your home. As you might expect, these metals flow down the pipes, and into your drinking water. Alkaline water is typically "hard" - meaning it contains a lot of dissolved minerals. Hard water isn't considered a health concern, but it can give drinks like coffee and tea a bitter taste.

Resources for this article:

Note: I went to the local libraries and university libraries in New Mexico and University of Maine. The subject matter of much of this research was photocopied and most of it was actual research results, anyway they are way too many to list here, but these are the biggies ;-}

20-gallon Solar Heated Hot Water Heater and Shower	http://www.savehouseholdenergy.com/solarshower.html
5 DIY Outdoor Solar Shower Ideas	http://www.offgridworld.com/5-diy-outdoor-solar-shower-ideas/
62 Principle US Aquifers Regional Water-quality Assessments	http://water.usgs.gov/nawqa/studies/praq/images/USAaquiferMAP11_17.pdf
A DIY Solar Shower	http://proficientprepping.wordpress.com/2013/02/15/a-diy-solar-shower/
A Guide to Drinking Water Treatment and Sanitation for Backcountry and Travel	http://www.cdc.gov/healthywater/pdf/drinking/Backcountry_Water_Treatment.pdf
A Portable Solar Water Heater	http://www.motherearthnews.com/renewable-energy/portable-solar-water-heater-zmaz80mazraw.aspx#axzz36qimocUS
A Primer on Water Quality FS-027-01	http://pubs.usgs.gov/fs/fs-027-01/pdf/FS-027-01.pdf
A Sewer Catastrophe Companion-Dry Toilet for Wet Disasters (PDF)	http://www.portlandoregon.gov/pbem/article/447707
Affordable Camp Shower	http://www.instructables.com/id/Affordable-Camp-Shower/
Alpha Radiation	http://healthvermont.gov/enviro/rad/alpha.aspx

American Red Cross	http://www.redcross.org/
An Earthen Filter For Radioactive Water	http://modernsurvivalblog.com/nuclear/an-earthen-filter-for-radioactive-water/
Arsenic in Ground-Water Resources of the US 2000	http://pubs.usgs.gov/fs/2000/fs063-00/pdf/fs063-00.pdf
Back to Basics, Third Edition	Edited by Abigail R Gehring, Skyhouse Publishing
Basic Essentials Of Backpacking	By Harry Roberts, ICS Books, Inc
Basic Essentials Of Camping	By Cliff Jacobson, ICS Books, Inc
Basic Essentials Of Canoe Paddling	By Harry Roberts, ICS Books, Inc
Basic Essentials Of Canoe Poling	By Harry Rock, ICS Books, Inc
Basic Essentials Of Canoeing Cliff Jacobson	By Cliff Jacobson, ICS Books, Inc
Basic Essentials Of Desert Survival	By Dave Ganci, ICS Books, Inc
Basic Essentials Of Minimizing Impact On The Wilderness	ICS Books, Inc
Basic Essentials Of Survival James E. Churchill	By Michael Hodgson, ICS Books, Inc
Beginners Guide to Family Preparedness	By Rosalie Mason, Green Trust
Benefits, Limitations and Costs of various POU water treatment methods table	http://www.everythingyoualwayswantedtoknow.com/watertreatment/treatment-table.html
Beyond the BabySteps: Emergency Chemical Toilet	http://foodstoragemadeeasy.net/2009/05/08/emergency-chemical-toilet/
Blue Wolf Survival and Preparedness	http://www.bwolf.com/
Boundary Waters Canoe Camping...With Style Cliff Jacobson	
Boy Scouts of America Fieldbook (NOT to be confused with the BSA handbook)	Publisher: Workman Pub Co (June 1978) ISBN-10: 0894800191 ISBN-13: 978-0894800191
Brigham Young University; Department of Nutrition, Dietetics and Food Science	801.422.3912
Buyer's Guide to Composting Toilets	http://inspectapedia.com/septic/Composting_Toilets.htm
Camp Power shower	http://www.bonnarootips.com/build-a-shower.html
Camping Healthy: Hygiene For The Outdoors	By Buck Tilton
Camping or Portable Toilets for Camping or Emergency Home Use	http://inspectapedia.com/septic/Camping_Toilet.htm
Camping Secrets	By Cliff Jacobson
Camping Shower	http://living.weelife.com/2011/07/camping-shower.html

Camping Shower!	http://www.instructables.com/id/Camping-Shower-1/
Camping's Forgotten Skills	By Cliff Jacobson
Camping's Little Book of Wisdom	By David Scott
Campmor (outdoor supplies)	http://www.campmor.com/
Captain Dave's Survival Center	http://www.survival-center.com/
CDC Centers for Disease Control and Prevention	1600 Clifton Rd, Atlanta, GA 30329-4027; 800-232-4636
CDC Drink Safe Water Checklist	http://www.cdc.gov/healthywater/pdf/emergency/09_202278-A_Drink_Safe_Water_Flyer_508.pdf
CDC Keep Food and Water Safe After a Disaster or Emergency	http://emergency.cdc.gov/disasters/foodwater/facts.asp
CDC Personal Preparation and Storage of Safe Water	http://www.cdc.gov/healthywater/emergency/safe_water/personal.html
CDC The Safe Water System	http://www.cdc.gov/safewater/
CDC The Safe Water System, Household Water	http://www.cdc.gov/safewater/household-water.html
CDC Water-Related Emergencies & Outbreaks	http://www.cdc.gov/healthywater/emergency/safe_water/index.html?s_cid=ostltsdyk_cs_117
Chemical Toilets - How to Use & Maintain a Chemical Toilet or "Porta Potty"	http://inspectapedia.com/septic/Chemical_Toilet_Guide.htm
Cloth Baby Diapers	http://www.provident-living-today.com/Cloth-Baby-Diapers.html
Common Health-Related Contaminants	http://www.wqa.org/sitelogic.cfm?ID=2343
Compare the costs of using different drinking water treatment methods	http://www.cyber-nook.com/chart/default.asp?Usage=5&Years=4
Comparison of Drinking Water Treatment Method	http://www.cyber-nook.com/water/Solutions.html#treatment Clicking on a table thumbnail takes you to: Benefits, Limitations and Costs of various POU water treatment methods table @ http://www.everythingyoualwayswantedtoknow.com/watertreatment/treatment-table.html and Drinking Water Contaminant Removal Table http://www.cyber-nook.com/water/WaterTreatment.htm#chart and Water Problem Table Identify Common Water Contaminants by Their Sensory Clues @ http://www.cyber-nook.com/water/TasteOdor.htm#top
Comparison of Drinking Water Treatment Methods	http://www.cyber-nook.com/water/Solutions.html#treatment
Comparison of Treatments and Options for Drinking Water	http://www.air2water.biz/compare-water-purification-systems.html
Compost Toilets in Times of Need	http://www.composttoilets.co.nz/
Country Wisdom & Know-How	Storey Books

Create an Oasis with Greywater: Choosing, Building and Using Greywater Systems	By Art Ludwig
CSI - Contaminant Specific Information	http://www.wqa.org/consumer/newindex.cfm
CSI - Contaminant Specific Information by the Water Quality Association (WQA)	http://www.wqa.org/consumer/newindex.cfm
Design for Water Rainwater Harvesting, Stormwater Catchment and Alternate Water Reuse	By Heather Kinkade-Levario
Disaster Preparedness Guide, The Complete Idiots	By Dr. Mauurice A Ramirez, DO, John Hedtke, Alpha / Penguin Publishing
Disaster Toilet	http://www.toiletology.com/Disaster-toilet.shtml
Disaster Zone Toilet Flush Methods or Makeshift Emergency Toilet Options	http://inspectapedia.com/plumbing/Disaster_Zone_Toilets.php
Distill the Radiation Out of Your Water	http://www.offthegridnews.com/2011/04/24/distill-the-radiation-out-of-your-water/
DIY Outdoor Shower – Great for Camping Trips	http://thegardeningcook.com/diy-outdoor-shower/
DIY Portable Post Surf/SUP/Diving Shower	http://craftysurf.blogspot.com/2012/03/diy-portable-post-surfsupdiving-shower.html
DIY Shower Can and its Multiple Uses	http://www.sailmagazine.com/cruising-tips/diy-shower-can
DIY Solar Shower for Camping	http://www.trails.com/how_7406_diy-solar-shower-camping.html
DIY Solar Shower for Camping	http://traveltips.usatoday.com/diy-solar-shower-camping-13876.html
DIY: Homemade Camp Shower	http://www.trails.com/how_40383_diy-homemade-camp-shower.html
DIY: Homemade Camp Shower	http://www.ehow.com/how_6723697_diy_-homemade-camp-shower.html
DIY: Make Your Own Pressurized Solar Shower	http://voices.yahoo.com/diy-own-pressurized-solar-shower-11151012.html
DIY: Make Your Own Pressurized Solar Shower	http://voices.yahoo.com/diy-own-pressurized-solar-shower-11151012.html
Drinking water and health: what you need to know	http://water.epa.gov/drink/index.cfm
Drinking Water Contaminant Removal Table	http://www.cyber-nook.com/water/WaterTreatment.htm#chart
Drinking Water From Household Wells 2002	http://www.epa.gov/privatewells/pdfs/household_wells.pdf
Electric Water: The Emerging Revolution in Water and Energy	By Christopher C. Swan
Emergency Food Storage & Survival Handbook	By Peggy Layton

Emergency Hygiene and Sanitation	http://www.provident-living-today.com/Emergency-Hygiene.html
Emergency or Camping Shower	http://foodstorageandsurvival.com/emergency-or-camping-shower/
Emergency Preparedness and Survival Guide book and CD	by Backwoods Home Magazine
Emergency Sanitation	http://osceola.ifas.ufl.edu/pdfs/FCS/EmergencySanitation.pdf
Emergency Sanitation	http://www.practicalsurvivor.com/emergencysanitation
Emergency sanitation for refugees from Loughborough University of Leicestershire, UK	http://www.lboro.ac.uk/well/resources/technical-briefs/38-emergency-sanitation-for-refugees.pdf
Emergency Toilet	http://www.ibs-life.com/emergency-toilet.html
Emergency Toilet Options	http://www.yourfamilyark.org/sanitation/emergency-toilet-options
Emergency Toilet Systems	http://www.phlush.org/emergency-toilets/
Emergency Water Storage	http://www.nationalterroralert.com/safewater/
Emergency Water Supplies and Treatment No 6.704 Jan 8 2014	http://www.ext.colostate.edu/pubs/natres/06704.html
Emergency Water Supply and Storage	http://theepicenter.com/tow02236.html
Encyclopedia of Country Living (set of 3)	By Carla Emery
Environmental Working Group: drinking water	http://www.ewg.org/tap-water/getawaterfilter
EPA Drinking Water	http://water.epa.gov/drink/
EPA Drinking Water Contaminants	http://water.epa.gov/drink/contaminants/
EPA Emergency Disinfection of Drinking Water	http://water.epa.gov/drink/emerprep/emergencydisinfection.cfm
EPA Emergency Drinking Water	http://howtoto.com/pdf/EPA_emergency-drinking-water.pdf
EPA Information for private wells	http://water.epa.gov/drink/info/well/index.cfm
EPA Local Drinking Water Information	http://water.epa.gov/drink/local/
EPA Primary Contaminant List	http://water.epa.gov/drink/contaminants/index.cfm
EPA US, Region 1	EPA New England Customer Call Center (888) 372-7341 Outside New England: (617) 918-1111
EPA US, Region 6	Main Office, 1445 Ross Avenue, Suite 1200, Dallas, Texas 75202; 800-887-6063
EPA US, Region 8	1595 Wynkoop Street, Denver, CO 80202-1129; 303-312-6312
EWG's UPDATED Water Filter Buying Guide	http://www.ewg.org/report/ewgs-water-filter-buying-guide

Factors Affecting Public-Supply-Well Vulnerability to Contamination 2013 Circular 1385	http://pubs.usgs.gov/circ/1385/pdf/Cir1385.pdf
FAQs about drinking water systems	http://www.culliganmidmissouri.com/methods-and-benefits-of-treated-water/faqs-about-drinking-water-water-systems/
Feminine Hygiene: DIY Emergency Tampons Video	http://www.rookiemag.com/2013/03/sunday-video-diy-tampons/
Feminine Hygiene: How to Make a Substitute Sanitary Pad	http://www.wikihow.com/Make-a-Substitute-Sanitary-Pad
Feminine Hygiene: Make Yourself An Emergency Maxi-Pad	http://jezebel.com/5812246/diy-pad-crisis
Filter Recommendation	http://www.everythingyoualwayswantedtoknow.com/multi-pure/
Final Barrier brochure	http://www.wqa.org/pdf/Technical/WQAConsumerTrifoldFINAL0213v3.pdf
Final Barrier: A better solution for high-quality & healthier drinking water	http://www.wqa.org/pdf/Technical/FinalBarrier_HandoutFINAL0213v3.pdf
Find hidden water supplies in an emergency	http://www.kingcounty.gov/healthservices/health/preparedness/disaster/HiddenWater.aspx
Fly & Flying Insect Removal from Buildings	http://inspectapedia.com/Environment/Get_Rid_of_Flies.php
Food Grade Containers	http://www.burwood.nsw.gov.au/verve/_resources/Fact_Sheet_-_Food_Grade_Containers.pdf
Food Grade Storage Containers	http://www.simplycanning.com/food-grade-storage-containers.html
Fresh Water from the Sea	http://www.acs.org/content/acs/en/pressroom/podcasts/globalchallenges/freshwater.html
Glad Rags Feminine Hygiene Products	http://www.provident-living-today.com/Glad-Rags.html
Greywater or Gray Water Systems for Water Conservation, Re-Use, and as Components of Alternative Septic Systems for Difficult Sites (includes state by state grey water regulations links)	http://inspectapedia.com/septic/Greywater_Systems.htm
Ground Water and the Rural Homeowner 2013	http://pubs.usgs.gov/gip/gw_ruralhomeowner/
Guidelines for drinking-water quality 3rd ed. Vol 1 2008	http://www.who.int/water_sanitation_health/dwq/fulltext.pdf?ua=1
Home Water Supply, The	by Stu Campbell, Storey Press
Homemade Baby Wipes	http://www.provident-living-today.com/spice-traders-homemade-baby-wipes.html
How can I find out more about my water quality?	http://water.usgs.gov/nawqa
How can I find out more about my water quality?	http://www.epa.gov/safewater
How Can I Make an Emergency Waterless Toilet?	http://www.ehow.com/way_5569079_can-make-emergency-waterless-toilet.html

How Desalination Works	http://science.howstuffworks.com/environmental/earth/oceanography/desalination.htm
How Does Reverse Osmosis Work?	http://www.culliganmidmissouri.com/how-does-reverse-osmosis-work/
How Much of Your Body Is Water?	http://chemistry.about.com/od/waterchemistry/f/How-Much-Of-Your-Body-Is-Water.htm
How to Build a Camping Shower	http://www.ehow.com/how_5066368_build-camping-shower.html?ref=Track2&utm_source=ask
How to Build a Camping Shower	http://www.mademan.com/mm/how-build-camping-shower.html
How to Build a Homemade Portable Water Heater for Your Outdoor Camping Adventures	http://survivial-training.wonderhowto.com/how-to/build-homemade-portable-water-heater-for-your-outdoor-camping-adventures-0141458/
How to Build a Portable Camping Shower	http://www.ehow.com/how_4510477_build-portable-camping-shower.html
How to Build a PVC Camp Shower	http://www.ehow.com/how_4793638_build-pvc-camp-shower.html?ref=Track2&utm_source=ask
How to Build a Solar Camp Shower	http://www.ehow.com/how_5268574_build-solar-camp-shower.html?ref=Track2&utm_source=ask
How to create an emergency toilet	http://www.kingcounty.gov/healthservices/health/preparedness/disaster/EmergencyToilet.aspx
How to Desalinate Water	http://www.wikihow.com/Desalinate-Water
How to Filter Radiation from Water	http://www.buzzle.com/articles/how-to-filter-radiation-from-water.html
How to Find Water in an Emergency	http://www.wikihow.com/Find-Water-in-an-Emergency
How to Identify Food Grade Buckets	http://www.wikihow.com/Identify-Food-Grade-Buckets
How to Make a Camp Shower	http://www.ehow.com/how_2062450_make-camp-shower.html
How to Make a Camping Shower	http://www.buzzle.com/articles/diy-camp-showers-how-to-make-camp-showers.html
How to Make a Substitute for Toilet Paper	http://www.wikihow.com/Make-a-Substitute-for-Toilet-Paper
How to make an Emergency Toilet	http://www.disasterstuff.com/store/pc/How-to-make-an-Emergency-Toilet-p1134.htm#.U6gUQ7GHMbc
How to Make Homemade Camping Showers	http://www.ehow.com/how_5136643_make-homemade-camping-showers.html
How to prepare safe water after a disaster	http://www.kingcounty.gov/healthservices/health/preparedness/disaster/SafeWater.aspx
How to Purify Radioactive Materials	http://chemwiki.ucdavis.edu/Physical_Chemistry/Nuclear_Chemistry/Radioactivity/How_to_purify_radioactive_materials

How to Survive Anywhere Urban, Suburban, Rural and Wilderness Environments	by Christopher Nyerges
How to Survive the End of the World as We Know It: Tactics, Techniques, and Technologies for Uncertain Times	by James Wesley Rawles
How To: Scepter Water Can Portable Camp Shower	http://www.overlandtheworld.com/2012/08/how-to-scepter-water-can-portable-camp.html
Hydrogen Sulfide Gas (H_2S)	http://inspectapedia.com/odor_diagnosis/Hydrogen_Sulfide_Gas.htm
Index of Water-Related Frauds and Quackery	http://www.quackwatch.com/01QuackeryRelatedTopics/waterindex.html
Just in Case: How to Be Self-Sufficient When the Unexpected Happens	By Kathy Harrison, Storey Publishing
Learn about Earthquakes and Sewers	http://www.phlush.org/emergency-toilets/earthquakes-sewers/
Living for Tomorrow Alternative Ways	by Brent Lee, Cedar Fort Publishing
Living off the Grid: A Simple Guide to Creating and Maintaining a Self-Reliant Supply of Energy, Water, Shelter and More	By Dave Black
Living Safe in an Unsafe World: The Complete Guide to Family Preparedness	By Randall C. Duncan
Local drinking water quality information	http://water.epa.gov/drink/local/index.cfm
Long Descent, The A User's Guide to the End of the Industrial Age	By John Michael Greer
Make a Camp Shower from an Umbrella	http://campfish.net/make-camp-shower.php
Make a DIY Twin-Bucket Emergency Toilet	http://preparednessmama.com/emergency-toilet/
Make a Twin Bucket Toilet	http://www.phlush.org/emergency-toilets/diy-christchurch-twin/
Making the Twin-Bucket Emergency Toilet	http://www.portlandoregon.gov/pbem/article/394125
Making the Twin-Bucket Emergency Toilet Apr 2012	http://www.portlandoregon.gov/pbem/article/394125 or http://www.phlush.org/wp-content/uploads/2014/03/Twin-Bucket-Leaflet-in-pdf.pdf
Making the Twin-Bucket Emergency Toilet Apr 2012 (Word format)	http://www.phlush.org/wp-content/uploads/2014/03/Twin-Bucket-Leaflet.doc
Methane Gas & Sewer Gas Dangers	http://inspectapedia.com/septic/Methane_Gas_Hazards.htm
Minimum Impact Camping Curt Schatz and Dan Seemon	Adventure Publications
Most Common Aesthetic Water Contaminants	http://www.wqa.org/sitelogic.cfm?ID=2344

Mountainman Crafts and Skills A Fully Illustrated Guide to Wilderness Living and Survival	by David Montgomery
National Water-Quality Assessment Program (NAWQA) Status and Trends Network and Assessments of Streams and Rivers 2006	http://water.usgs.gov/nawqa/studies/mrb/mrb_factsheet.pdf
Native American Survival Skills	By W. Ben Hunt, Skyhorse Publishing
New Mexico State University	Plant and Environmental Sciences Library
NSF Drinking Water Standards	http://www.nsf.org/consumer-resources/what-is-nsf-certification/water-filters-treatment-certification/selecting-a-water-treatment-system
Oh No, There Is No Toilet Paper! What Do I Do?	http://www.offthegridnews.com/2012/08/20/oh-no-there-is-no-toilet-paper-what-do-i-do/
Outdoor Skills	by Sports Afield, Hearst Books
Outhouse, Privy, or Dunny Construction & Maintenance Guide	http://inspectapedia.com/septic/Outhouse_Latrine.htm
Ozone, UV And Your Health	By Buck Tilton And Roger G. Cox
Planning for an Emergency Drinking Water Supply EPA 600 R-11/054 June 2011	http://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=502174
Plastic Container Symbols for Food Grade Plastics	http://www.georgianewsday.com/lifestyle/56040-plastic-container-symbols-for-food-grade-plastics.html
Portable Battery Operated Shower	http://anypreview.blogspot.com/2013/07/portable-battery-operated-shower.html
Portable Outdoor Camping Shower With Unlimited Hot Water	http://www.doityourselfrv.com/portable-outdoor-camping-shower/
Portable Shower	http://www.2dayblog.com/2009/12/26/portable-shower/
Portable Toilet for Emergency Sanitation	http://www.family-survival-planning.com/portable-toilet-for-emergency-sanitation.html
Press Release: Updated Tap Water Databases and Drinking Water Quality Analysis December 9, 2009	http://www.ewg.org/news/news-releases/2009/12/09/press-release-updated-tap-water-databases-and-drinking-water-quality
Pro's and Con's of Water Purification Systems	http://www.sportstrader.co.za/pages/Product%20knowledge/Product%20knowledge%20Water%20purification.pdf
Purification Technology	http://www.drinkmorewater.com/water-purification-methods
Quality of Water from Domestic Wells in Principal Aquifers of the US 1991–2004 Circular 1332	http://pubs.usgs.gov/circ/circ1332/includes/circ1332.pdf
Questions to Ask when Purchasing Water Treatment Equipment	http://www.bae.ncsu.edu/extension/ext-publications/water/drinking/ag-473-3water-equip-jennings.pdf

Ragnar's Urban Survival: A Hard-Times Guide to Staying Alive in the City	Paladin Pr. The 10 digit ISBN is 1581600593 and the 13 digit ISBN is 9781581600599
Regional Assessments of Aquifers 2005	http://pubs.usgs.gov/fs/2005/3013/pdf/PASforWeb.pdf
Response Protocol Toolbox-Planning for and Responding to Drinking Water Contamination Threats and Incidents Aug 2004	http://www.epa.gov/watersecurity/pubs/rptb_response_guidelines.pdf
Retrospective Analysis on the Occurrence of Arsenic in Ground-Water Resources of the US 1999	http://pubs.usgs.gov/wri/wri994279/pdf/wri994279.pdf
Reusing the Resource Adventures in Ecological Wastewater Recycling	By Carol Steinfeld; David Del Porto, Charles A. Sanders
SAFE AGUA: Ducha Halo Portable Shower	http://nciia.org/openminds/2011/duchahalo
Safe Plastics For Food and Drink	http://modernsurvivalblog.com/preps/safe-plastics-for-food-and-drink/
Saline water: Desalination	http://water.usgs.gov/edu/drinkseawater.html
Sanitation	http://www.endtimesreport.com/sanitation.html
Sanitation and Hygiene In An Emergency	http://www.nationalterroralert.com/sanitationhygiene/
Selecting a Home Water Treatment System	http://www.nsf.org/consumer-resources/what-is-nsf-certification/water-filters-treatment-certification/selecting-a-water-treatment-system
Selecting a water treatment product	http://www.culliganmidmissouri.com/methods-and-benefits-of-treated-water/selecting-a-water-treatment-product/
Sewage Solutions: Answering the call of nature	By Nick Grant; Mark Moodie; Chris Weedon
Should I get a water softener or water filter – and what's the difference between them?	http://www.haguewaterofmd.com/faq/services/water-softener-or-water-filter.php
Simple Project Of The Month: The DIY Camping Shower (car-lighter-powered)	http://www.popsci.com/diy/article/2010-08/simple-project-month-diy-camping-shower
Simply Prepared: A Guide to Emergency Preparedness and Food Storage	By Cheryl F. Driggs
Soft Paths	Bruce Hampton and David Cole, Handouts from a class by NOLS (National Outdoor Leadership School)
Storey's Basic Country Skills	by John and Martha Storey, Publisher: Storey Publishing, LLC (September 1, 1999) ISBN-10: 1580172024 ISBN-13: 978-1580172028
Study Finds Safety of Drinking Water in U.S. Cities at Risk	http://www.nrdc.org/water/drinking/uscities.asp
The Backcountry Classroom	By Bruce F. Bonney & Jack K. Drury
The Backpacker's Field Manual by Rick Curtis	first edition published by Random House March, 1998 (I have the book however you can find part of this online as "OA Guide

	to Water Purification" @ http://www.princeton.edu/~oa/manual/water.shtml)
The Difference Between Water Softening and Filtering	http://www.culliganmidmissouri.com/methods-and-benefits-of-treated-water/the-difference-between-softening-and-filtering/
The Differences Between the Water Treatment Technologies, Water Softeners, Water Conditioners and Water Filters	http://clearwatergmx.com/watersofteners.php
The Home Water Supply	By Stu Campbell
The Humanure Handbook 3rd Edition	By Joseph Jenkins, I have the book but I found this PDF link http://www.weblife.org/humanure/pdf/humanure_handbook_third_edition.pdf
The Self-Reliant Homestead	By Charles A. Sanders
The Truth: Salt -vs- Salt Free Water Softeners	http://idahowatersolutions.com/water-softeners/the-truth-salt-vs-salt-free-water-softeners/
The University of New Mexico	Environmental Information Management Institute Library
The Water Quality Association (WQA)	http://www.wqa.org/
There are precisely TWO DIFFERENT WAYS in which to compare water purification systems with each other	http://www.aquatechnology.net/system_comparisons.html
Things to Consider when Selecting a Water Purification Solution	http://www.cyber-nook.com/water/Solutions.html#difference
Toilet Paper Kits or Portable Bidet	http://www.provident-living-today.com/Portable-Bidet.html
Total Alkalinity of Surface Waters National Map	http://water.usgs.gov/owq/alkus.pdf
Twin Bucket Toilet: Find Parts & Supplies	http://www.phlush.org/emergency-toilets/parts-supplies/
University of Maine	Civil and Environmental Engineering
Urban Survival – Emergency Water sources	http://offgridsurvival.com/emergency-water/
US Locations of Regional Water Assessments of Streams and Rivers	http://water.usgs.gov/nawqa/studies/mrb/
USGS Water Resources of the United States	http://www.usgs.gov/water/
USGS Water Science School	http://water.usgs.gov/edu/
VOCs in Nation's Ground Water and Drinking-water Supply Wells 2006 Circular 1202	http://pubs.usgs.gov/circ/circ1292/pdf/circ1292_front.pdf
Water	http://www.ready.gov/water
Water distribution on Earth	https://en.wikipedia.org/wiki/Water_distribution_on_Earth
Water Facts	http://www.waterinfo.org/resources/water-facts

Water Filtration Versus Purification	http://foodstoragemadeeasy.net/2012/03/27/water-filtration-versus-purification/
Water Filtration vs Water Softening – The Showdown!	http://www.freedrinkingwater.com/whole-house/water-filter-knowledge-base/water-softening-vs-water-filtration.htm
Water Filtration vs. Purification: What's the Difference?	http://dailycaller.com/2012/02/27/water-filtration-vs-purification-what%E2%80%99s-the-difference/
Water Filtration vs. Purification: What's the Difference?	http://www.offthegridnews.com/2011/10/31/water-filtration-vs-purification-whats-the-difference/
Water for Health-Guidelines for drinking-water quality 3rd ed 2004	http://www.who.int/water_sanitation_health/dwq/en/waterforhealth.pdf
Water Frequently Asked Questions	http://water.usgs.gov/owq/FAQ.htm
water harvesting and purification in rural uganda DiVA	http://his.diva-portal.org/smash/get/diva2:323152/FULLTEXT01.pdf
Water Needs and Costs online Calculator	http://www.cyber-nook.com/chart/default.asp?Usage=5&Years=4
Water on Tap-What You Need to Know 2009 (an EPA Consumer Guide to the Nation's Drinking Water)	http://water.epa.gov/drink/guide/upload/book_waterontap_full.pdf
Water Problem Table: Identify Common Water Contaminants by Their Sensory Clues	http://www.cyber-nook.com/water/TasteOdor.htm#top
Water purification	http://www.sciencedaily.com/articles/w/water_purification.htm
Water purification vs Basic filtration	http://www.freedrinkingwater.com/water-education/quality-water-purification.htm
Water Quality Information Center (WQIC)	http://wqic.nal.usda.gov/
water softener FAQs	http://mcgowanwater.com/customer-resources/faqs/
Water Softeners vs. Water Conditioners	http://vibranth2o.com/water-softeners-vs-water-conditioners/
Water Storage	http://www.thereadystore.com/water-storage
Water Treatment FAQs	http://www.aquascience.net/faq/
Water Treatment for Dummies	by Wiley Brand, I have the book, however you can download a PDF @ http://www.wqa.org/WTFD/WaterTreatmentForDummies.pdf
Water Treatment Terms & Definitions	http://www.aquascience.net/glossary.cfm
Water: Purification Methods	http://channel.nationalgeographic.com/channel/doomsday-preppers/articles/water-purification/
What Do Recycling Symbols on Plastics Mean?	http://www.thedailygreen.com/green-homes/latest/recycling-symbols-plastics-460321
What exactly is "food grade plastic"?	https://answers.yahoo.com/question/index?qid=20090606150900AAKF1eh

What Is a Food Grade Container for Transporting?	http://www.ehow.com/about_6675188_food-grade-container-transporting_.html
What is Food Grade Packaging?	https://www.usaemergencysupply.com/information_center/food_storage_faq/what_is_food_grade_packaging.htm#.U6b_FrGHMbc
What is the difference between water softener, water filter and water purification systems?	http://nimbuswatersystems.com/learning-center/water-faq/what-difference-between-water-softener-water-filter-and-water-purification
What is water pollution?	http://www.lenntech.com/water-pollution-faq.htm
What Percent of Earth is Water?	http://www.universetoday.com/65588/what-percent-of-earth-is-water/
What's A Water Softener vs. a Water Filter?	http://blog.puriteam.com/whole-house-water-filter/faqs/whats-a-water-softener-vs-a-water-filter/
What's the Difference Between Water Purification and Filtration?	http://www.ebay.com/gds/What-s-the-Difference-Between-Water-Purification-and-Filtration-/10000000177627491/g.html
What's On Tap?	http://www.nrdc.org/water/drinking/uscities/map.asp
When All Hell Breaks Loose	by Cody Lundin
When Technology Fails	by Matthew Stein, Publisher: Chelsea Green Publishing; 2nd edition (August 18, 2008) ISBN-10: 1933392452 ISBN-13: 978-1933392455
Where does water pollution come from?	http://charmeck.org/stormwater/pollutionprevention/pages/wheredoeswaterpollutioncomefrom.aspx
Why Disaster Sanitation?	http://www.phlush.org/emergency-toilets/intro-to-emergency-toilets/
Why don't we get our drinking water from the ocean by taking the salt out of seawater?	http://www.scientificamerican.com/article/why-dont-we-get-our-drinking-water-from-the-ocean/