



Water Disinfection Options for International Travel and Camping Use

Boiling is by far the most reliable method to make water of uncertain purity safe for drinking.

- Bring water to a rolling boil for 1 minute; 3 minutes if at altitude >6,562 feet.
- Cool to room temperature. Do NOT add ice that could be made from contaminated water.

Filtration combined with Chemical Disinfection is the second most reliable method of water disinfection.

- Use a filter with an absolute pore size of ≤ 1 micron to remove protozoa. Then add chemical disinfectant for other pathogens.
- CHS's *Healthy Heels Shoppe* stocks LifeStraw[®], a 0.2 micron filter that is best suited for short term use.

Chemical Disinfection (Chlorine dioxide tablets available in CHS's *Healthy Heels Shoppe*)

Chlorine dioxide (ClO ₂): Potable Aqua [®] Chlorine Dioxide tablets	Iodine: Potable Aqua [®] tablets
Dose: 1 tablet per quart or liter of water. Strain cloudy water through a clean cloth and then treat.	Dose: 1 tablet per quart or liter of clear water; 2 tablets per qt. or L of turbid (cloudy) or cold water. Strain cloudy water through a clean cloth and then treat.
Organisms effective against: Highly effective against bacteria, viruses and Giardia. CDC rates it low to moderate effectiveness against Cryptosporidium. A military research group rates it effective against Cryptosporidium with increased contact time for colder water.	Organisms effective against: Highly effective against bacteria and viruses. Low to moderate effectiveness against Giardia cysts. Ineffective against Cryptosporidium oocysts.
Contact time: 4 hours (away from sunlight). 15 minutes adequate for bacteria and viruses. Six hours (or overnight) contact time is suggested for the more resistant Cryptosporidium oocysts in water < 10 °C (50°F).	Contact time: 30 minutes adequate for water at room temperature. Increased contact time is needed for colder water (and very cloudy water). 2 hours is recommended for water near 5°C (41°F). Can attempt to warm extremely cold water to increase effectiveness.
Notes: May need scissors or knife to clip sturdy foil packaging. Doesn't add disagreeable taste or color to the water.	Notes: Ascorbic acid (common in flavored drink mixes) can be added to treated water after the recommended contact time is completed to improve taste and remove color and odor.
Safety: ClO ₂ is an option used in municipal drinking water plants for disinfection.	Safety: NOT recommended for pregnant women, persons with thyroid disease, those allergic to iodine, or for continuous use more than a few weeks at a time.
Shelf life: Packaging has an expiration date. Tablets are individually wrapped.	Shelf life: 1 year after opening. Tablet color can be used as guideline of potency: steel gray-fully effective; white to yellowish-brown ~50% effectiveness; deep brown-deteriorated.
Chlorine's effectiveness varies greatly with pH, temperature, and organic content of the water; making it less reliable than iodine or chlorine dioxide.	

Portable filters offer various degrees of protection. **Absolute pore size of the filter determines which organisms it is capable of removing.**

Absolute pore size of filter:	≤ 1 micron	~ 0.1 to 0.3 microns	< 0.01 microns
Waterborne pathogens removed:	Protozoa (Cryptosporidium oocysts, Giardia cysts)	Bacteria Plus Protozoa	Most Viruses Plus Protozoa & Bacteria

Most portable filters have an absolute pore size of 0.1 to 1 micron therefore do not effectively remove viruses, making chemical disinfection still necessary. Ceramic filters offer the advantage of maintainability for long term use. Similarly, Polar Pure Iodine is a sustainable source of chemical disinfectant. Hollow fiber membrane filters offer faster filtration times. The Sawyer[®] Viral Water Purifier is such a filter with an absolute pore size of 0.02 microns, so that it will remove 99.9997% of viruses as well as protozoans and bacteria.

Ultraviolet (UV) light can inactivate protozoan cysts, bacteria and viruses in **clear** water. Viruses are the most resistant to UV light disinfection. Requires effective pre-filtering due to its dependence on low turbidity and correct contact times to achieve maximum effectiveness. A military research group concluded that the hand held UV light device (SteriPen) is not expected to consistently provide adequate reduction of waterborne organisms even when using the optional pre-filter when treating more turbid water. However, UV light may be useful for treating suspect clear tap water.

Last resort-Water that is too hot to touch will be *safer* than cold tap water. Freezing will not kill Cryptosporidium oocysts, but is effective against Giardia.

Choosing a water source: When camping or otherwise using surface water sources, **choose clear, cool, fast moving water, upstream of any evidence of human or animal traffic.** (Beavers often harbor Giardia and Cryptosporidium is associated with cattle). Choose smaller streams rather than larger ones (choose a spring if possible). Smaller watershed areas lessen the chance of contamination with pathogens. Collect water from just below the surface, not off the bottom. Avoid warm, stagnant, muddy, or algae filled water if possible. Updated 8/14 cg

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