# Removing Giardia Cysts from Drinking Water

This article describes proper treatment methods to remove Giardia cysts from drinking water.

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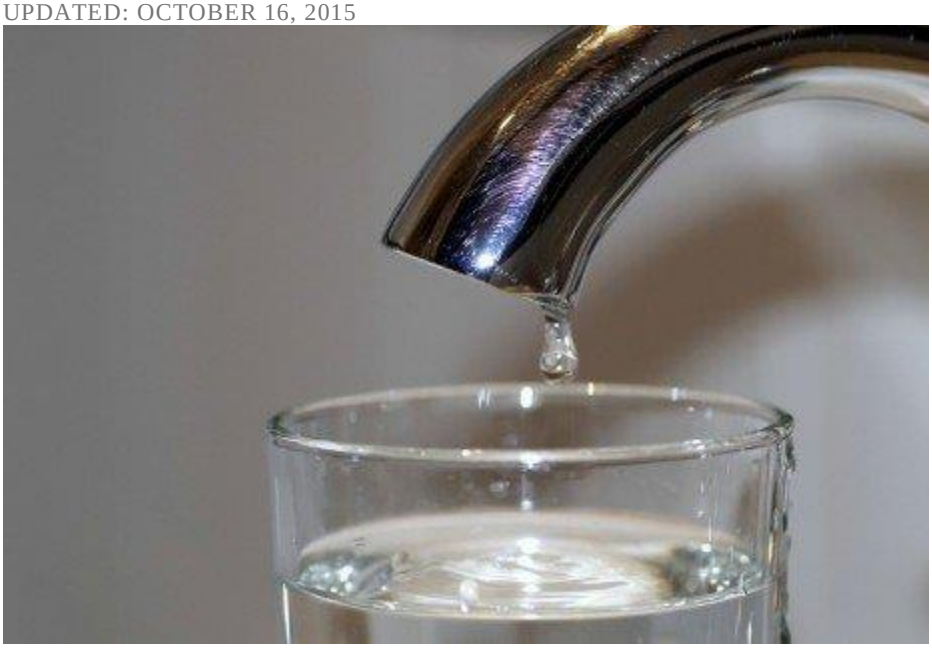
UPDATED: OCTOBER 16, 2015



In the mid-1980s several Pennsylvania communities experienced outbreaks of a waterborne disease called Giardiasis. Hundreds of citizens suffered with symptoms ranging from mild nausea to acute, severe intestinal distress. How did the *Giardia* cysts enter drinking water supplies? Studies showed that the outbreaks occurred in communities with inadequate chlorination systems, improperly operated and maintained filtration equipment, and even unfiltered water supplies. Since water supplies are not regularly tested for *Giardia*, the contamination was not detected until it was too late and entire communities had been exposed to contaminated drinking water.

From a health standpoint, *Giardia* has no long-term health effects. However, EPA studies conducted in Pennsylvania communities reveal that even a single *Giardia* outbreak may require investment in high cost filtration systems.

For residents relying on private wells, the presence of *Giardia* cysts from unfiltered water, although unlikely, may indicate that other contaminants are making it to the tap, as well. In either case, everyone will agree that the illness-causing cysts must be removed.

## What is Giardiasis?

*Giardiasis* is a gastrointestinal illness caused by the introduction of *Giardia* cysts from human or animal wastes into water supplies. The microscopic cysts are capable of surviving in cold water for several months. Mammals, such as beavers, that spend time in or near water have been implicated in some *Giardia* outbreaks, hence the name "Beaver Fever". However, beavers are not the major carrier of *Giardia* and fever is not a common symptom. Many animals as well as humans are known to carry the disease.
Once ingested by the host animal, the cyst develops into the adult protozoan life stage and attaches itself to the wall of the small intestine at the outlet of the stomach. There it reproduces cysts which can develop and infect other hosts. One gram of feces from an infected animal may contain as many as two million cysts. Diarrhea, abdominal cramps, and gas are among the common symptoms that may appear within 3 to 25 days, but usually within 10 days after cyst ingestion.

*Giardiasis* affects persons of all ages. Medication will eliminate the organism from the intestines, but re-occurrence of the symptoms occurs in some individuals. *Giardia* is frequently spread from person to person.

## Preventing Giardiasis

Detection of *Giardia* cysts is difficult and is usually not done until an individual becomes infected and is showing symptoms. Testing water for *Giardia* requires filtering 10 to 50 liters of water and having a trained analyst inspect the concentrated sample with a microscope. This testing typically costs several hundred dollars through an accredited water testing laboratory. Testing water is somewhat limited because the absence of cysts in a single sample is still no guarantee that none exist in the water supply.
The Department of Environmental Protection (DEP) currently samples public water supplies for *Giardia* and enforces regulations concerning proper operation and maintenance of water treatment plants to insure removal of the cysts. If you suspect that *Giardia* contamination has occurred, contact your local community water company or the DEP.
For individuals drawing water from private wells, safeguarding the water supply rests on the homeowner. Where deep (greater than 80') groundwater sources are used for water supply, *Giardia*cysts are usually not a problem. However, if surface water seeps directly into a well, *Giardia* can contaminate even the deepest well. A well casing that extends

above the surface of the ground and is properly grouted will keep surface water out of the well.

Springs and shallow wells have a higher probability of contamination because there is reduced soil filtration of the water flowing into these systems. A recent Penn State study found *Giardia* cysts in many roadside springs.

## Removing Giardia Cysts

Removing *Giardia* cysts before they reach the tap usually involves disinfection to inactivate the cysts and filtration through a fine media to physically remove the cysts from the water. Because *Giardia*cysts are resistant to normal disinfection, filtration is usually required. Cysts are large in comparison to bacteria and viruses (ranging from 7-10 microns in diameter); consequently, they are more easily removed by filtration.

Both disinfection and filtration processes are used in combination at municipal plants to protect water supplies and assure customers of high quality drinking water. Home water treatment techniques and devices are also available to assist water users in effectively removing *Giardia*. Techniques such as boiling and manufactured treatment devices are available to the homeowner.

### Boiling

Boiling is a simple, effective means of killing *Giardia* cysts and can also be used away from home on camping or hiking trips. To inactivate the cysts, bring water to a full boil for 1 minute on a stove or in a microwave. *The heat from a hot water tank is not sufficient to inactivate Giardia cysts.*

Boiling water is a viable, temporary solution to *Giardia* contamination. Boiling often leaves water with a bland taste, so you may wish to refrigerate boiled water in a sanitized container to restore taste or purchase bottled water in lieu of boiling drinking water.

### Manufactured treatment devices

Manufactured treatment devices also remove *Giardia* cysts. Various **filters** are probably the most common devices used. They are constructed of very fine media that traps small particles like bacteria, cysts and sediment. Sand, diatomaceous earth, spiral wound fiber, ceramic and activated carbon are five common media used for filtration.

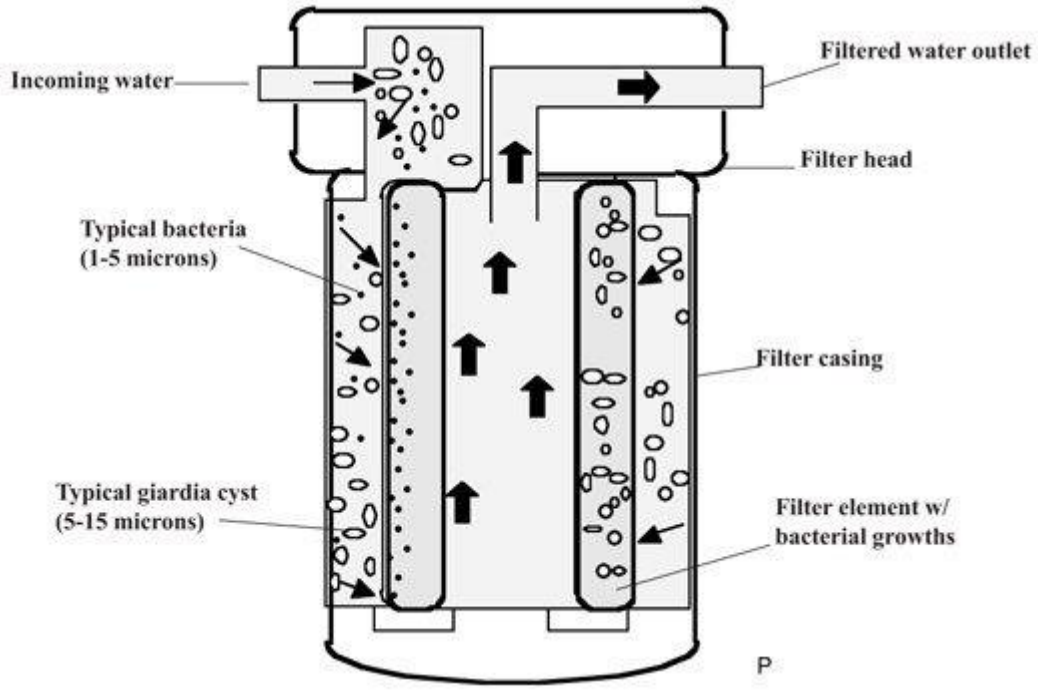



Figure 1. An activated carbon filter with a partially spent filter.

This illustration shows how the filtration process works to trap *Giardia* and other water constituents. The most widely available filter for point-of-use/point-of-entry treatment is the activated carbon filter (ACF). Many types of ACFs are currently on the market. Tap mounted filters attach to the faucet and pour through models work like automatic drip coffee makers. High volume models are installed under the sink.

Although many people believe that filters are a fail-safe treatment, filters are ineffective unless properly maintained and operated. Where un-disinfected water is used, filters are susceptible to bacterial growths which plug and coat the filters, reduce the filtering capacity, and create a source of bacterial contamination. For this reason, only disinfected water should be filtered.

Filters must also be cleaned regularly and replaced. Filters such as the tap mounted type must be changed at least every six months. Read the manufacturer's instructions to make sure that you are properly maintaining your filter.

## Other Disinfection Methods

Some disinfection processes widely used in European water treatment plants are now emerging as a home treatment technology in the United States.

## Ozone

Ozone, a strong oxidizing gas, is injected into water and kills bacteria and *Giardia* cysts with less contact time than other disinfection processes. Unlike chlorination, ozone leaves no after taste or residues and has been found to be more effective and more costly at *Giardia* deactivation than chlorine.

## Reverse Osmosis

Some manufacturers have also marketed Reverse Osmosis (RO) and ultraviolet light equipment for *Giardia* treatment. Reverse Osmosis devices are compact units designed to force pressurized water through a semi-permeable membrane. Contaminants are left on one side of the membrane while clean water flows out the other side. Filters or reverse osmosis units should have an absolute pore size of one (1) micron or smaller or meet NSF/ANSI standard 53 or 58 for cyst removal or reduction to be effective against cysts.

## Ultraviolet Light (UV)

Ultraviolet or UV light treatment systems pass water through a chamber housing a quartz mercury lamp. Properly sized UV light systems can be effective in treating cysts in water but the sizing of the unit is critical. Other water quality parameters like sediment, iron and hardness can also affect the efficiency of a UV light system and may require pre-treatment.

## References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Prepared by Paul D. Robillard, Associate Professor, Agricultural Engineering, William E. Sharpe, Professor, Forest Hydrology, and Bryan R. Swistock, Extension Associate


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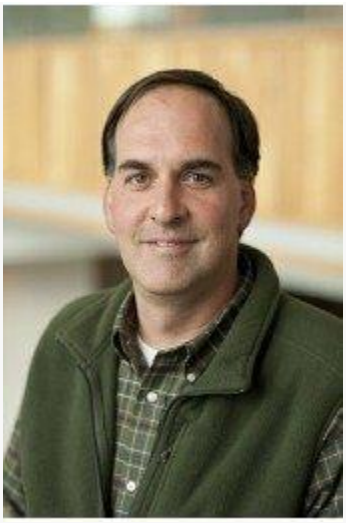

**BRYAN SWISTOCK**

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Expertise

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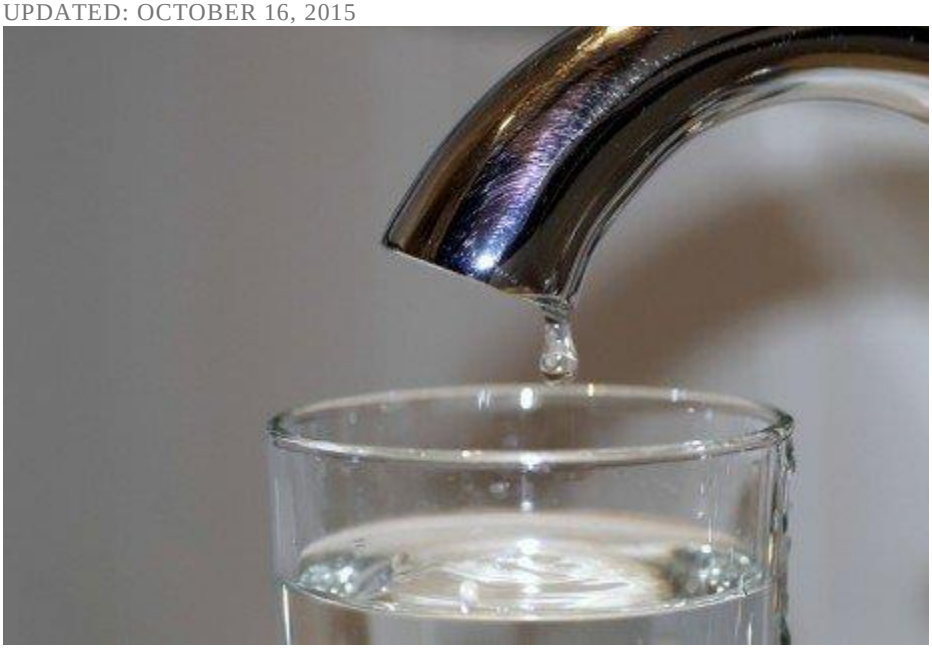

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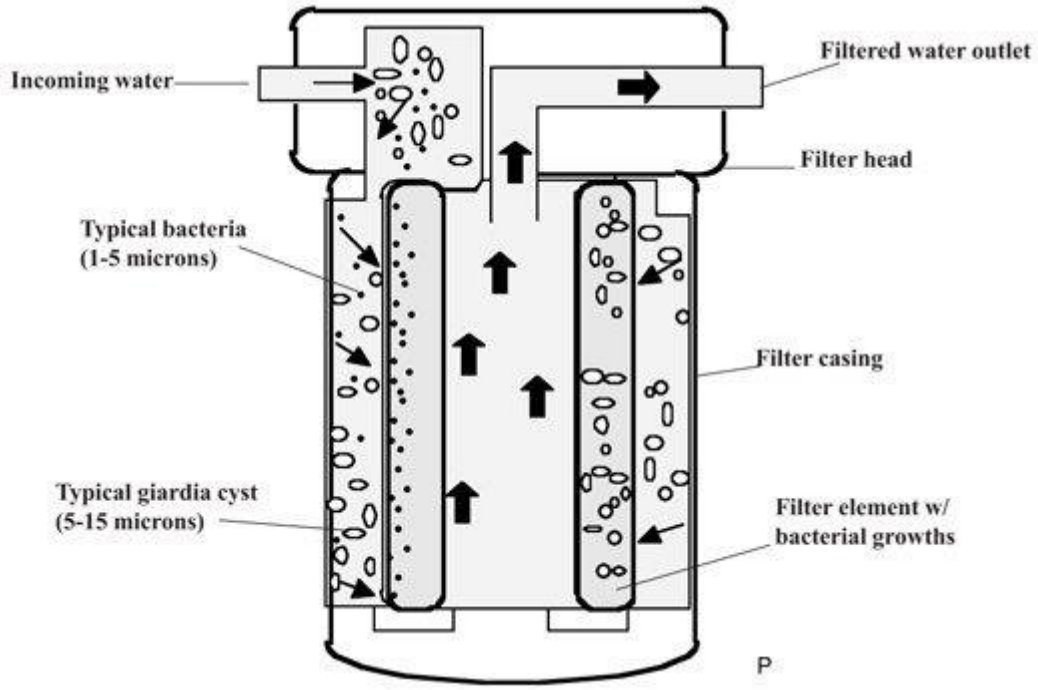


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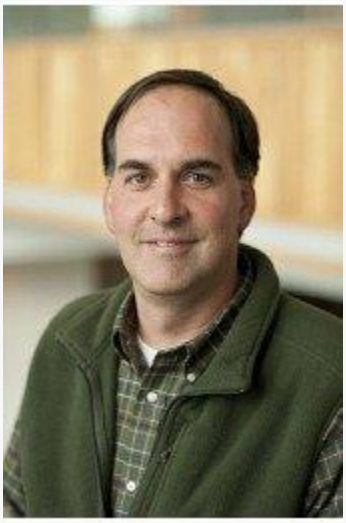


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