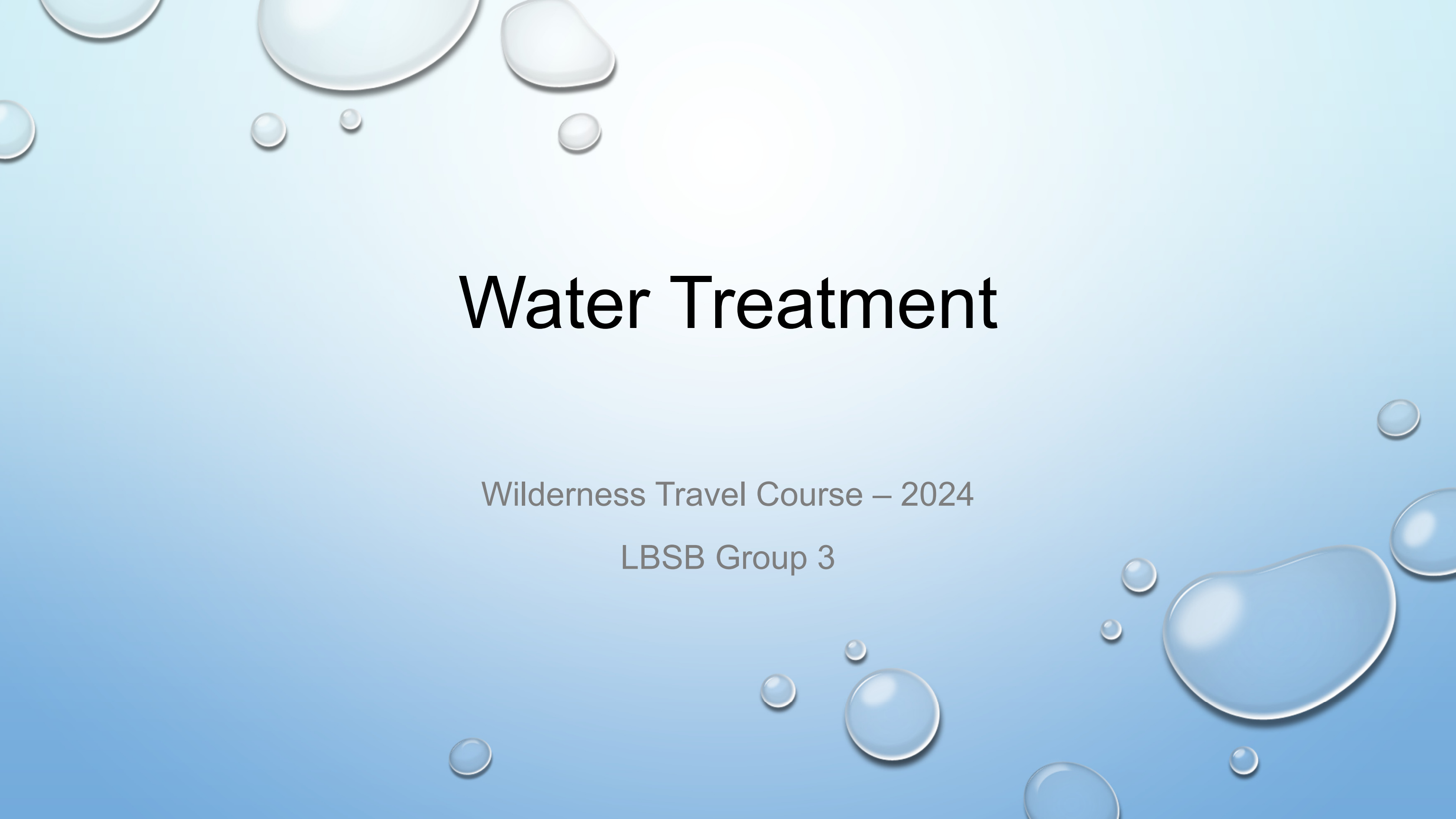


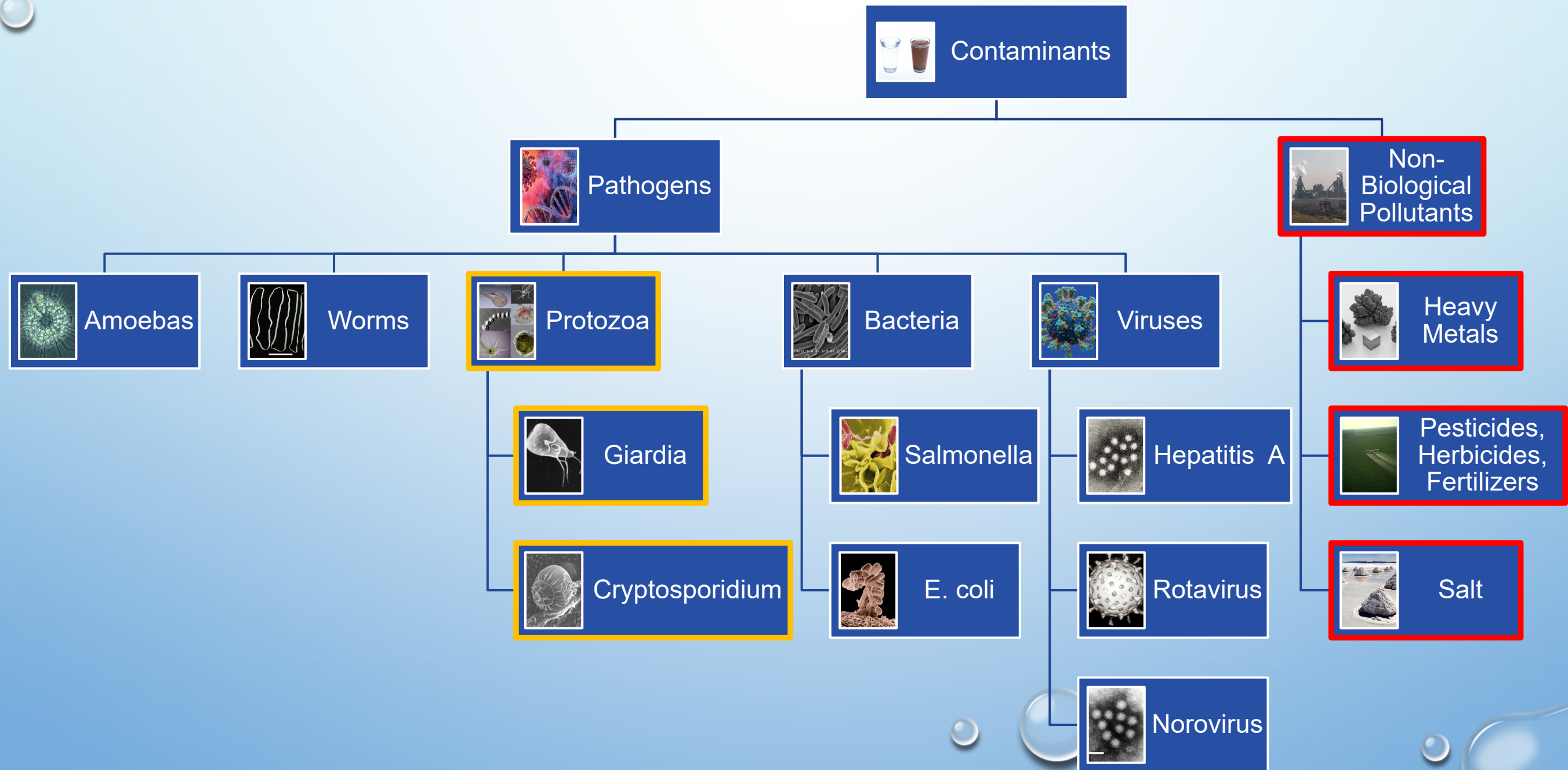
The background is a light blue gradient with several realistic water droplets of various sizes scattered across it. Some droplets are at the top, some at the bottom, and some in the middle. They have highlights and shadows, giving them a 3D appearance.

Water Treatment

Wilderness Travel Course – 2024

LBSB Group 3

What's in the Water?



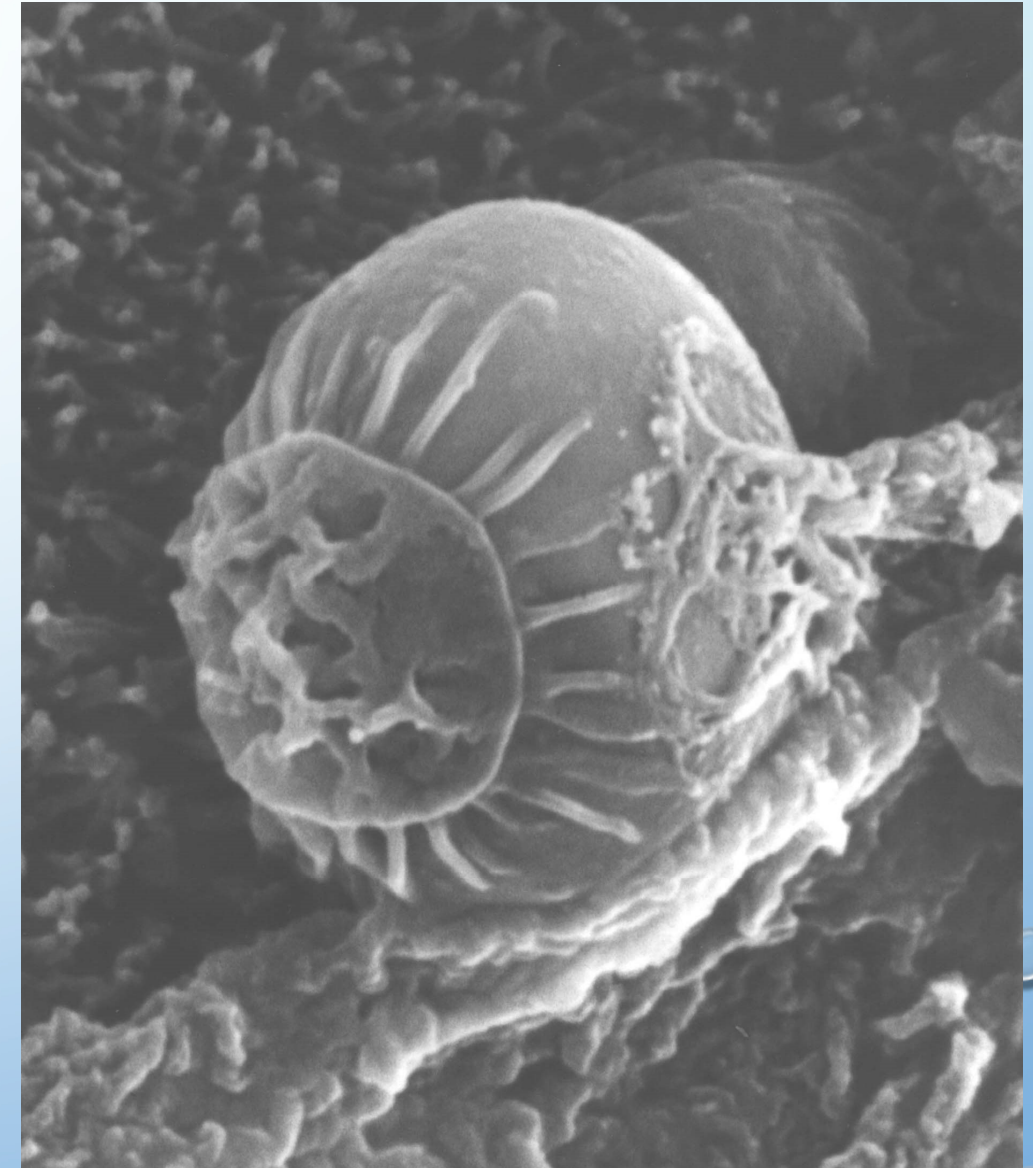
Giardia

- Waterborne parasite that is worldwide in distribution, causes Giardiasis
- Typically 7-15 μm in size
- Most commonly ingested via fecal-oral route
- Cysts are ingested, metamorphose into a trophozoite, and attach to intestinal wall
- Symptoms appear on average 7 days after exposure (range of 1-14 days), and last 1 to 3 weeks
- Some people can be asymptomatic
- Symptoms include:
 - Explosive diarrhea, flatulence
 - Intense nausea
 - Stomach cramps
 - Fever



Cryptosporidium (“Crypto”)

- Waterborne parasite that is worldwide in distribution, causes cryptosporidiosis
- Typically 3-6 μm in size
- Most commonly ingested via fecal-oral route
- Symptoms appear on average 7 days after exposure (range of 2-10 days), and last 2-3 weeks
- Some people can be asymptomatic
- Symptoms include:
 - Explosive diarrhea, flatulence
 - Intense nausea
 - Stomach cramps
 - Fever



Water Treatment Methods



Boiling

Effectiveness	Kills all waterborne pathogens
Treatment Time	Rolling boil for ~1 min
Weight	-
Cost	-
Pros	Gold standard in effectiveness, no aftertaste, typically already carrying necessary tools
Cons	Very time-consuming, need to carry extra fuel, need to wait for water to cool



Filters

Effectiveness	Extracts protozoa, bacteria, sediment, large microbes, but usually not viruses. Water purifiers are similar to filters but also remove viruses.		
Type	Pump	Gravity	Inline
Example			
Treatment Time (qt/min)	1-2.5	1-2	1-2
Weight (oz)	12-16	10-20	2-5
Cost (\$)	75-350	75-225	20-55
Notes	Filters should be at most 0.5 microns in size, exact filter type (ceramic, carbon, fiberglass) less important		
Pros	Creates clear water with no aftertaste, high effectiveness		
Cons	Heavy, bulky, expensive, can be tiring to pump, filters need replacement and can get blocked/cracked/frozen in the field, need to be careful about cross-contamination		

Chemicals (Chlorine Dioxide)

Effectiveness	Effective against most pathogens, including giardia and cryptosporidium
Treatment Time	5 mins to mix plus 15-30 mins for most pathogens, up to 4 hours for crypto or if in very cold weather
Weight	2 oz or less
Cost	\$0.50/gallon
Pros	Very lightweight, small, inexpensive, not many failure modes, high effectiveness
Cons	Wait time for drinkable water, can (rarely) leave a slight aftertaste, liquid version can potentially freeze in very cold conditions



Ultraviolet Light

Effectiveness	Kills all pathogens (protozoa, bacteria, and viruses)
Treatment Time	90 sec/liter
Weight	3-5 oz
Cost	\$75-150
Pros	High effectiveness, lightweight, no aftertaste, no effort to use
Cons	Serious reliability concerns, requires batteries/charger, not effective if water is cloudy, electronics are sensitive to temperature



Additional Tips and Notes

- **Personal hygiene is *critical* to ensuring you avoid most of these pathogens**
 - Some research has concluded that it's more likely to be infected for this reason than drinking contaminated water
- Prevalence of giardia and crypto in the wilderness is likely overstated, particularly at higher altitudes and in more remote areas away from human and animal activity
 - Always treating is still recommended unless very confident the risk is small
- Pass turbid water through a clean cloth or coffee filter before applying primary treatment method
- If water is highly suspect, consider combining treatment methods
- By volume, takes about 10 liters of snow to make 1 liter of water, so factor this in if planning to melt snow
 - Don't eat snow directly, takes too much energy/lowers body temperature



Tenaya Lake, Yosemite National Park

Questions?



Sierra Nevada High Route

Definitions

- **Amoeba:** A type of cell or unicellular organism with the ability to alter its shape, primarily by extending and retracting fingerlike projections of protoplasm
- **Cyst:** A tough protective capsule enclosing the larva of a parasitic worm or the resting stage of an organism
- **Enteric:** Relating to or occurring in the intestines
- **Helminths:** Large, multicellular organisms, either free-living or parasitic, that are generally visible to the naked eye in their adult stages
- **Pathogen:** A bacterium, virus, or other microorganism that can cause disease
- **Protozoa:** Single-celled organisms, either free-living or parasitic, that feed on organic matter such as other microorganisms or organic debris
- **Trophozoite:** A growing stage in the life cycle of some parasites, when they are absorbing nutrients from the host
- **Turbidity:** The cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye

References

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- Townsend, C. (2012). *The Backpacker's Handbook* (4th ed.)
- <https://www.cdc.gov/dpdx/giardiasis/index.html>
- <https://www.cdc.gov/dpdx/cryptosporidiosis/index.html>