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"Lesson Plan: Drinking Water Quality"

in the Household Water Treatment and Safe Storage (HWTS) Trainer Manual

Available at resources.cawst.org

Drinking Water Quality

2018 | June

What are the most common drinking water contaminants in your region?

Image Credit: CAWST

Learning Outcomes

1. Describe how to prevent common water-related diseases
2. List and describe the 4 different groups of pathogens
3. List and describe common chemical contaminants
4. Discuss factors that affect the acceptability of drinking water

Aspects of Drinking Water Quality

(World Health Organization, 2017)

Microbiological

- Microorganisms in water
- Four groups: viruses, bacteria, protozoa, helminths

Acceptability

- Factors that influence the appearance, smell, or taste of water
- Examples: suspended solids, some chemicals, organic material

Chemical

- Natural or human-made elements or compounds in water
- Examples: nitrogen, pesticides, heavy metals, salts

Radiological

- Radioactive substances from natural or human sources
- Usually very small risk; not considered in this training

Microbiological Aspects: **Types of Microbes**

Viruses 0.03–0.2 microns

Bacteria 0.2–0 microns

Protozoa 2–50 microns

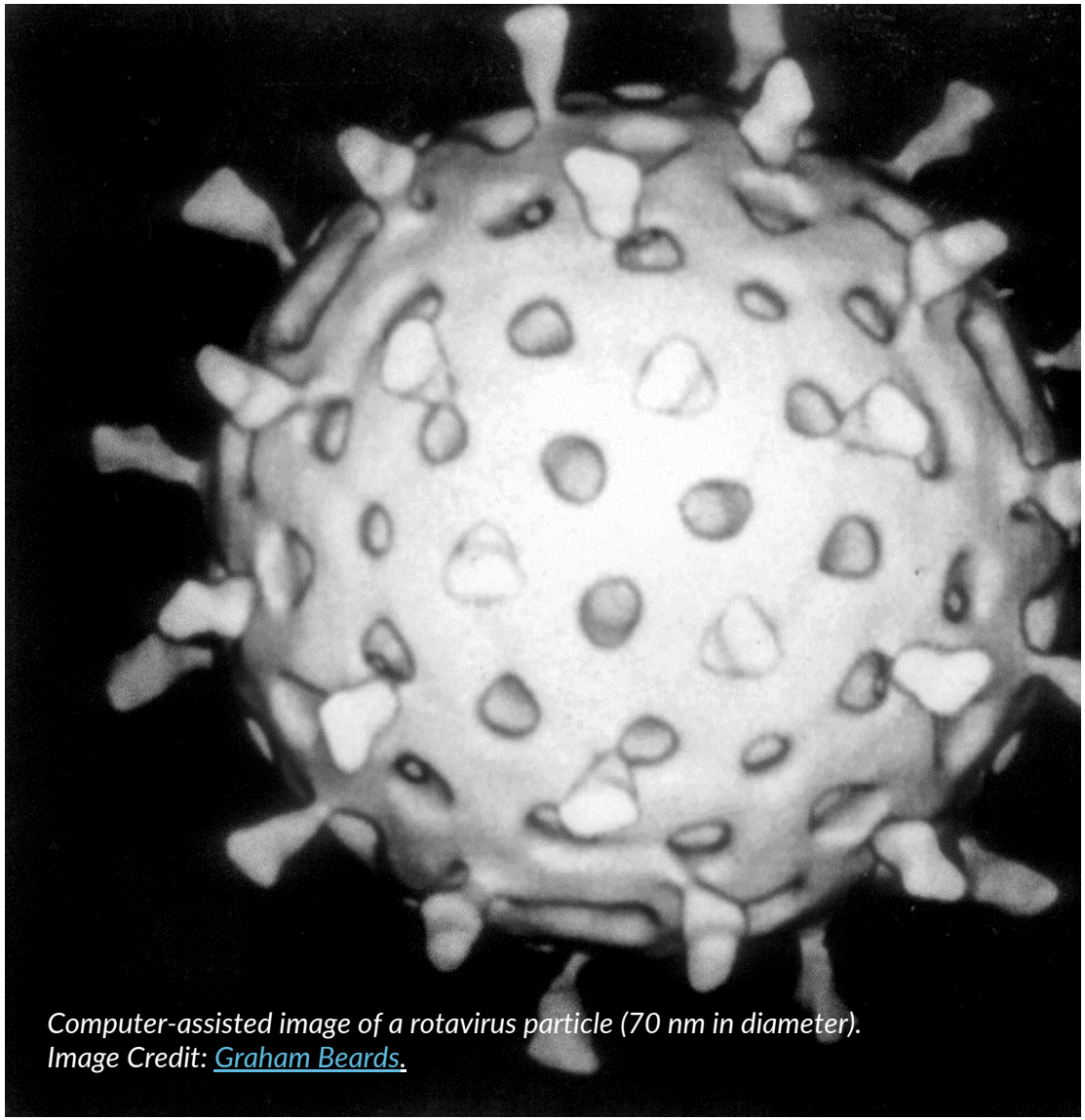
Helminths 40–00+ microns

What Is a Pathogen?

A microorganism that causes disease (not all microorganisms are pathogens)

Viruses

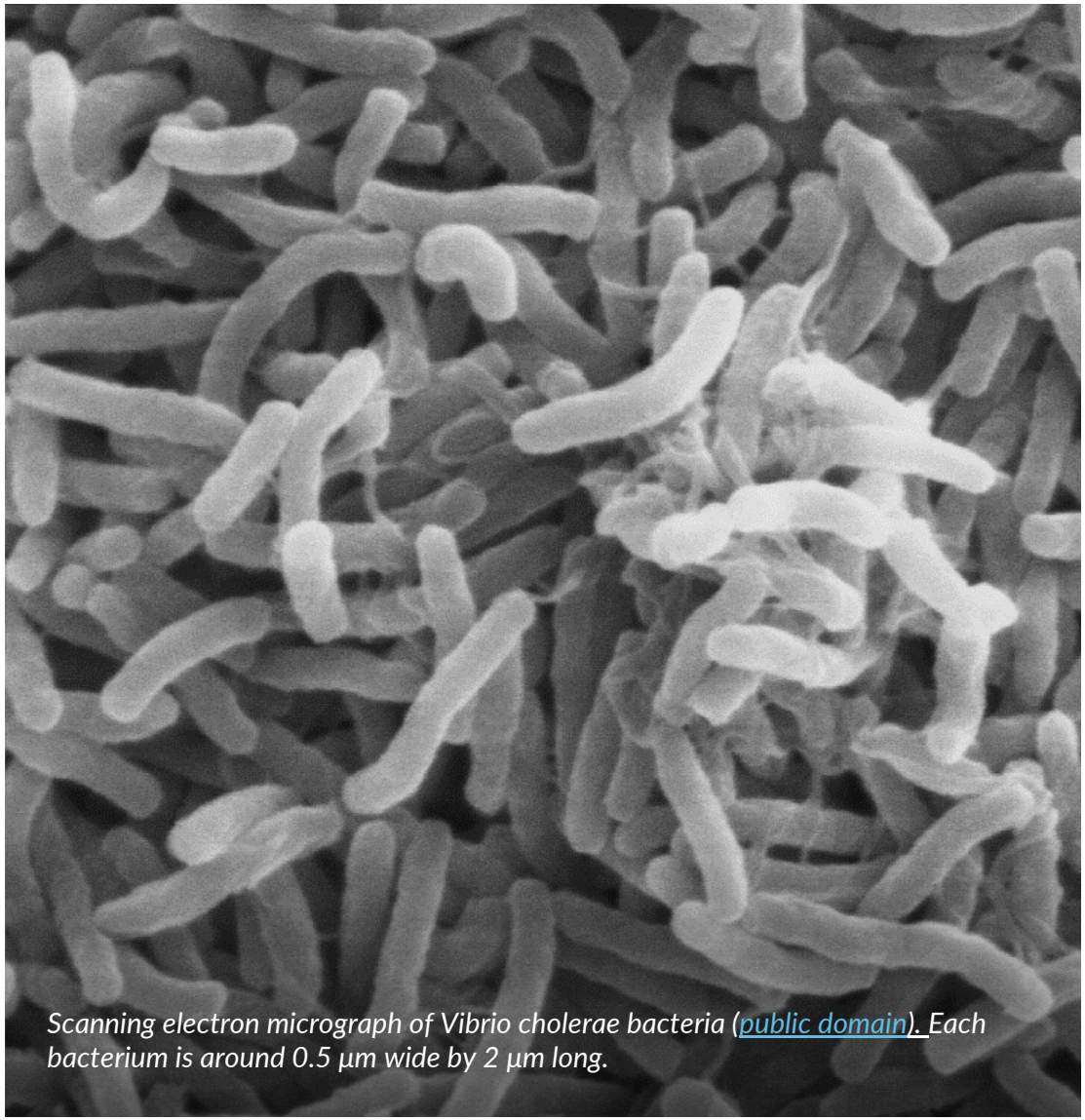
- Unable to reproduce by themselves
- Invade host cells
- Water-borne examples: Hepatitis A & E, rotavirus
- Mosquito-borne examples: Dengue fever, Japanese encephalitis, West Nile fever



Computer-assisted image of a rotavirus particle (70 nm in diameter).
Image Credit: Graham Beards.

Bacteria

- Very common in feces
- Waterborne disease examples: cholera, shigellosis, typhoid



Scanning electron micrograph of Vibrio cholerae bacteria (public domain). Each bacterium is around 0.5 µm wide by 2 µm long.

Protozoa

- Some need a host to survive
- Some can form cysts
- Waterborne examples: Amoeba, cryptosporidium, giardia
- Mosquito-borne example (breeds in standing water): Malaria

Micrograph of a Giardia parasite (approximately 12 µm long). Image credit: CDC / Dr. Stan Erlandsen (public domain).

Helminths

- Need a host to survive
- Many are passed in feces
- Water-related examples: pin worms, hook worms, schistosomes, guinea worms

Scanning electron micrograph of a pair of Schistosoma mansoni (public domain). Adults can grow to over 1 cm long.

Stretch Break!

How Do Pathogens Enter the Body?

Disease Class:	Waterborne
How It Enters the Body:	Ingestion
Pathogen Examples:	*E. coli*, Hepatitis A and E viruses, *Cryptosporidium*, Guinea worm (*Dracunculus*)
How to Prevent Disease:	Treat drinking water Practice food hygiene Use safe sanitation

How Do Pathogens Enter the Body?

Disease Class:	Water-washed (water-access related)
How It Enters the Body:	Contact
Pathogen Examples:	*Chlamydia trachomatis*, *Sarcoptes scabei* (scabies mite)
How to Prevent Disease:	Provide enough safe water for basic hygiene Improve basic hygiene practices

How Do Pathogens Enter the Body?

Disease Class:	Water-based
How It Enters the Body:	Contact
Pathogen Examples:	*Acanthamoeba*, *Schistosoma*, some hookworms
How to Prevent Disease:	Do not bathe or swim in contaminated water Treat drinking water Kill pathogen hosts (for example, snails)

How Do Pathogens Enter the Body?

Disease Class:	Water-insect vector
How It Enters the Body:	Insect Bite
Pathogen Examples:	Dengue virus, Japanese encephalitis virus, *Plasmodium* (malaria), *Trypanosoma*
How to Prevent Disease:	Control insect populations Remove pools of standing water Use bed nets

Chemical Aspects

- Natural or human-made elements or compounds.
- Examples: arsenic, fluoride, nitrate, pesticides.
- Health effects are often more gradual and long-term (compared to microbiological)

Activity: Disease Meet & Greet

Acceptability Aspects

Affect the appearance, taste, or smell of water

Affect how consumers feel about drinking the water

Acceptability: **Turbidity**

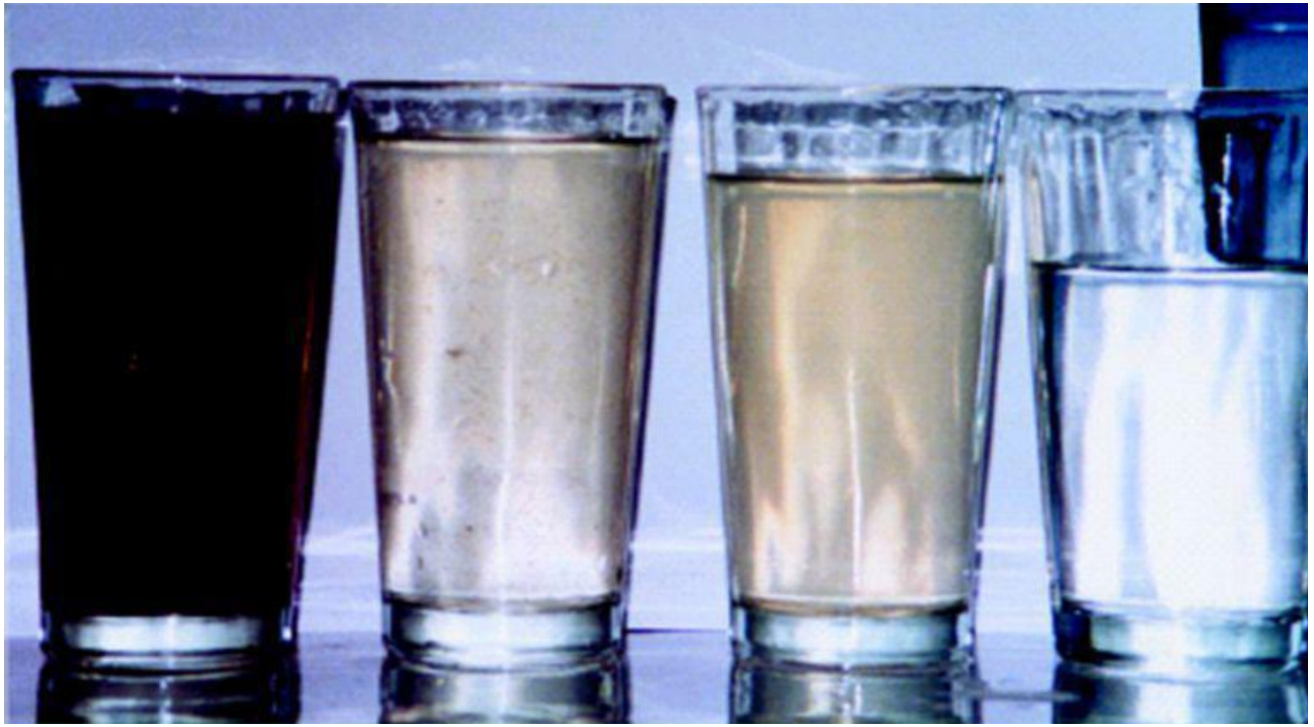


Image Credit: P & G Health Sciences Institute

Acceptability: **Colour**

Causes:

- Organic material → brown/yellow
- Silt and clay → red/brown
- Iron → red/orange
- Manganese → black
- Algae → green
- Bacterial growth → black (or other colours)

Acceptability: **Taste and Smell**

Causes:

- Algae and some bacteria → unpleasant taste and smell
- Sulphate → bitter taste, rotten egg smell
- Iron → strange taste
- Mineral concentration → affects taste
- Chlorine → affects taste and smell

Why Do We Care About **Acceptability**?

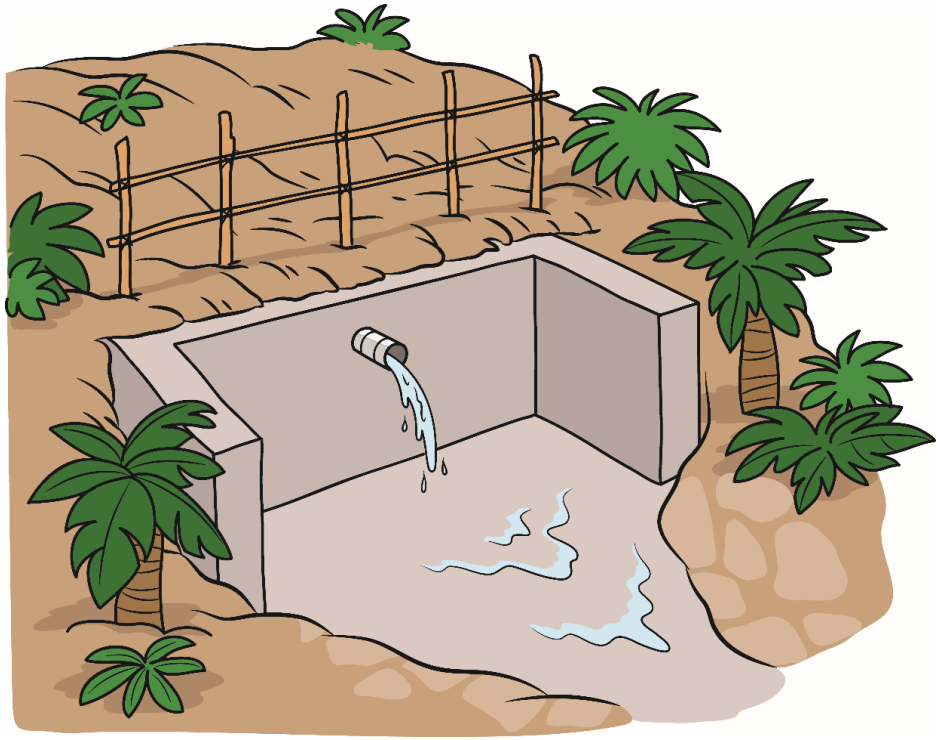
Radiological Aspects

Radioactive substances from natural or human sources

Generally, the amount of radiation people consume in their water is tiny compared to radiation exposure from other sources (for example, the sun).

Water Quality and Water Supply Systems

For most water supply systems, which aspects of water quality are most important to monitor and treat?



Review: Paper Cabbage

References

World Health Organization. (2017). *Guidelines for drinking-water quality: fourth edition incorporating the first addendum.* Retrieved from http://apps.who.int/iris/handle/10665/43428

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Calgary AB, Canada
+ 1 403 243 3285
cawst@cawst.org
cawst.org

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