



Centre for Affordable
Water and Sanitation Technology

12, 2916 – 5th Avenue
Calgary, Alberta, T2A 6K4, Canada
Phone: + 1 (403) 243-3285, Fax: + 1 (403) 243-6199
E-mail: cawst@cawst.org, Website: www.cawst.org

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This presentation is used with
Lesson Plan 11:

Intro to Microbiological
Parameters in the Drinking
Water Quality Testing Trainer
Manual.

Available at

www.cawst.org/resources



Introduction to Microbiological Parameters



Learning Expectations

1. Identify different types of pathogens.
2. Describe microbiological indicator organisms.
3. Explain the WHO guidelines for microbiological contamination in drinking water.

What is a Pathogen?

*A microorganism that
causes disease*

Types of Pathogens

- 1. Viruses:** (0.02 – 0.2 microns), unable to reproduce by themselves
- 2. Bacteria:** (0.2 - 5 microns), most common living things found in human and animal feces
- 3. Protozoa:** (4 - 20 microns), may be able to form cysts
- 4. Helminths:** (40 – 100 microns), worms and flukes, require a host and passed in human and animal feces

How big are they?

CELLS *alive!* HowBig Interactive

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Loading

Size Comparison

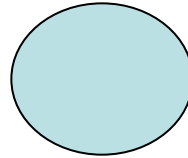
Smallest



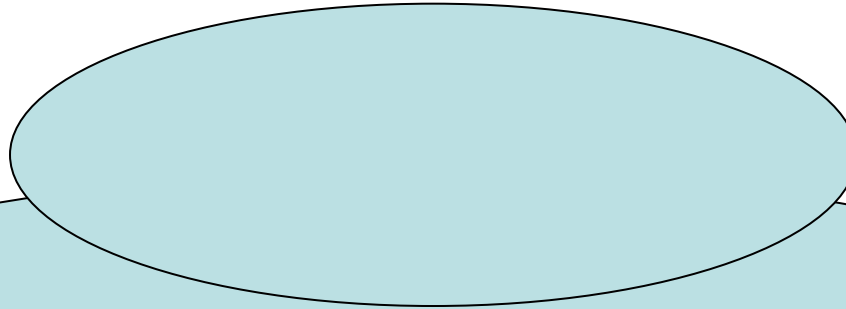
- Virus**
- Bacteria**
- Protozoa**
- Helminth**



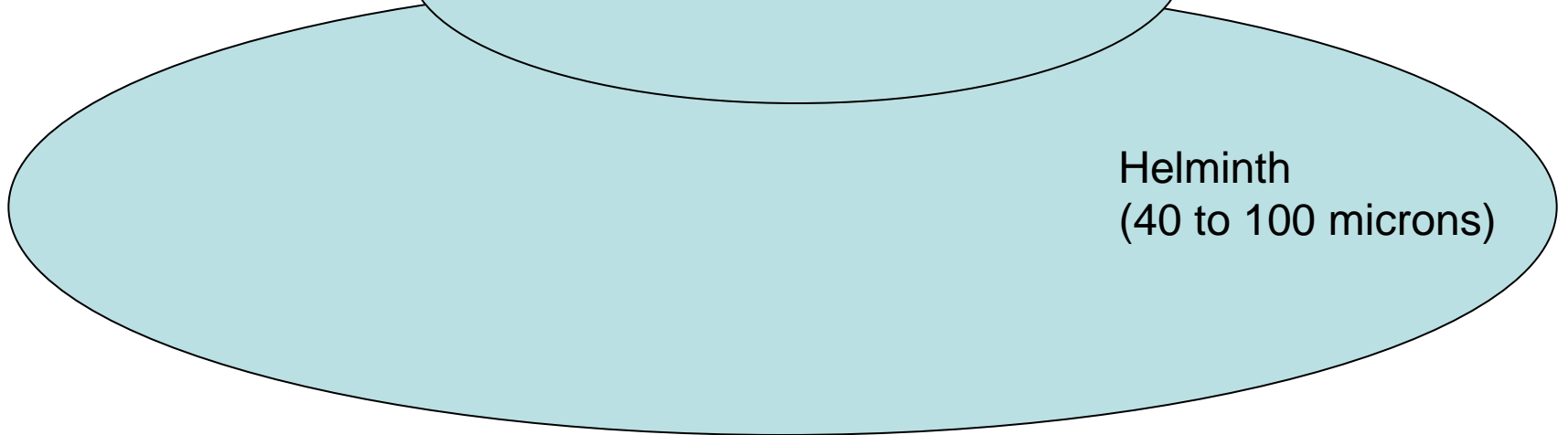
Virus (0.02 to 0.2 micron)



Bacteria (0.2 to 5 microns)



Protozoa
(4 to 20 microns)



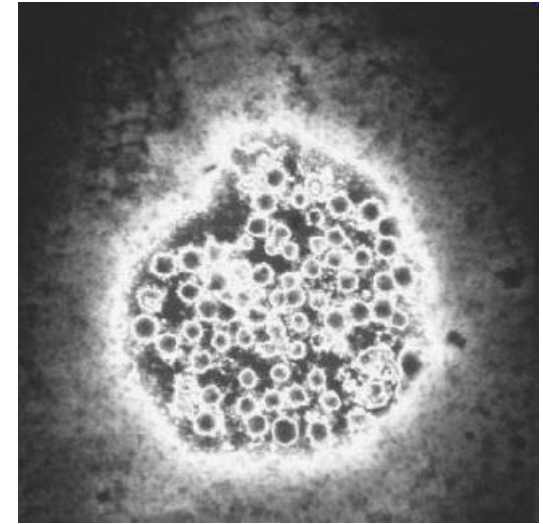
Helminth
(40 to 100 microns)



Pore size in a sand filter (1 micron)

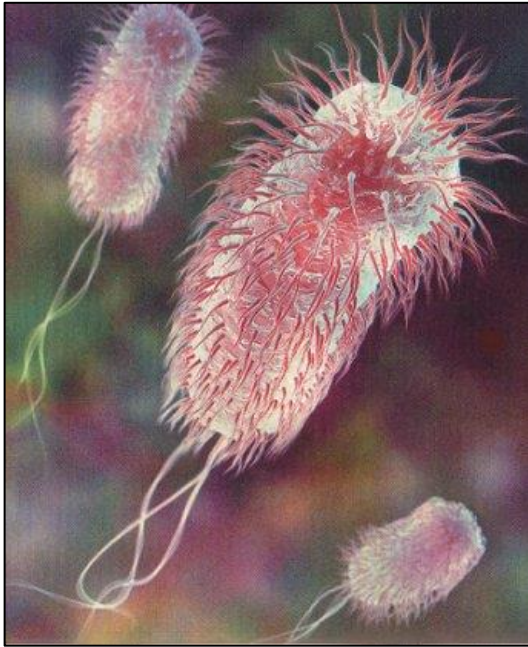
Viruses

- Hepatitis A and E
- Unable to reproduce by themselves
- Must use another living thing called a host
 - Microorganism, animal, human
- Water cannot spread HIV or influenza viruses

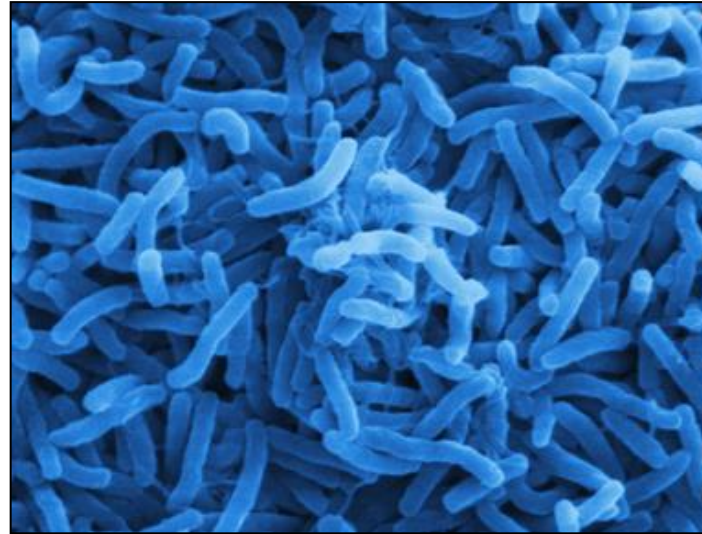


Hepatitis A

Bacteria



Escherichia coli



Cholera

- Most common living thing found in feces
 - 1 gram = billions of bacteria
- Diarrhea is the major symptom of water-related diseases
 - Cholera, typhoid, shigellosis

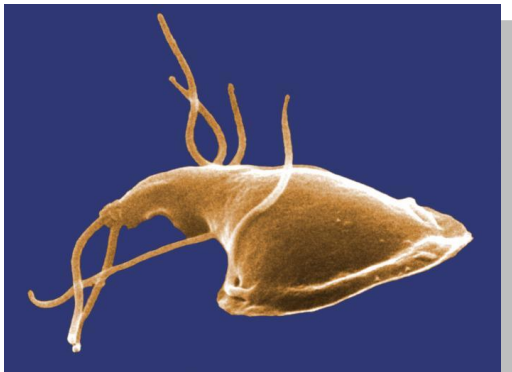
Bacteria in Action

Protozoa

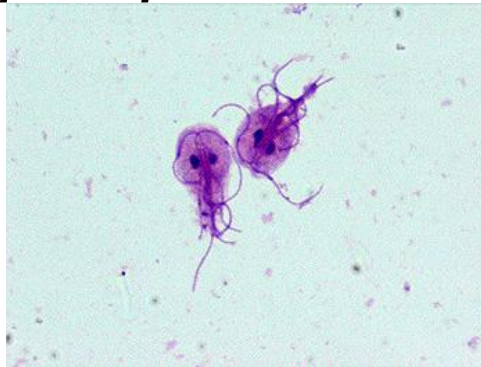


Cryptosporidium Cyst

- Some need a host to survive
- Able to form cysts which are resistant to chlorine
- Some can stay alive outside of a host
- *Entamoeba histolytica*
- *Cryptosporidium and Giardia*



Giardia (side view)
Credit: CDC, 1982



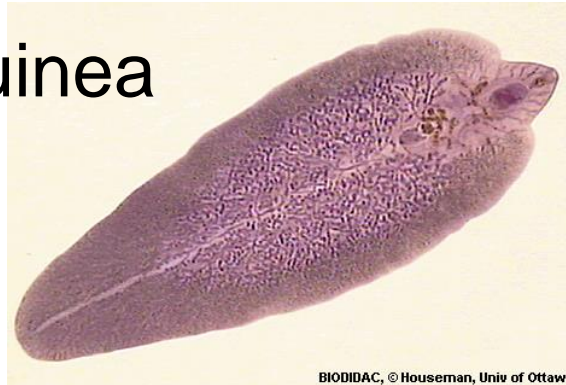
Giardia (top view)
Credit: Mount Sinai Hospital



Entamoeba histolytica
Credit: Science Photo Library 12

Helminths

- *Dracunculus medinensis* (guinea worm)
- *Fasciola* (liver flukes)
- Schistosomiasis (bilharzia)
- Need a host to survive
- Do not multiply within people, but weaken person by using their food
- Most are passed in feces



BIODIDAC, © Houseman, Univ of Ottawa

Liver Fluke

Credit: BIODIDAC,
Jon Houseman



Guinea Worm

Credit: The Carter Center,
Louise Gubb, Ghana, 2007

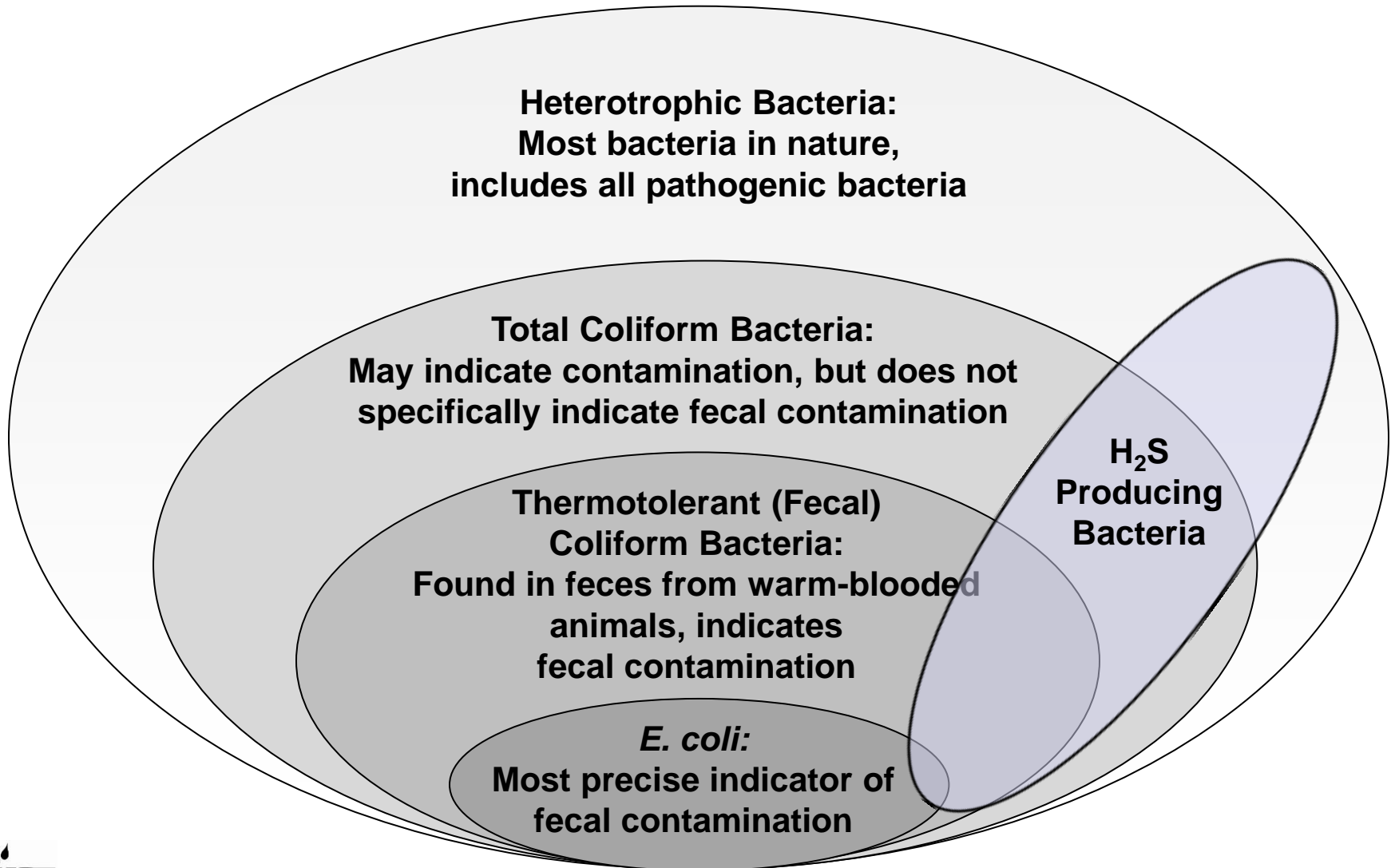
Why Do We Use Indicator Organisms in Testing?

- Testing for every pathogen is time consuming, complicated, and expensive
- Indicators of fecal contamination
- What are benefits of indicators?
 - Cheaper
 - Easier to perform
 - Faster results
 - Does not require highly trained personnel

What are Good Indicator Organisms?

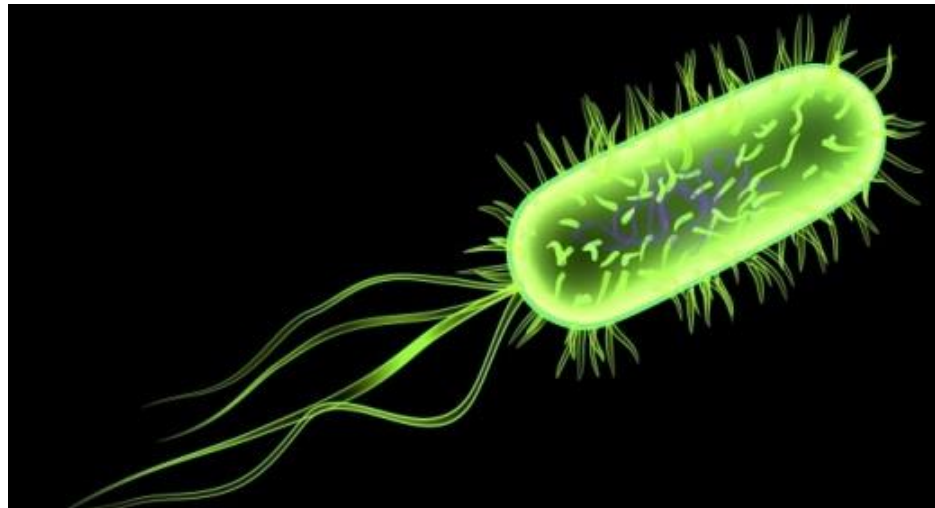
- Present in large numbers in feces
- Not multiply in natural waters
- Survive in water similar to fecal pathogens
- Present in higher numbers than fecal pathogens
- Respond to treatment similar to fecal pathogens
- Be readily detected by simple, inexpensive culture methods
- Not pathogenic

Bacteria Subgroups



Escherichia coli (E. coli)

- Found mainly in feces of warm-blooded animals
- Majority is harmless, some strains are pathogenic
- Meets criteria for good indicator
- Preferred indicator of fecal contamination in drinking water



E. coli bacterium

Thermotolerant (Fecal) Coliforms

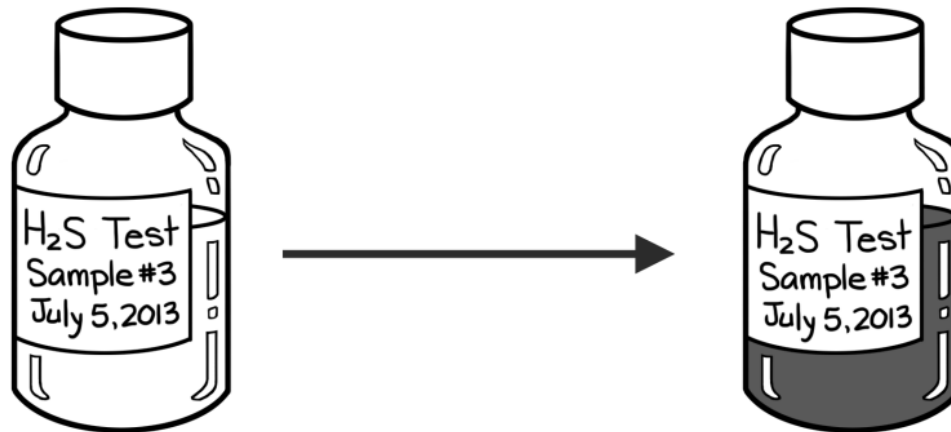
- Subgroup of total coliforms
- Used to be called fecal coliforms
- 96.4% of bacteria in human feces are thermotolerant coliforms
- Able to grow at higher temperatures (42-44.5°C)
- Acceptable indicator if it is not possible to test for *E. coli*

Total Coliforms

- Does not always indicate fecal contamination
 - Only 10 of the 19 groups associated with feces
- Does not meet criteria for a good indicator
 - Also associated with soil, vegetation, and water sediment
 - Able to multiply in water
- Should not be used as a drinking water indicator!

H₂S Bacteria

- Large number of bacteria from feces can produce H₂S
- Fecal bacteria are not the only bacteria that produce H₂S
- Not as specific to fecal contamination as *E. coli* or other thermotolerant bacteria



WHO Guideline for Fecal Contamination

**0 Fecal Contamination in Any
100 mL Sample**

Risk of Fecal Contamination in Drinking Water

<i>E. coli</i> level (CFU/100 mL sample)	Risk¹	Recommended Action²
0-10	Reasonable quality	Water may be consumed as it is
11-100	Polluted	Treat if possible, but may be consumed as it is
101-1,000	Dangerous	Must be treated
> 1,000	Very Dangerous	Rejected or must be treated thoroughly

Source: (¹ WHO, 1997; ² Harvey, 2007)

Review

- What did you learn that was new to you about microbiological parameters?