

Introduction to Microorganisms

Mary Jo Kirisits, Ph.D.

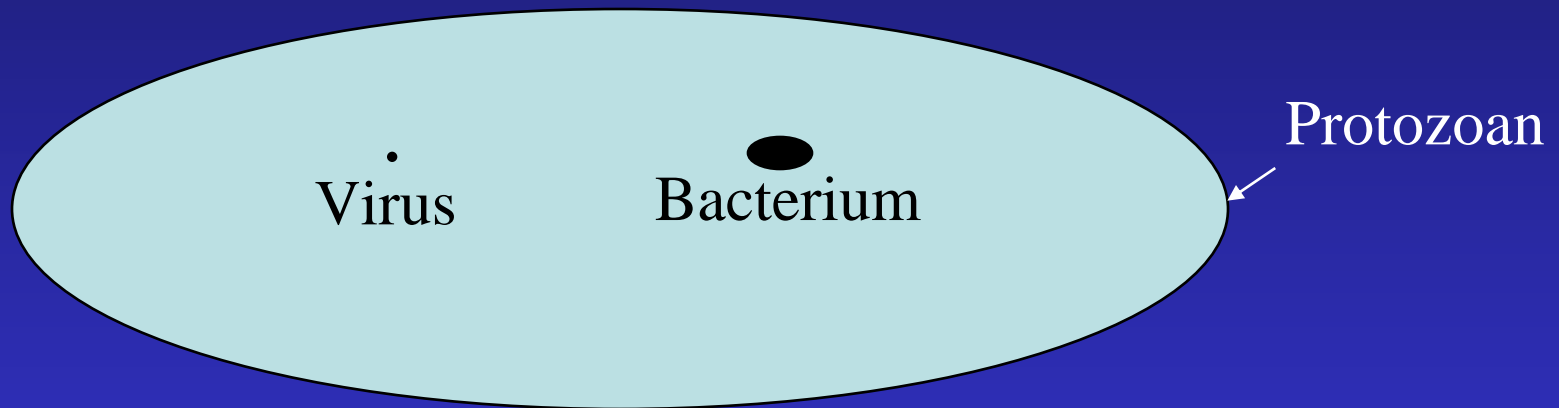
University of Texas at Austin

The Questions

- What are microorganisms?
 - Bacteria, protozoa, and viruses
- Where do they exist?
- Can microorganisms be beneficial?
- Can they be problematic for human health?
- How do pathogenic microorganisms get into natural waters?
- How do we measure pathogenic microorganisms?

What are microorganisms?

- Organisms that can only be seen with a microscope



- Typical bacterium: 1 x 3 μm
 - 500 bacteria fit across the head of a pin.
- Pathogenic microorganisms cause human disease.

What are microorganisms? (cont'd)

I. Single-celled living entities

- Self-producing
- Self-feeding
- Two types of interest to us
 - Protozoa
 - Bacteria



Pseudomonas aeruginosa
(Kirisits, 2000)

II. Non-living entities

- Viruses
 - Need a host (e.g., animal) to reproduce themselves

Where do they exist?

- Microorganisms are almost everywhere
 - Soil
 - Hot springs
 - Glaciers/Antarctica
 - Fresh water, salt water
 - Plants
 - Animals
 - 1 lb feces contains ~0.3 lb microorganisms



**Yellowstone National Park
(Kirisits, 2000)**

Microorganisms outnumber us

- On Earth
 - Bacteria: 6×10^{30} cells*
 - Humans: 6×10^9 humans*
- In/on the human body
 - Bacterial cells: 7×10^{13} *
 - Human cells: $1-10 \times 10^{13}$

*Whitman, W.B., D.C. Coleman, and W.J. Wiebe. 1993. *PNAS* 95: 6578-6583.

Can microorganisms be beneficial?

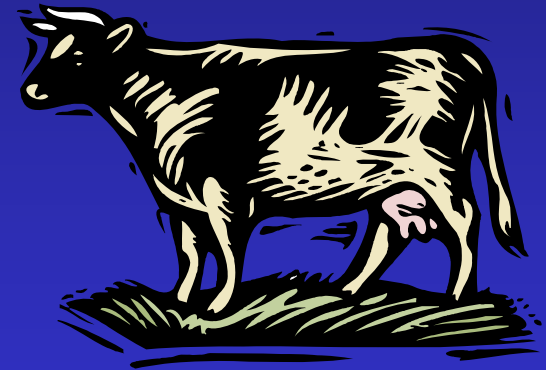
- YES!

- Food production

- Wine, yogurt, vinegar



- Digestion in ruminant animals



- Waste treatment

- Wastewater, hazardous waste

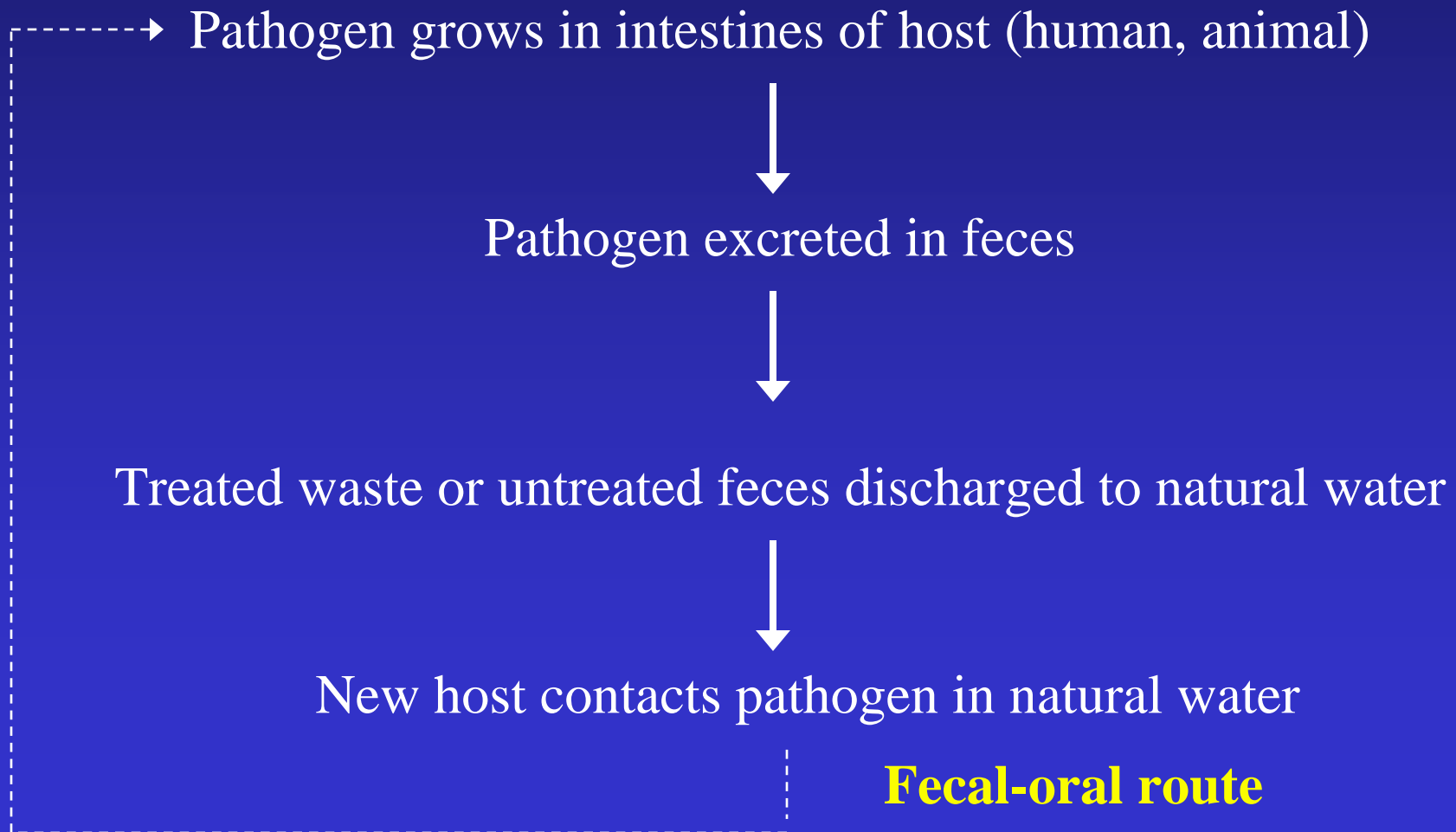


Can they be a problem for human health?



- YES!
- Pathogenic microorganisms
 - Cause disease in humans and other organisms
 - Pathogens often waterborne
 - Transmitted through contact with contaminated water
 - Swimming at a contaminated beach
 - Consuming improperly disinfected drinking water
 - Human defense
 - Stomach acid
 - Liver
 - Immune system

How do pathogenic microorganisms get into natural waters?



Examples of waterborne disease caused by bacteria

MJK1

Microorganism (Infectious dose)	Disease	Symptoms
<i>Campylobacter</i> <i>Escherichia coli</i> (10^8)	Gastroenteritis	Nausea, diarrhea, abdominal pain
<i>Salmonella</i> (10^5)	Salmonellosis	Headache, chills, vomiting, diarrhea, fever
<i>Vibrio cholerae</i> (10^{10})	Cholera	Life-threatening diarrhea
<i>Yersinia enterocolitica</i>	Yersiniosis	Diarrhea, abdominal pain, fever

Examples of waterborne disease caused by protozoa

MJK2

Microorganism	Disease	Symptoms
<i>Cryptosporidium</i>	Cryptosporidiosis	Diarrhea, nausea, abdominal cramps
<i>Giardia</i> (10)	Giardiasis	Diarrhea, nausea, abdominal cramps

Examples of waterborne disease caused by viruses

MJK3

Microorganism	Disease	Symptoms
Norovirus (10)	Viral gastroenteritis	Vomiting, abdominal cramps, diarrhea, nausea
Hepatitis A virus	Hepatitis	Jaundice, fatigue, abdominal pain, diarrhea, nausea

Some pathogens from animals also infect humans (zoonotic transmission)

- *E. coli* O157
 - Sheep manure (Licence et al., 2001)
 - Cow manure (Crampin et al., 1999)
- *Salmonella, Campylobacter*
 - Birds (Reed et al., 2003)
- *Cryptosporidium*
 - Cattle, cats, and birds (Morgan et al., 2000)

↑
Of most concern to immune-compromised

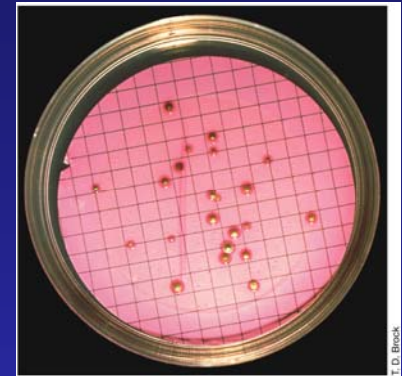
How do we measure pathogenic microorganisms in water?

- Too costly and time-consuming to measure each individual type of human pathogen
- Measure indicator microorganisms instead
 - Live in intestinal tract of warm-blooded animals
 - Excreted in feces
 - Environmental survival similar to pathogenic bacteria
 - **Their presence indicates fecal contamination and possible presence of pathogens**

Types of indicator microorganisms

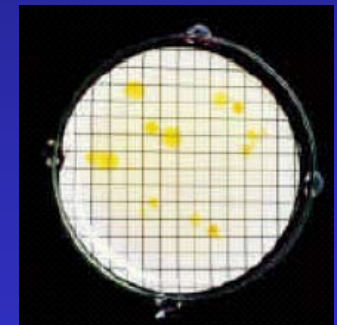
1. Fecal coliforms

- Indicator organism for oyster water use



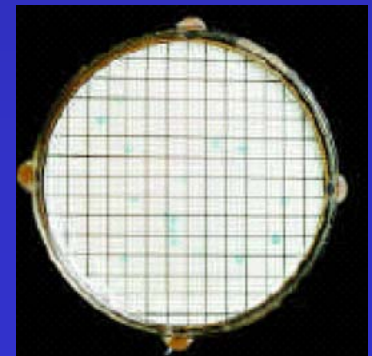
2. *E. coli*

- Indicator organism for contact recreation use in freshwater



3. Enterococci

- Indicator organism for contact recreation use in saltwater



Summary

- Bacteria, protozoa, viruses are microorganisms
 - May be carried by human and other animal hosts
 - Shed in feces
 - Transmitted to a new host by contaminated water
 - Some are human pathogens
 - Often cause diarrhea, nausea, and abdominal pain
 - Monitor indicator organisms for water quality
 - Simpler and less expensive than monitoring all pathogenic microorganisms