

BACTERIA AND VIRUSES

ANTIBIOTICS

AND

BACTERIAL RESISTANCE TO

ANTIBIOTICS

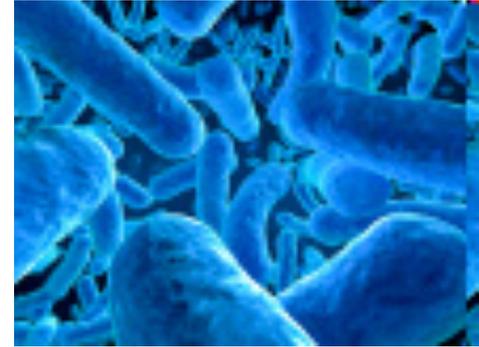
Module One: What We Will Learn

- What are microbes?
- What are viruses?
- What are bacteria?
 - Where do they live?
 - What is their structure?
- Bacteria and humans
 - How to identify bacteria
 - Colonization
 - Host cell defenses
 - How bacteria cause infection



What Are Microbes?

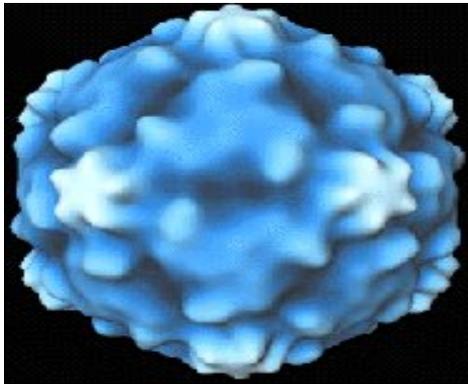
- Microscopic living organisms
- Four major types of microbes:
 1. Viruses
 2. Bacteria
 3. Fungi
 4. Parasites
 - **We will provide some information about viruses and then spend most of our time focusing on bacteria.**



Viruses and Bacteria

Viruses

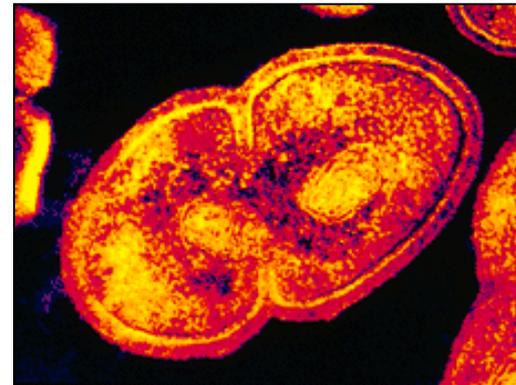
- Genetic material (DNA or RNA) in a protective coat
- Attach themselves to a host cell to reproduce inside that cell



Rhinovirus (cold)

Bacteria

- Independent cell
- Able to live and reproduce outside human or animal cells



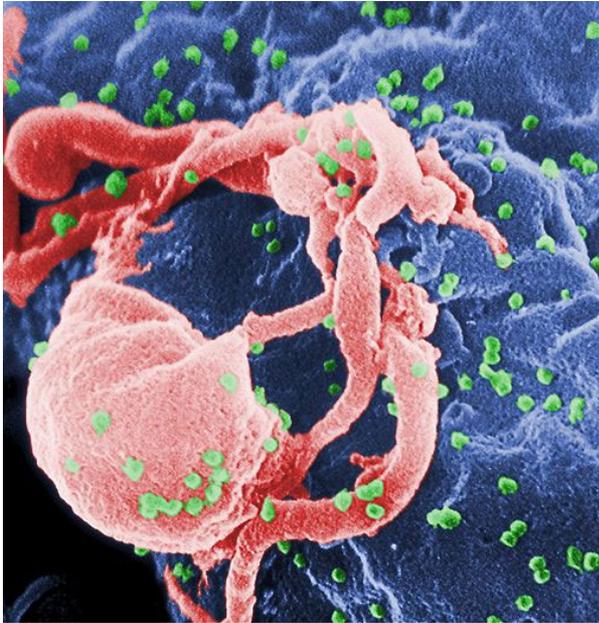
Streptococcus pneumoniae

What Are Viruses?

- The smallest infectious particles with a core of genetic material (DNA or RNA)
- Surrounded by:
 - a protein,
 - a lipid (fat), or
 - a combination of a lipid and a sugar-protein coat

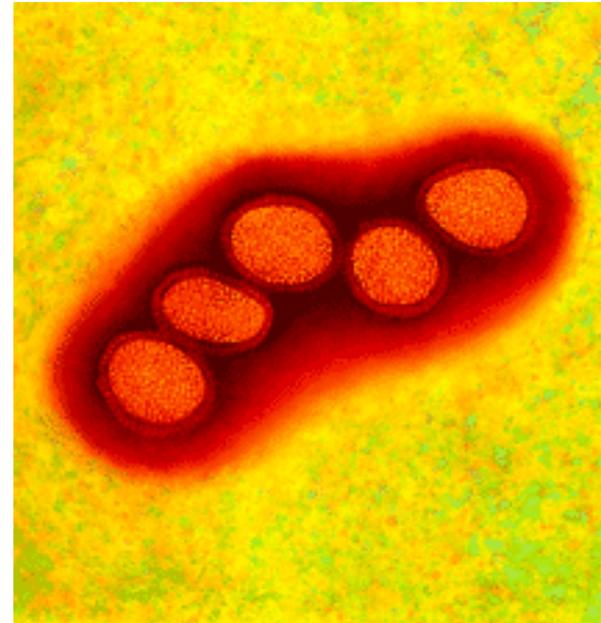
What Some Viruses Look Like

(not to scale)



HIV

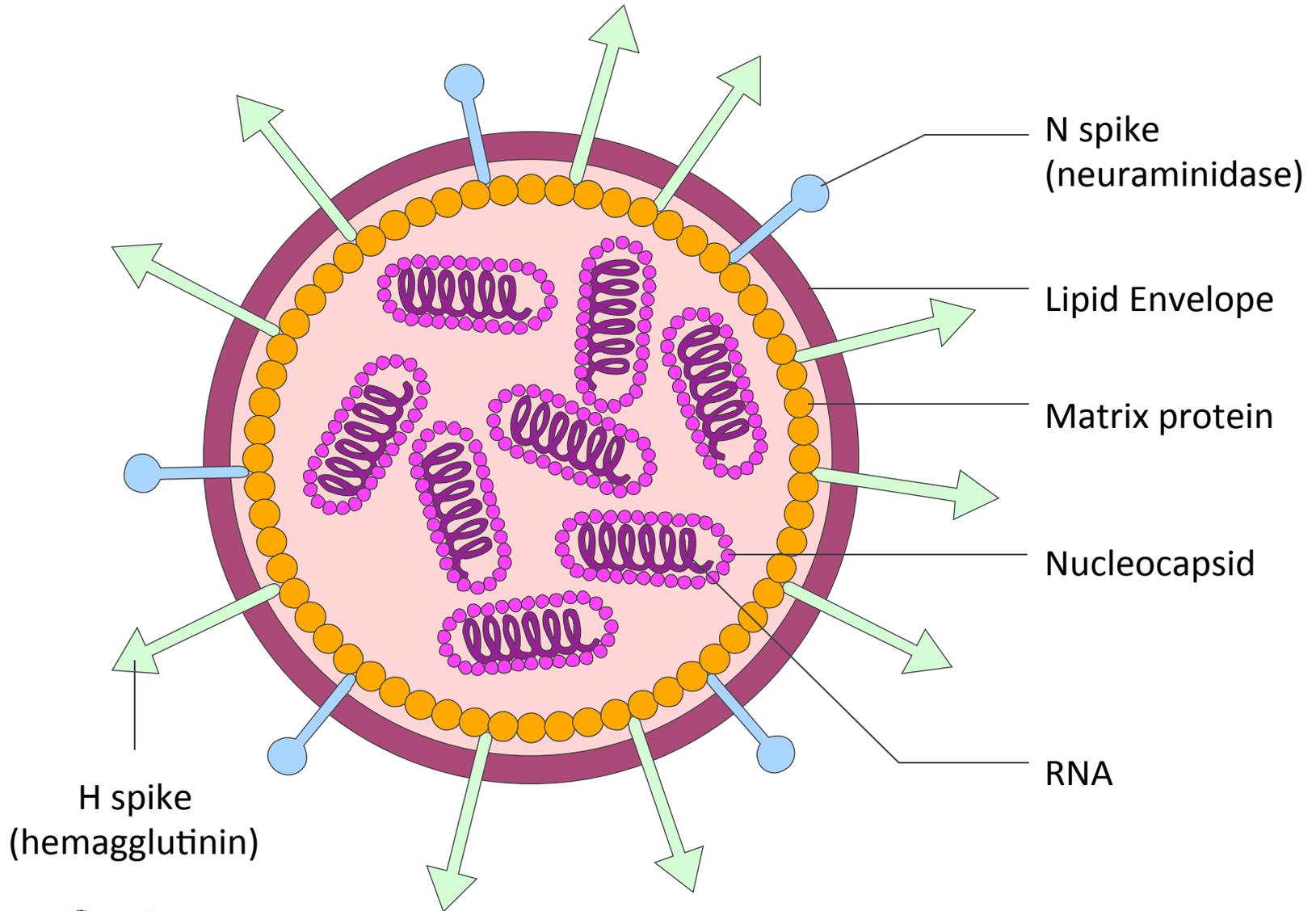
- Human immunodeficiency virus (HI-V budding in green)



Influenza Virus

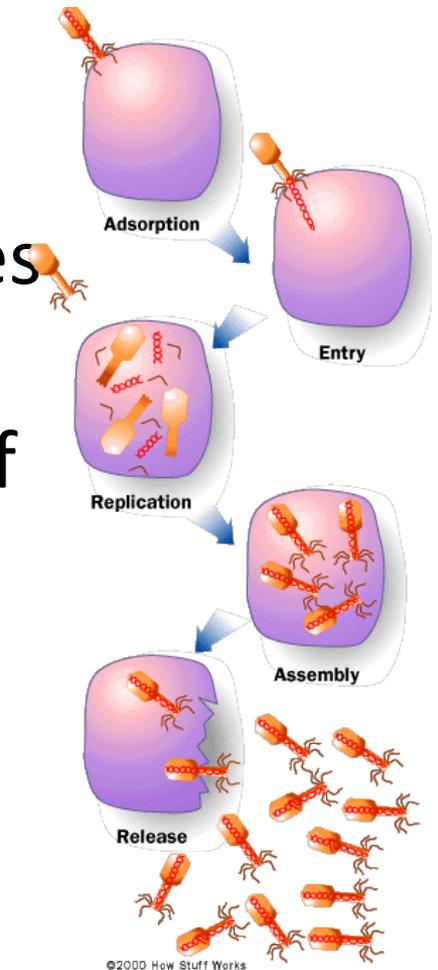
- Flu

Influenza Virus Structure



Viruses Invade Host Cells

- Viruses lack some of the machinery to grow and reproduce by themselves
- A virus invades a live host cell inside your body and starts replicating itself
- The host cell releases the copied viruses
- Each released virus will look for a new live host cell to invade and repeat the process



Virus infecting a cell

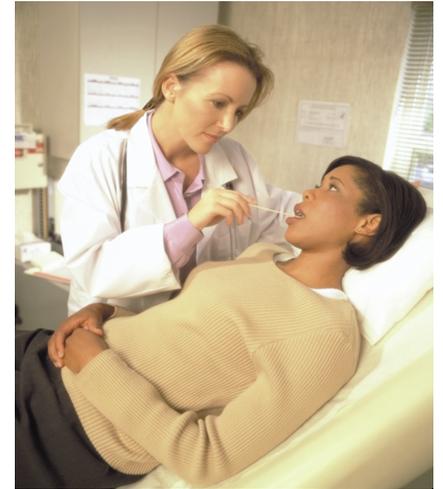
The Host Defends Itself

- The Immune System
 - Detects the virus
 - Produces specific antibodies to inactivate the virus
 - Sends white blood cells to fight and destroy the virus



What Are Some Diseases Caused by Viruses?

- Common cold
- Influenza
- Measles, chickenpox, mononucleosis
- Herpes (e.g., cold sores)
- HIV
- Genital warts (Human Papillomavirus or HPV can result in cervical cancer)
- Hepatitis
- Rabies



How Do We Contract Viruses?



- Simple contact with an infected person (shaking hands [direct contact] or sneezing [respiratory or airborne spread])
- Exchange of bodily fluids such as saliva
- Sexual contact (e.g., HIV, HPV)
- Contaminated food or water
- Insects (e.g., mosquitoes)
- Infected animals (e.g., animals with rabies)

The Power of a Sneeze

- Did you know that a sneeze can blast microbes into the air at 100 miles per hour?!



Photograph of a real sneeze

Other Facts About Viruses

- Some viral infections can be prevented by vaccines (e.g., influenza, HPV, hepatitis B, measles and mumps)
- Treatment for the common cold is directed toward relief of symptoms with over-the-counter (OTC) medicines while the body's immune system is fighting the virus
- Antiviral medications are available for certain viruses



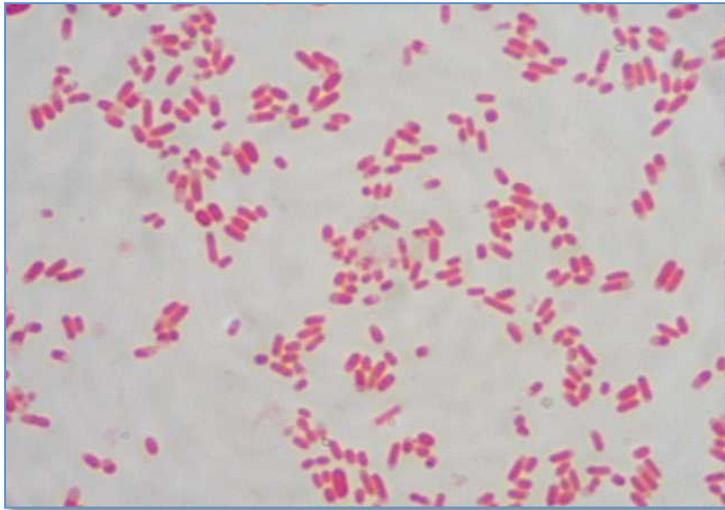
What Are Bacteria?

- Single-celled microscopic organisms
- Larger than viruses but smaller than human cells
 - Majority play a positive role in nature:
 - Aid in digestion
 - Digest sewage into simple chemicals
 - Extract nitrogen from air and make it available to plants for protein production
 - Some are harmful (pathogenic):
 - Damage tissues or produce toxins that cause disease



What Some Bacteria Look Like

(not to scale)



Escherichia coli (*E. coli*)

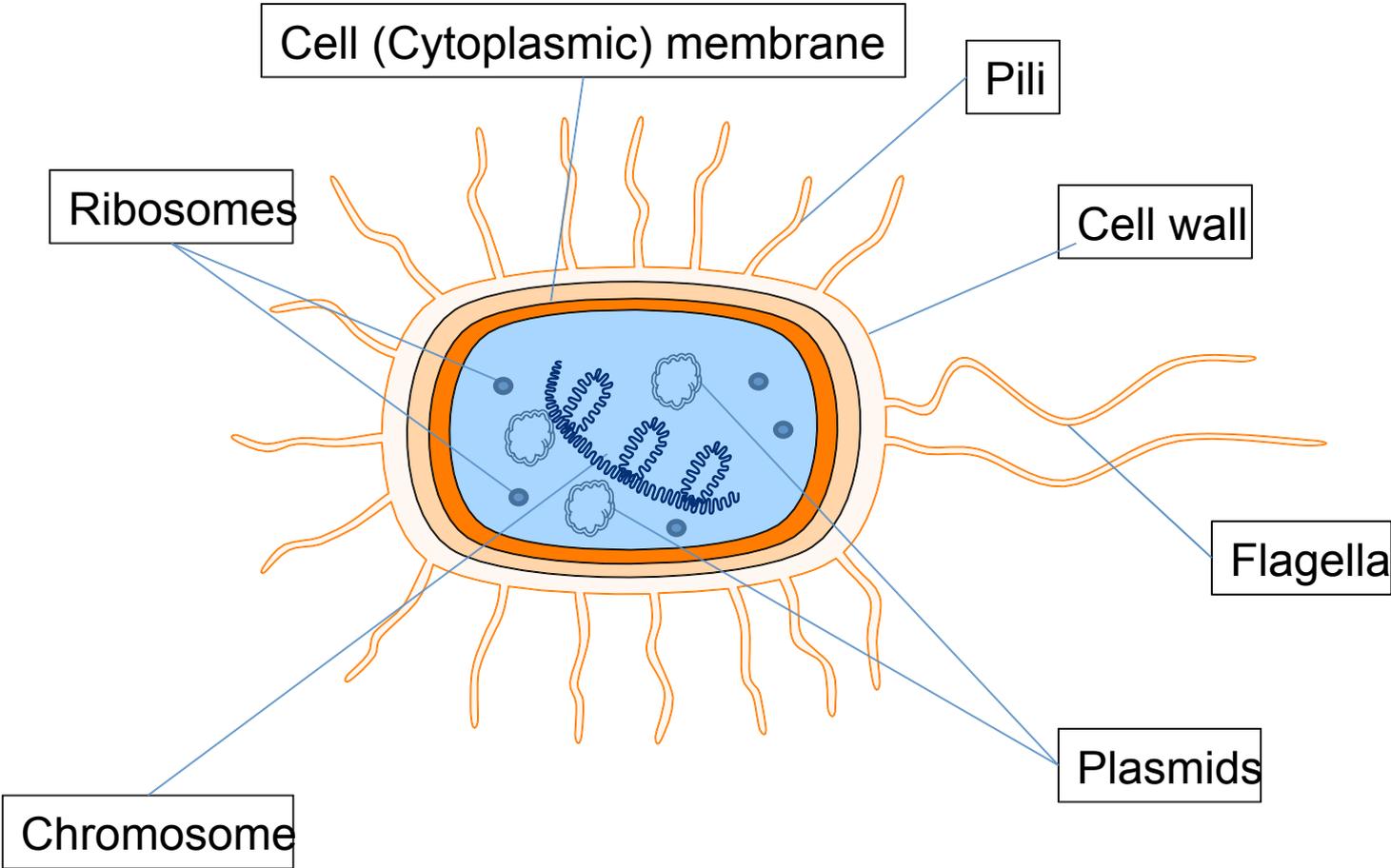
- Urinary Tract Infection



Streptococcus pyogenes
(Group A Streptococcus)

- Strep throat (pharyngitis),
skin infections

Example of Bacterial Structure



Natural Habitats of Bacteria

Environment

- Soil, plants, water

Animals and Humans

- Skin
- Upper airway and mouth
- Gastrointestinal tract
- Genital tract



Most Bacteria Are Harmless And Even Beneficial

- Soil, water, plants
 - Recycle organic matter and wastes
- Animals
 - Aid in digestion of cellulose in stomachs of cows
- Humans
 - Occupy (colonize) sites that might otherwise be invaded by harmful (pathogenic) bacteria
 - Aid in digestion



Bacteria May Inhabit Other Sites

- Bacteria may survive for various times on a variety of surfaces
 - toilets
 - sinks
 - cell phones
 - desks
 - remote controls
 - food
 - computers



Colonization vs. Infection

- **Colonization:** The presence of bacteria in or on your body without causing any symptoms of infection
- **Infection:** Bacteria invade and damage tissue, or produce a toxin that damages tissue



Identification of Bacteria

Generally identified by:

1. shape when viewed with the microscope
2. a procedure called the Gram stain which is positive or negative, depending on the absence or presence of an outer membrane and the thickness of the cell wall
3. whether they require oxygen to grow or are poisoned by oxygen
4. nutrients they can use to grow
5. identification of sequences of proteins made by the bacteria, or sequences of the bacteria's DNA or RNA



Host Defenses Against Pathogenic Bacteria

- First line of defense is a barrier preventing entry into the tissue:
 - Intact skin
 - Lining of upper airway, gastrointestinal (GI) tract, vagina
 - Stomach acid
 - Frequent flushing out of eyes by tears, or of bladder by urine
 - Mucus in the lungs and coughing



Host Defenses Against Pathogenic Bacteria (cont.)



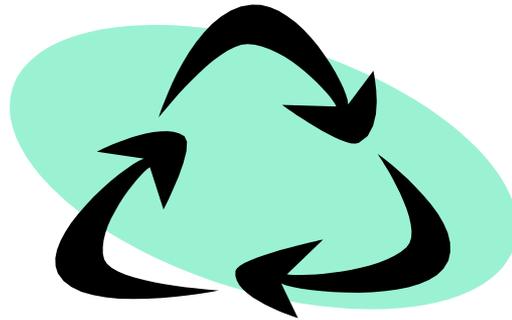
- Immune System
 - Detects bacteria and their products
 - Produces specific antibodies (proteins)
- Antibodies work at the infection site to:
 - Bind and inactivate the bacteria
 - Cause inflammation and increase blood flow
 - Recruit white blood cells to ingest and kill the bacteria

How Do Bacteria Damage the Host Cell?



I am a sneaky fighter!

How Bacteria Cause Infection

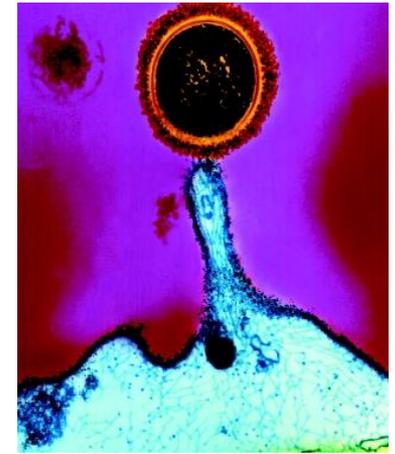


- Pathogenic bacteria have certain disease-producing features
- These features are called “virulence factors”

Bacterial Offense

“Virulence Factors”

- Allow bacteria to attach to host cells
- Produce toxic compounds that damage host cells or surround tissue
- Produce proteins that either disrupt the host cells or stimulate uptake into the host cells, allowing them to penetrate deeper into various parts of the body
- Produce factors that inhibit the host’s immune response



A colored transmission electron micrograph of Streptococcus bacteria attached to a human tonsil cell.

The Battle Between Bacteria and Host

- Pathogenic (disease-causing) bacteria attack healthy host cells
- Three potential outcomes:
 1. host cell wins, bacteria are removed, cell recovers, **or**
 2. bacteria win and kill the host cell, **or**
 3. bacteria and host cell live together



End of Module I

