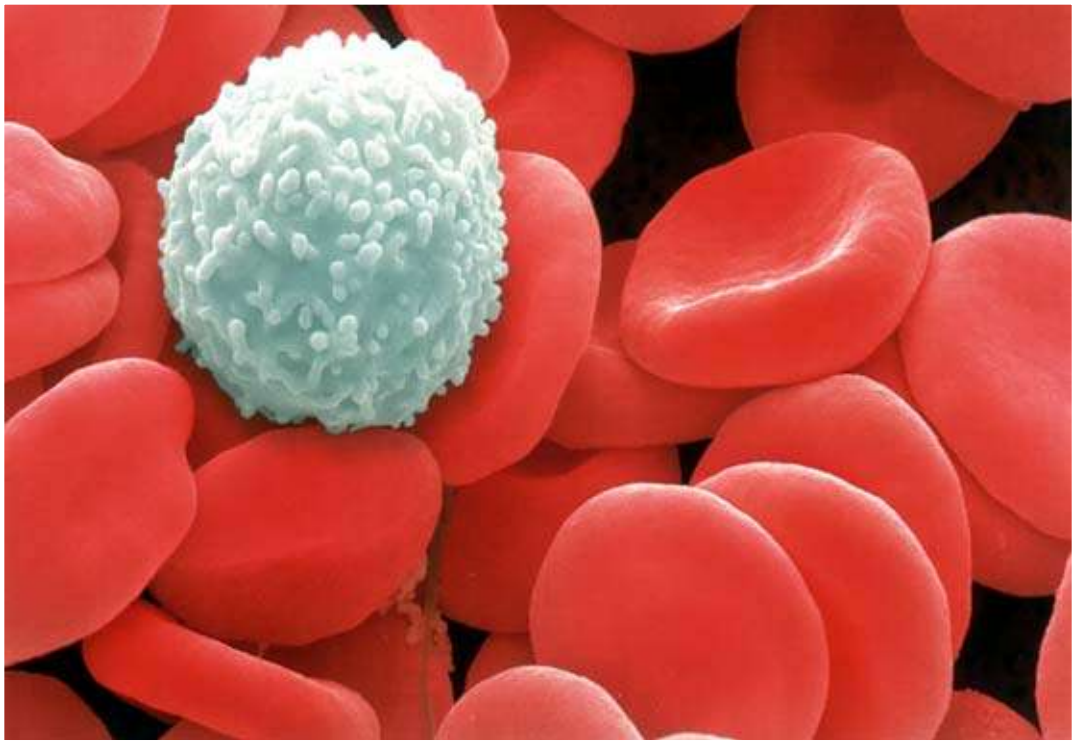
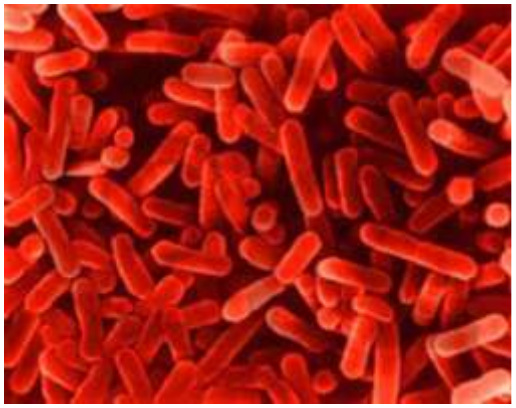
The Human Immune System

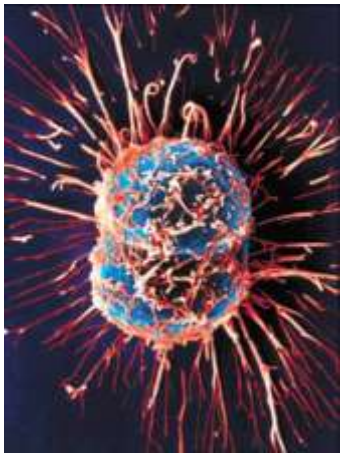


Video

What is the immune system?

- The body's defense against disease causing organisms, malfunctioning cells, and foreign particles
- A collections of cells, tissues, and organs that fight disease-causing agents





Lines of Defense

- First line of Defense – skin
  - Lining of stomach and intestines
  - Lining of nose eyes and ears
  - Secretations

The First Line of Defense
~Skin~

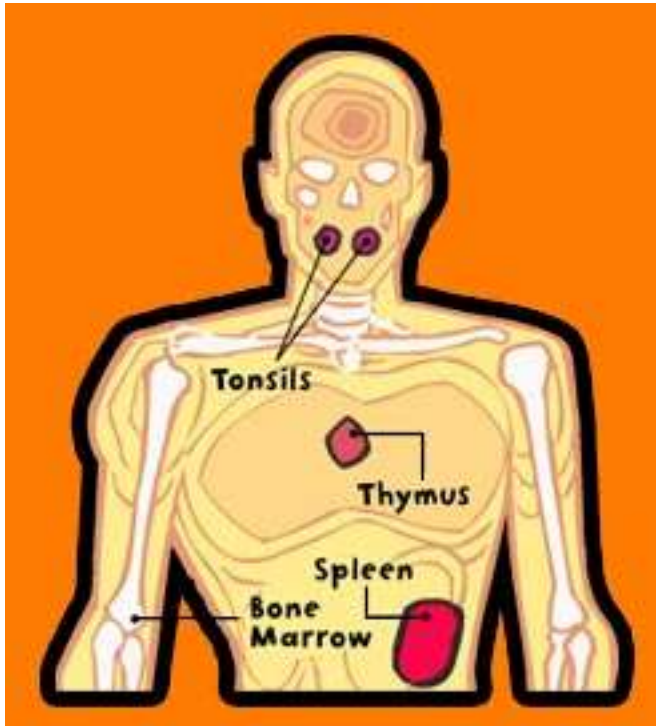
- The dead, outer layer of skin, known as the **epidermis**, forms a shield against invaders and secretes chemicals that kill potential invaders
- You shed between 40 – 50 thousand skin cells every day!

Internal First Line of Defense

- White blood cells
- Body temperature
- Inflammation- because more blood is flowing to a certain area

White blood Cells (WBCs)

- Destroy pathogens (bacteria, viruses)
- The thymus and spleen release WBCs into the blood. The spleen also filters the blood. It recycles the old, run down red blood cells – some parts are reused.



The Second Line of Defense

White Blood Cells	**Blood cells that protect the body against pathogens (bacteria/virus)**
Phagocytes	A cell that ingests (eats) and destroys bacteria and other foreign particles
Interferon	Play a role in the 1st line of defense It that helps to stop virus from reproducing. Boosts immune system
T-Cells	Type of white blood cell. "Soldiers" Adapts to pathogens and destroys them
Inflammatory Response	Defense reaction of the body to invasion by a foreign substance/organism; involves WBC, pus, increase in temp.

Specific Immunity

- Antigens are molecules that are foreign to your body
- Antibody is a protein that is made in response to a specific antigen
  - Antibody attaches to a specific antigen and makes it useless.

What is an Antibody

- Protein made by the body that makes the antigen so that is useless or can be destroyed by a lymphocyte.

Active immunity vs passive

- Active your body makes its own antibodies
- Passive when antibodies are produced in another organism are introduced into your body to help destroy the antigens.

Vaccination

- Antigen that is injected or taken orally into the body so that the body can build up antibodies to destroy the pathogen.
- A booster vaccine is to keep your antibody #s up.
  - Example would be a tetanus

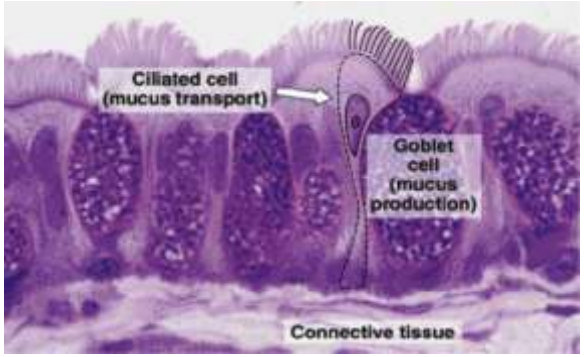
Protecting against disease

- Heat (pasteurize)
- Chemicals
- Radiation
- Water

How disease spreads

- By coming in contact with the pathogen

- As you breathe in, foreign particles and bacteria bump into **mucus** throughout your respiratory system and become stuck
- Hair-like structures called **cilia** sweep this mucus into the throat for coughing or swallowing

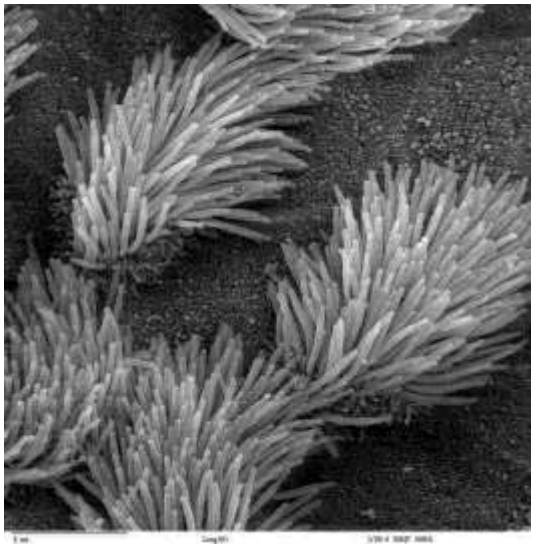


- Swallowed bacteria are broken down by incredibly strong acids in the stomach that break down your food
- The stomach must produce a coating of special mucus or this acid would eat through the stomach!

How does our body keep viruses and bacteria out?

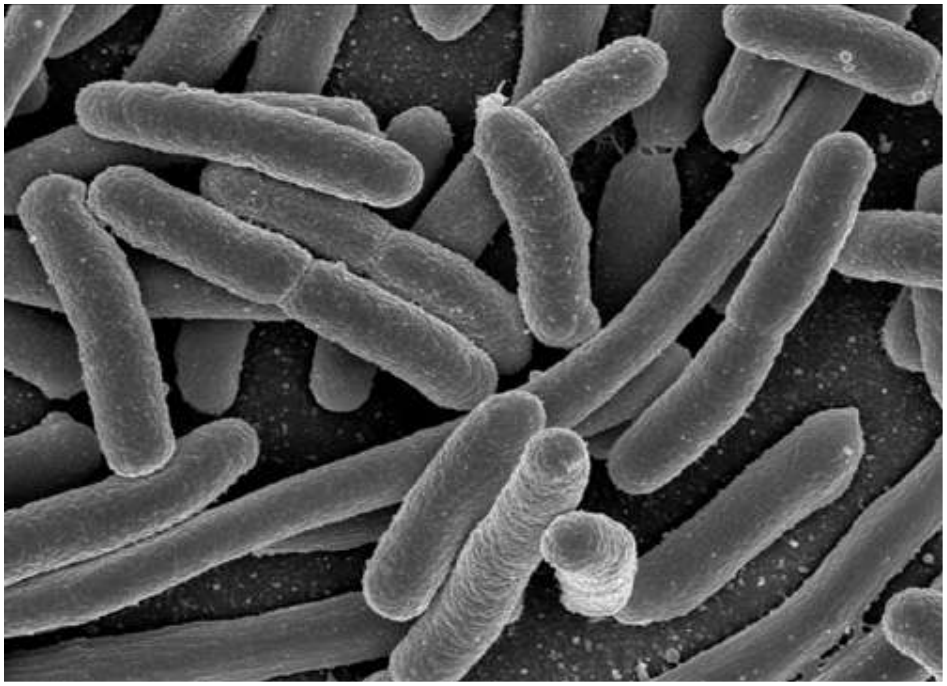
- Examples include:
- Skin, tears, earwax, saliva, gastric juice, mucus, cilia
- how might each of these keep out the invaders?

- What do you think this is?



What's the first thing you do when you cut your finger?

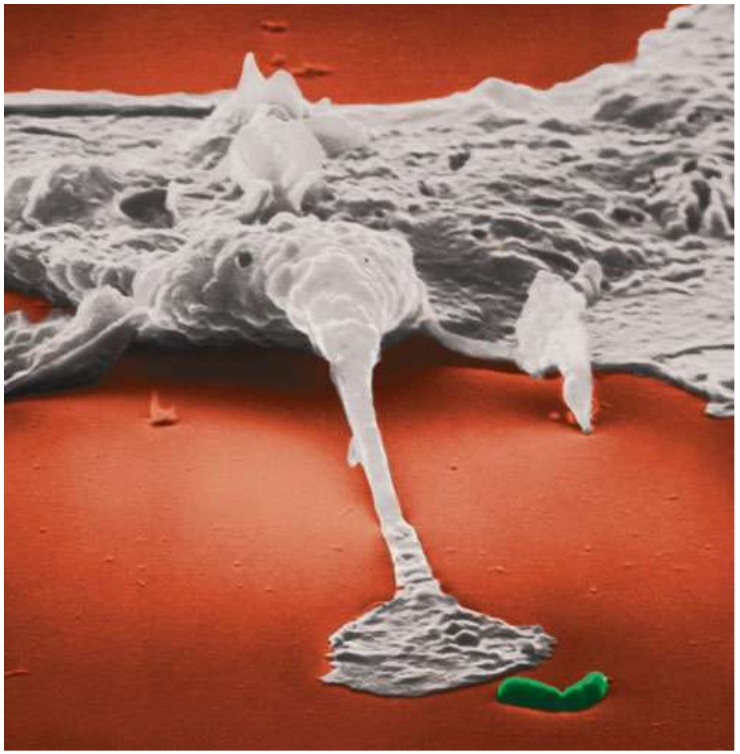
Escherichia coli (E. coli)
is common and plentiful in all of our digestive tracts. Why are we all not sick?



The Second Line of Defense

~White Blood Cells~

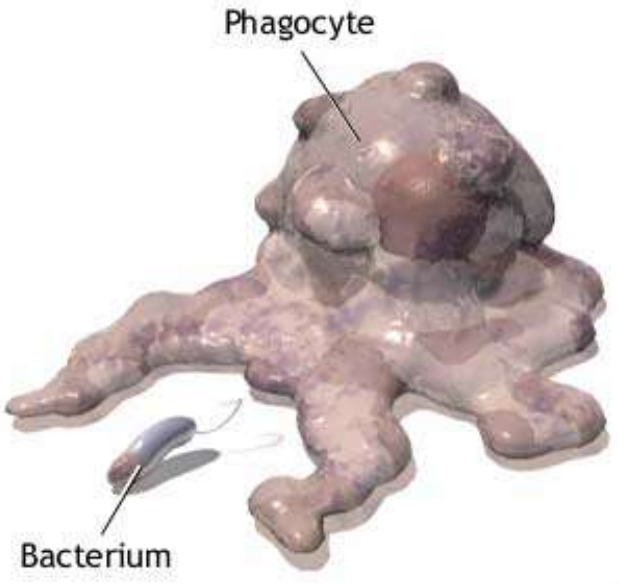
- If invaders actually get **within** the body, then your white blood cells (WBCs) begin their attack
- WBCs normally circulate throughout the blood, but will enter the body's tissues if invaders are detected



Video

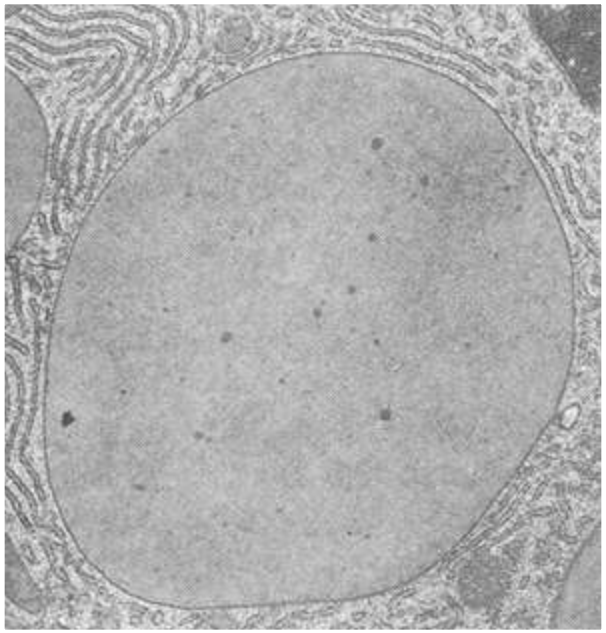
Chasing Bacterium

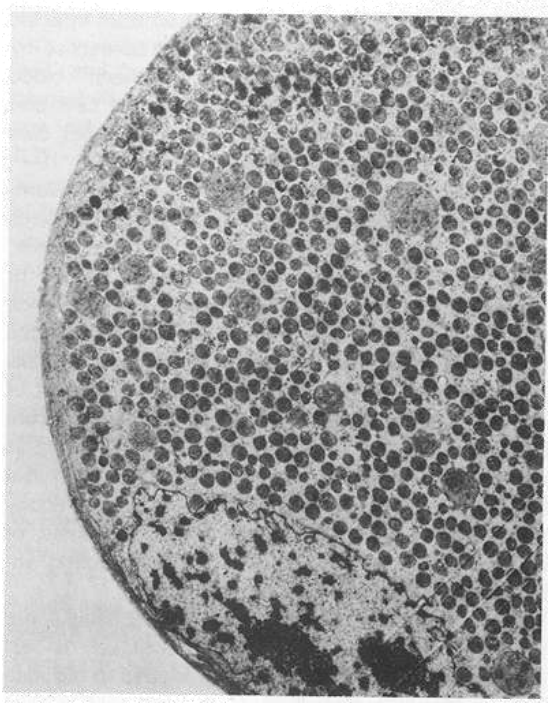
- These white blood cells are responsible for eating foreign particles by engulfing them
- Once engulfed, the phagocyte breaks the foreign particles apart in organelles called _____



Viruses

Viruses enter body cells, hijack their organelles, and turn the cell into a virus making-factory. The cell will eventually burst, releasing thousands of viruses to infect new cells.

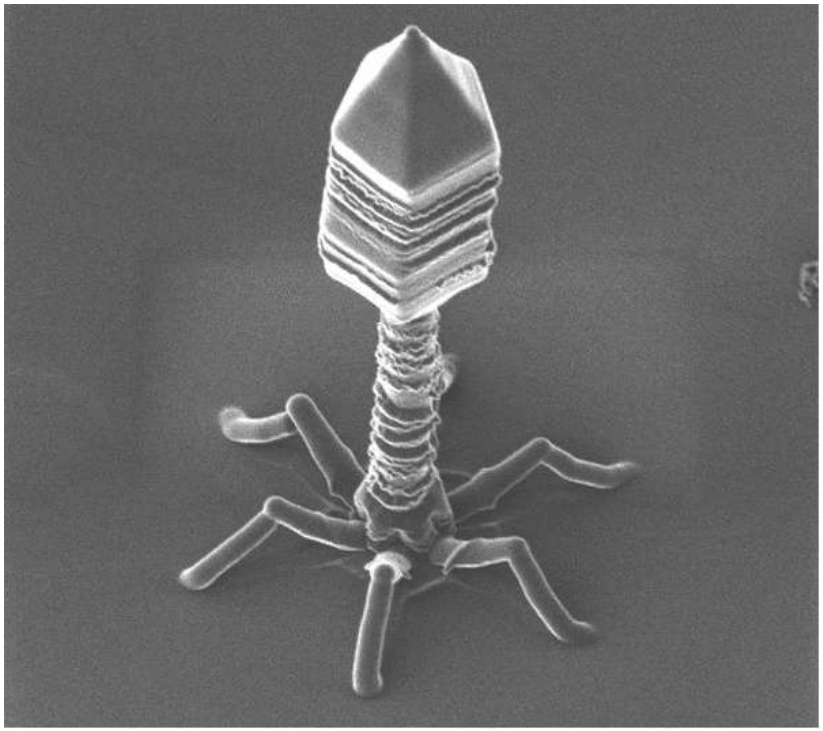




The Second Line of Defense

~Interferon~

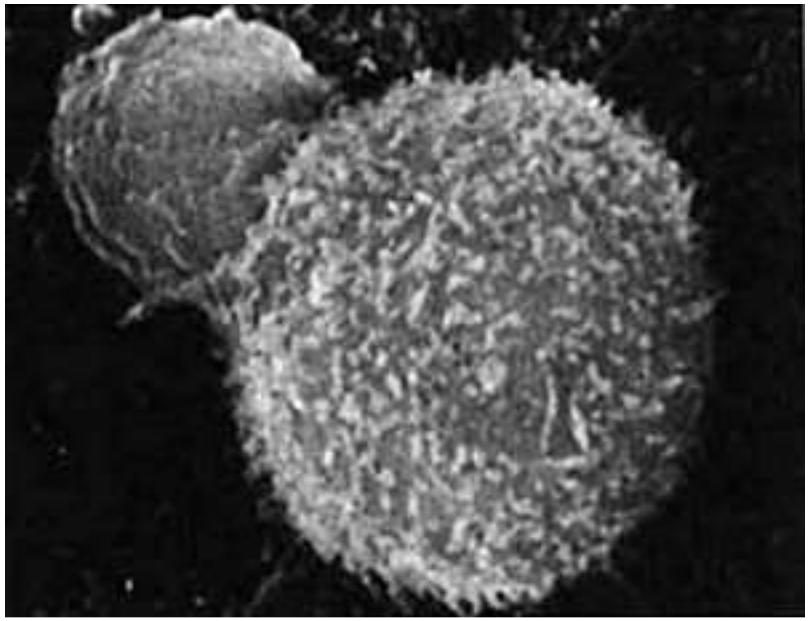
- Virus-infected body cells release **interferon** when an invasion occurs
    - Interferon – chemical that **interfer**es with the ability to viruses to attack other body cells



How Viruses Invade

White Blood Cells
~T-Cells~

- T-Cells, often called “natural killer” cells, recognize infected human cells and cancer cells
- T-cells will attack these infected cells, quickly kill them, and then continue to search for more cells to kill



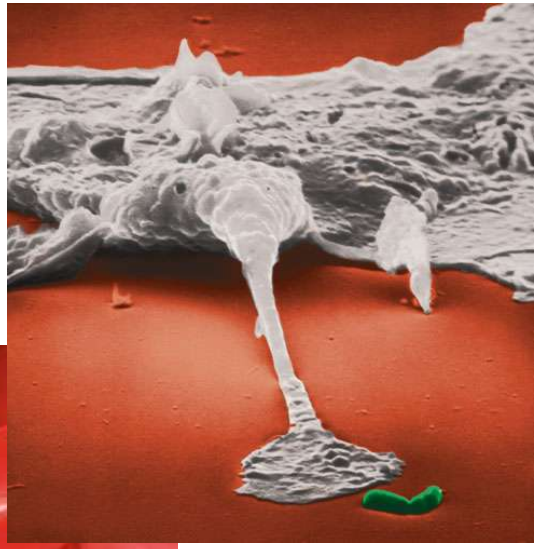
The Second Line of Defense

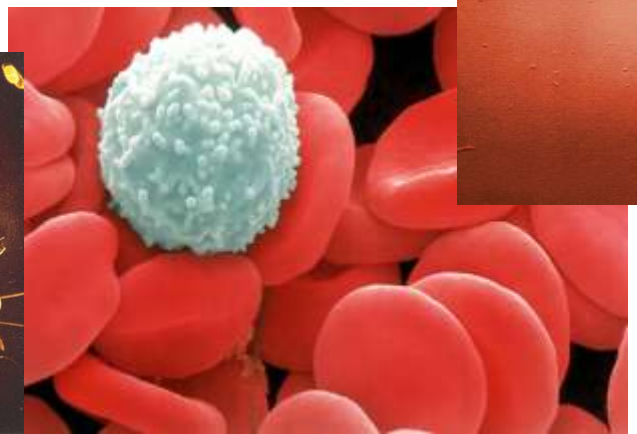
~The Inflammatory Response~

- Injured body cells release chemicals called **histamines**, which begin **inflammatory response**
  - Capillaries dilate
  - Substances released by the bacterium reach hypothalamus, and temperature rises
  - Pain receptors activate
  - WBCs flock to infected area like sharks to blood

Two Divisions of the Immune System

- The efforts of the WBCs known as phagocytes and T-cells is called the **cell-mediated immune system.**
  - Protective factor = living cells
    - Phagocytes – eat invaders
    - T-cells – kill invaders





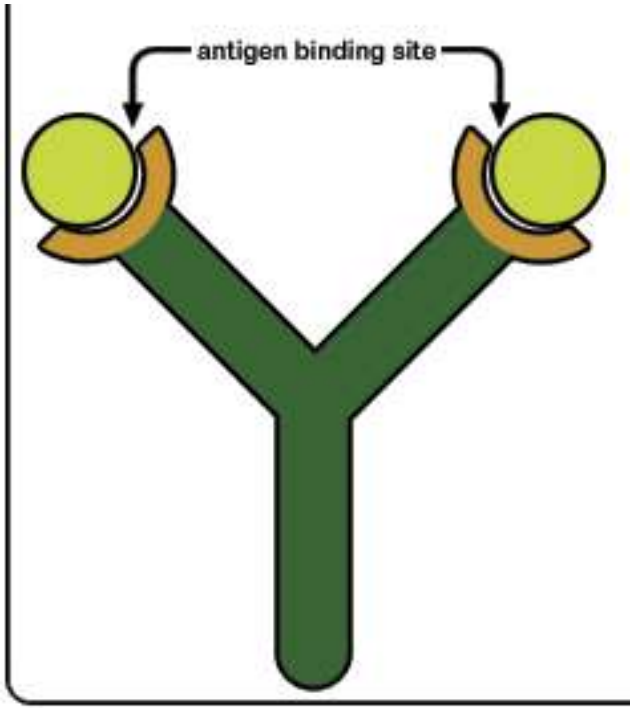
Two Divisions of the Immune System

- The other half of the immune system is called antibody-mediated immunity, meaning that is controlled by antibodies
- This represents the third line of defense in the immune system

The Third Line of Defense

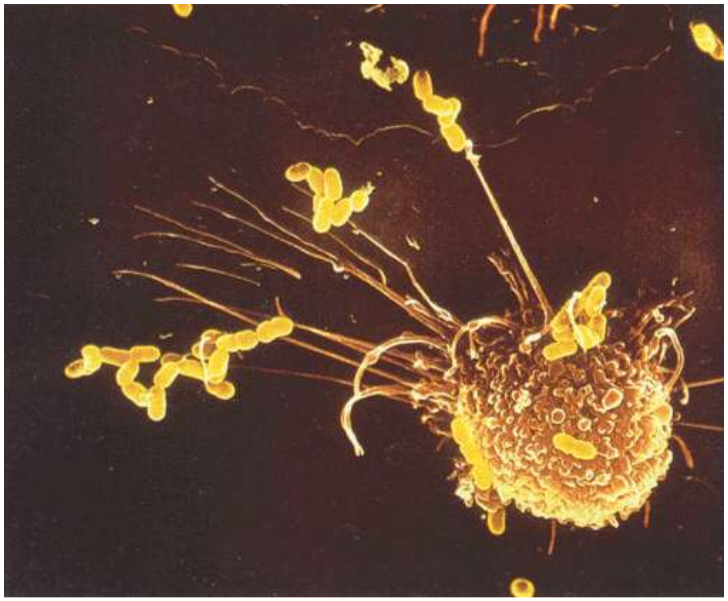
~Antibodies~

- Most infections never make it past the first and second levels of defense
- Those that do trigger the production and release of **antibodies**
  - Proteins that latch onto, damage, clump, and slow foreign particles
  - Each antibody binds only to one specific binding site, known as an **antigen**



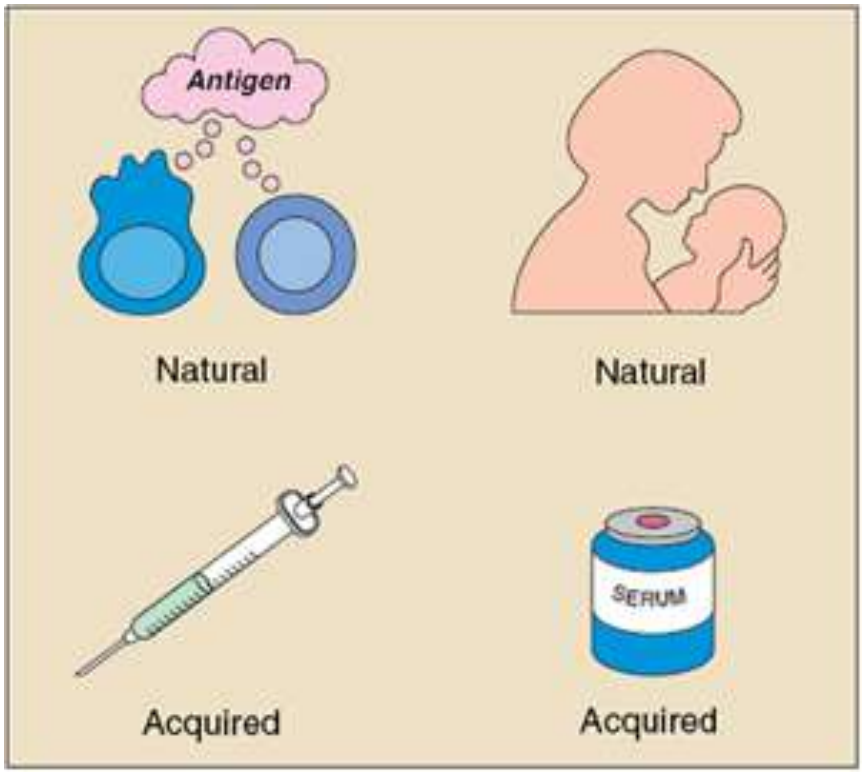
Antibody Production

- WBCs gobble up invading particles and break them up
- They show the particle pieces to T-cells, who identify the pieces and find specific B-cells to help
- B-cells produce antibodies that are equipped to find that specific piece on a new particle and attach



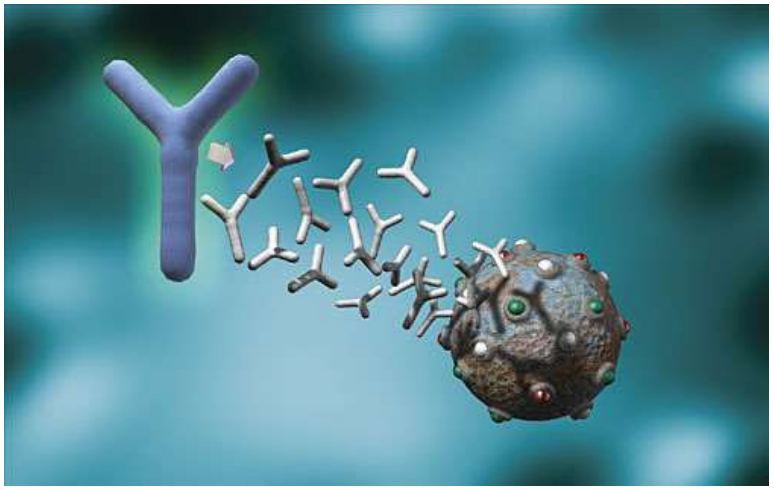
Immunity

- New particles take longer to identify, and a person remains ill until a new antibody can be crafted
- Old particles are quickly recognized, and a person may never become ill from that invader again. This person is now immune.



What is immunity?

- Resistance to a disease causing organism or harmful substance
- Two types
  - Active Immunity
  - Passive Immunity



Active Immunity

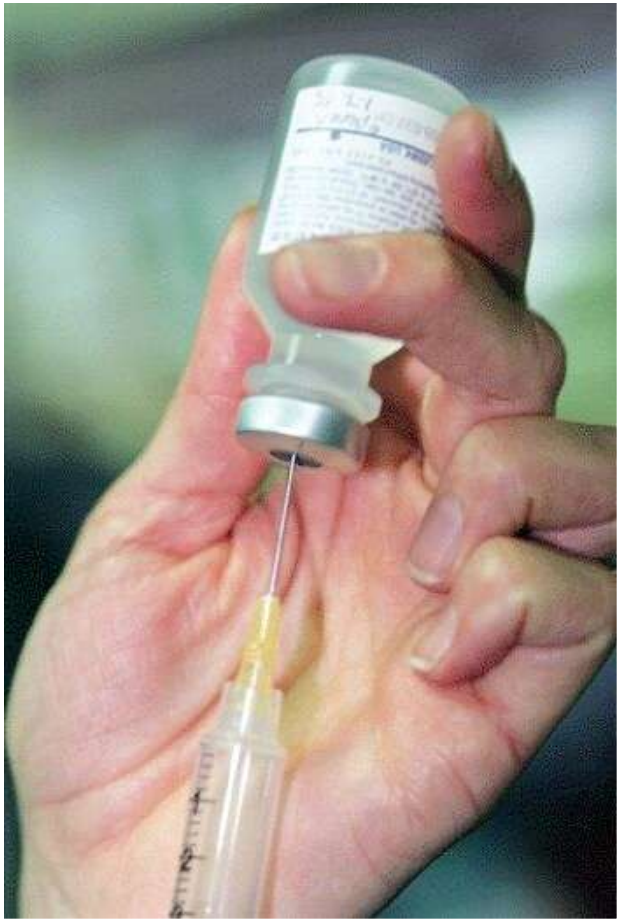
- **<u>You</u>** produce the antibodies
  - Your body has been exposed to the antigen in the past either through:
    - Exposure to the actual disease causing antigen – You fought it, you won, you remember it
    - Planned exposure to a form of the antigen that has been killed or weakened – You detected it, eliminated it, and remember it

Vaccine

- Antigens are deliberately introduced into the immune system to produce immunity
- Because the bacteria has been killed or weakened, minimal symptoms occur
- Have eradicated or severely limited several diseases from the face of the Earth, such as polio and smallpox

How long does active immunity last?

- It depends on the antigen
- Some disease-causing bacteria multiply into new forms that our body doesn't recognize, requiring annual vaccinations, like the flu shot
- Booster shot - reminds the immune system of the antigen
- Others last for a lifetime, such as chicken pox



Think the flu is no big deal?

- Think again…
- In 1918, a particularly deadly strain of flu, called the Spanish Influenza, spread across the globe
- It infected 20% of the human population and killed 5%, which came out to be about 100 million people

Passive Immunity

- You **don't** produce the antibodies
  - A mother will pass immunities on to her baby during pregnancy - through what organ?
  - These antibodies will protect the baby for a short period of time following birth while its immune system develops. What endocrine gland is responsible for this?
  - Lasts until antibodies die

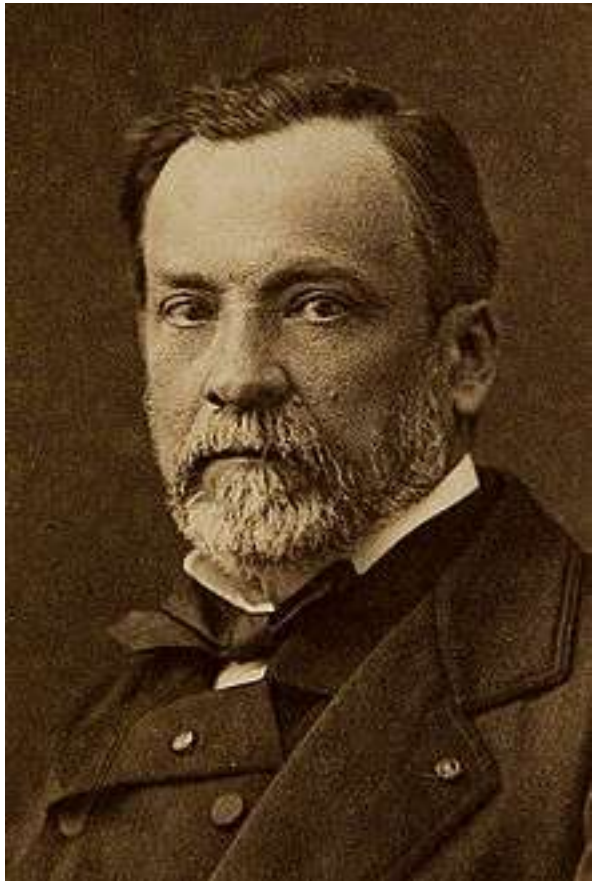
Pasteurization

Pasteurization is the process of heating liquids for the purpose of destroying bacteria, protozoa, molds, and yeasts.

- It does NOT kill all bacteria. It reduces the numbers so they don't harm us.

Pasteurization, cont.

- The process was named after its creator Louis Pasteur. The first pasteurization test was completed by Pasteur and Claude Bernard on April 20, 1862.

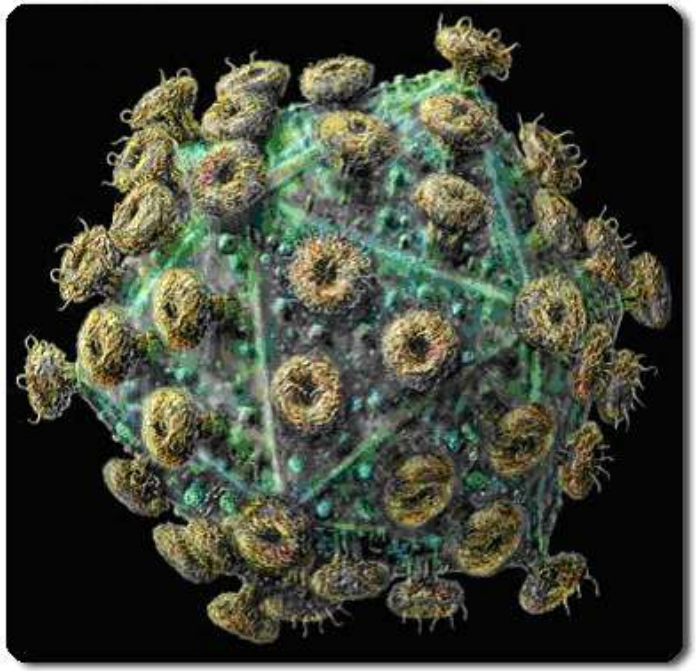


Immune Disorders
~Allergies~

- Immune system mistakenly recognizes harmless foreign particles as serious threats
- Launches immune response, which causes sneezing, runny nose, and watery eyes
- Anti-histamines block effect of histamines and bring relief to allergy sufferers

Aquired **I**mmune **D**eficiency **S**yndrome

- Caused by the Human Immunodeficiency Virus
- Discovered in 1983
- Specifically targets and kills T-cells
- Because normal body cells are unaffected, immune response is not launched



AIDS

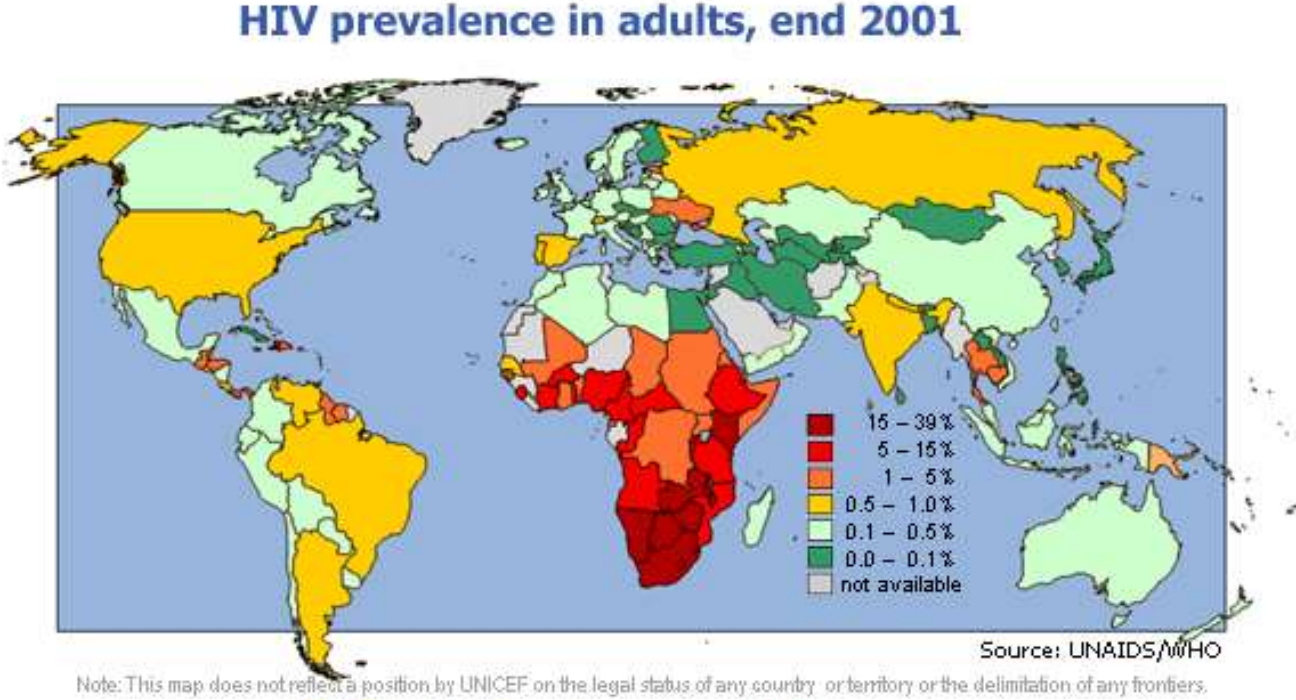
~The Modern Plague~

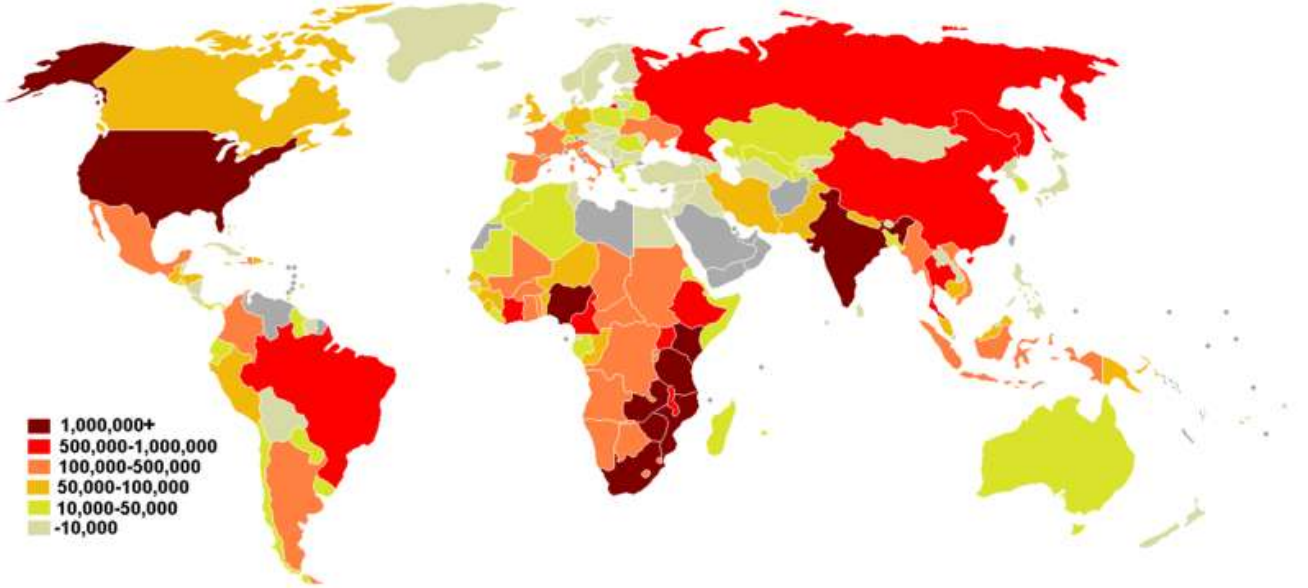
- The HIV virus doesn't kill you – it cripples your immune system
- With your immune system shut down, common diseases that your immune system normally could defeat become life-threatening
- Can show no effects for several months all the way up to 10 years

AIDS

~The Silent Spread~

- Transmitted by sexual contact, blood transfusions, contaminated needles
- As of 2007, it affects an estimated 33.2 million people





Wrap-up

- What is the immune system?
- What is 1 thing you learned today?
- What is 1 thing you still have a question about?

Koch’s Postulates

Robert Koch

- First to Prove that bacteria caused disease.
  - Anthrax broke out in local cattle.
  - Found the agent *Bacillus anthracis* by an experimental process now known as Koch's postulates

Koch's Postulates

1. Microorganisms are isolated from dead animals

2. Microorganisms are grown in pure culture

2b. Microorganisms are identified

3. Microorganisms are injected into healthy animals

4. Disease is reproduced in second animal

5. Microorganisms are grown in pure culture

5b. Identification of identical microorganism.

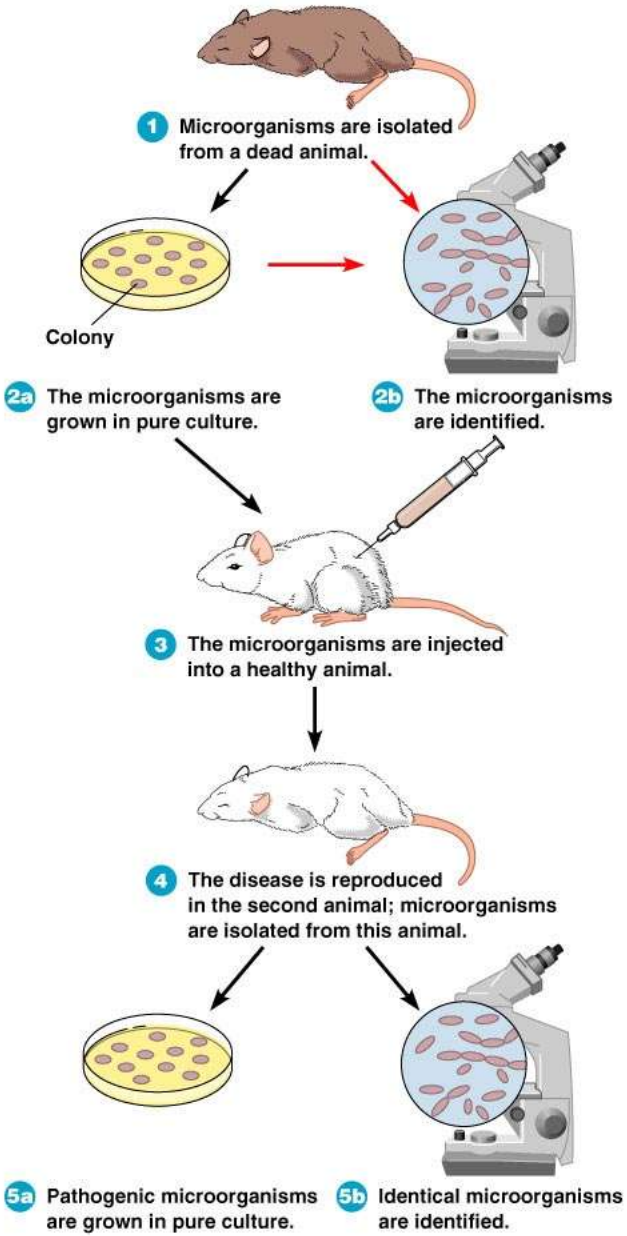
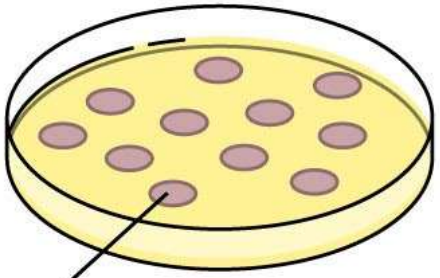
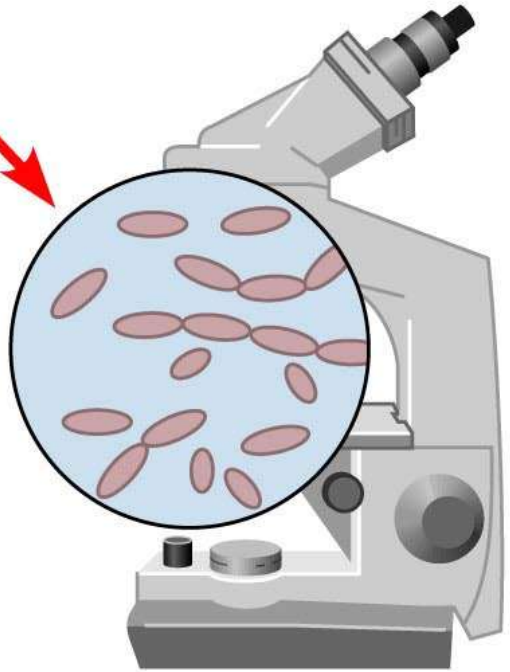


Figure 14.3 - Overview

1 Microorganisms are isolated from a dead animal.



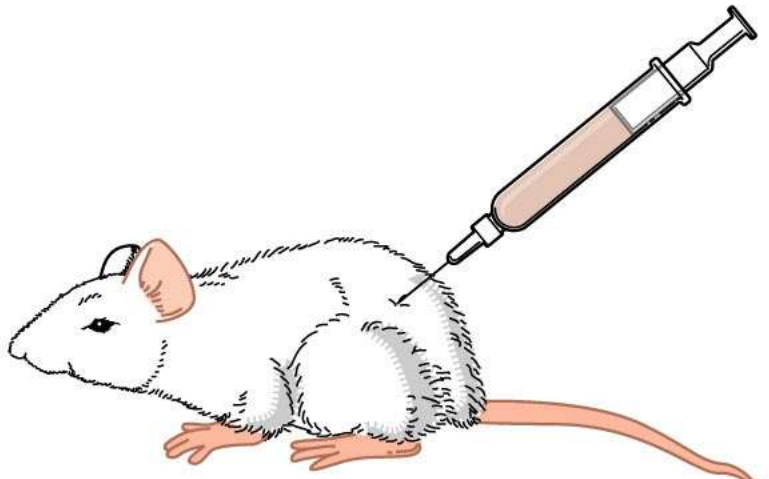
Colony



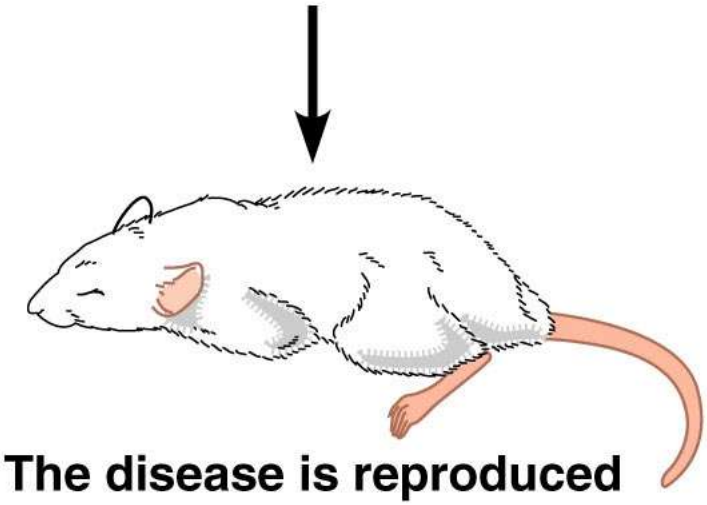
2a The microorganisms are grown in pure culture.

2b The microorganisms are identified.

Figure 14.3, steps 1–2

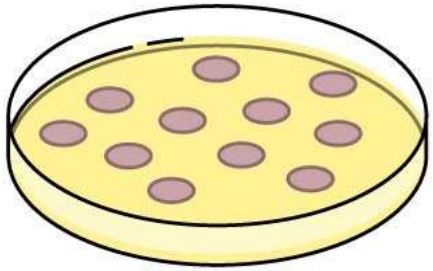


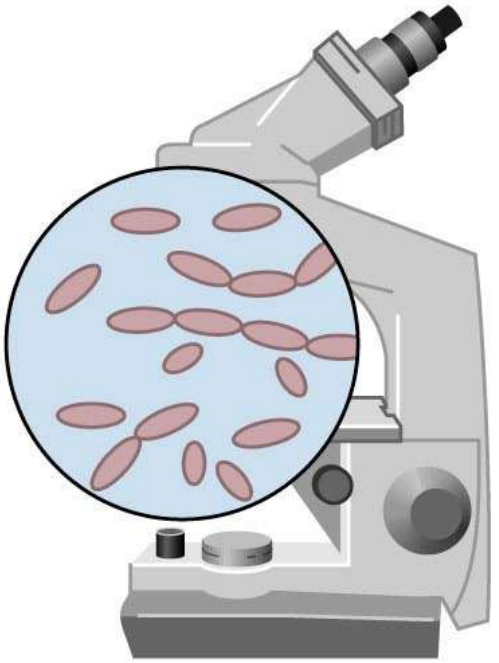
3 The microorganisms are injected into a healthy animal.



4 The disease is reproduced in the second animal; microorganisms are isolated from this animal.

Figure 14.3, steps 3–4





5a Pathogenic microorganisms are grown in pure culture.

5b Identical microorganisms are identified.

Figure 14.3, step 5

Exceptions to Koch's Postulates

- Microorganisms that are unable to be cultured on artificial media
  - (example: *Treponema pallidum*)
- 2 or more organism work in synergy to cause a disease.
- Symptoms and diseases can be causes by any one of several microbes.