

# LECTURE 28

## 6/2/20

# Announcements

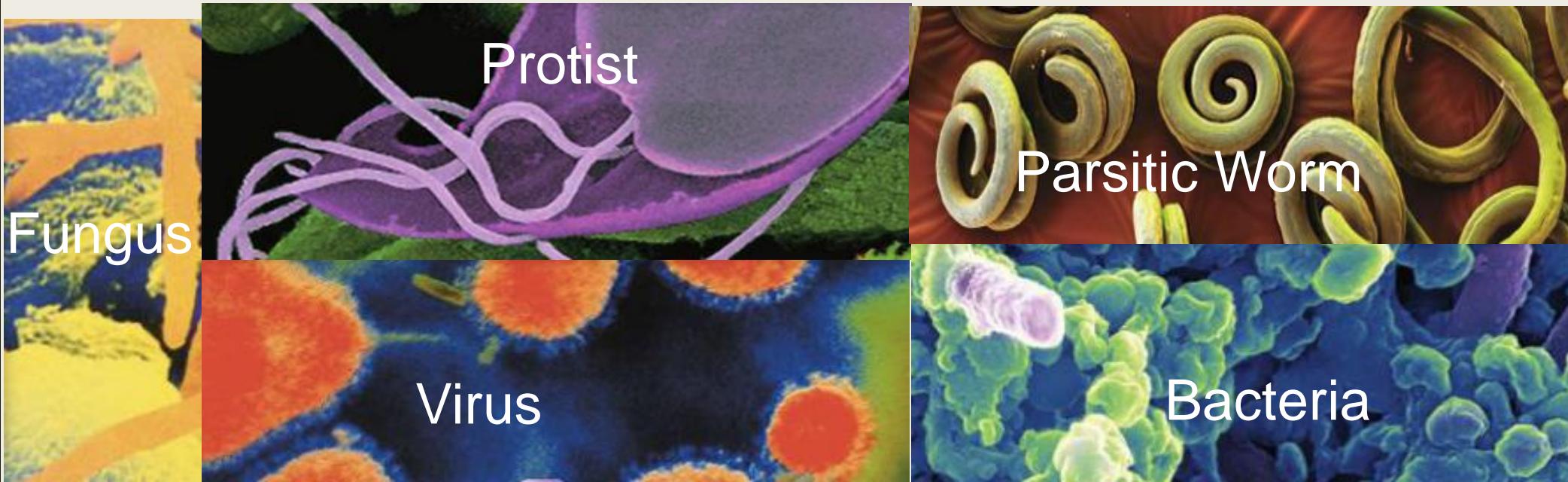
- 6/2 is our last online session
- Grades are finalized!

# Bellringer

- What was your favorite topic in science this school year?

# 35.1 infectious diseases

- Infectious diseases are caused by **pathogens**—organisms that invade the body and disrupt its normal functions.
- Examples of pathogens are viruses, bacteria, single-celled eukaryotes, fungi, and parasites.



# Symbionts v pathogens

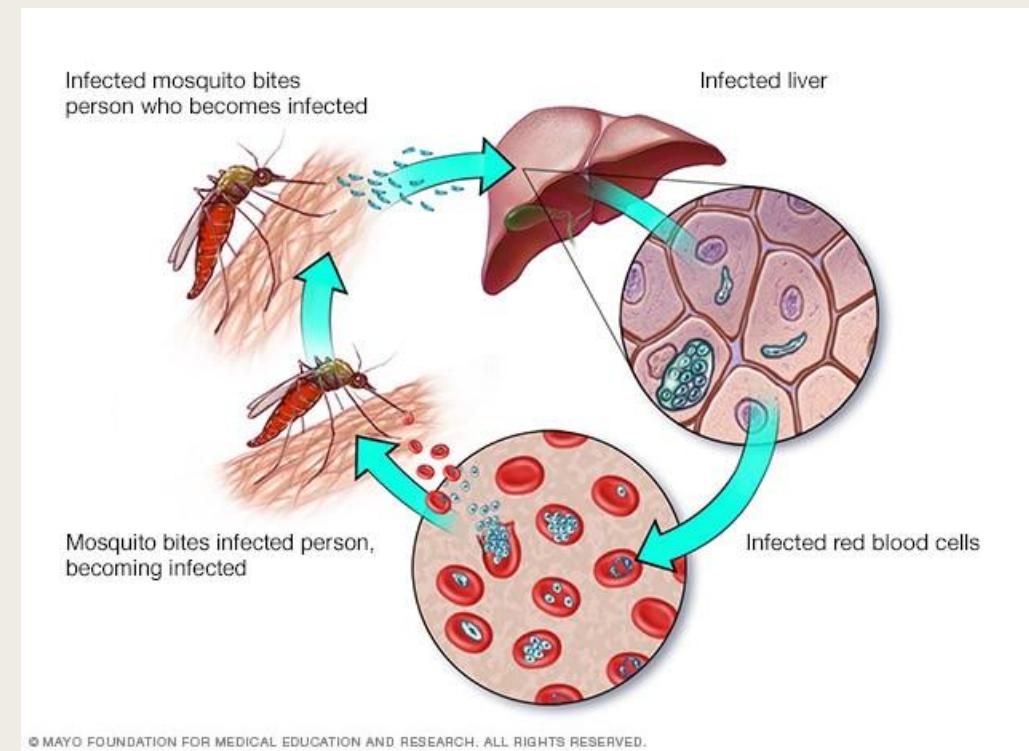
- Symbionts=Good Guys
- Yeast and bacteria grow in the mouth and throat without causing trouble.
- Bacteria in the large intestine help with digestion and produce vitamins.
- Pathogens=Bad guys
- Some viruses and bacteria directly destroy the cells of their host.
- Other bacteria and single-celled parasites release poisons that kill the host's cells or interfere with their normal functions.
- Parasitic worms may block blood flow through blood vessels or organs, take up the host's nutrients, or disrupt other body functions

# Agents of disease

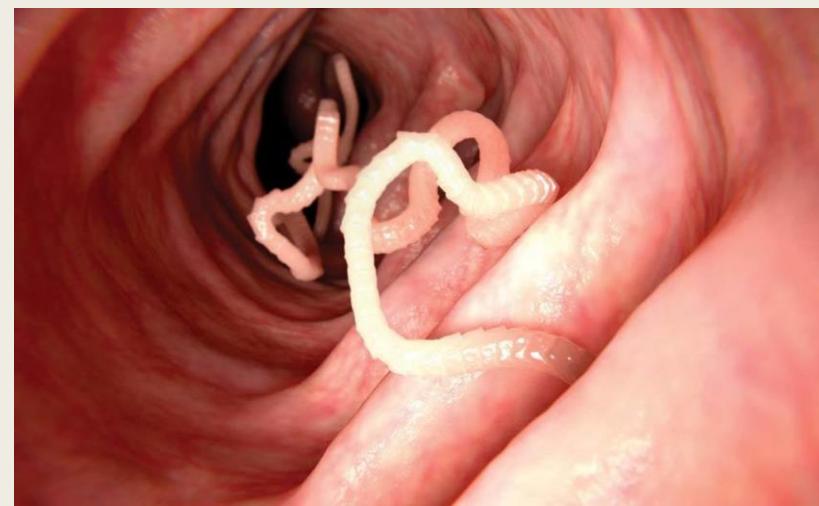
- **Viruses** are nonliving particles that replicate by inserting their genetic material into a host cell and taking over many of the host cell's functions.
- Viruses cause the common cold, influenza, chicken pox, and warts.
- Bacteria cause disease by breaking down the tissues of an infected organism for food, or by releasing toxins that interfere with normal activity in the host.
- Different types of fungus may infect the surface of the skin, mouth, throat, fingernails and toenails.
- The fungus *Trichophyton interdigitale* causes athlete's foot.



- The single-celled eukaryote *Plasmodium* causes malaria, a very damaging infectious disease.
- The single-celled eukaryote *Trypanosoma brucei* feeds off nutrients in its host's blood and causes African sleeping sickness.
- Both *Plasmodium* and *Trypanosoma brucei* are spread to human by insects.
- *Giardia intestinalis* causes infection of the digestive tract and is transmitted in infected water.



- People may be infected with the roundworm *Trichinella spiralis* from eating infected pork.
- The flatworm *Schistosoma mansoni* can be contracted by people working in rice paddies.
- Other parasitic worms include tapeworms and hookworms.



# How diseases spread

- Pathogens are often spread by symptoms of disease, such as sneezing, coughing, or diarrhea.
- In many cases, these symptoms are changes in host behavior that help pathogens spread and infect new hosts.
- If a virus infects only one host, that virus will die when the host's immune system kills it or when the host dies.
- For that reason, natural selection favors pathogens with adaptations that help them spread from host to host.

# Coughing, sneezing, and physical contact

- Many bacteria and viruses that infect the nose, throat, or respiratory tract are spread by indirect contact.
- Coughing and sneezing releases thousands of tiny droplets that can be inhaled by other people.
- Other pathogens, including drug-resistant staphylococci that cause skin infections, can be transferred by almost any kind of body-to-body contact.
- They can also be transferred by contact with towels or certain kinds of sports equipment.
- The most important means of infection control is thorough and frequent hand washing.
- If you have a cold or flu, cover your mouth with a tissue when you cough or sneeze, and wash your hands regularly.



# Zoonoses: the animal connection

- Any disease that can be transmitted from animals to humans is called a zoonosis.
- Mad cow disease, severe acute respiratory syndrome (SARS), West Nile virus, Lyme disease, Ebola, and bird flu are all zoonoses.
- Sometimes an animal carries, or transfers, zoonotic diseases from an animal host to a human host.
- These carriers, called vectors, transport the pathogen but usually do not get sick themselves.
- Mosquitos can transfer West Nile virus between birds and humans.
- In other cases, infection may occur when a person is bitten by an infected animal, consumes the meat of an infected animal, or comes in close contact with an infected animal's wastes or secretions.



## 35.2 defenses against infection

- Nonspecific defenses:
- The body's first defense against pathogens is a combination of physical and chemical barriers:
- skin, tears, and other secretions
- the inflammatory response, interferons, and fever
- These barriers are called nonspecific defenses because they act against a wide range of pathogens.

# First line of nonspecific defense

- The most widespread nonspecific defense is the skin [Very few pathogens can penetrate the layers of dead cells that form the skin]
- Saliva, mucus, and tears contain enzymes that break down bacterial cell walls
- Mucus in your nose and throat traps pathogens and cilia push the mucous-trapped pathogens away from the lungs
- Stomach secretions destroy many pathogens that are swallowed.



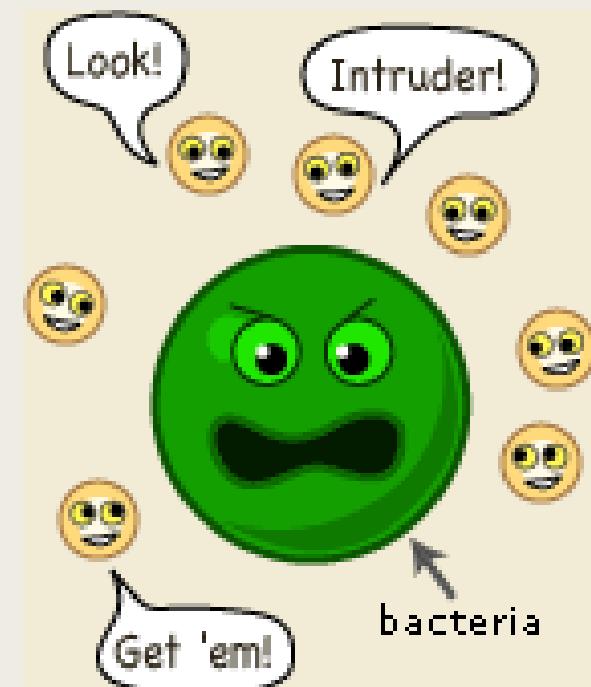
# Second line of nonspecific defense

- If pathogens make it into the body, through a cut in the skin, for example, the body's second line of nonspecific defense swings into action:
- Inflammatory response = infected areas become red and painful due to increased blood flow, which brings white blood cells that engulf and destroy bacteria
- Interferons = proteins that "interfere" with synthesis of viral proteins and help block viral replication
- Fever = increased body temperature slows down growth of pathogens and speeds up several parts of the immune response



# Specific defenses: the immune system

- What is the function of the immune system's specific defenses?
- Distinguish between “self” and “other” and inactivate or kill any foreign substance or cell that enters the body
- The specific immune response has two main styles of action:
- Humoral immunity and cell-mediated immunity

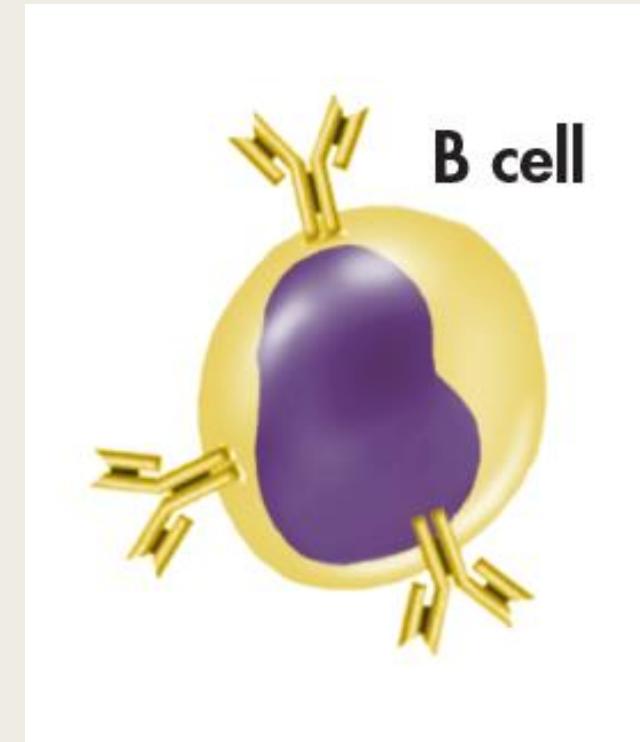


# Self vs non self

- A healthy immune system recognizes all cells & proteins that belong in the body as “self.”
- The immune system controls powerful cellular and chemical weapons that could cause problems if turned against the body’s own cells.
- The immune system recognizes foreign organisms as “nonself.”
- Once the immune system recognizes “others,” it attacks
- After encountering a specific invader, the immune system “remembers” the invader
- This recognition, response, and memory → the immune response.

# Humoral Immunity

- The immune response that defends against antigens in body fluids
- 1.) blood 2.) lymph
- B cells play the major role
- When pathogens invades the body, its antigens are recognized by antibodies on the surfaces of e B cells.
- Antibodies are the main weapons

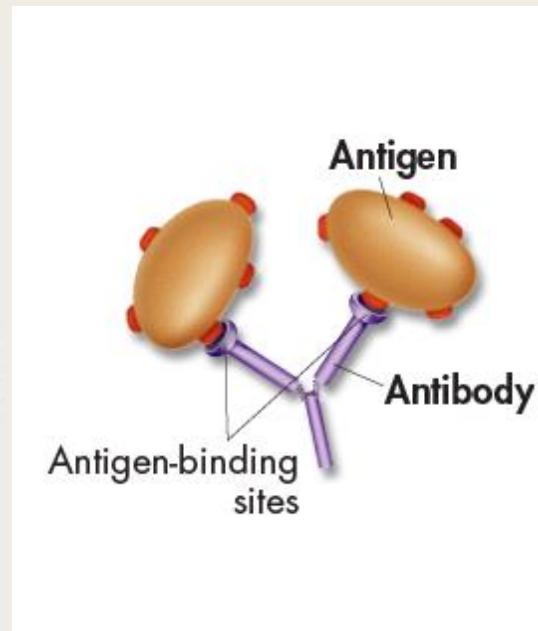
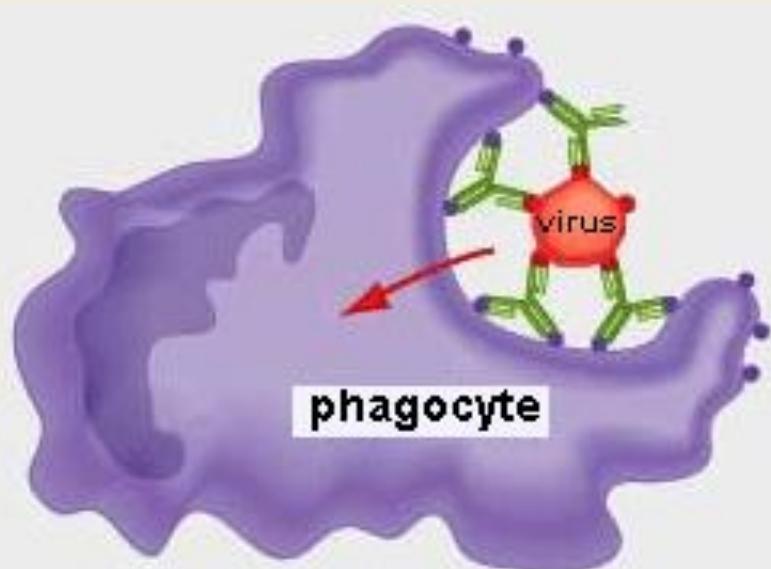


# Antigens

- Specific immune defenses are triggered by molecules called antigens.
- **Antigen** = any foreign substance that can stimulate an immune response. (bad guy)
- Typically, antigens are located on the outer surfaces of bacteria, viruses, or parasites.
- The immune system responds to antigens by increasing the number of cells that attack invaders or that produce **antibodies** (good guy)

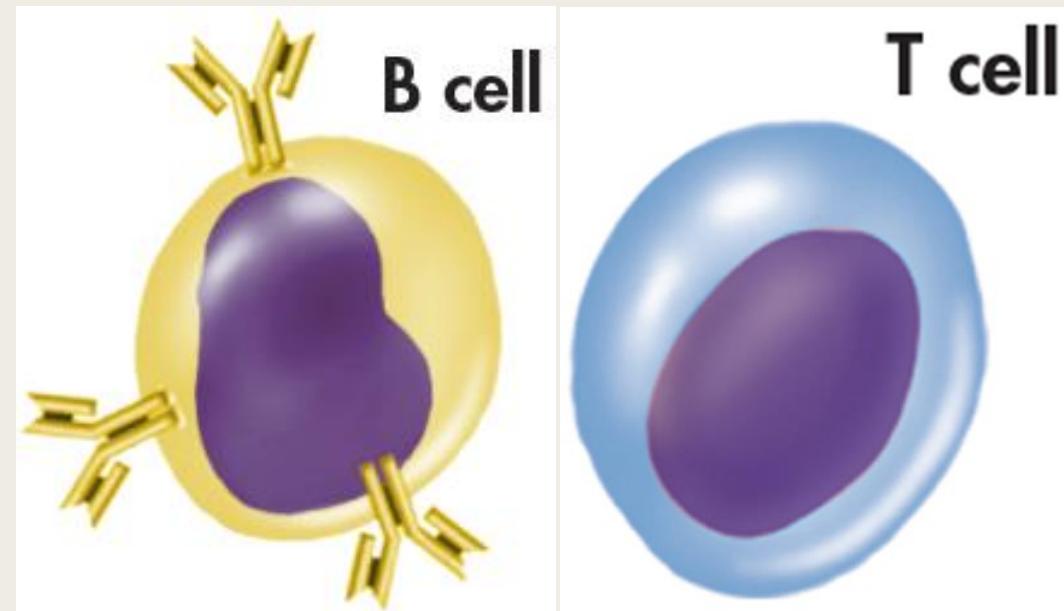
# Antibodies

- Antibodies = tag antigens for destruction by immune cells
- The shape of each type of antibody allows it to attach to one specific antigen



# Lymphocytes

- The main working cells of the immune response are B lymphocytes (B cells) and T lymphocytes (T cells)
- B cells = mature in red bone marrow (B for bone marrow) and have antibodies that find antigens
- T cells = mature in the thymus—an endocrine gland (T for thymus)—and must be presented with an antigen by infected body cells



# Humoral Immunity

- When an antigen binds to an antibody,
- T cells stimulate the B cell to grow and divide rapidly.
- That growth and division produces many B cells of two types:
  - 1.) plasma cells
  - 2.) memory B cells.

**Plasma cells**

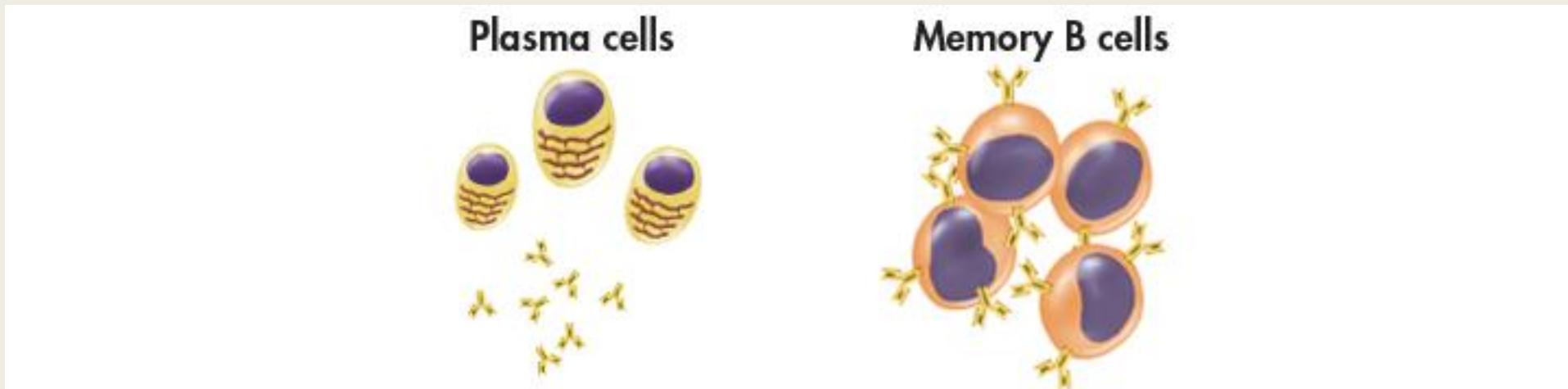


**Memory B cells**



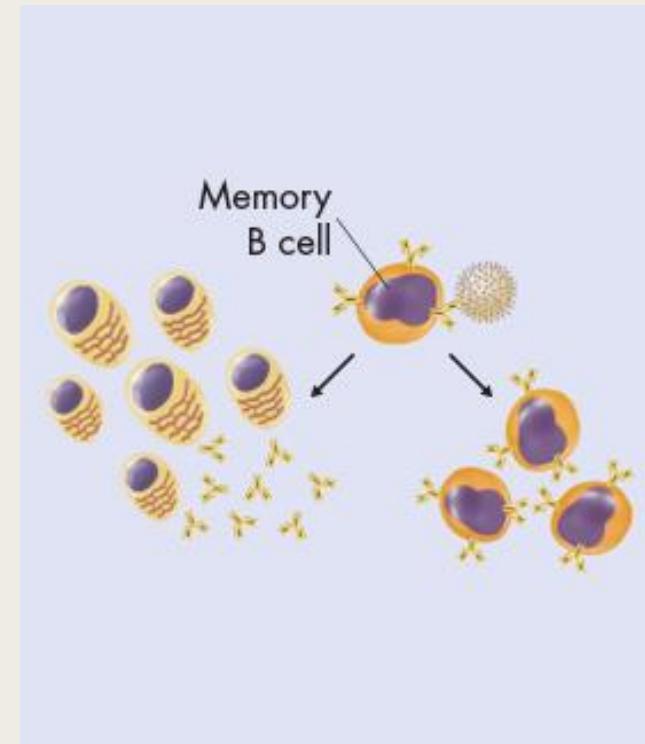
# Plasma cells

- Plasma cells produce and release antibodies that recognize antigens on the surfaces of pathogens.
- When antibodies bind to antigens, they signal other parts of the immune system to attack and destroy the invaders.



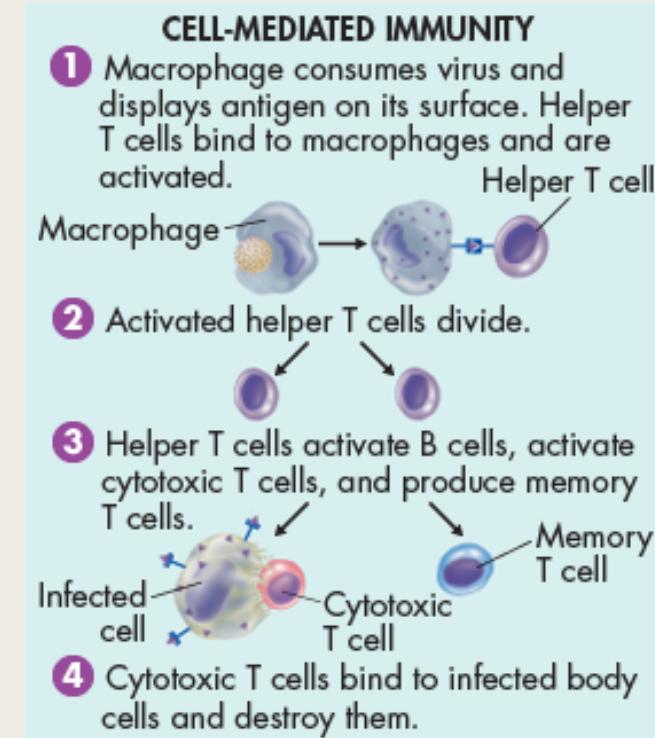
# Memory B cells

- Plasma cells die after an infection is gone
- some B cells that recognize a particular antigen remain alive.
- These cells, called memory B cells, react quickly if the same pathogen enters the body again.
- Memory B cells rapidly produce new plasma cells to battle a returning pathogen.
- This secondary response occurs much faster than the first response to a pathogen.
- Immune memory helps provide long-term immunity to certain diseases and is the reason that vaccinations work.



# Cell mediated immunity

- Another part of the immune response is called cell-mediated immunity.
- This immune system defends the body against viruses, fungi, and single-celled pathogens.
- T cells also protect the body from its own cells when they become cancerous.



# The immune system review

- <https://www.youtube.com/watch?v=GIJK3dwCWCw>
- <https://www.youtube.com/watch?v=zQGOcOUBi6s>
- <https://www.youtube.com/watch?v=fSEFXI2XQpc>
- <https://www.youtube.com/watch?v=PzunOgYHeyg>
- Covid 19:
- <https://www.youtube.com/watch?v=BtN-goy9VOY>
- <https://www.youtube.com/watch?v=OOJqHPfG7pA>
- <https://www.youtube.com/watch?v=5DGwOJXSxqg>