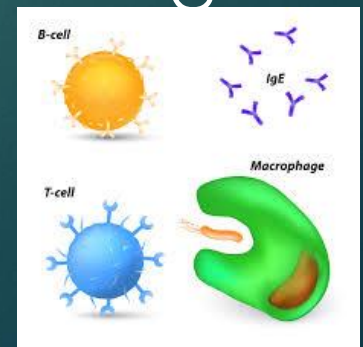


The Immune System

- ▶ The body's main defense against pathogens
- ▶ It recognizes, attacks, destroys and remembers each type of pathogen that enters the body
- ▶ For each type of pathogen, the immune system produces cells specific to that pathogen
- ▶ The immune system functions to fight infections through the productions of cells providing immunity.



Two General Categories

- ▶ Non specific defenses
 - ▶ Keeps pathogens out of the body
 - ▶ Like fortress wall of the system
 - ▶ Guard by keeping most things out
 - ▶ Response is the same for any type of invader



2007

- ▶ Specific defenses
 - ▶ Security guard
 - ▶ Track down and destroy harmful pathogens that have made it past the non specific defenses.



Nonspecific Defenses

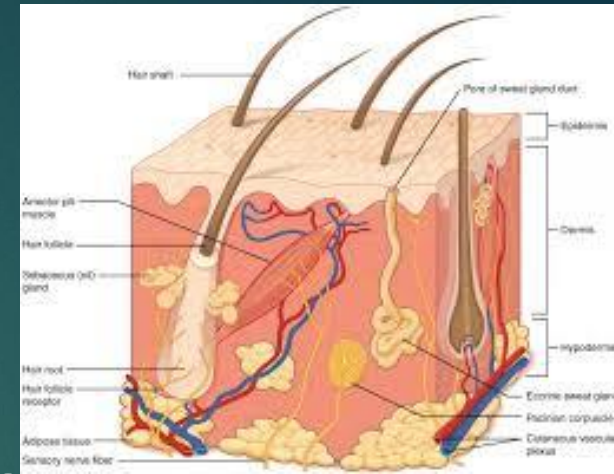
► First line of defense

► Physical and Chemical barriers

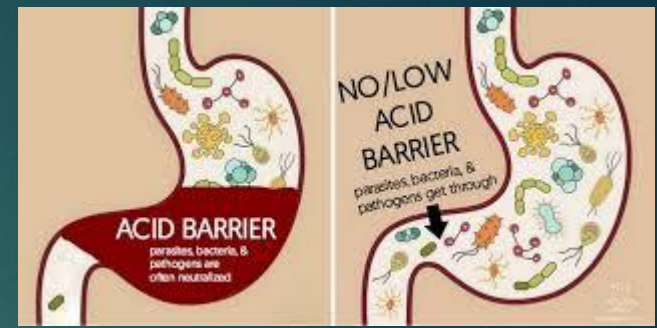
► The skin is a physical barrier that stops most pathogens from entering the body (MOST IMPORTANT)

► Once the skin is broken pathogens can enter the body and quickly multiply.

► WHY???



First line of Defense

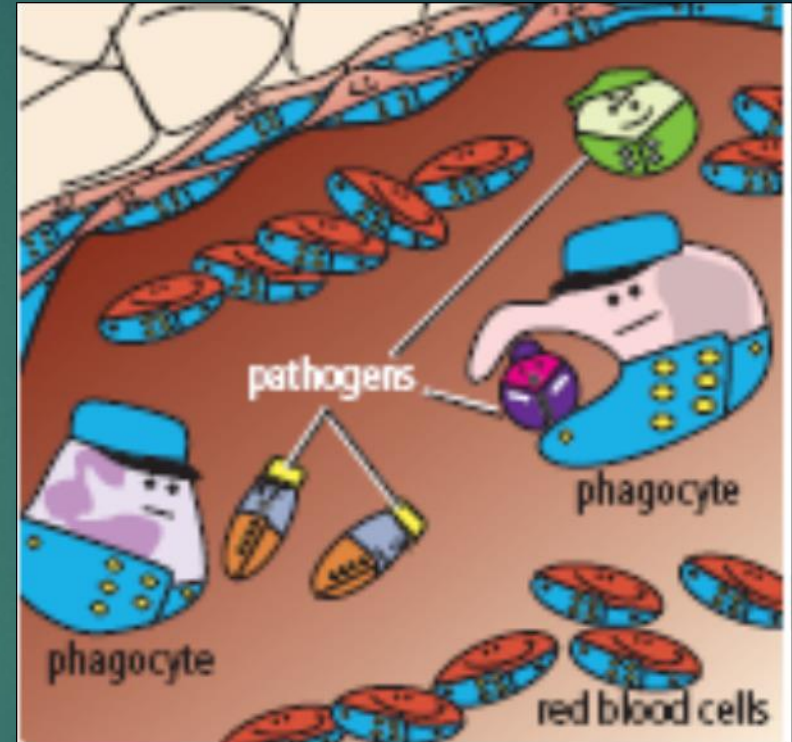


- ▶ Mucus and Saliva contain enzymes that can kill bacteria by breaking down their cell wall
- ▶ The sweat and oils on skin are slightly acidic.
- ▶ Gastric juices in your stomach can destroy some pathogens.
- ▶ Mucus and cilia in your nose prevent pathogens from entering your respiratory system.

Second line of Defense

If a pathogen makes it past the first line of defense.

- ▶ The second line of defense includes two types of immune response:
 - ▶ Innate Immune Response
 - ▶ A response you are born with.
 - ▶ Acquired Immune Response
 - ▶ A highly specific attack on a pathogen.

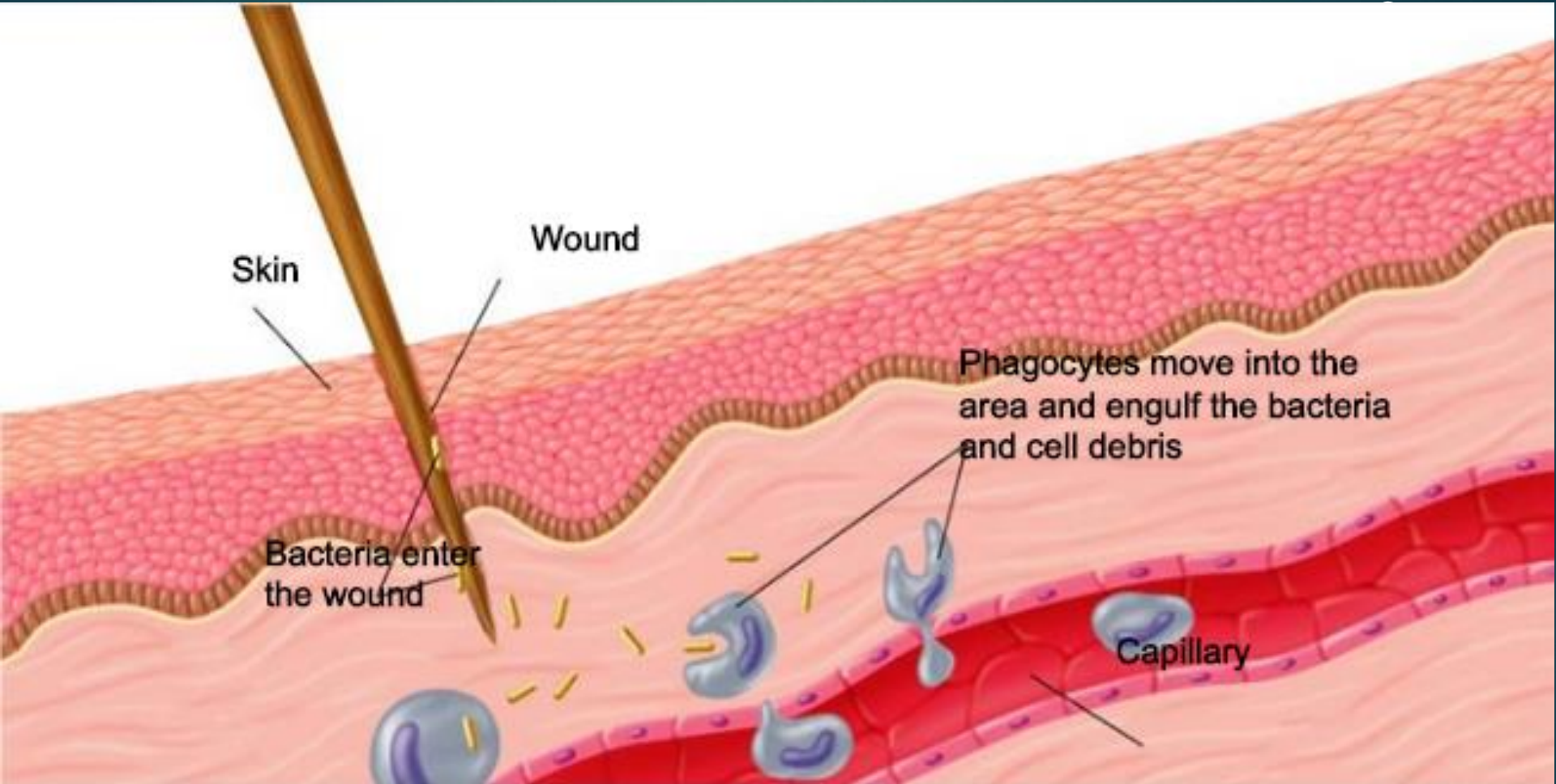


Non specific defenses -Innate



- ▶ If pathogens enter body 2nd line of defense is activated
 - ▶ Inflammatory Response
 - ▶ Reaction to tissue damage caused by injury or infection
 - ▶ Immune system produces millions of white blood cells(WBC) to fight the infection
 - ▶ Blood vessels near wound expand allowing White Blood Cells to move from the vessels into the infected tissue causing flow of fluid into the area
 - ▶ Infected tissue may become swollen, red and painful
 - ▶ Many of these WBC are phagocytes which engulf and destroy bacteria

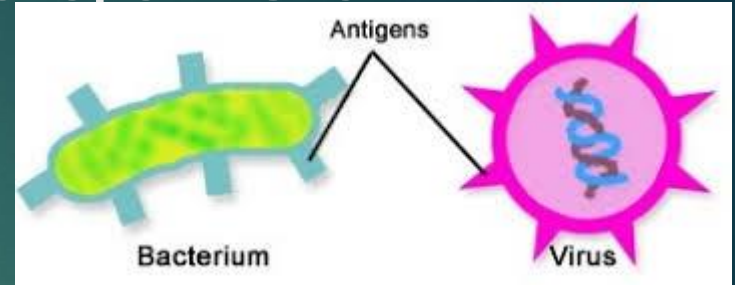
Inflammatory Response





- ▶ Immune response also releases chemicals that increase body temperature
 - ▶ Fever
 - ▶ Kills many pathogens as many can only survive in a narrow temperature
 - ▶ An elevated temperature also increases the heart rate which allows the WBC to travel to the site of infection faster
- ▶ Fever and elevated numbers of white blood cells indicate to doctors that your body is working hard to fight an infection.

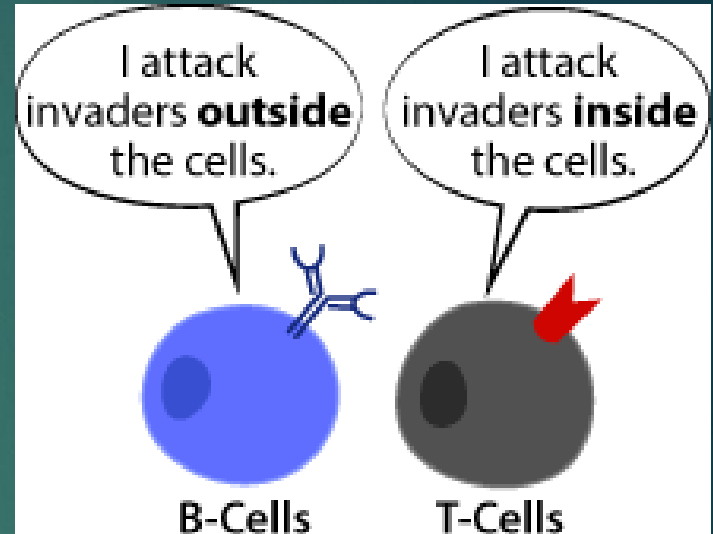
Specific Defenses-Acquired Immune Response



- ▶ Highly specific attack on a specific pathogen or antigen.
- ▶ Also known as the Immune Response
 - ▶ Triggered by an antigen
 - ▶ An antigen is a non-living particle or substance that body cannot recognize.
 - ▶ Virus, bacteria or other pathogen may serve as an antigen

Specific Defenses-Acquired Immune Response

- ▶ Cells of the immune system that recognize specific antigens are two types of Lymphocytes (WBC)



- ▶ B-cells
- ▶ T-cells

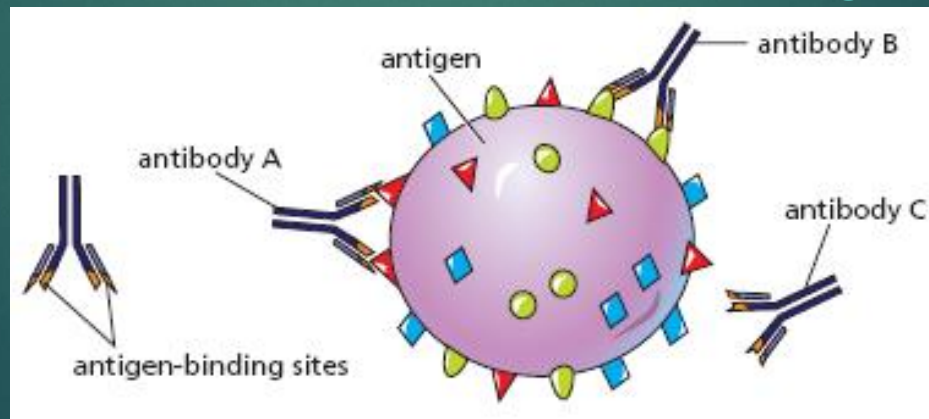
Types of Immunity

- ▶ B-Cells provide immunity against antigens/pathogens in the BODY FLUIDS (outside the cell)
 - ▶ Called Humoral Immunity
- ▶ T-Cells provide a defense against abnormal cells and pathogens that manage to enter the cell
 - ▶ Called Cell Mediated Immunity

Acquired Immune Response- Humoral Response

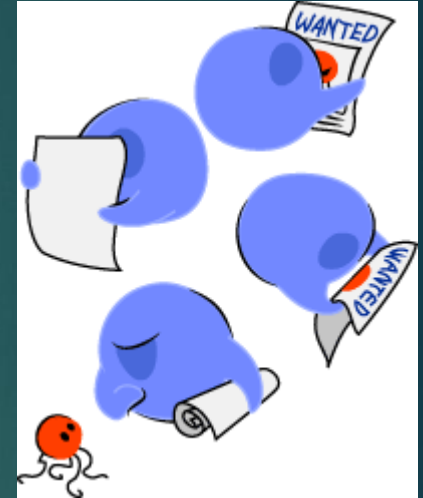
B cells in action

- ▶ First process in the acquired immune response:
 - ▶ Occurs in the body fluids or “humours” outside the cell
 - ▶ B Cells recognize antigens present in the body and start to rapidly grow and divide.
 - ▶ B Cells produce particles, called antibodies
 - ▶ Antibodies are proteins that recognize and bind to the antigen
 - ▶ Antibodies attach to and mark or destroy pathogens and antigens



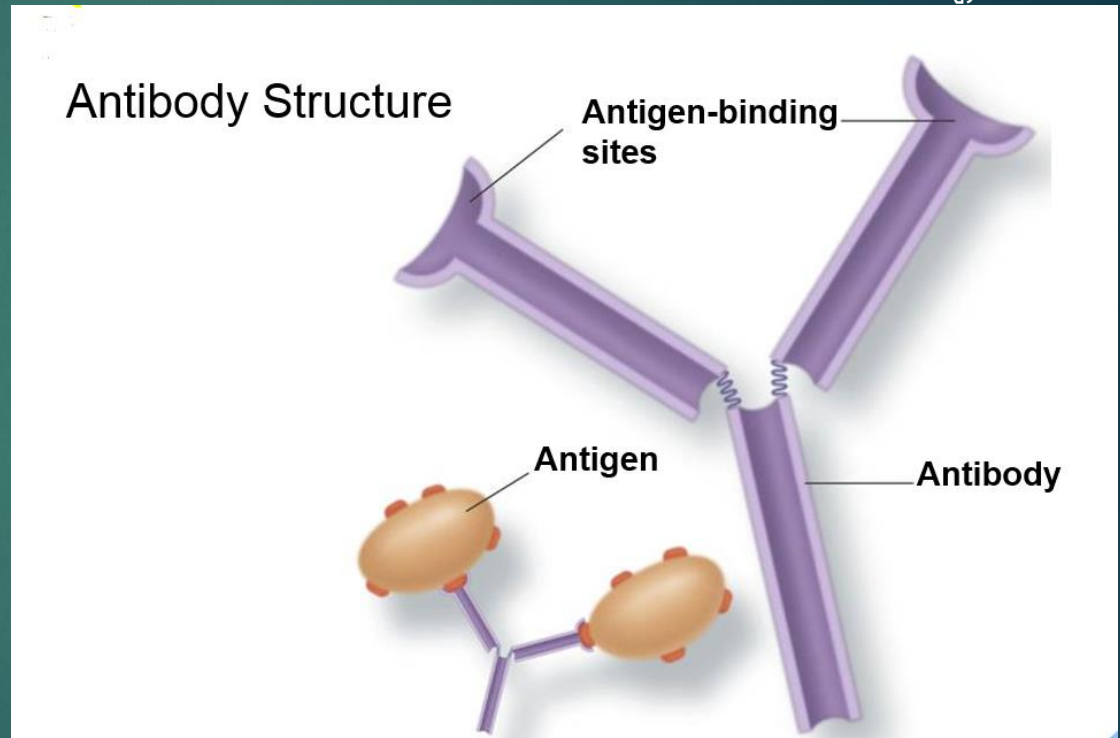
Immunity

- ▶ Once the body has been exposed to a pathogen, millions of Memory B cells remain capable of producing antibodies specific to that pathogen
 - ▶ This happens much quicker than the first exposure to the pathogen
 - ▶ Greatly decreases your chance of developing that disease a second time.



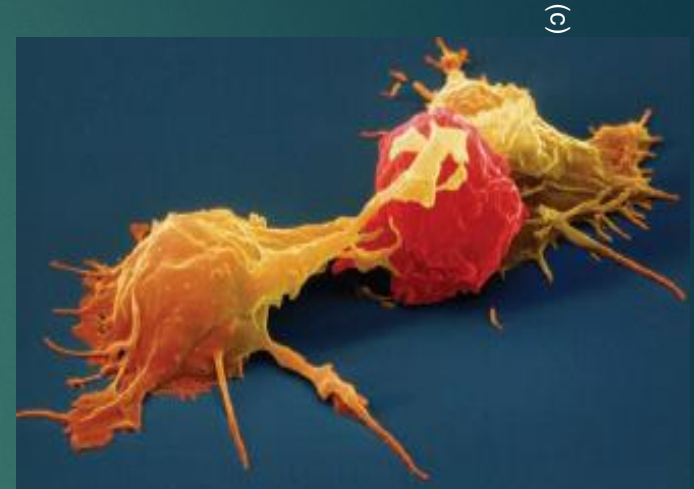
Antibodies

- ▶ Small differences in amino acids affect shapes of binding sites.
- ▶ Different shapes allow antibodies to recognize a variety of antigens with complementary shapes



Acquired Immune Response- Cell Mediated

- ▶ Second process in the acquired immune response:
- ▶ Occurs if the pathogen is able to get inside living cells
 - ▶ Antibodies alone cannot destroy them
- ▶ Two types of T cells:
 - ▶ Helper T cells
 - ▶ Recognize antigen or pathogen and activate B cells
 - ▶ Produce Memory T Cells
 - ▶ Killer T cells
 - ▶ Track down and destroy bacteria, fungi, protists or foreign tissue that contain the antigen



Two killer T cells (yellowish in colour) attack a cancer cell.

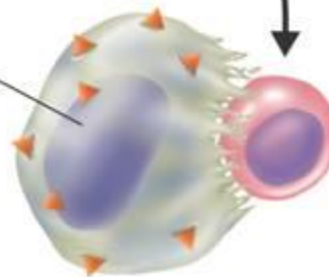
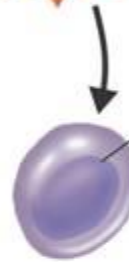
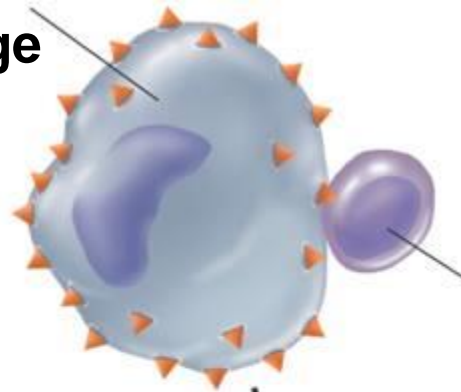
Macrophage

T cell

Helper T cell

Killer T cell

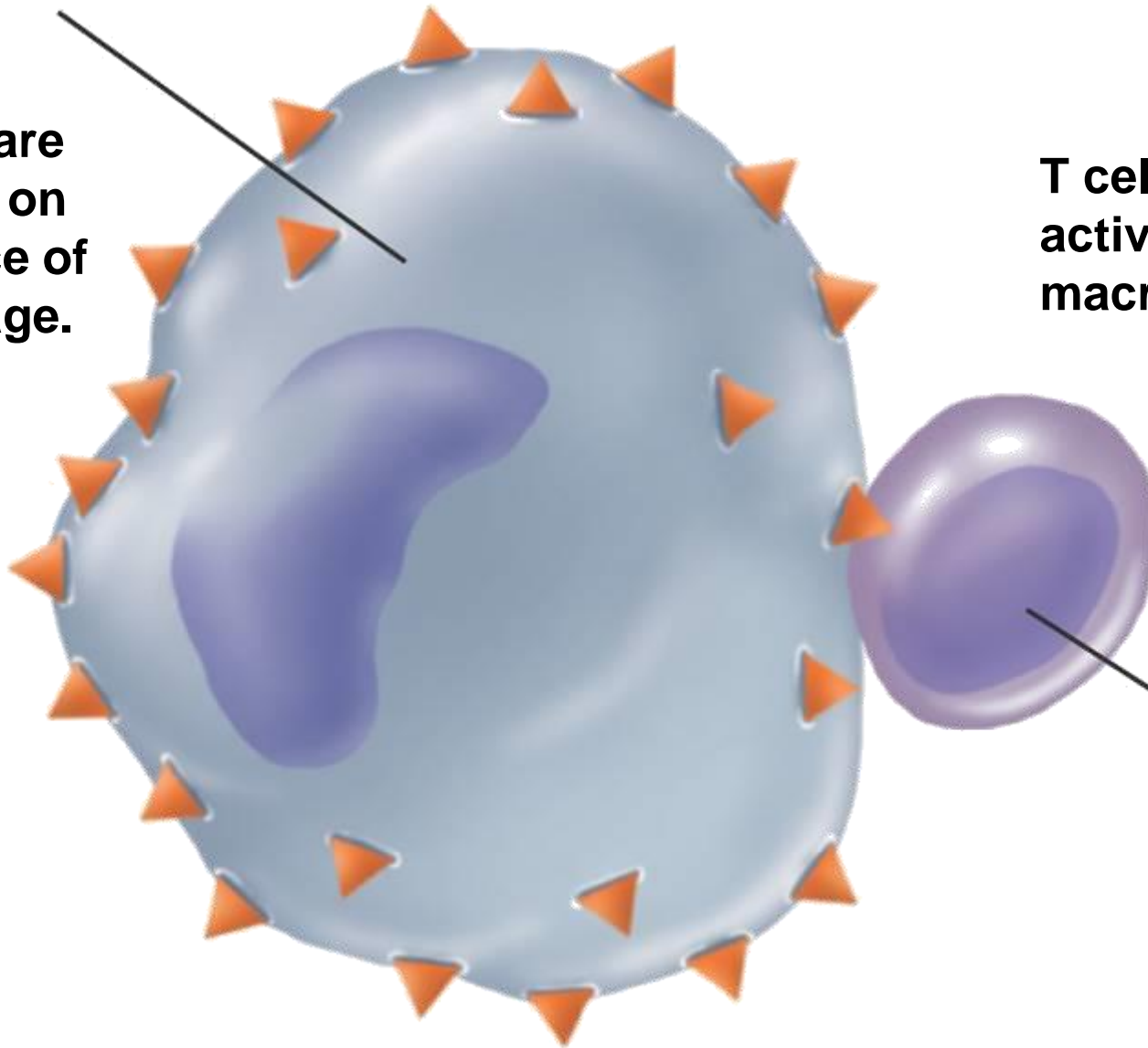
**Infected
cell**



Macrophage

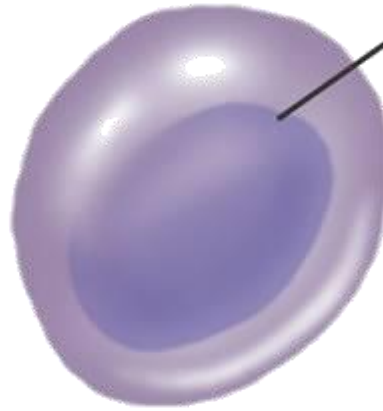
Antigens are displayed on the surface of macrophage.

T cell binds to activated macrophage.



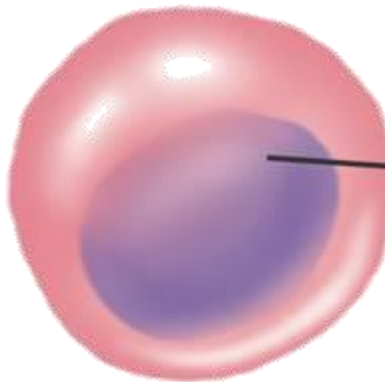
T cell

**T cell, activated by
macrophage,
becomes a helper
T cell.**



**Helper T
cell**

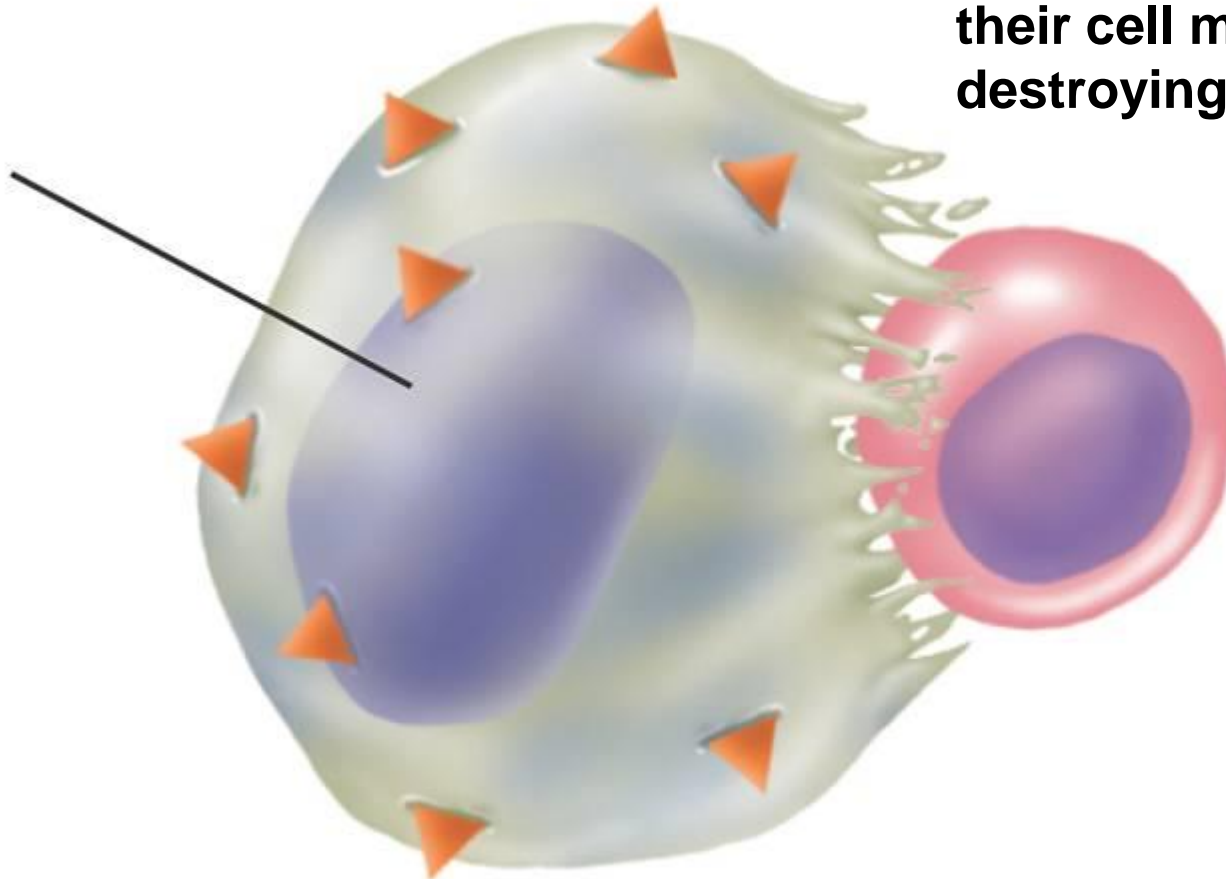
**Helper T cell
activates killer
T cells and B
cells.**



Killer T cell

Killer T cells bind to infected cells, disrupting their cell membranes and destroying them.

Infected cell



Result

- ▶ All acquired immune responses help give you active immunity.
 - ▶ This means your body remembers how to fight a pathogen that has infected it before.
 - ▶ After an infection antibodies get stored on B cells (Memory B Cells)
 - ▶ These can reactivate if the antigen/pathogen reappears
 - ▶ This is why you get diseases such as chicken pox only once.



Immune Response (4 Steps)

The response of your immune system to disease-causing organisms can be divided into four steps:

1. Recognition
2. Mobilization
3. Disposal
4. Immunity

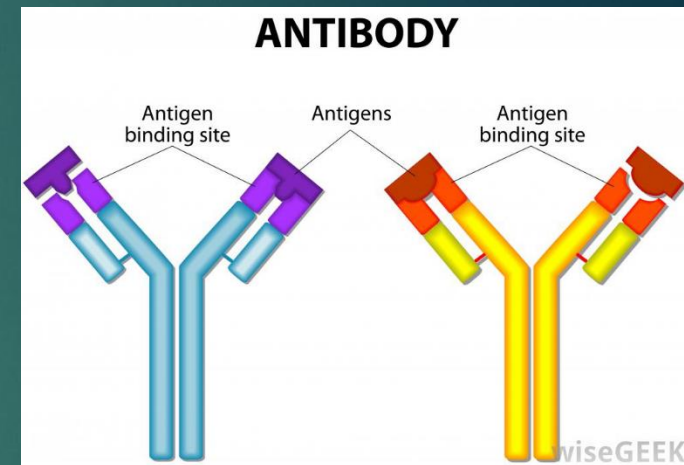
Jenners Famous Experiment

- ▶ <https://www.youtube.com/watch?v=yqUFy-t4MIQ>
- ▶ Would his experiment happen today?
 - ▶ Is it ethical?



Active Immunity

- ▶ The body makes its own antibodies in response to an antigen.
- ▶ Results from:
 - ▶ Natural exposure to the antigen
 - ▶ Fighting an infection
 - ▶ Deliberate exposure to the antigen
 - ▶ Vaccination
- ▶ Vaccines
 - ▶ The injection of a weakened form of a pathogen to produce immunity
 - ▶ Stimulate the immune system to create millions of cells ready to produce specific types of antibodies
- ▶ Boosters are needed for some vaccines to extend the immune system's memory (tetanus)



Traveling to another Country

- ▶ Why do you have to check with your doctor about vaccinations before travelling to another country?



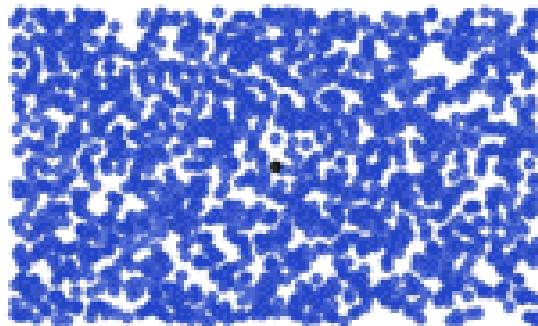
Passive Immunity

- ▶ Antibodies produced by other animals against a pathogen are injected into the bloodstream
 - ▶ Does not last very long as the body will destroy the foreign antibodies
 - ▶ Can develop naturally or by deliberate exposure
- ▶ Natural Exposure
 - ▶ Antibodies produced by a mother are passed to the infant via breastmilk
 - ▶ Will protect a child against most infectious diseases for the first few months or longer if breast fed
- ▶ Deliberate Exposure
 - ▶ Individuals bitten by rabid animals are injected with antibodies that attack the rabies virus

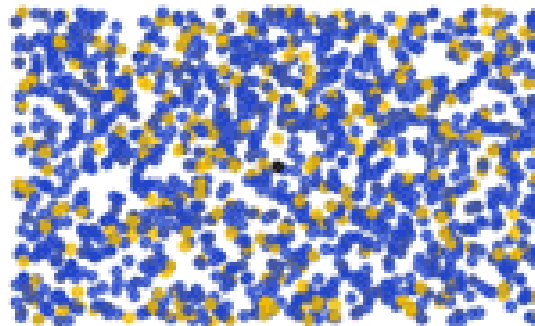


Herd Immunity: How It Works

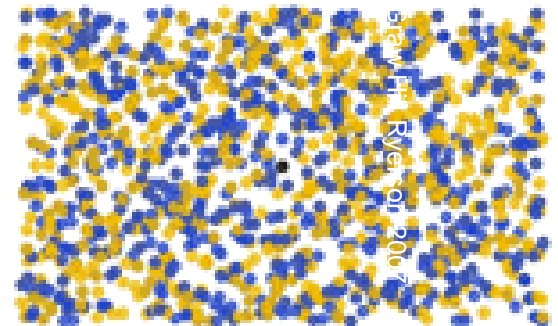
Percent Vaccinated: 0%



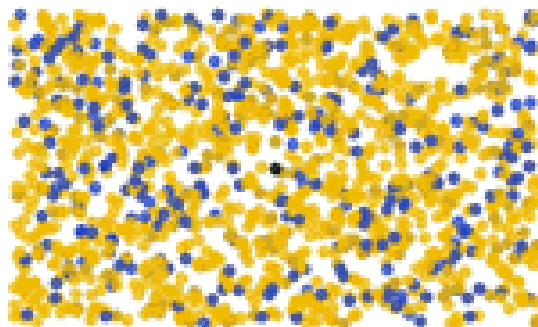
Percent Vaccinated: 25%



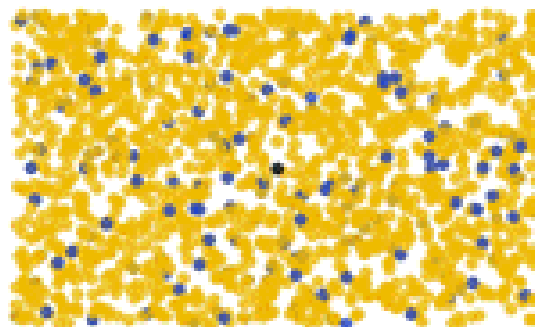
Percent Vaccinated: 50%



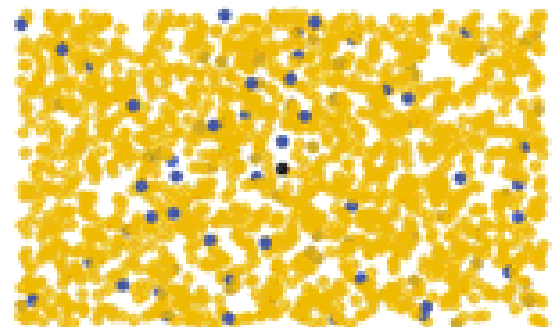
Percent Vaccinated: 75%



Percent Vaccinated: 90%



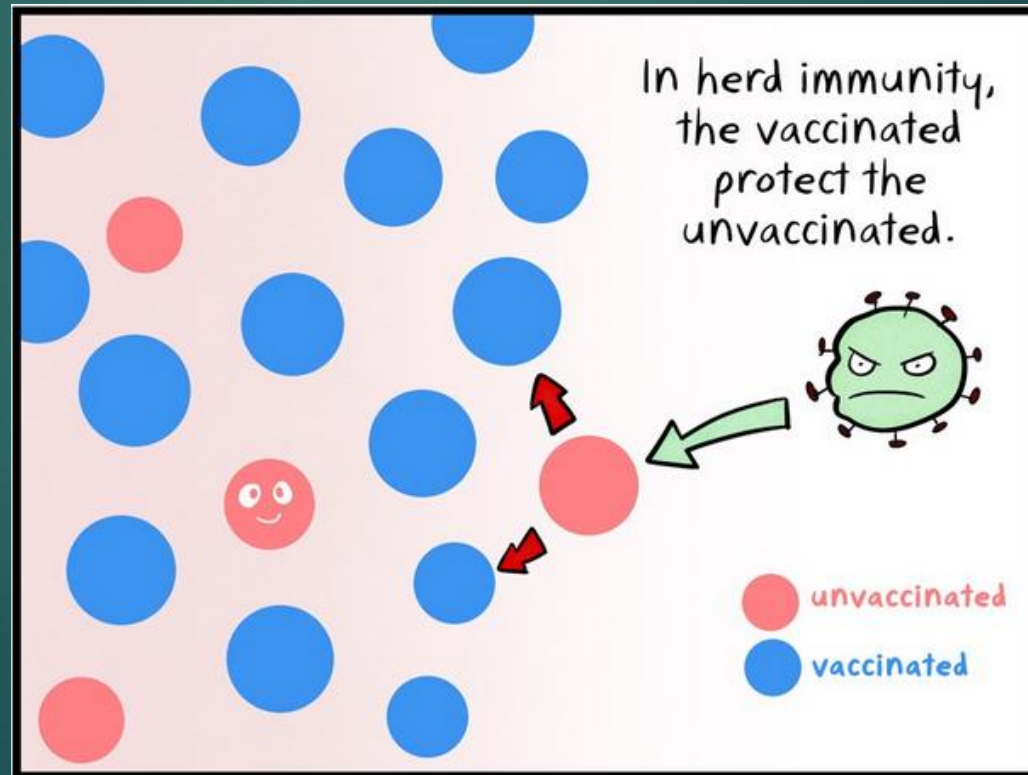
Percent Vaccinated: 95%



• Infected • Unvaccinated • Vaccinated

Herd Immunity

- ▶ Herd immunity is a form of immunity that occurs when the vaccination of a significant portion of a population (or herd) provides a measure of protection for individuals who have not developed immunity.



Vaccine Wars

- ▶ Should we be vaccinating our children?



What happens when your immune system works against you?????

- ▶ Allergies → life threatening diseases



Disorders of the Immune System

Dust Mite



► Allergies

- An allergy is an unusually high sensitivity to some substance.
- Any antigen that causes an allergic reaction is called an allergen.
 - Common allergens are: milk, pollen, and dust.
 - Allergens act as an antigen



Histamines

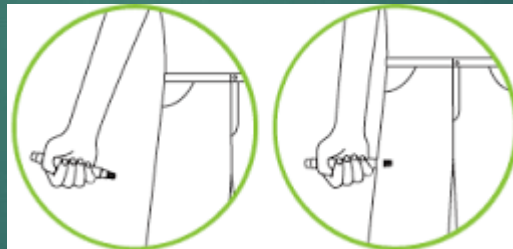
- ▶ Body releases chemical called histamine to fight allergen.
 - ▶ Common symptoms includes sneezing, runny nose and watery eyes.
- ▶ Increase the flow of blood and fluids to the surrounding area
- ▶ Antihistamines are drugs that are used to counteract the effects of histamines

(c) McGraw Hill



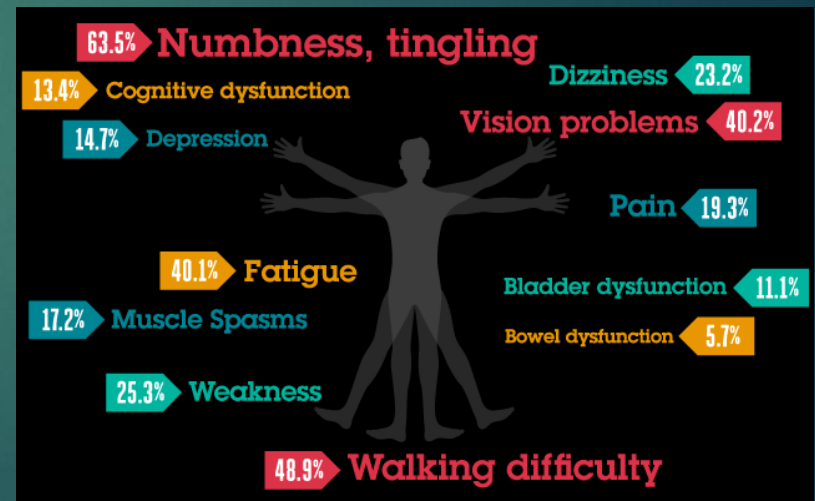
What happens when you are highly allergic?

- ▶ Severe allergies can cause an anaphylactic shock.
 - ▶ I.e. peanuts, bee stings
- ▶ People with severe allergies can experience
 - ▶ Swelling of airways
 - ▶ Breathing difficulty
 - ▶ Death
- ▶ Most likely will carry an “epi-pen”
 - ▶ Injected into thigh
 - ▶ Adrenaline autoinjector
 - ▶ Will decrease effects of allergic reaction



Autoimmune Disease

- ▶ When the immune system makes a mistake and attacks the body's own cells
 - ▶ Type I Diabetes
 - ▶ Rheumatoid arthritis
 - ▶ Multiple Sclerosis



Disorders of the Immune System

AIDS – Acquired Immunodeficiency Syndrome

- ▶ AIDS is caused by a virus called HIV
- ▶ HIV attacks the immune system by infecting Helper T Cells.
 - ▶ When other pathogens or antigens enter the body the immune system can't activate Killer T cells or B cells.
 - ▶ This can lead to a person dying from a less serious infection.

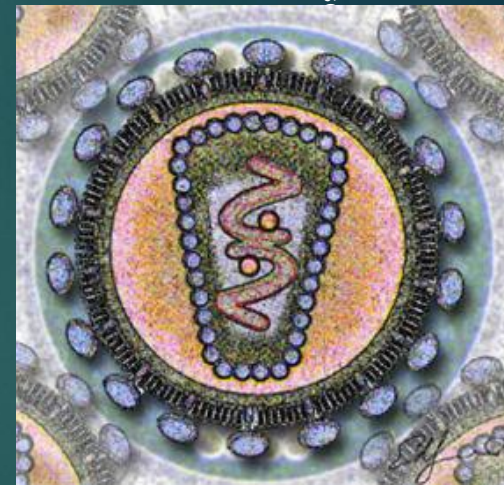


Illustration of HIV

(c) McGraw Hill Ryers

Transmission

- ▶ AIDS is transmitted by blood and semen.
 - ▶ Through unsafe sex or sharing needles
 - ▶ NOT through casual contact
- ▶ Currently no cure
 - ▶ The virus keeps changing its structure making the antigen hard to identify
 - ▶ New forms are identified every year
 - ▶ An infected person typically live 4-10 years

Taking Care of Your Immune System

Important steps you can take to help your immune system stay healthy.



- Eat a well-balanced diet.
- Maintain your personal hygiene—brush your teeth, shower or bathe, and wash your hands often.
- Keep your home clean.
- Avoid tobacco and other non-prescription drugs.
- Get plenty of rest and exercise.
- Keep your vaccinations up to date.
- Do not engage in activities that involve sharing body fluids with others.

