

Lesson

Immune System Vocab & Drawings
(antigen, pathogen, antibody)

Lymphatic System & Immunity Questions

1. Identify 5 components of the lymphatic system
Lymph vessels, lymph nodes, bone marrow, spleen, thymus
2. What is the lymphatic system's role in maintaining homeostasis?
It prevents the body from swelling by collecting excess fluid that escapes from blood out of capillaries & returns it to the circulatory system.

Lymphatic System & Immunity Questions

3. Compare & contrast infections and noninfectious disease and name one example of each.
- Infectious diseases are caused by organisms that invade the body (pathogens) like bacteria & viruses.
Ex. Flu, common cold, HIV
 - Non infectious diseases are caused by other factors like genetics, nutrition, etc.
Ex. Heart attack, stroke

Lymphatic System & Immunity Questions

4. What is bone marrow's role in immunity?

It produces white blood cells called lymphocytes (B and T cells)

5. The 1st and 2nd lines of immunological defense are considered “non-specific” defenses. Why?

They are barriers, fever, & inflammatory response that defend against MANY kinds of pathogens.

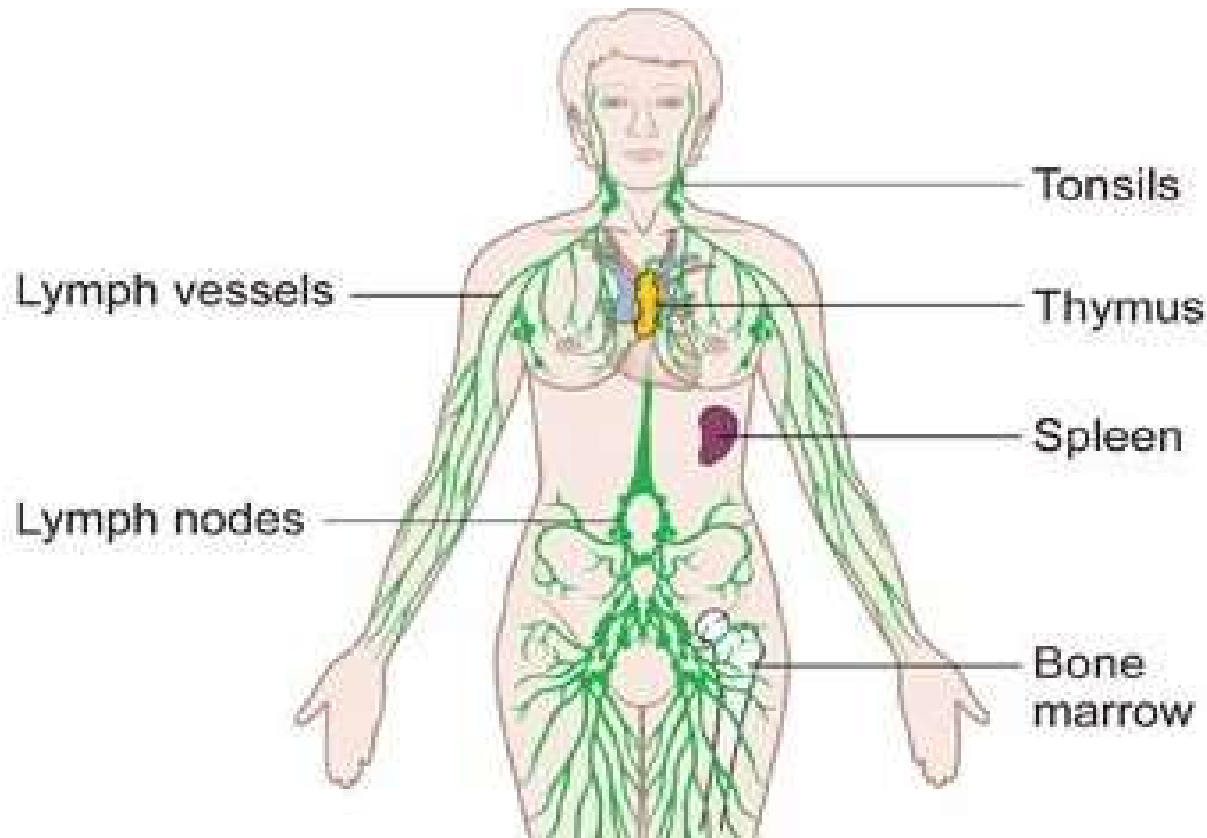
The Immune System



[Video - How a Virus Invades a Body](#)

Immunity - The Lymphatic System

- Contains white blood cells in lymph nodes
- Filter's lymph (plasma that leaks out from capillaries)



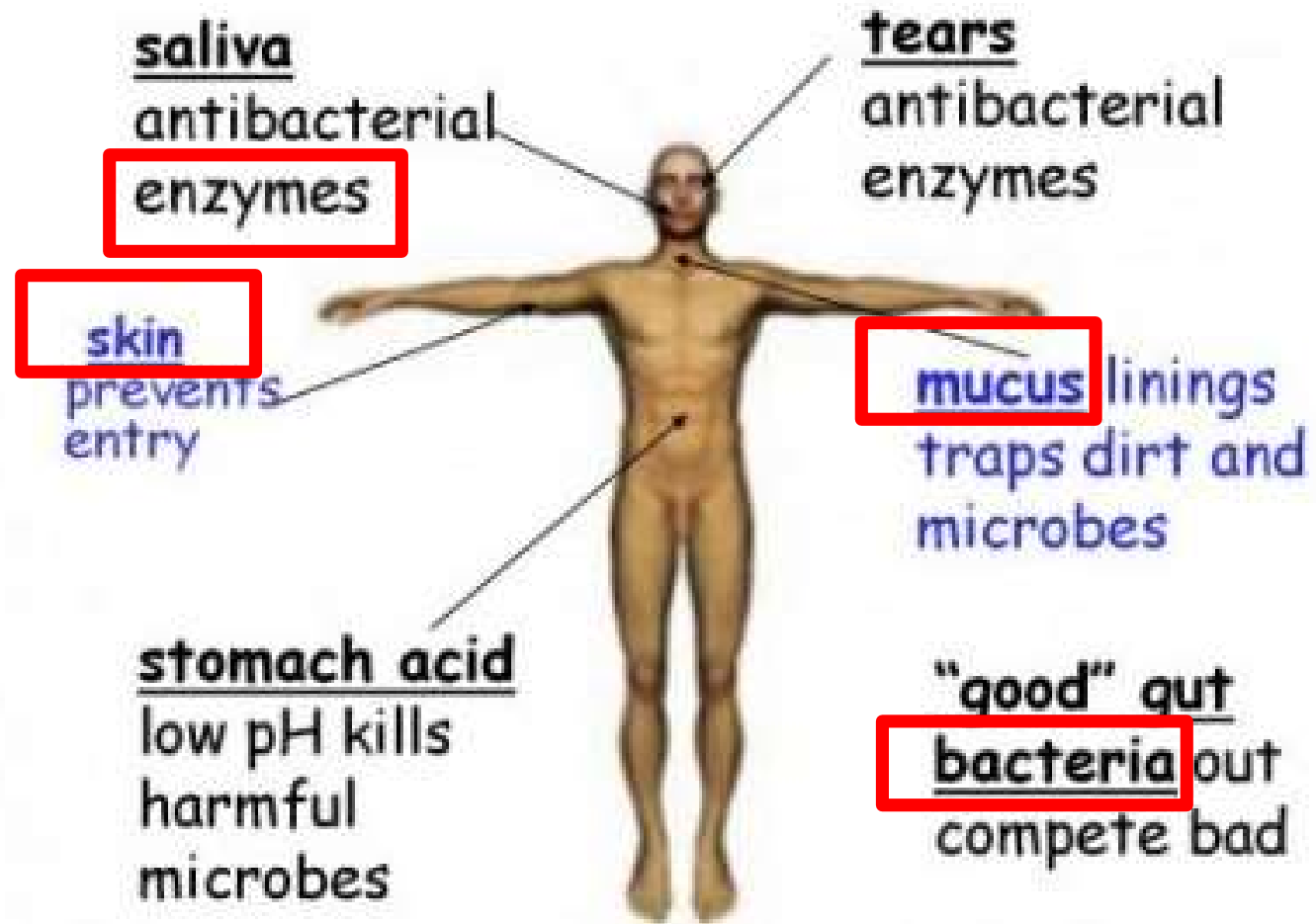
What is Immunity?

- a series of defenses that involve non-specific and specific attacks on disease causing agents (pathogens)



Examples of Non-Specific Defenses

- 1st line of defense: attempts to keep foreign invaders OUT of the body
- Ex. skin, mucus



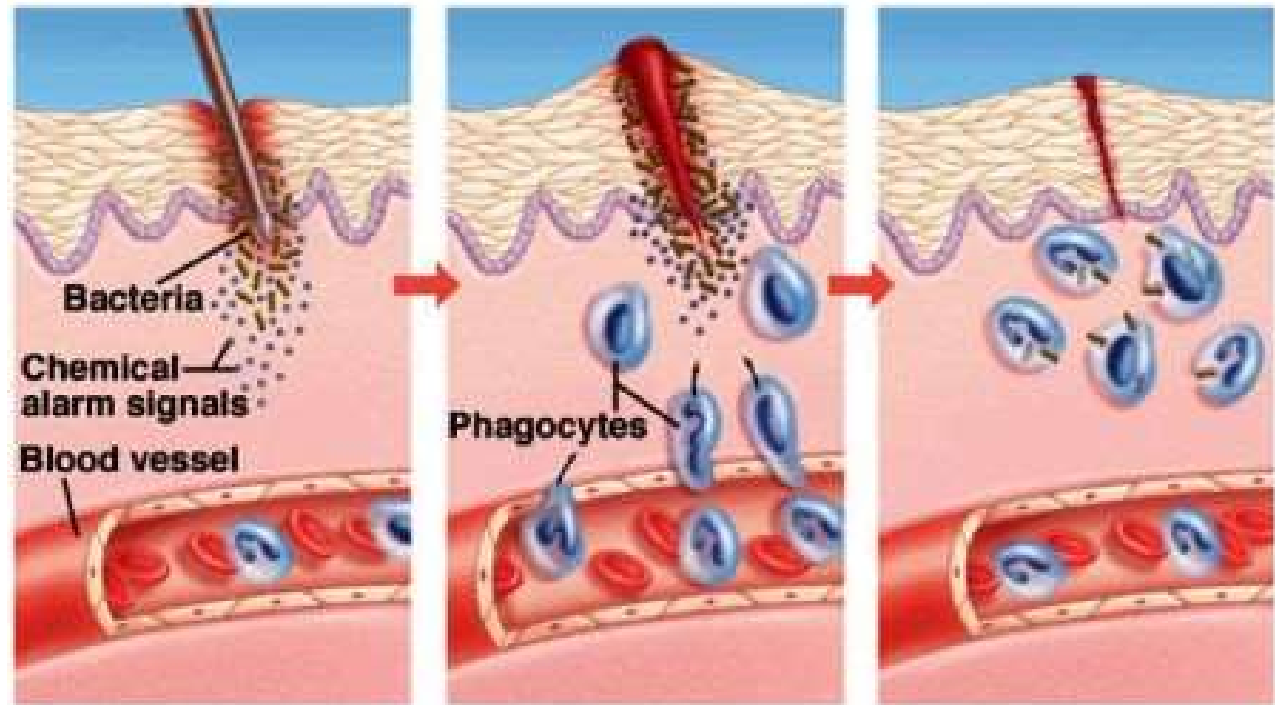
Boogers!

[Boogers Video](#)



Examples of Non-Specific Defenses

- 2nd line of defense: responses when foreign invaders penetrate the 1st line



- Ex. Inflammatory response (more blood flow to the area)
- Fever – high temp. slows pathogen reproduction

Three Lines of Defense Against Infection

1. First Line of Defense: Non-specific natural barriers which restrict entry of pathogen.

Examples: Skin and mucous membranes.

2. Second Line of Defense: Innate non-specific immune defenses provide rapid local response to pathogen after it has entered host.

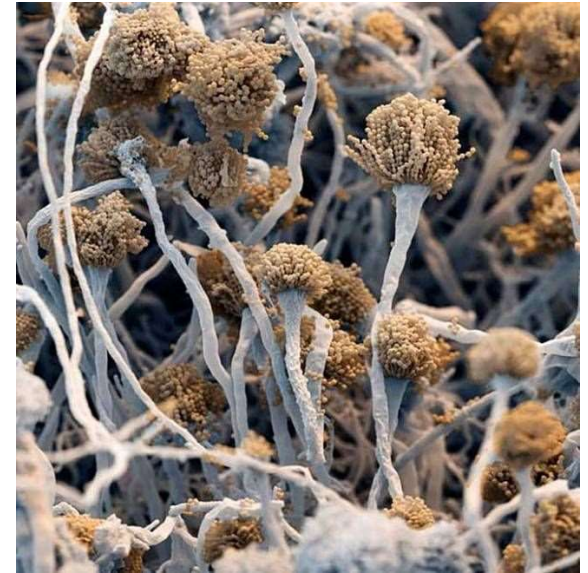
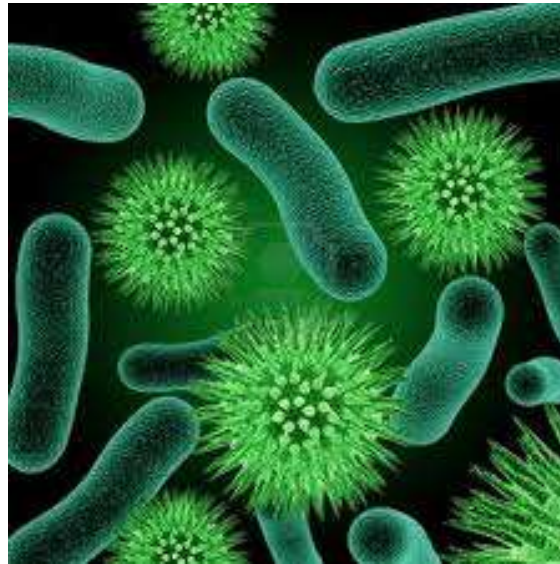
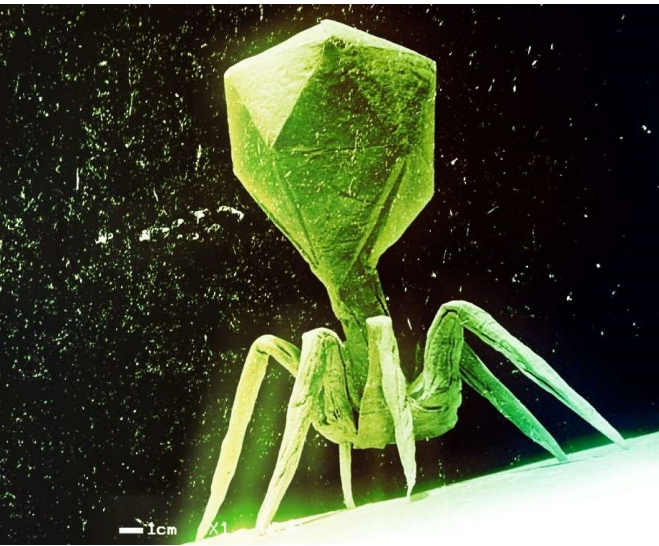
Examples: Fever, phagocytes (macrophages and neutrophils), inflammation, and interferon.

3. Third line of defense: Antigen-specific immune responses, specifically target and attack invaders that get past first two lines of defense.

Examples: Antibodies and lymphocytes.

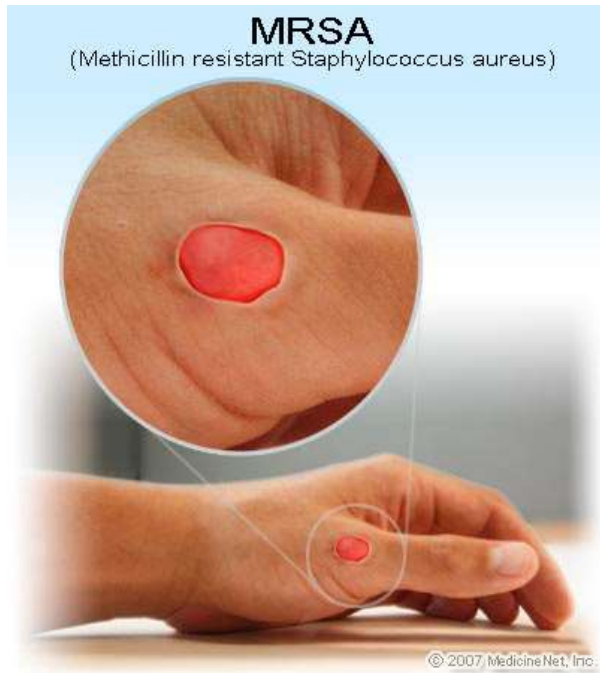
Important Immunity Vocab

- 1. Pathogen** – any disease-causing microorganism /
microbe (bacteria, virus, fungus)
 - Reminder: viruses are not considered “living”
b/c they need a host cell to reproduce



Examples of Pathogenic Infections

**MRSA
(Bacterial)**



**Oral Herpes
(Viral)**

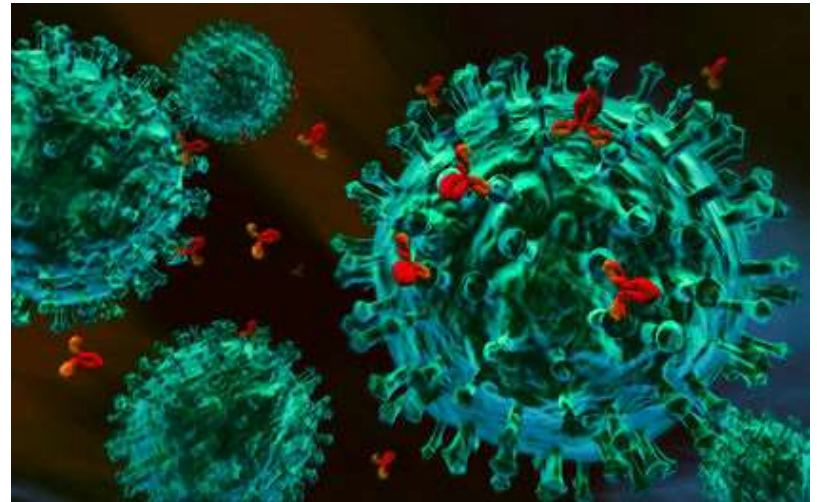


**Athlete's
Foot (Fungal)**

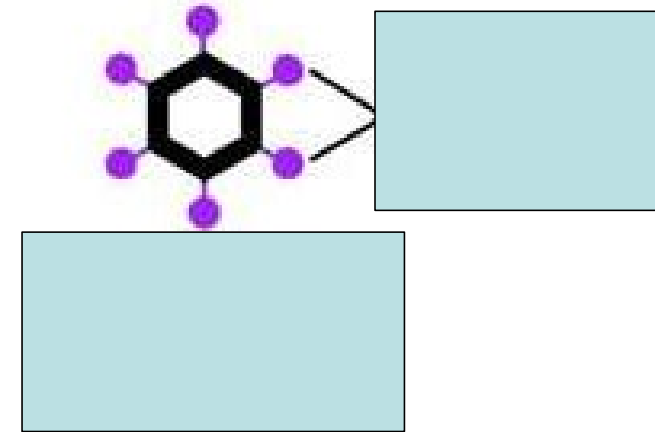
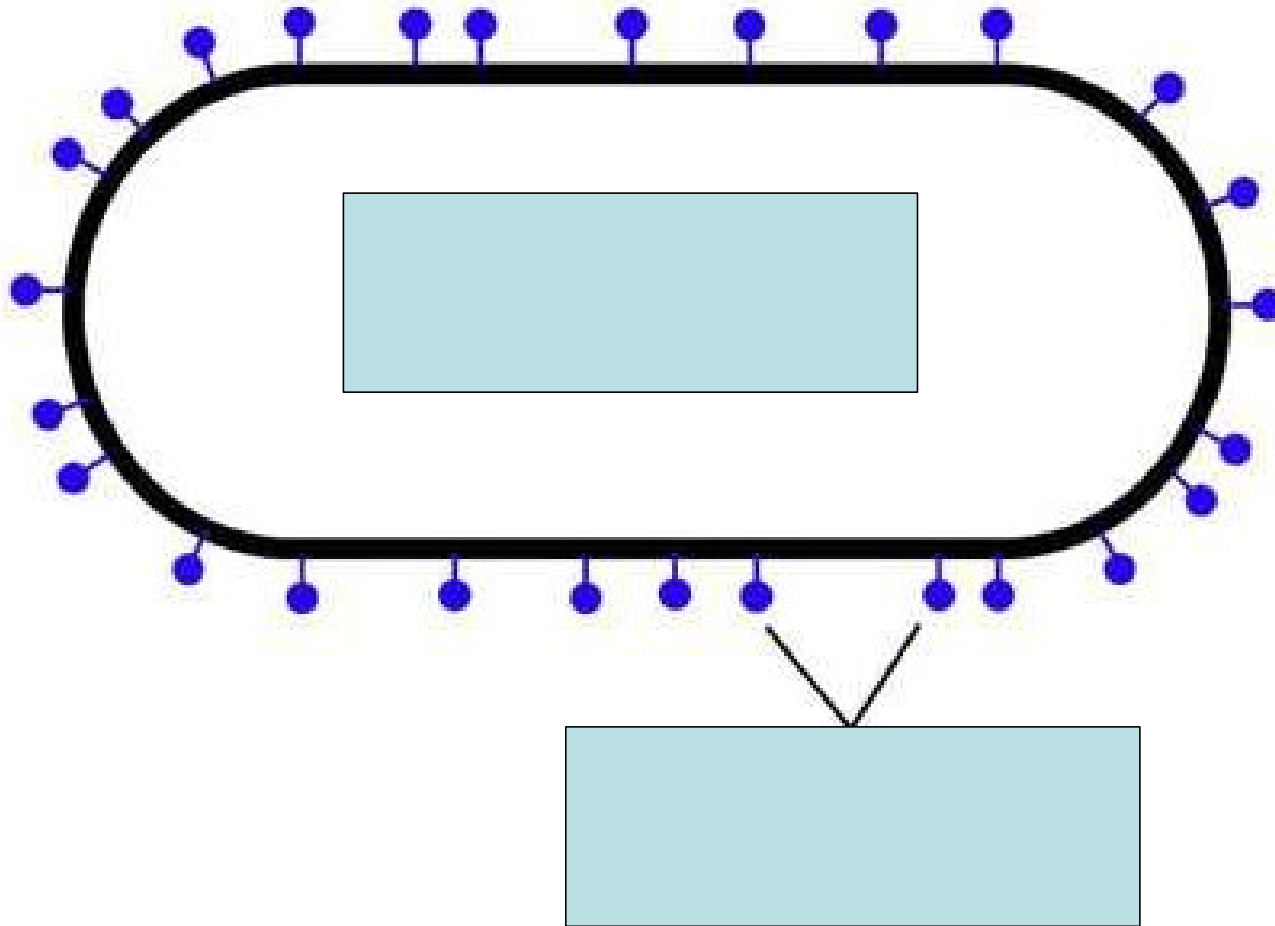


2. Antigen: *ID cards*

- proteins on the surface of a cell that allows white blood cells of the immune system to determine “self” or “non-self” (foreign)
- trigger an immune response if not recognized
 - Ex. Antigen on red blood cells determine blood type (A, B, AB, O)

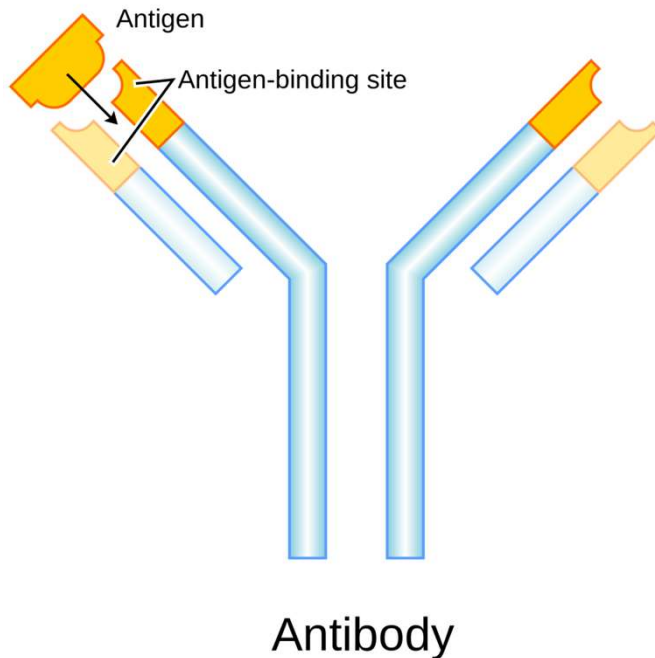
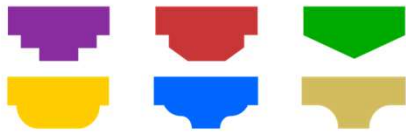


Examples of pathogens and their foreign antigens.



3. Antibodies:

Antigens



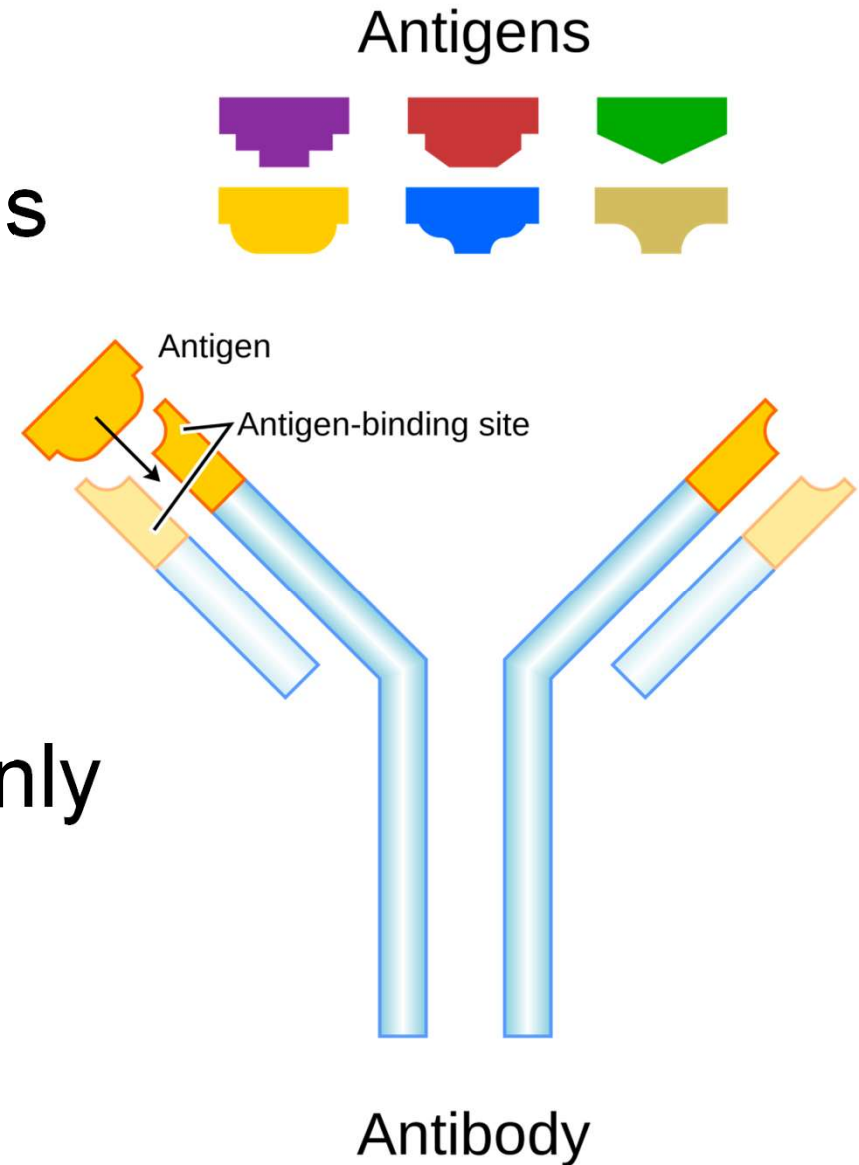
- proteins produced by WBC's in response to a foreign antigen
- mark a pathogen for destruction
- are **specific**, an antibody only binds to a certain shape antigen

Immunological Memory

- once antibodies are made, the body remembers how to make them (Memory cells)

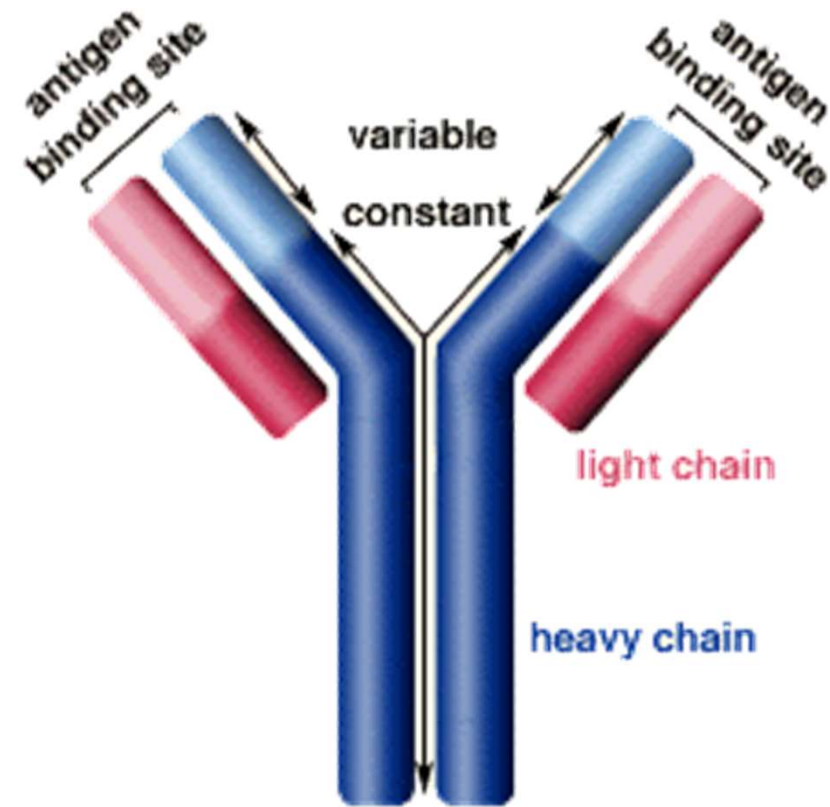
3. Antibodies:

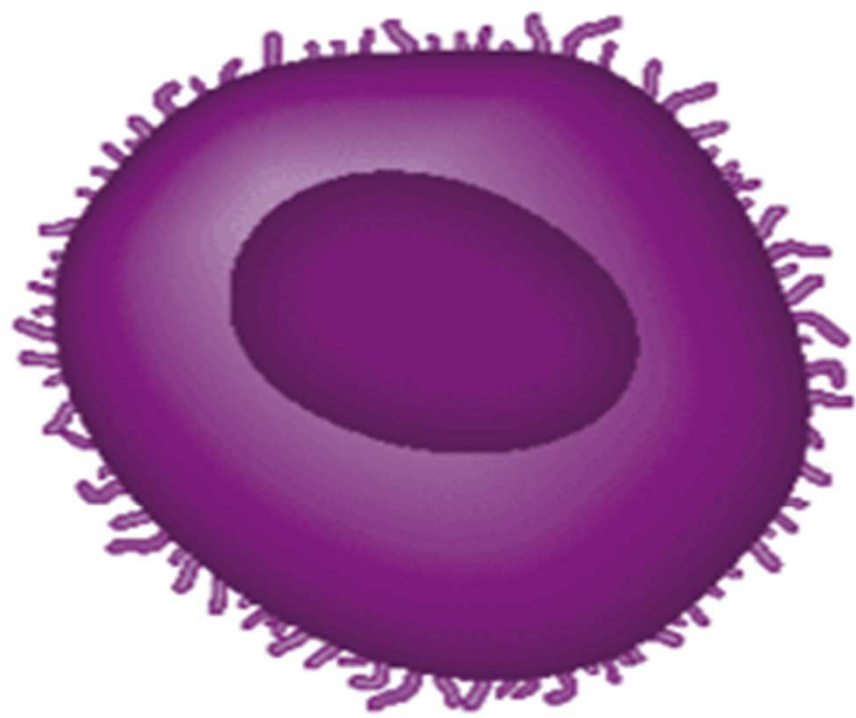
- proteins produced by WBC's in response to a foreign antigen
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Immunological Memory

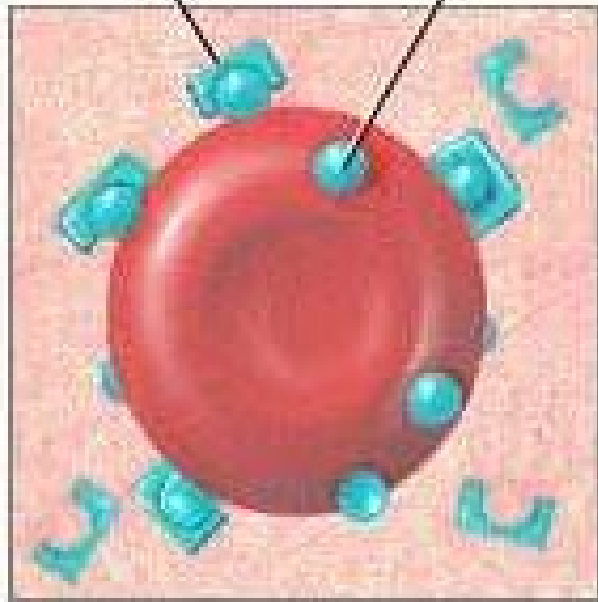
- once antibodies are made, the body remembers how to make them (Memory cells)
- Therefore, it takes less time for the body to recognize the same foreign invader in the future
ex. you usually get chicken pox only once





Antibody

Antigen



An antibody is a protein produced by the immune system in response to the presence of an antigen

Red blood cell

Ex. Red Blood Cell Antigens determine a person's
blood type (A, B, AB, O)

Type A

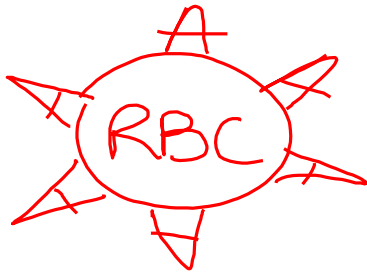
Type B

Type AB

Type O

Ex. Red Blood Cell Antigens determine a person's blood type (A, B, AB, O)

Type A



Type B



Type AB



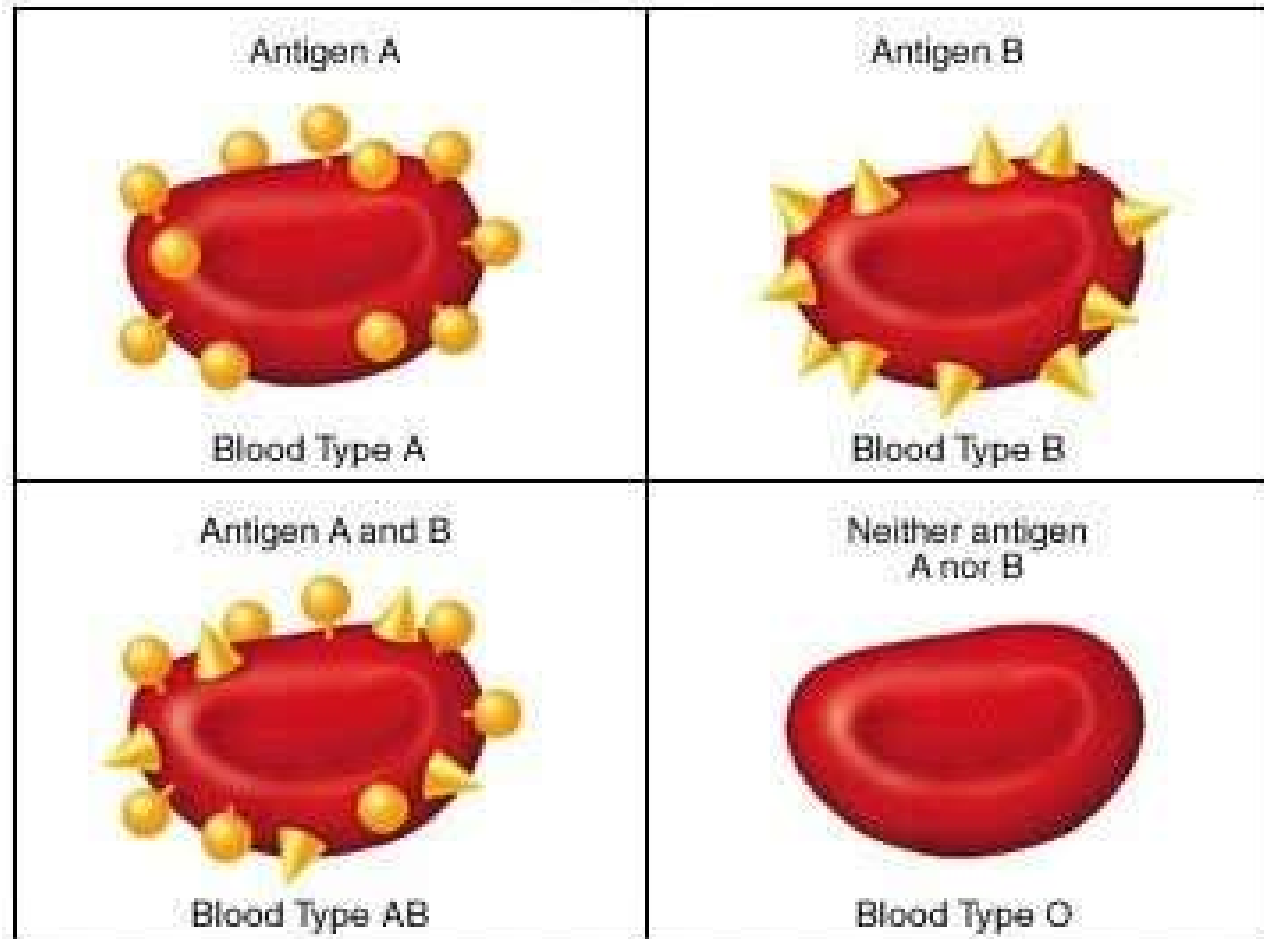
Type O

(zero)

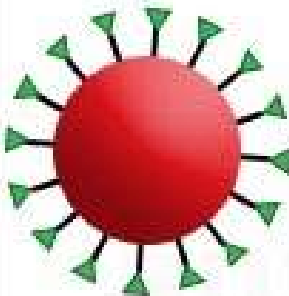
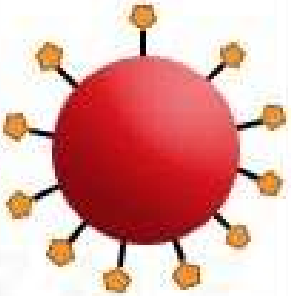
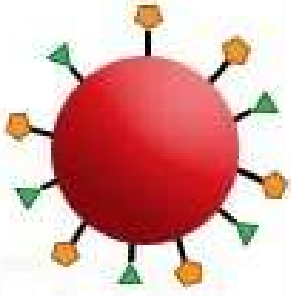
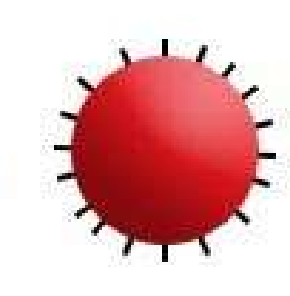
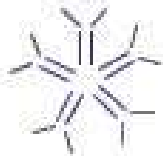
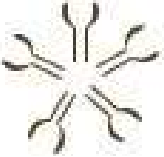






no A or B antigens

Examples of Red Blood Cell Antigens that determine a person's blood type (A, B, AB, O)

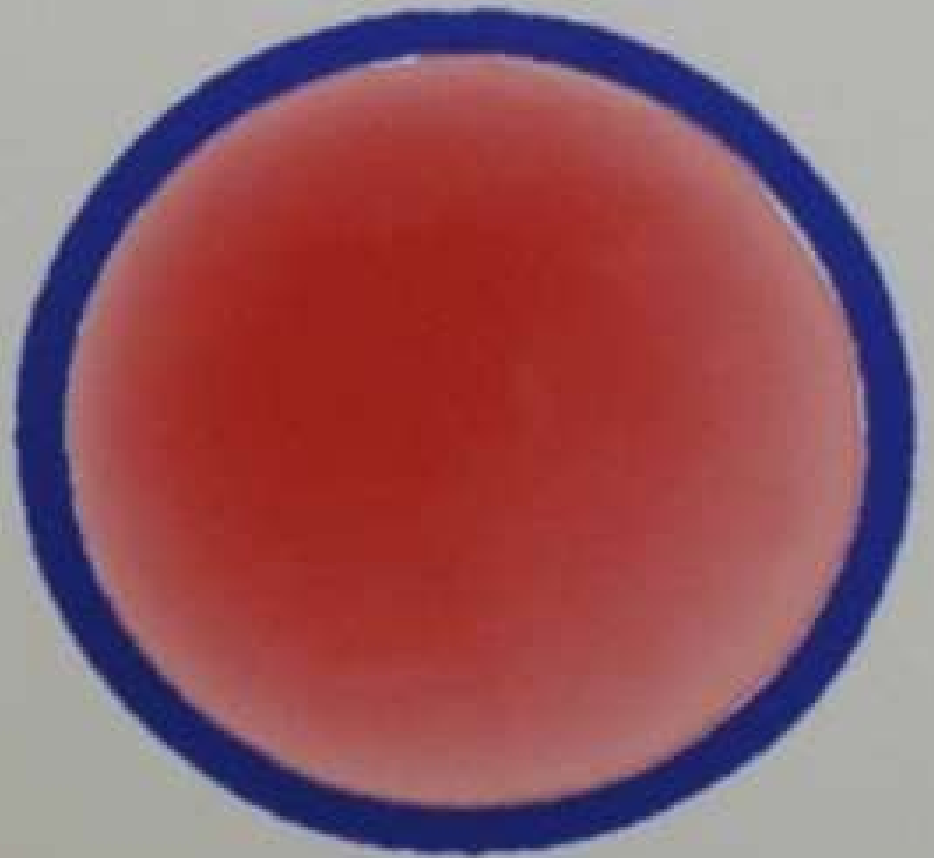


Summary of Blood Types

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in Plasma	 Anti-B	 Anti-A	None	 Anti-B and Anti-A
Antigens in Red Blood Cell	 A antigen	 B antigen	 A and B antigens	None







































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HOW TO READ YOUR RESULTS

BLOOD TYPE	ANTI-A	ANTI-B	ANTI-D	CONTROL
O-POSITIVE				
O-NEGATIVE				
A-POSITIVE				
A-NEGATIVE				
B-POSITIVE				
B-NEGATIVE				
AB-POSITIVE				
AB-NEGATIVE				
INVALID				

Blood Typing

- Only compatible blood types may be mixed
- Agglutination (dangerous clumping) will occur if there is an antibody-antigen reaction

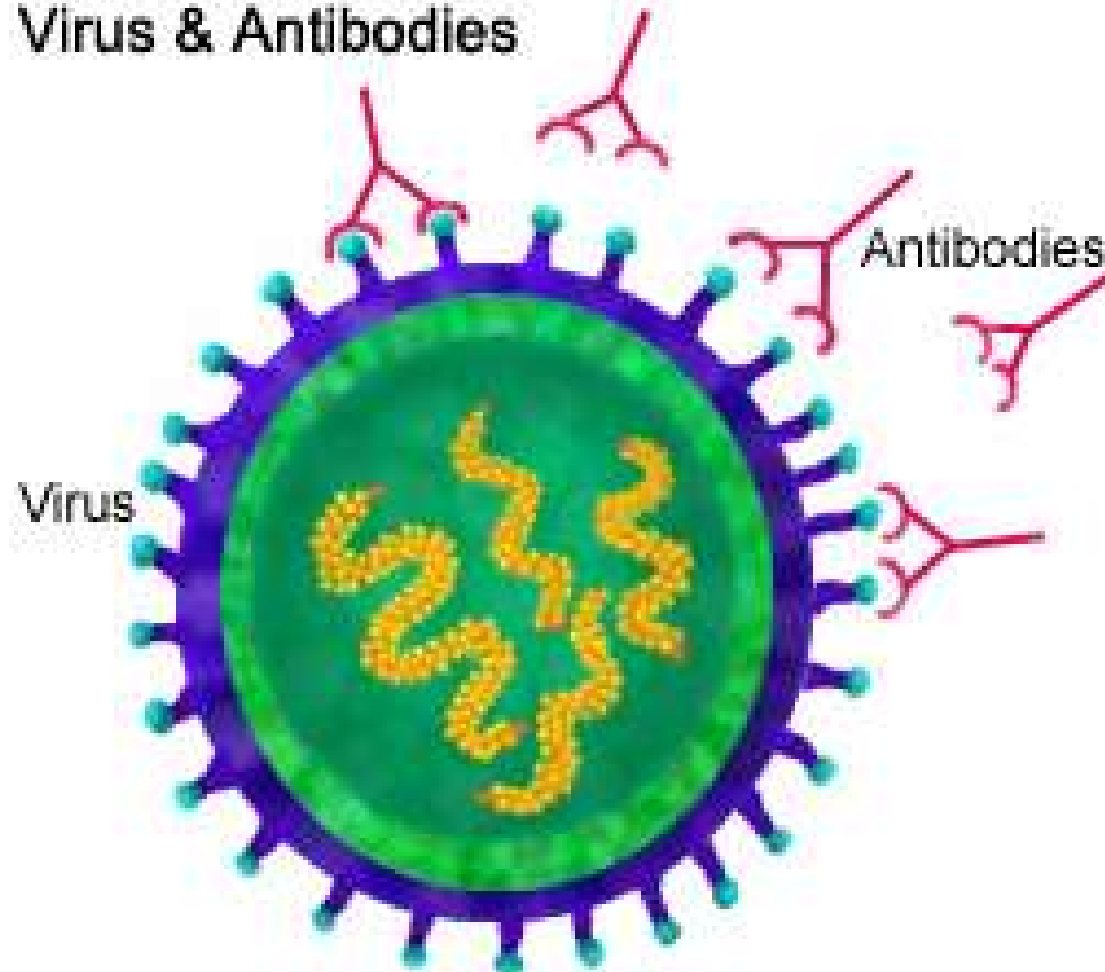
[How Rh factor affects a pregnancy \(2:21\)](#)

Lesson 3

White Blood Cell Types & Functions

Comic Strip

Virus & Antibodies



Antibodies surround the virus and bind to it. This prevents the virus from reproducing or being transported throughout the body.

[Antibodies Animation \(short\)](#)

Blood Cells



Monocyte



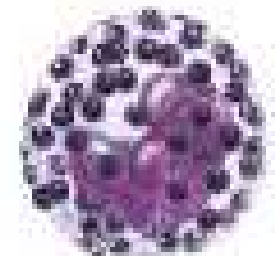
Lymphocyte



Neutrophil



Eosinophil



Basophil



Macrophage



Erythrocyte



Platelets

Leukocytes

white blood cells ~ WBC

agranular

granular

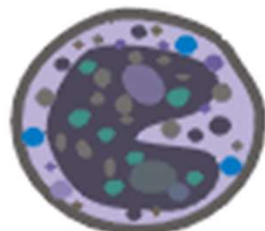
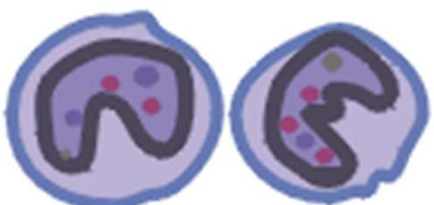
lymphocytes
20 - 25 %

monocytes
3 - 8%

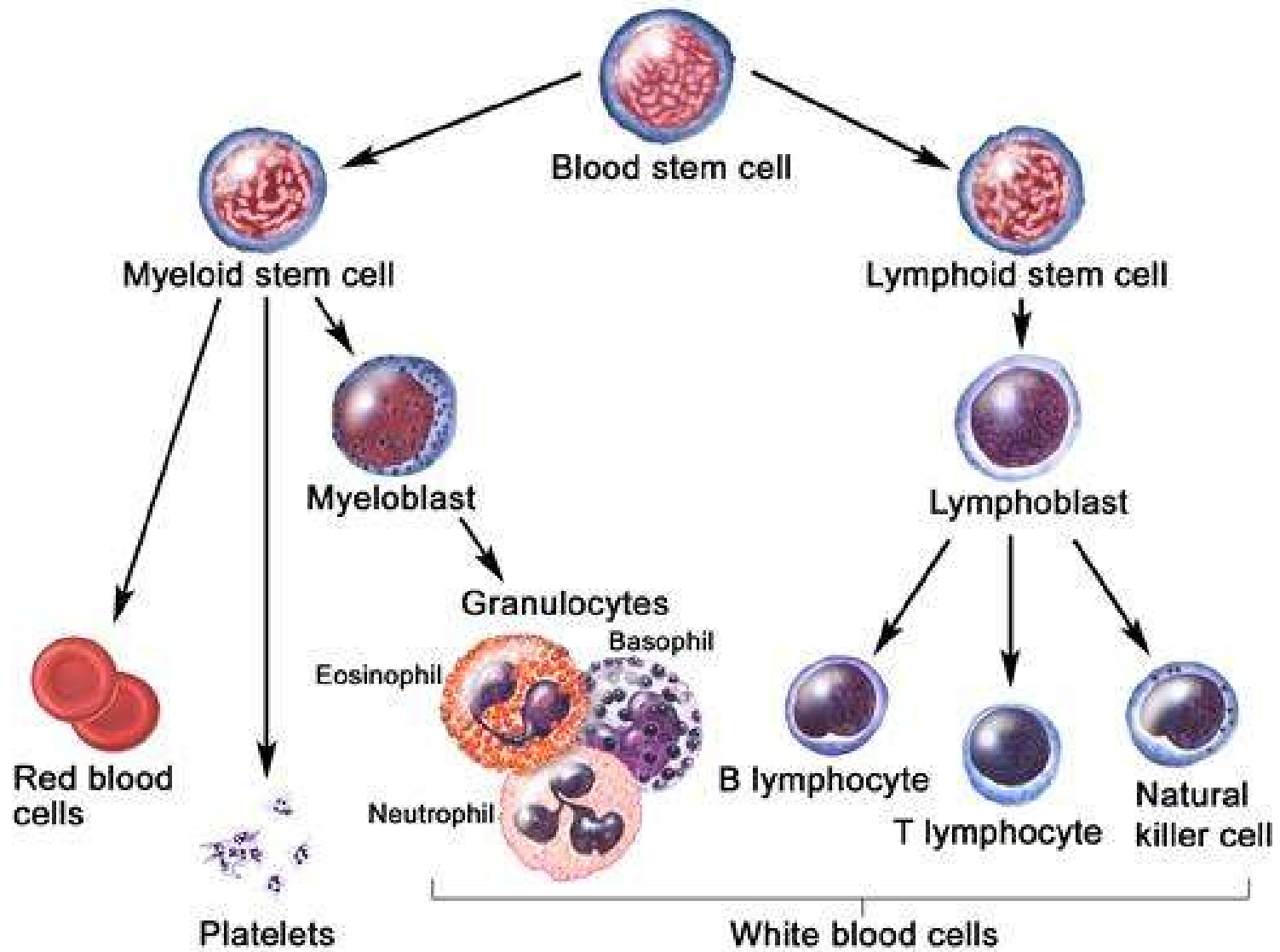
basophils
.5 - 1%

neutrophils
60 - 70%

eosinophils
2 - 4%

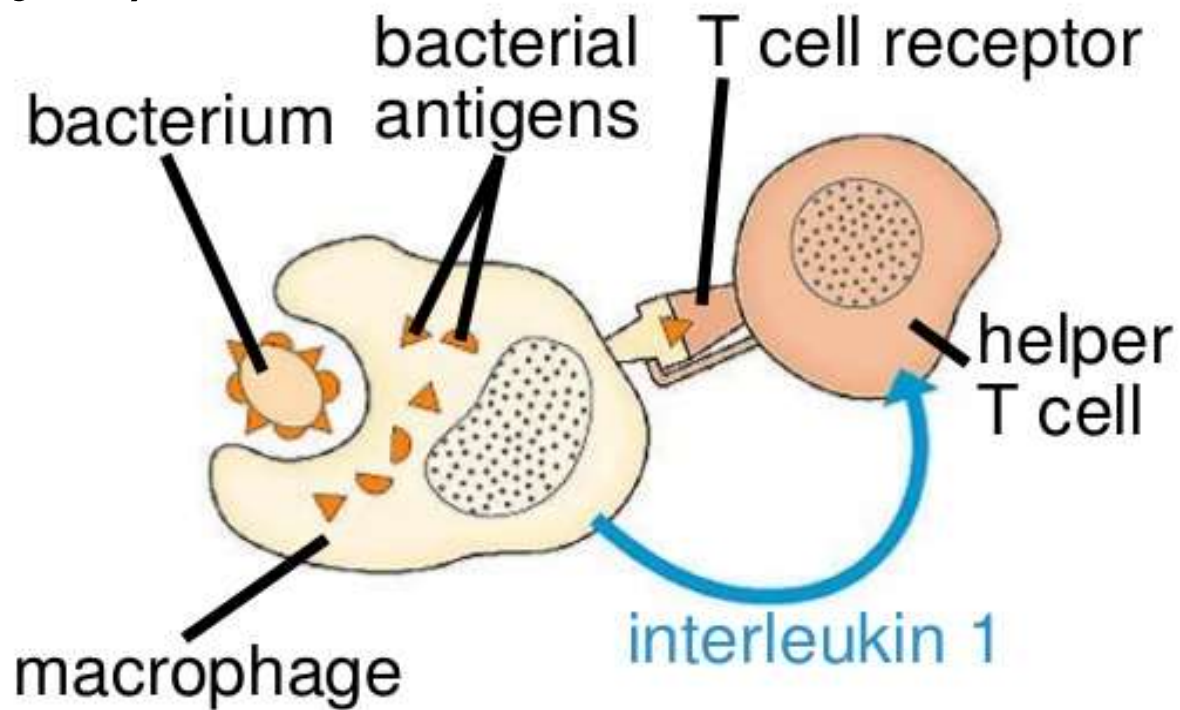


T-cell, B-cell, NK Cell



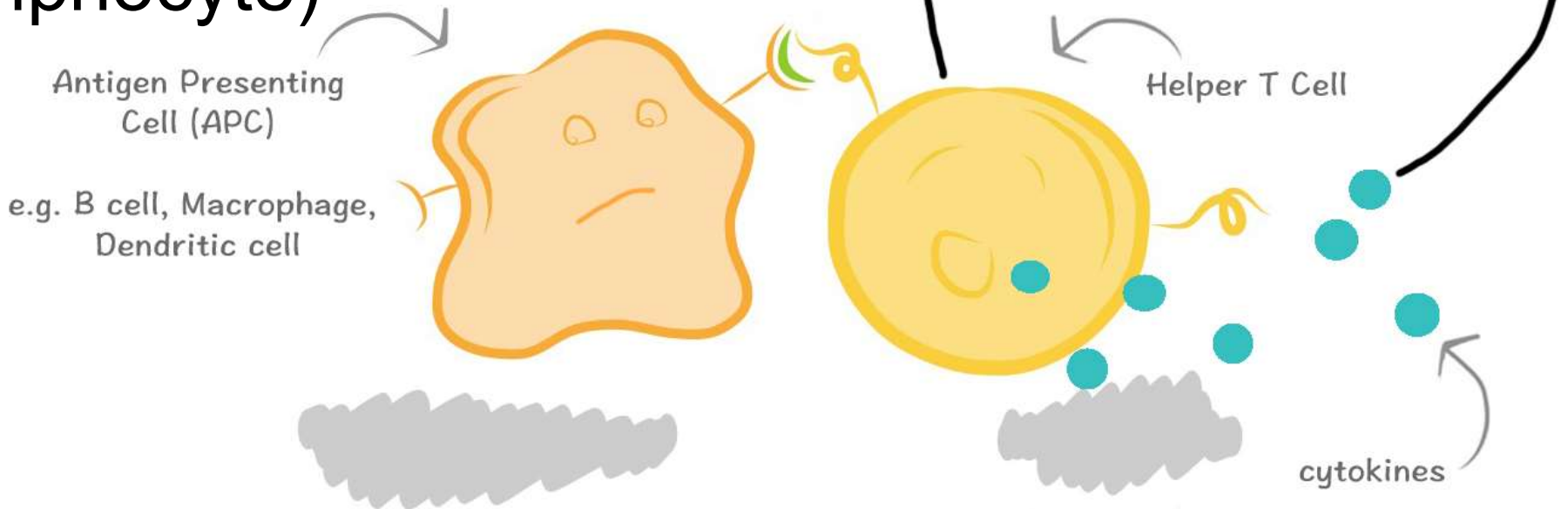
White Blood Cell Major Functions

1) Identify foreign antigens (Helper T-cells, a type of lymphocyte)



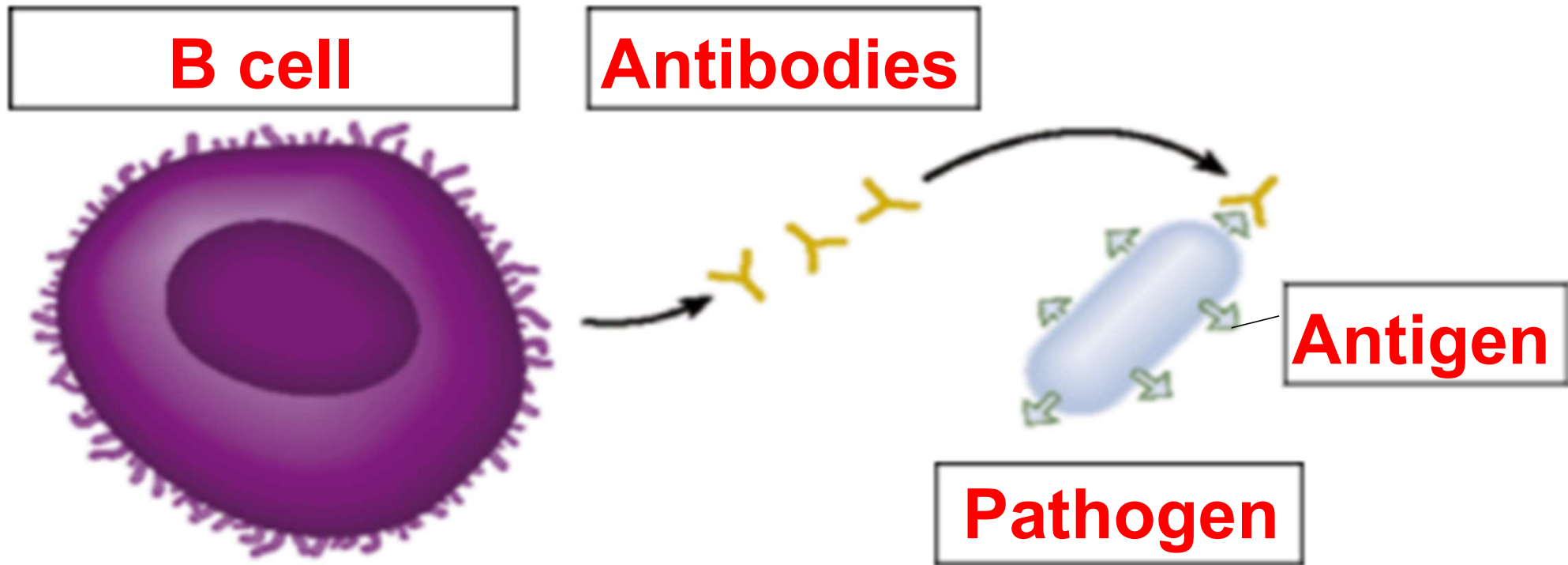
WBC Functions (con't.)

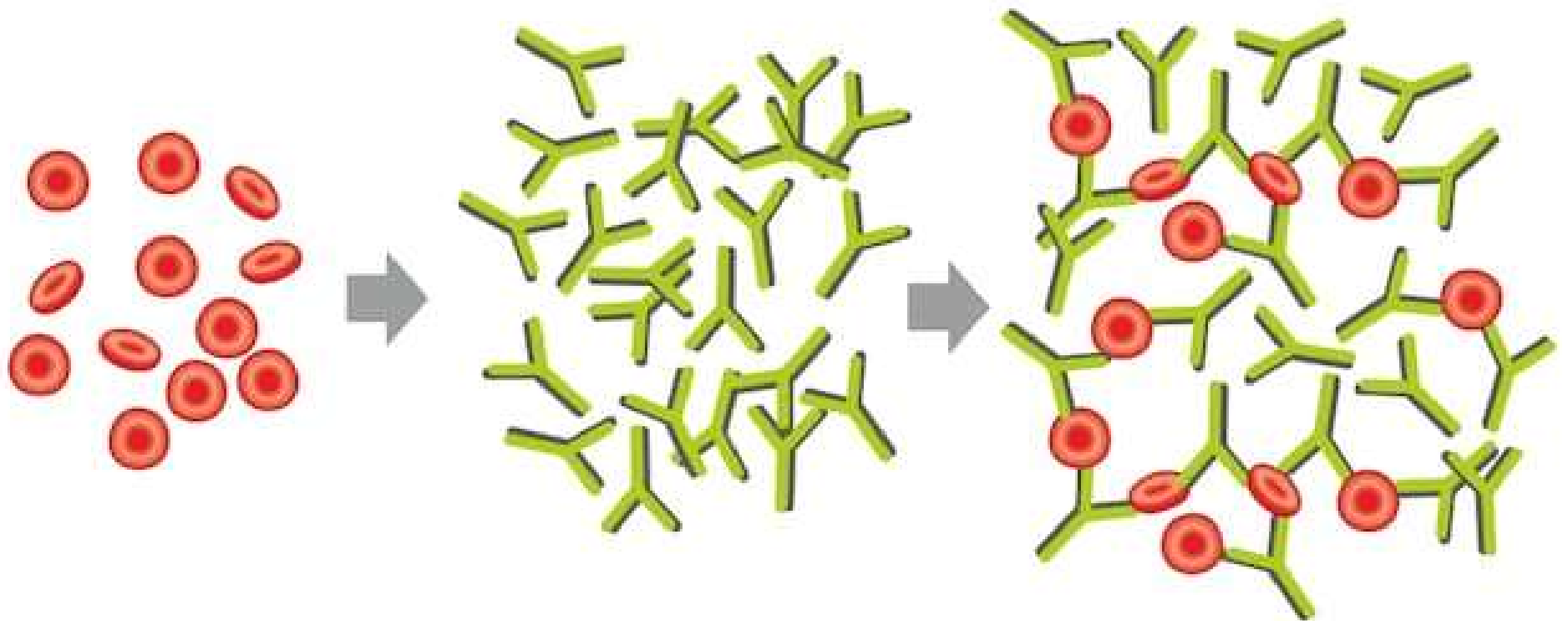
2) Direct /alert other white blood cells to increase production (Helper T-cells, a type of lymphocyte)



WBC Functions (con't.)

3) Produce antibodies (B-cells, a type of lymphocyte)

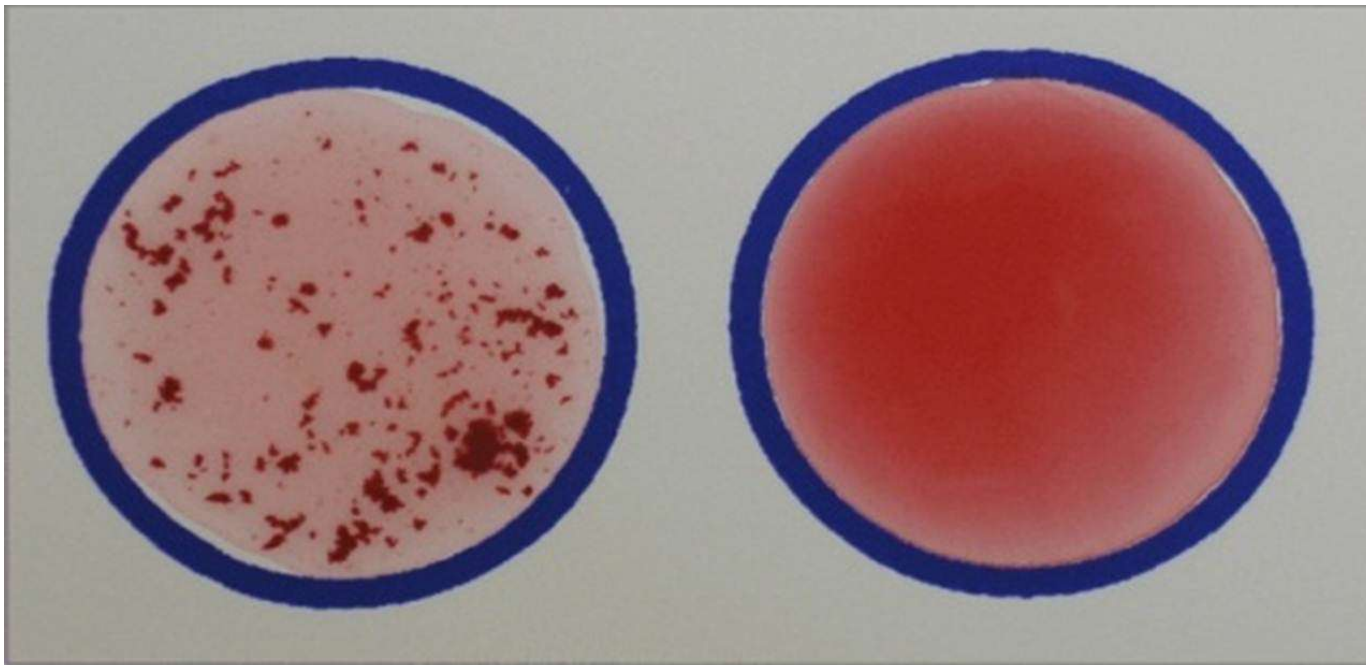




shutterstock.com • 791952742

Antibody-antigen reactions in RBC

Agglutination – clumping of RBC when antibodies bind to their specific antigens



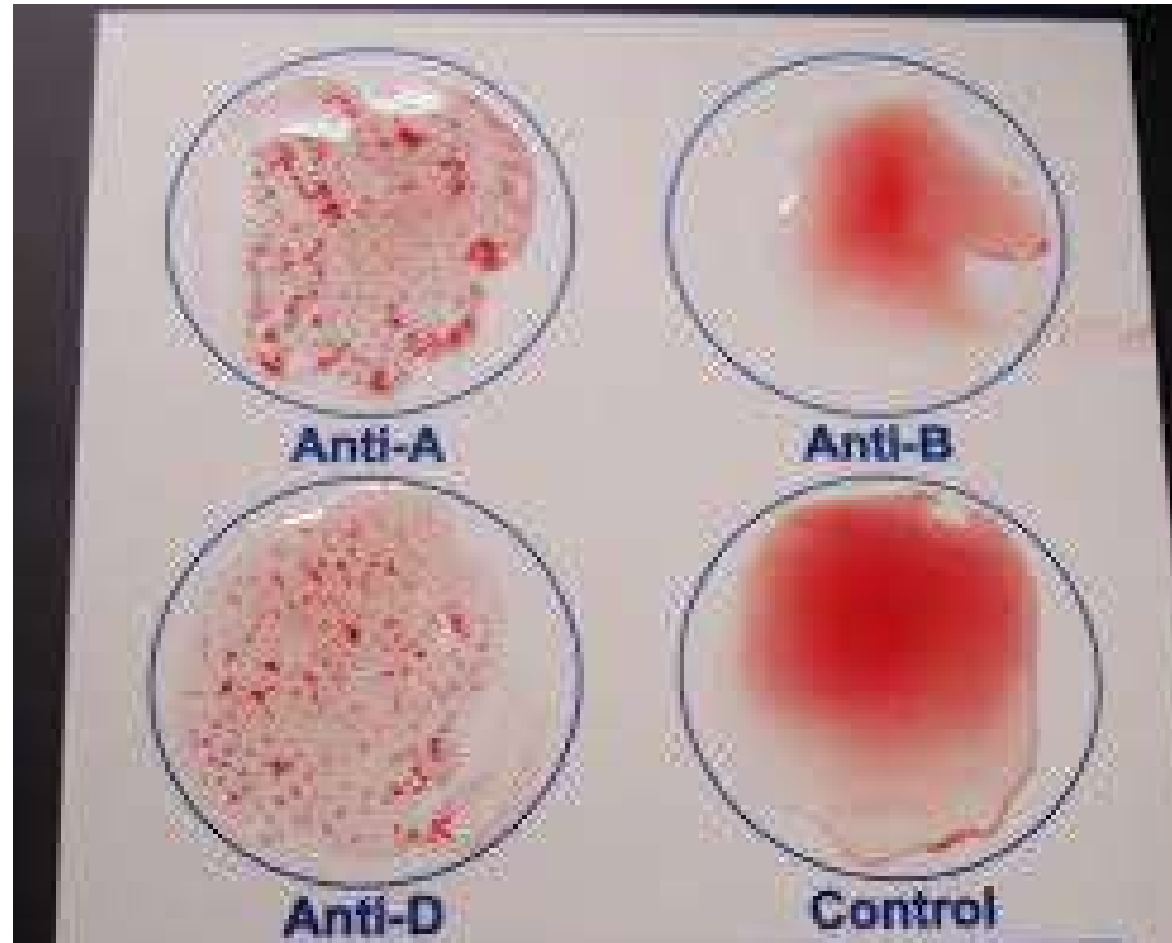
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Practice Blood Typing

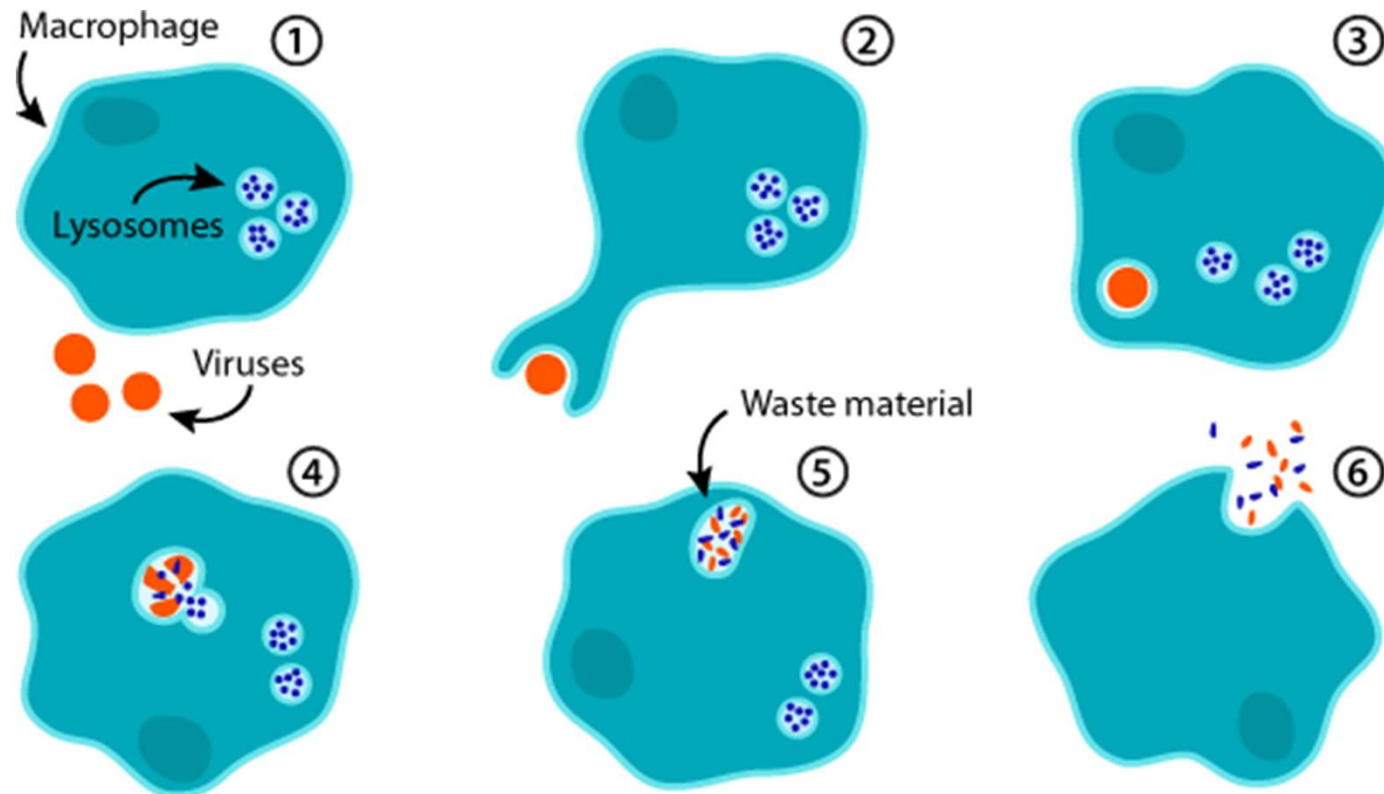
What blood type is this unknown sample if it produces these reactions when various antibodies are added to it?

Type A+ because it has the A and Rh antigens!

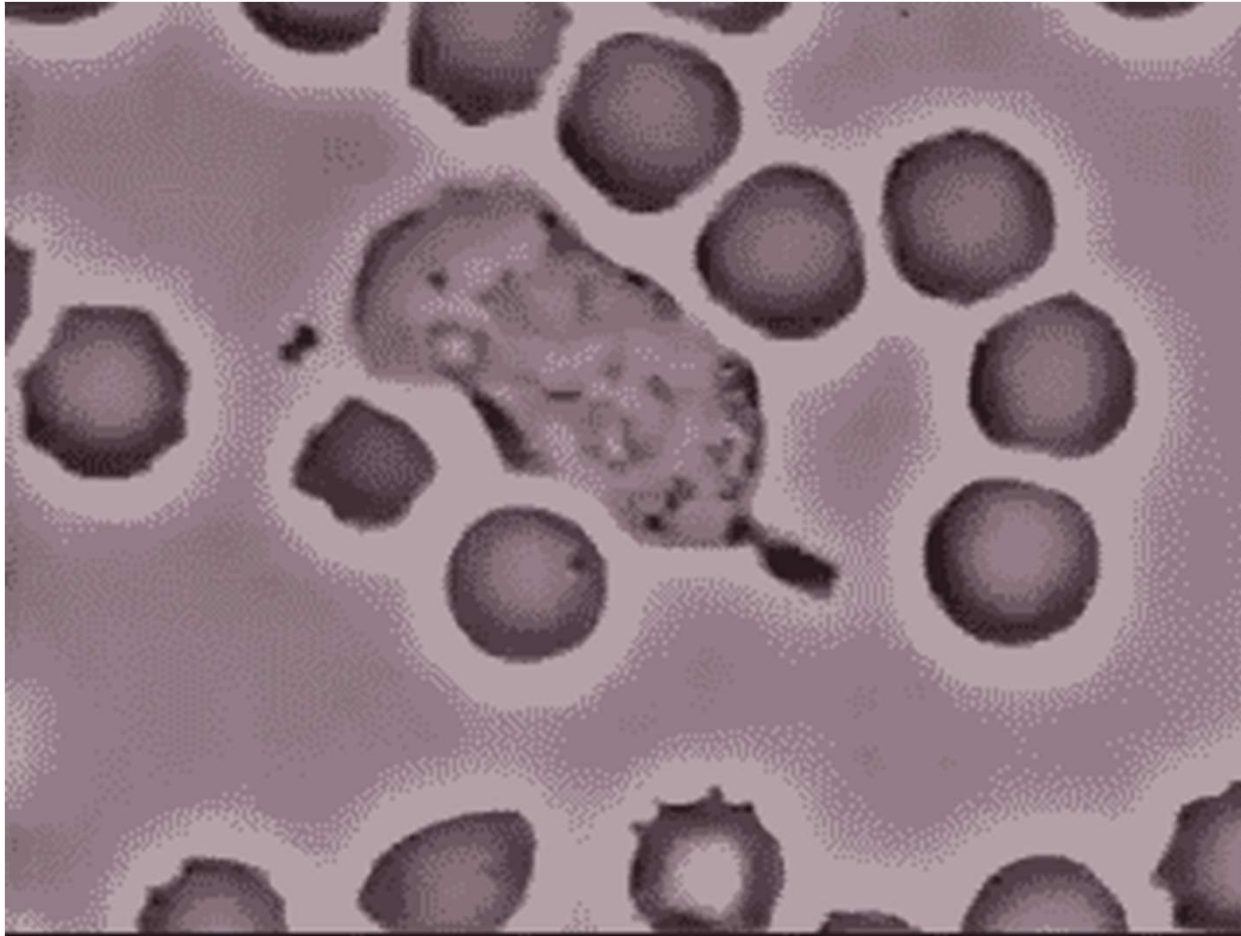


WBC Functions (con't.)

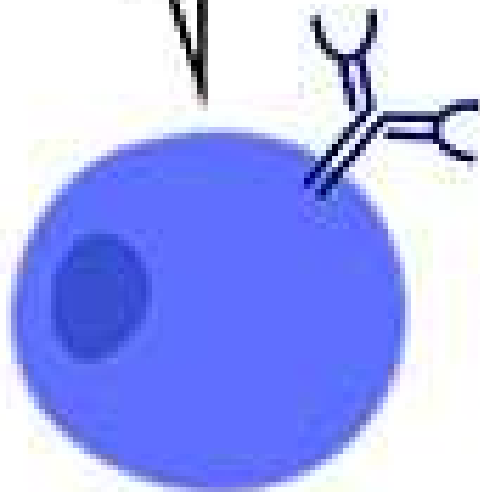
4) Engulf & destroy foreign invaders using phagocytosis (Macrophages / phagocytes)



Phagocytosis

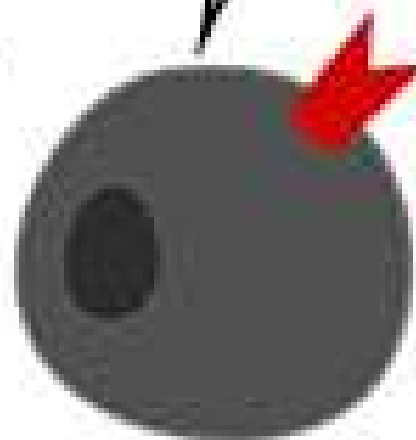


I attack
invaders outside
the cells.



B-Cells

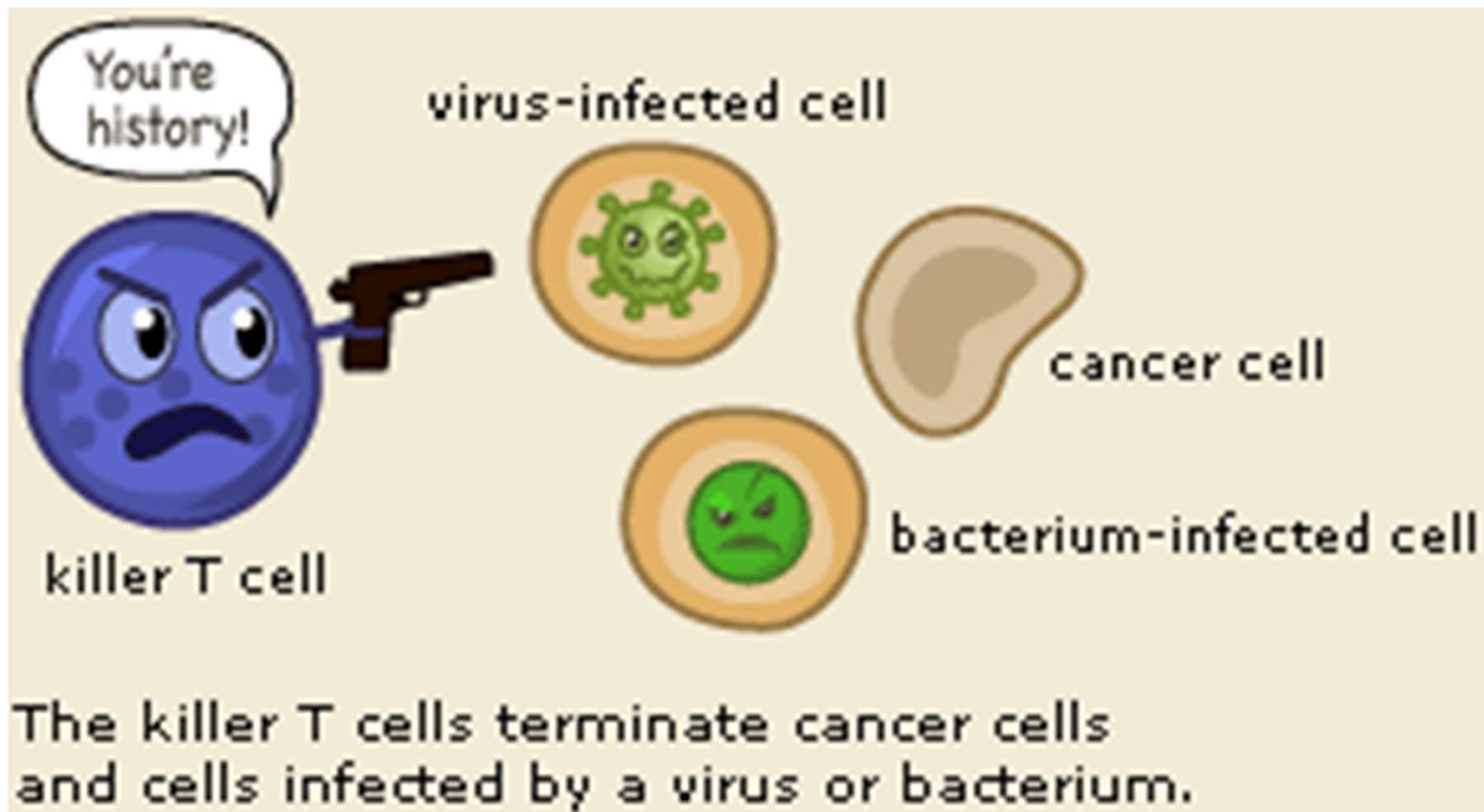
I attack
infected
cells.



T-Cells

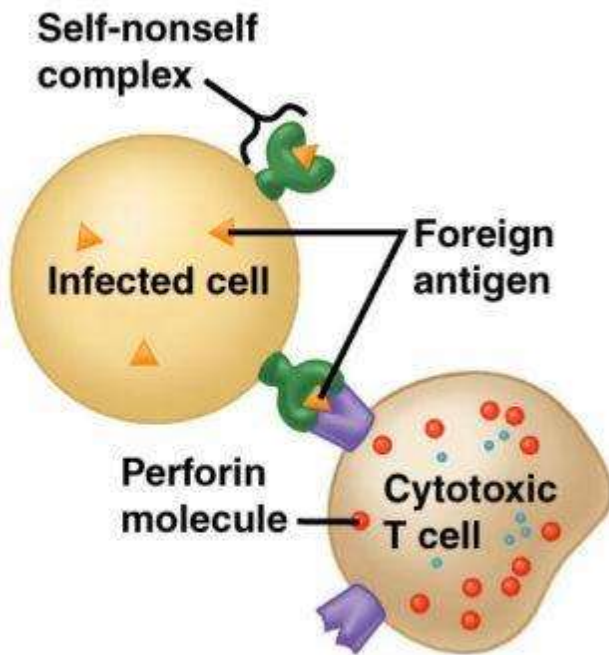
WBC Functions (con't.)

5) Kill infected, damaged cells (Killer T-cells, a type of lymphocyte, AKA cytotoxic T-cells)

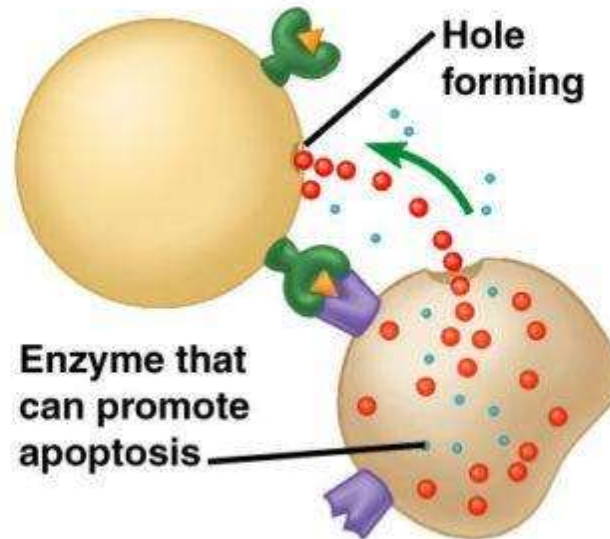


Apoptosis – controlled cell death

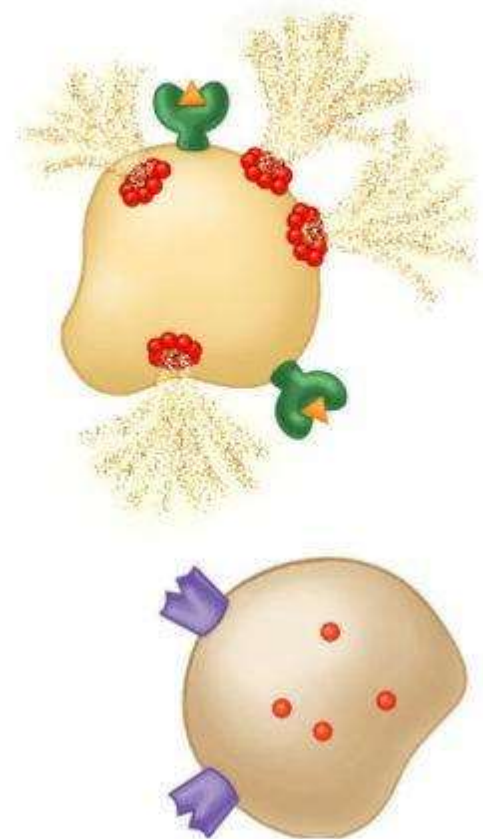
- 1** Cytotoxic T cell binds to infected cell to infected cell

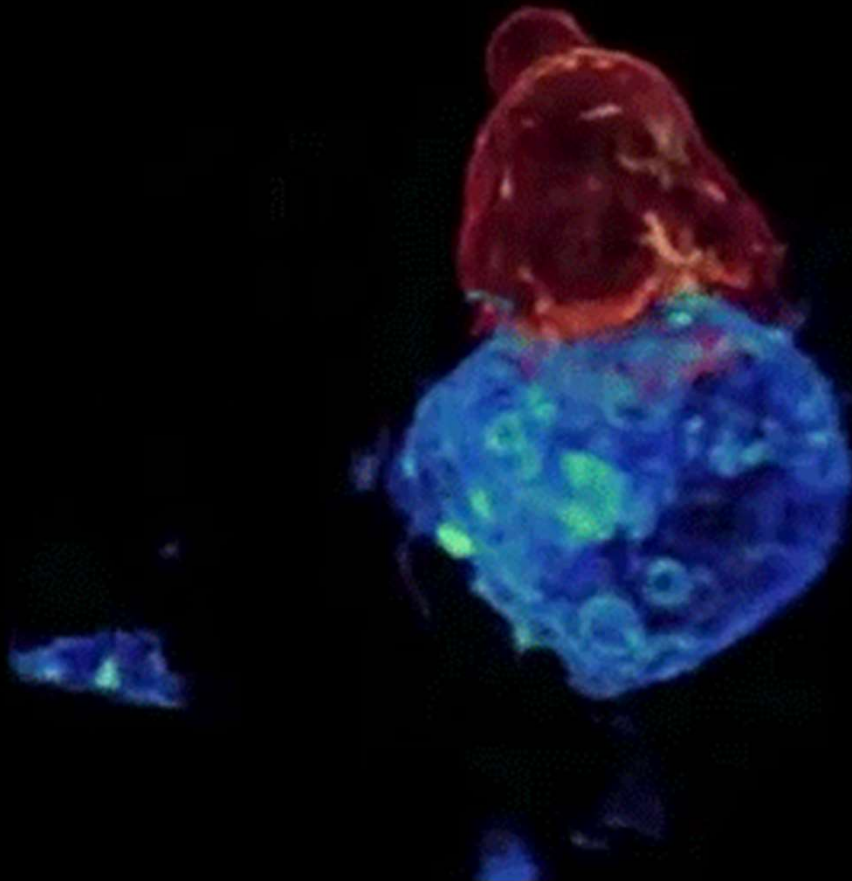


- 2** Perforin makes holes in infected cell's membrane and enzyme enters



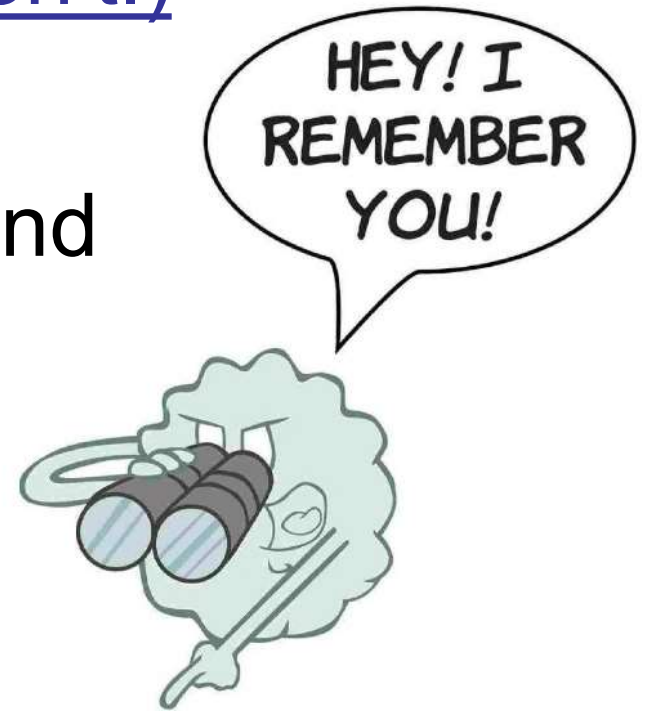
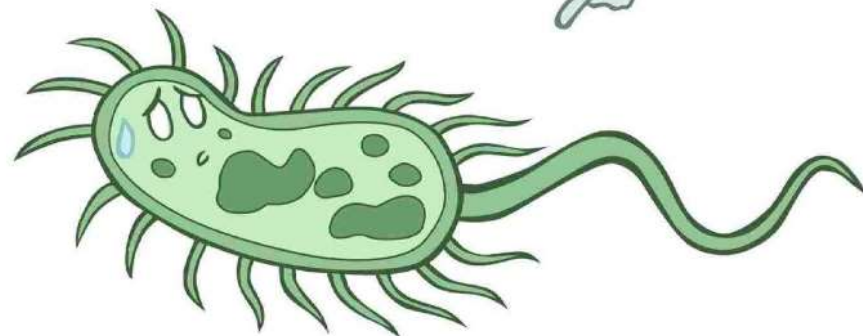
- 3** Infected cell is destroyed and is destroyed





WBC Functions (con't.)

6) Retain memory of how to fight specific pathogens (Memory B and T-cells)



Summary of WBC Functions

- 1) [redacted] foreign antigens (Helper T-cells)
- 2) [redacted] other white blood cells to increase production (Helper T-cells)
- 3) [redacted] (B-cells)
- 4) [redacted] & destroy foreign invaders using [redacted] (Macrophages / phagocytes)
- 5) [redacted] infected, damaged cells (Killer T-cells)
- 6) [redacted] of how to fight specific pathogens (Memory T-cells)

Summary of WBC Functions

- 1) Identify foreign antigens (Helper T-cells)
- 2) Direct /alert other white blood cells to increase production (Helper T-cells)
- 3) Produce antibodies (B-cells)
- 4) Engulf & destroy foreign invaders using phagocytosis (Macrophages / phagocytes)
- 5) Kill infected, damaged cells (Killer T-cells)
- 6) Retain memory of how to fight specific pathogens (Memory T-cells)

Are you “immune” to any diseases? Make a list!

Hepatitis B1 **HepB**

Rotavirus2 **RV RV RV2**

Diphtheria, Tetanus, Pertussis3 **DTaP DTaP DTaP**

Haemophilus influenzae type b4 **Hib Hib Hib4**

Pneumococcal5 **PCV PCV PCV**

Inactivated Poliovirus6 **IPV IPV**

Influenza7

Measles, Mumps, Rubella8

Varicella9

Hepatitis A10

Meningococcal11

Breastfeeding is best for baby

2

- ❑ **Ideal nutrition** to help baby grow
- ❑ **Less ear infections and respiratory infections**
- ❑ **Less gastrointestinal infections and diarrhea**
- ❑ **Less Sudden Infant Death Syndrome (SIDS)**
- ❑ **Less childhood obesity** which means less chance of diabetes and other illnesses later in life
- ❑ **Less allergies**
- ❑ **Higher IQ**
- ❑ **Formula provides NO protection against infection or illness**



Breastfeeding has benefits for mom, too

3

- ❑ **Less ovarian and breast cancer**
- ❑ Get back to pre-pregnancy weight quicker
- ❑ Easier
 - ❑ No bottles and nipples
 - ❑ No formula to prepare
- ❑ Saves money
 - ❑ Breastfeeding is free!
 - ❑ WIC only covers part of formula cost
 - ❑ Breastfeeding mothers get larger food packages from WIC than mothers who are formula feeding
- ❑ Breastfeeding hormones help mothers feel calm



SIgA

-"Secretory Immunoglobulin A"
-main mechanism for providing local immunity against infections in the gut or respiratory tract and is the main antibody in human milk. Not found in commercial formula.

Hanson, Lars A. *Immunobiology of Human Milk: How Breastfeeding Protects Babies.*

Website: texasmilkbank.org | Blog: texasbreastfeeding.org

Lacto·fer·rin

-A major milk protein that kills bacteria, viruses and fungi without inducing inflammation. Does not appear in commercial formula.

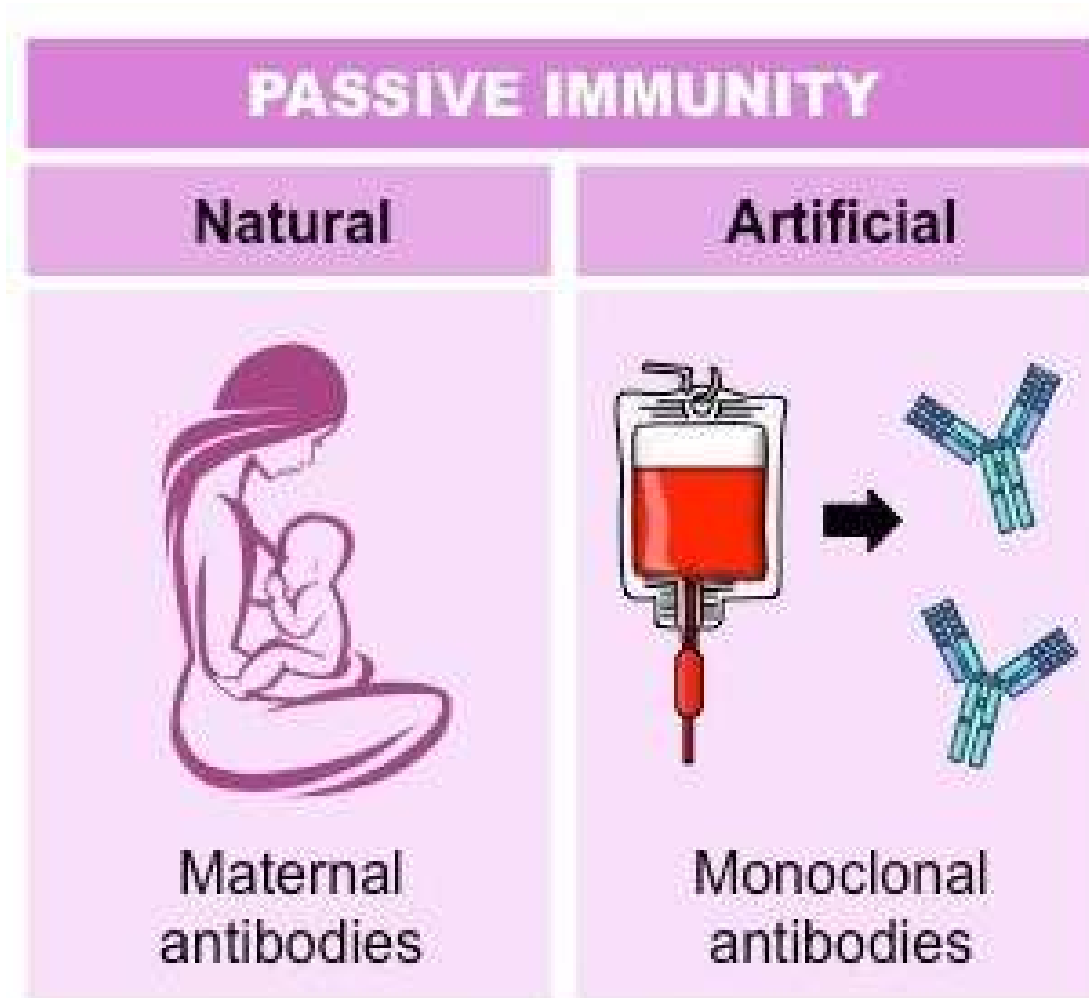
Hanson, Lars A. *Immunobiology of Human Milk: How Breastfeeding Protects Babies.*

Website: texasmilkbank.org | Blog: texasbreastfeeding.org

Types of Immunity

1) PASSIVE IMMUNITY

- Antibodies from an outside source, NOT made by the body
- Immediate but temporary (short term)



Examples of Passive Immunity

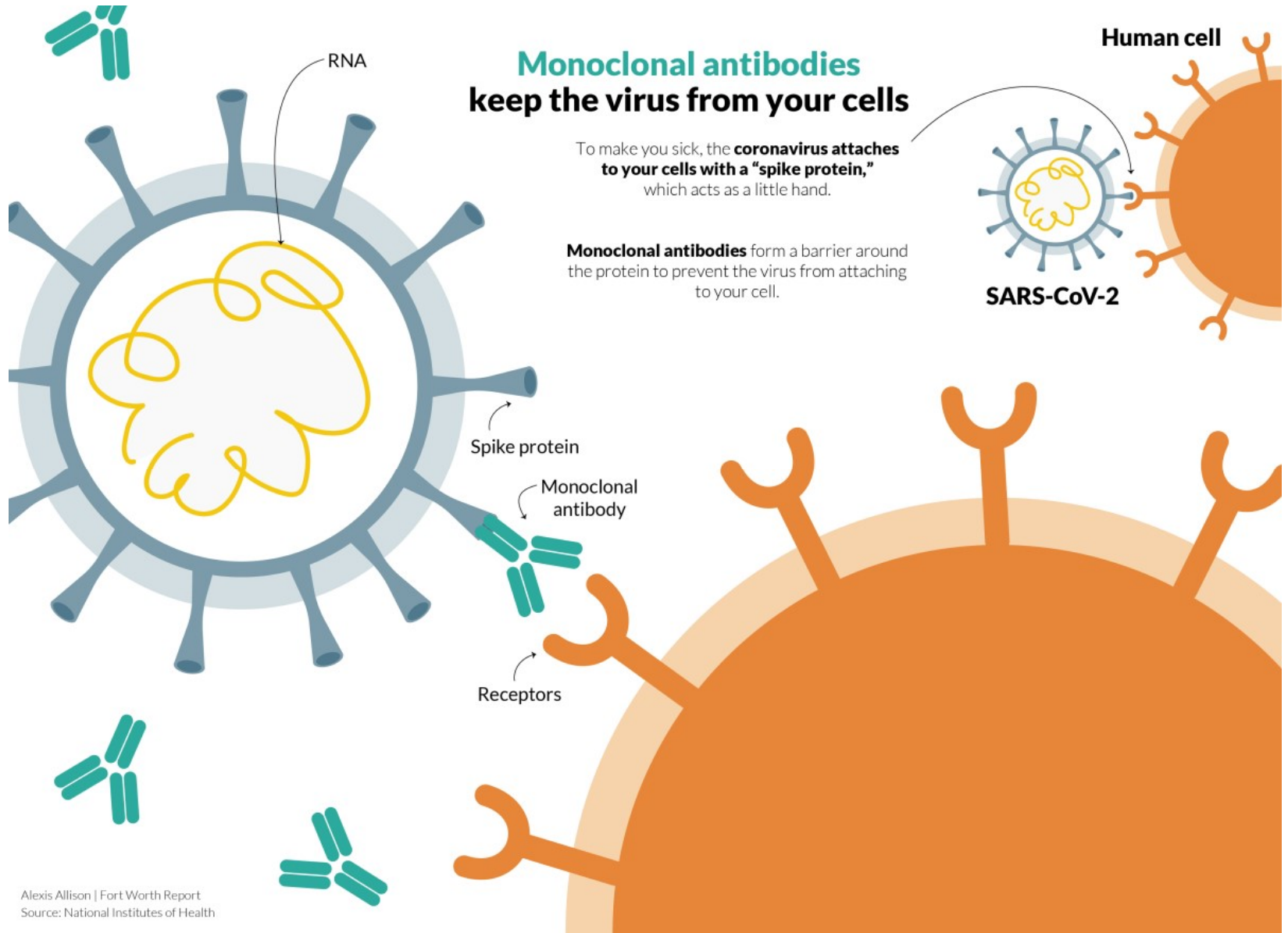
Ex. Breast Milk:

Mother's antibodies pass to the baby



Rabies/Tetanus shots: injection of antibodies after exposure

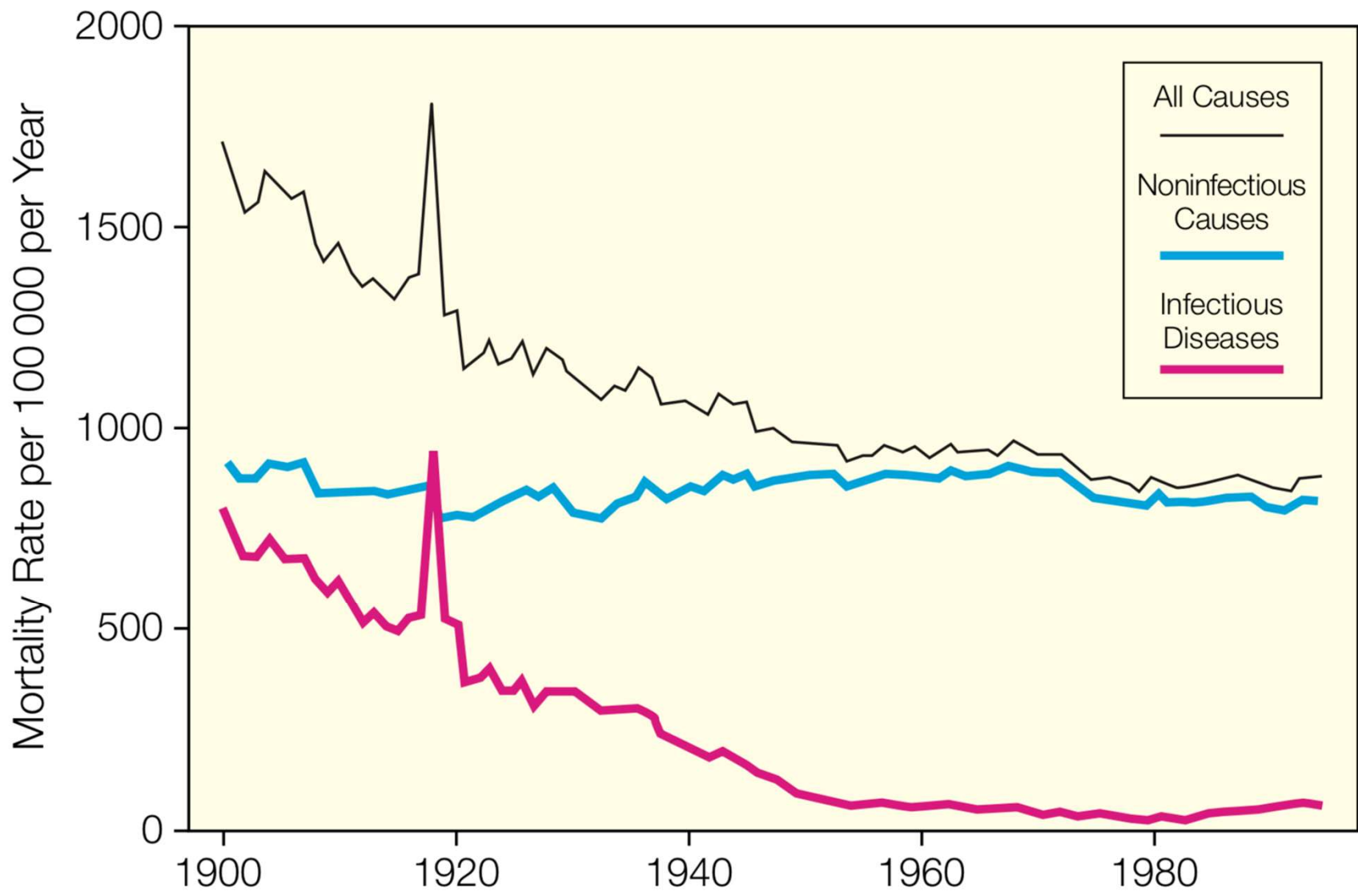




Antibody Therapy

- Treatment that administers antibodies to help the body fight infection, cancer, or other diseases





Antibiotics

- chemical substances naturally produced by microorganisms
- inhibit (stop) the growth of, or destroy bacteria
- Penicillin, produced by mold was the 1st antibiotic (discovered in 1928)



Usage of Antibiotics

- Only work on BACTERIAL infections, NOT viral
- Avoid overuse to preserve effectiveness as some germs become resistant over time
 - Ex. Only take antibiotics that are prescribed to YOU
- Finish the full prescription even if you feel better sooner





VS

Antibody Therapy

A protein that binds to the virus and stops it from infecting you

Treats those who are already infected with the COVID-19 virus

As soon as it is given

Weeks to months

Vaccine

A piece of the virus your immune system can recognize

Trains the immune system to fight against the COVID-19 virus

1-2 weeks after both doses are given

Years to lifetime
(may need boosters)



What is it?

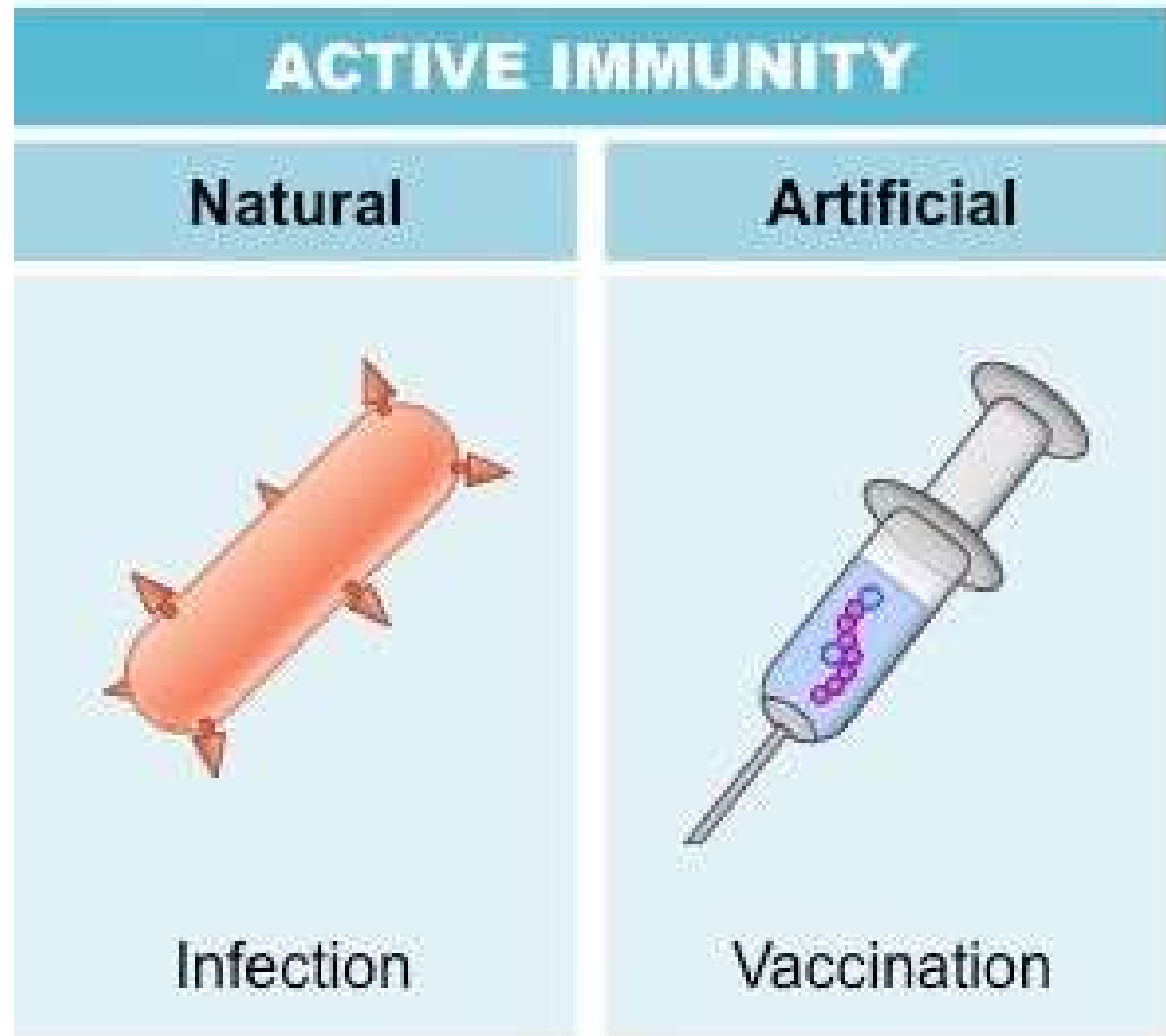
What is it for?

How fast does it work?

How long does the protection last?

2. ACTIVE IMMUNITY (AKA Adaptive Immunity)

- Antibodies are PRODUCED by the body
- PERMANENT (long term) due to
- immunological memory



Natural Active Immunity

Contract & Survive the Disease

- ex. chicken pox
- WBC initiate immune response, produce specific antibodies to fight it off providing immunological memory
- Should not get sick from that exact pathogen again



ADAM

★ **Note:** MANY strains (kinds) of viruses cause “the common cold” so you get many different “colds”

Vaccination / Vaccine

- Contains a small amount of a dead or weakened pathogen (or its antigens) is injected into the body
- Stimulates WBC to produce specific antibodies
- prepares the body for future invasions by that same microbe so it can be fought off more easily (immunological memory)

Does NOT exist for all pathogens
(none for the common cold)



Vaccination / Vaccine (continued)

[Video - Last of the Iron Lungs \(Polio Survivors\)](#)

- ★ **Note:** MANY different “strains” (varieties) of viruses cause the flu so you need a new flu shot each flu season



[Brainpop - Flu](#)

[Brainpop - Vaccines](#)

HPV Vaccine (Human Papilloma Virus)

- Group of viruses
- Cause warts but might not show symptoms
- Linked to cancer of the cervix, vulva, vagina, penis, or anus



HPV is a common virus that infects teens and adults.

80%

of people will get an HPV infection in their lifetime.

HPV VACCINE IS CANCER PREVENTION

The infographic features a white background with a purple border. At the top, it states 'HPV is a common virus that infects teens and adults.' Below this, there are ten human figures arranged in two rows of five. The top row has five purple figures, and the bottom row has three purple figures and two grey figures. To the right of the figures is a large purple box containing the text '80%'. Below the figures and the percentage box, it says 'of people will get an HPV infection in their lifetime.' At the bottom left is the CDC logo, and at the bottom right is the text 'HPV VACCINE IS CANCER PREVENTION'.

Vaccine ?



Yes

No

THE LANCET

Volume 354, Number 9205, 12 May 2000, Pages 1121-1200
ISSN 0950-2688
www.thelancet.com

Q. Do Vaccines Cause Autism?

A. Nope.

The myth began in 1998, when an English medical journal called **The Lancet** published a paper which claimed a link between autism and the Measles, Mumps, and Rubella vaccine (MMR).

Vaccines do not cause autism. The debate is OVER.

REJECTED

By the medical
community

REJECTED

By the scientific
community

REJECTED

By the research
community

REJECTED



REJECTED

By the autistic
community

REJECTED

By people with
autism

This myth is busted by science.

www.facebook.com/PCCVGN



Benefits of the flu vaccine from the Centers for Disease Control (CDC)

The estimated number of flu **illnesses prevented** by flu vaccination during the 2015-2016 season:

5 million

as many people use Denver International Airport in one month



The estimated number of flu **medical visits prevented** by vaccination during the 2015-2016 season:

2.5 million

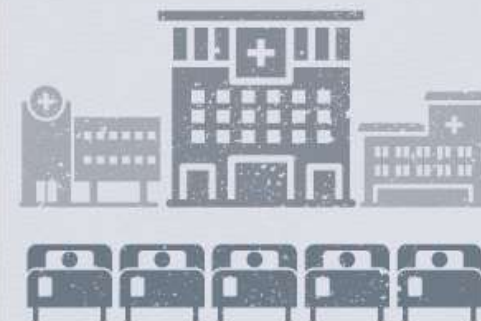
equal to the population of Portland, Oregon



The estimated number of flu **hospitalizations prevented** by vaccination during the 2015-2016 season:

71,000

enough to fill every registered hospital bed in the state of Texas



DATA: Influenza Division program impact report 2015-2016, <https://www.cdc.gov/flu/about/disease/2015-16.htm>.

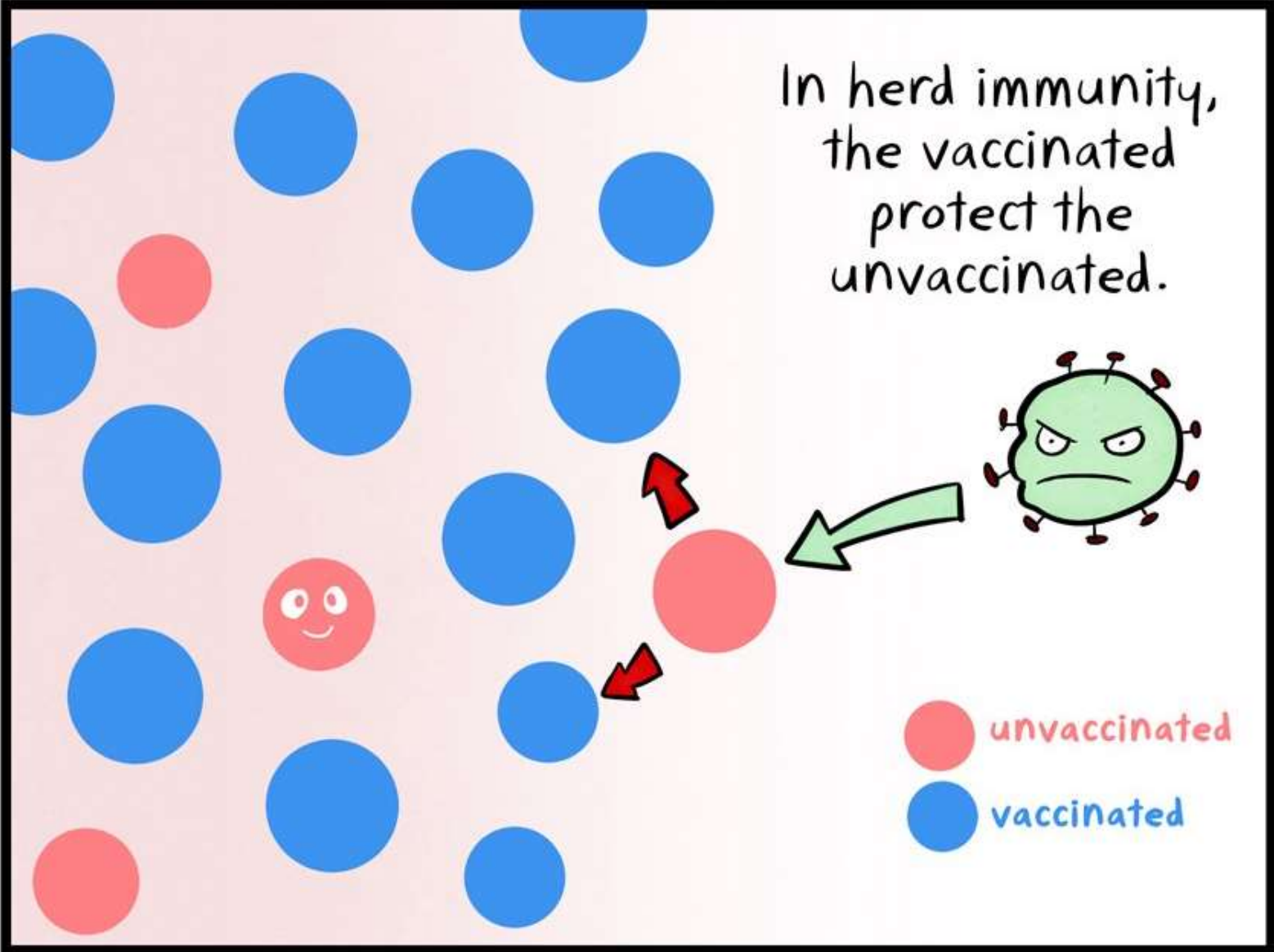
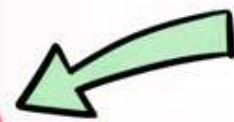
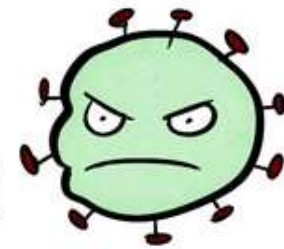
NCIRDig-607 | 12.06.2016



U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

get **vaccinated**
www.cdc.gov/flu

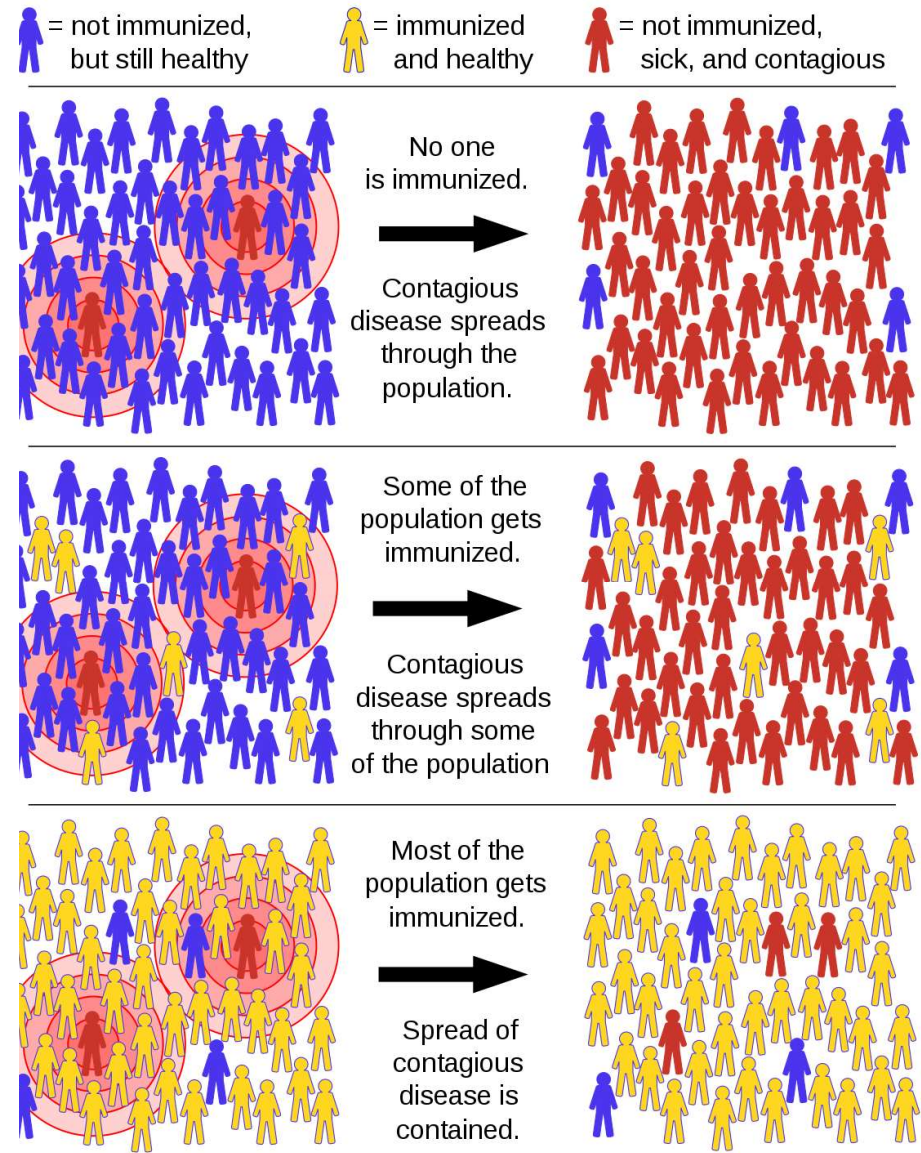
In herd immunity,
the vaccinated
protect the
unvaccinated.



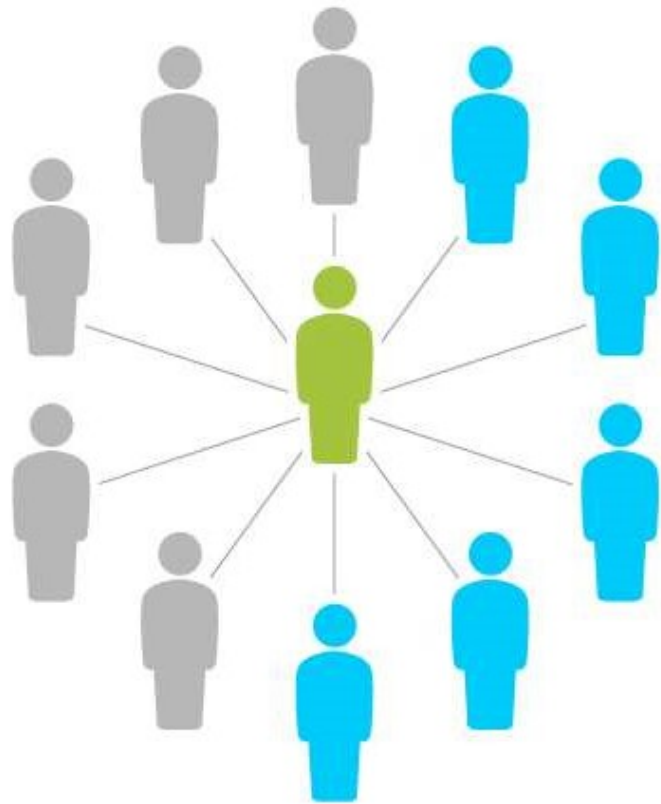
● unvaccinated
● vaccinated

Herd Immunity

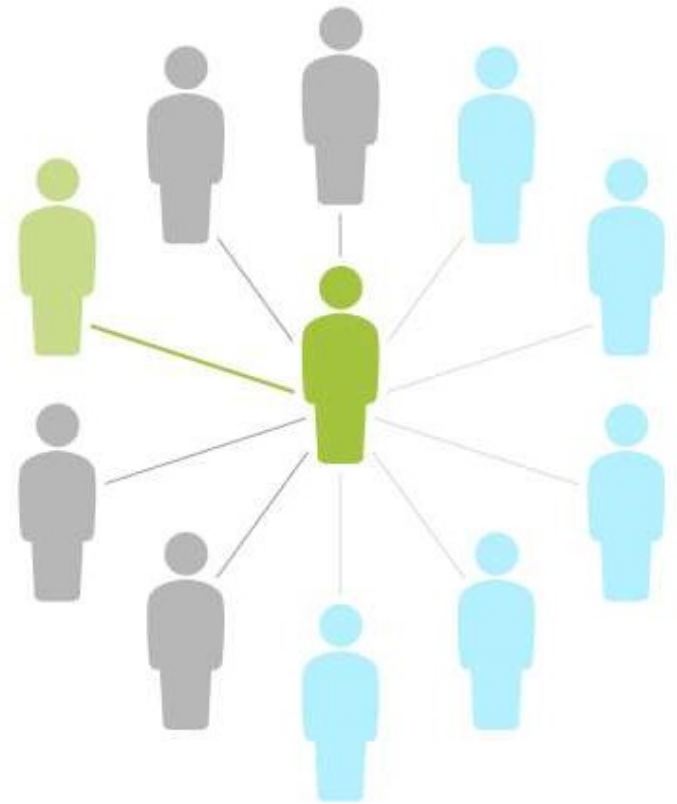
- indirect protection from an infectious disease
- a population develops herd immunity either through vaccine or previous infection
- Important to protect those unable to be vaccinated
–(ex. babies and immunocompromised individuals)



If enough people are immune, the virus has fewer pathways to spread.



5 people are immune

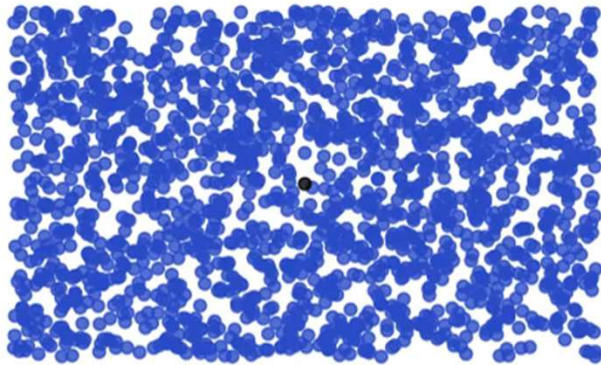


Only one person becomes infected

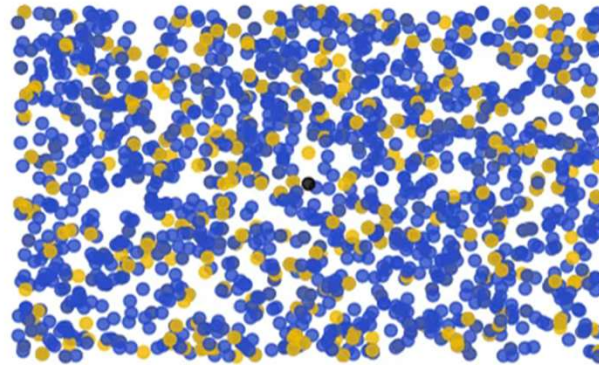
Press Play!

Herd Immunity: How It Works

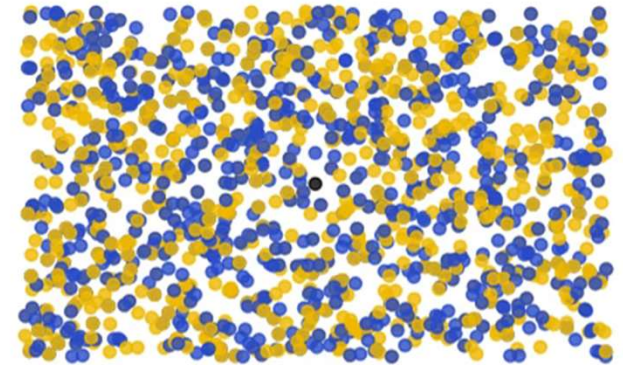
Percent Vaccinated: 0%



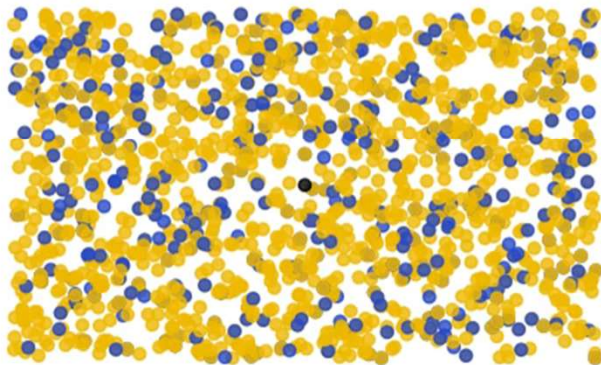
Percent Vaccinated: 25%



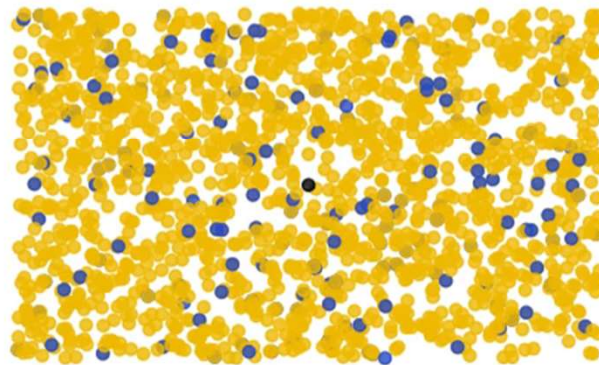
Percent Vaccinated: 50%



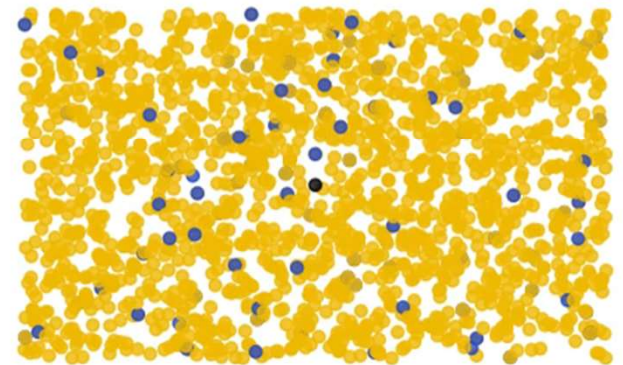
Percent Vaccinated: 75%



Percent Vaccinated: 90%



Percent Vaccinated: 95%



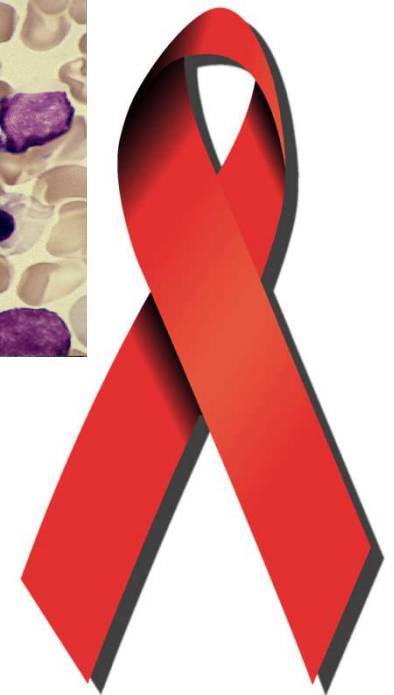
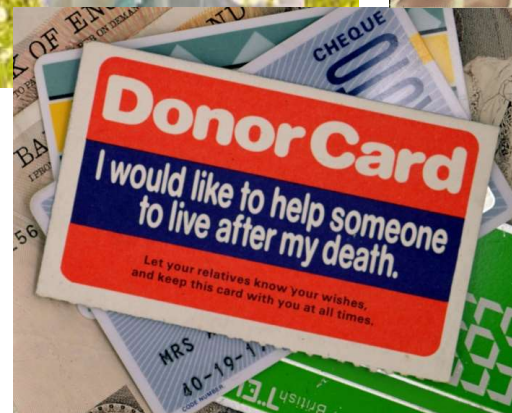
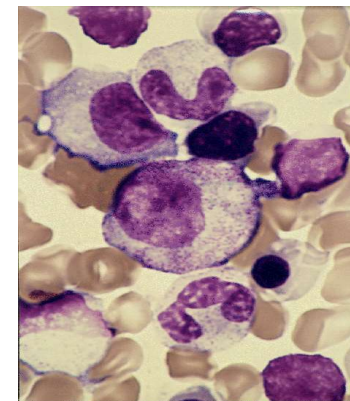
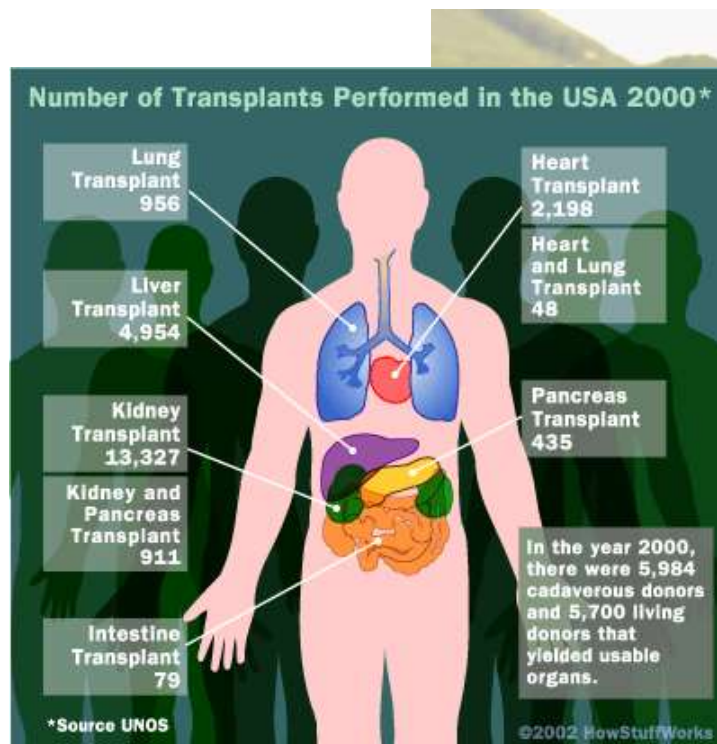
• Infected • Unvaccinated • Vaccinated

Lesson 5

Immune Disorders

- Allergies
- Organ transplant rejection
- AIDS
- Autoimmune diseases

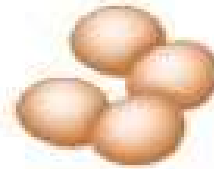
Malfunctions and Disorders of the Immune System



[Histamines video](#)



Cows' milk



Hen's eggs



Peanuts



Tree nuts, e.g. walnuts



Shellfish



Fish

1. Allergic Reactions

- A hypersensitive response to substances (allergens) that are not normally harmful
 - Pollen
 - Peanuts, shell fish
 - Cat/dog hair or dander
- causes chemical histamine to be produced (leads to itching, swelling, rash)



2. Rejection of Organ Transplant

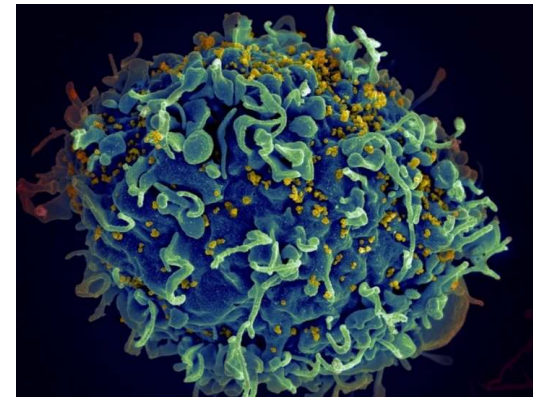
- Recipient produces antibodies against foreign antigens in the donor's tissues
- Getting the closest “match” reduces risk
- Recipient takes immunosuppressant drugs to prevent the body from rejecting the new organ
 - They are able to get sick (ex. a cold) more easily



[Face Transplant Video](#)

3. AIDS (Acquired Immune Deficiency Syndrome)

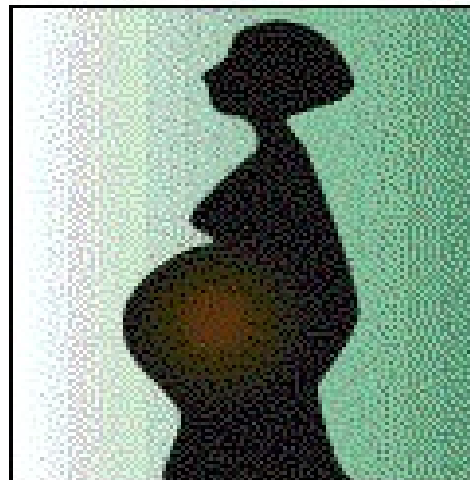
- Caused by **HIV** (Human Immunodeficiency Virus) (a Retrovirus)
 - Transmitted through bodily fluids (blood, semen, vaginal fluids, **NOT** sweat or saliva)
 - Prevention:
 - Safe sex (use condoms)
 - Don't share needles (IV drug use)
 - Disease transmission education



[Reverse Transcriptase Video](#)

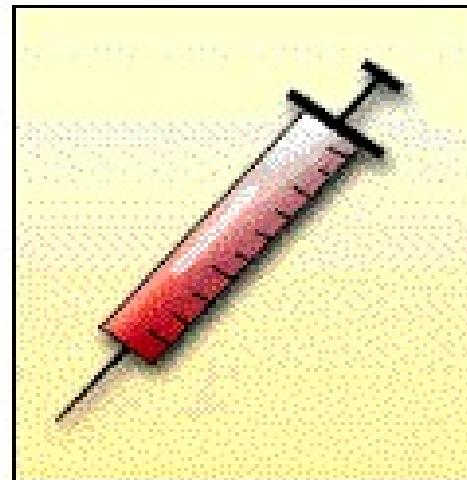


**Unprotected
sexual intercourse
with an infected partner**

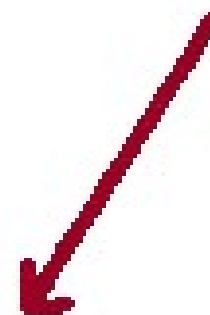
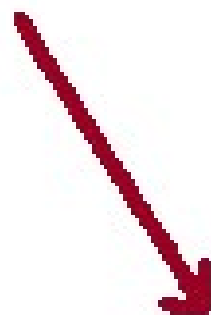


**Vertical
transmission**
(from mother
to child)

- in utero
- during delivery
- breastmilk



Injection drug use
(rare: infected
blood/blood products)

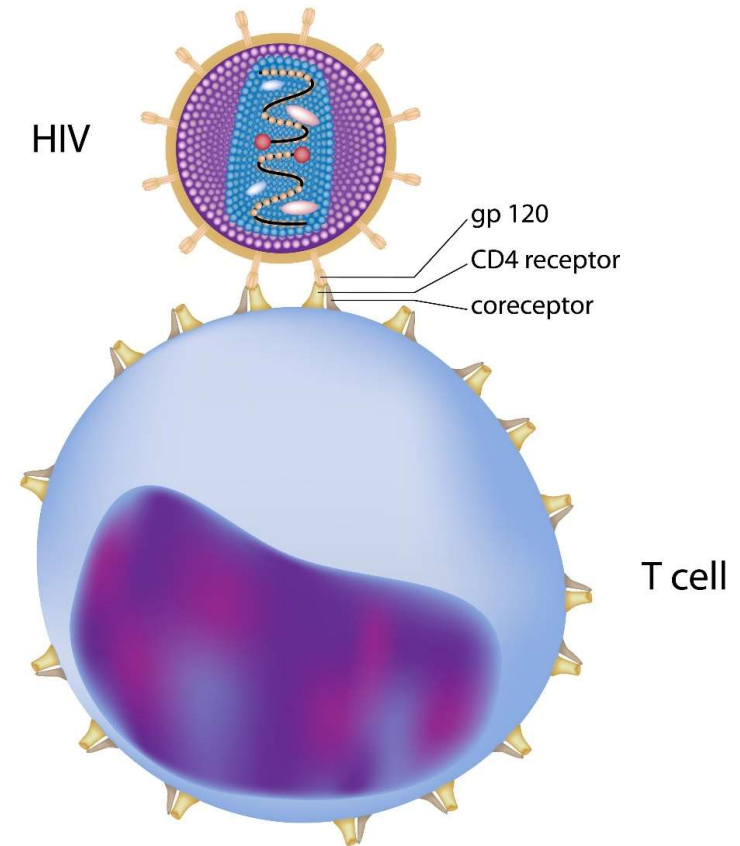


HIV INFECTION

AIDS (con't.)

- Attacks CD4 T-Cells (Helper WBC that direct others)
 - Prevents infected person from fighting other infections like pneumonia or a cold
- Virus reproduces rapidly and mutates (changes), making it hard to target with drugs

HIV attachment to receptors on target T cell



[Video - Dr. Fauci Why is it so difficult to develop HIV vaccine?](#)

AIDS (con't.)

[Video - HIV/AIDS vaccine?](#)

- A first-of-its-kind HIV vaccine, SAV001, in phase II trials in 2017
- Will be tested on 600 people in North America, to see how well it can prevent them from getting the virus



Chil-Yong Kang and a research team at Western's Schulich School of Medicine & Dentistry

HIV Lifecycle

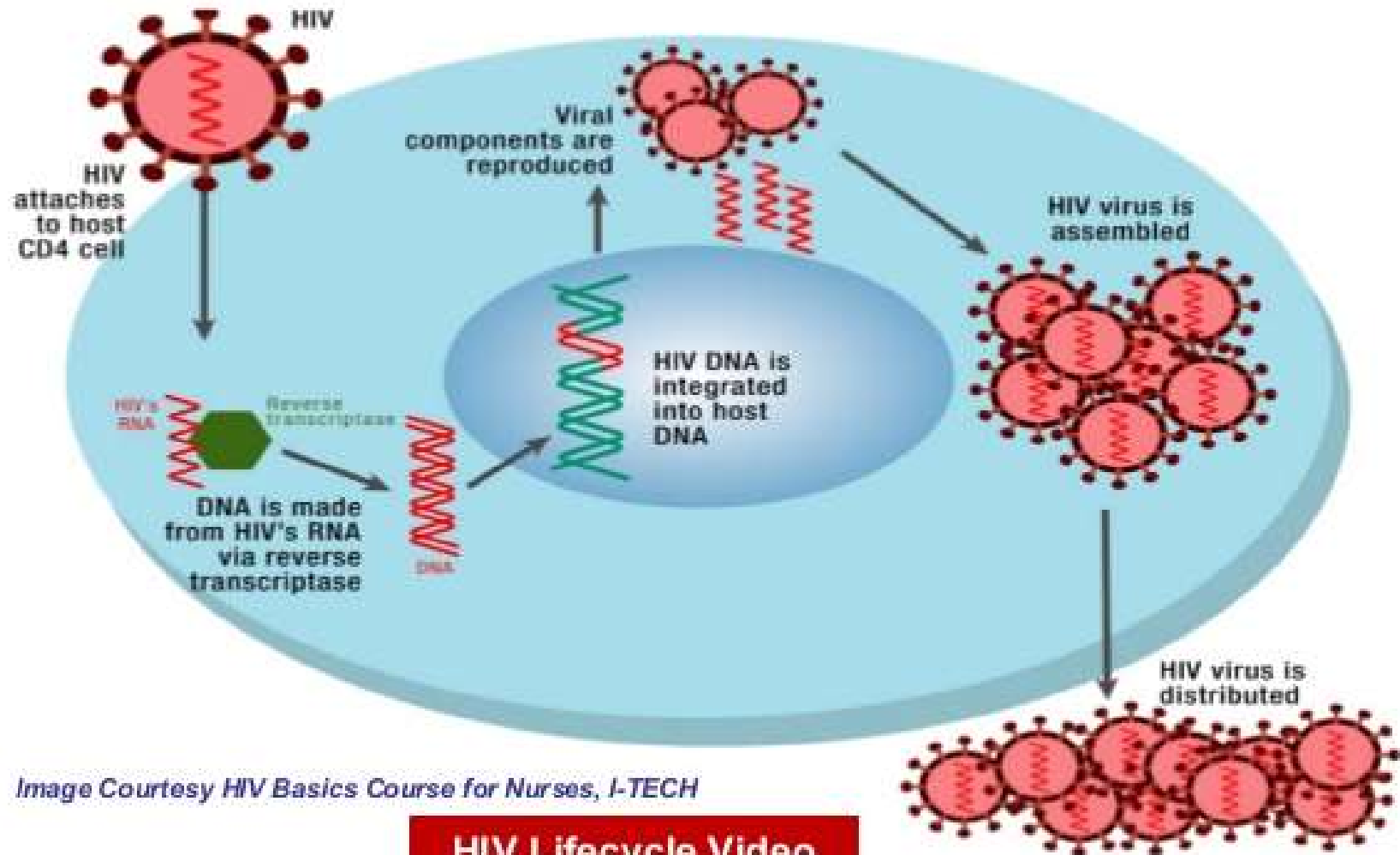


Image Courtesy HIV Basics Course for Nurses, I-TECH

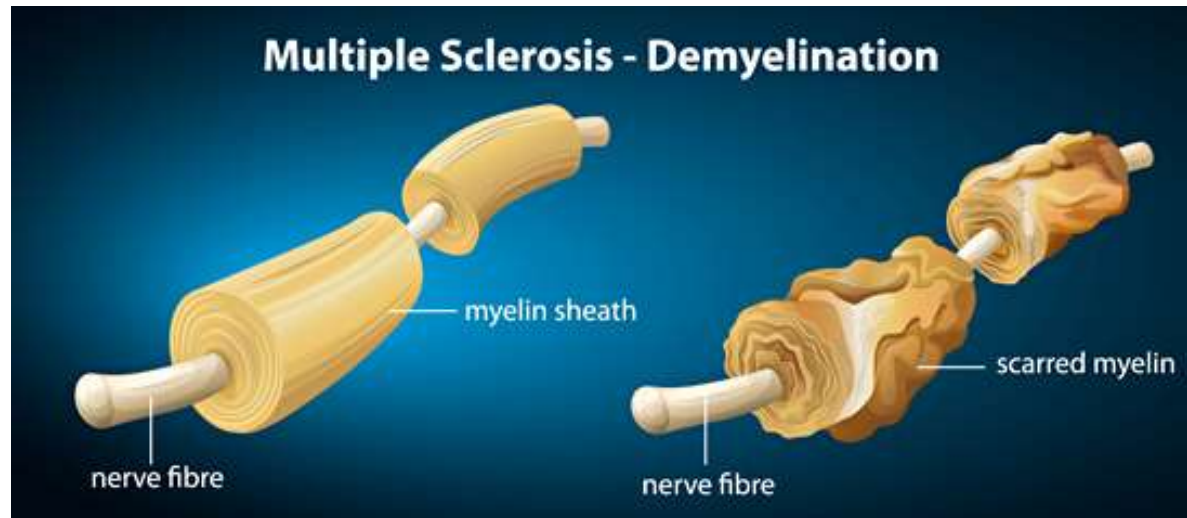
HIV Lifecycle Video

Natural History of HIV

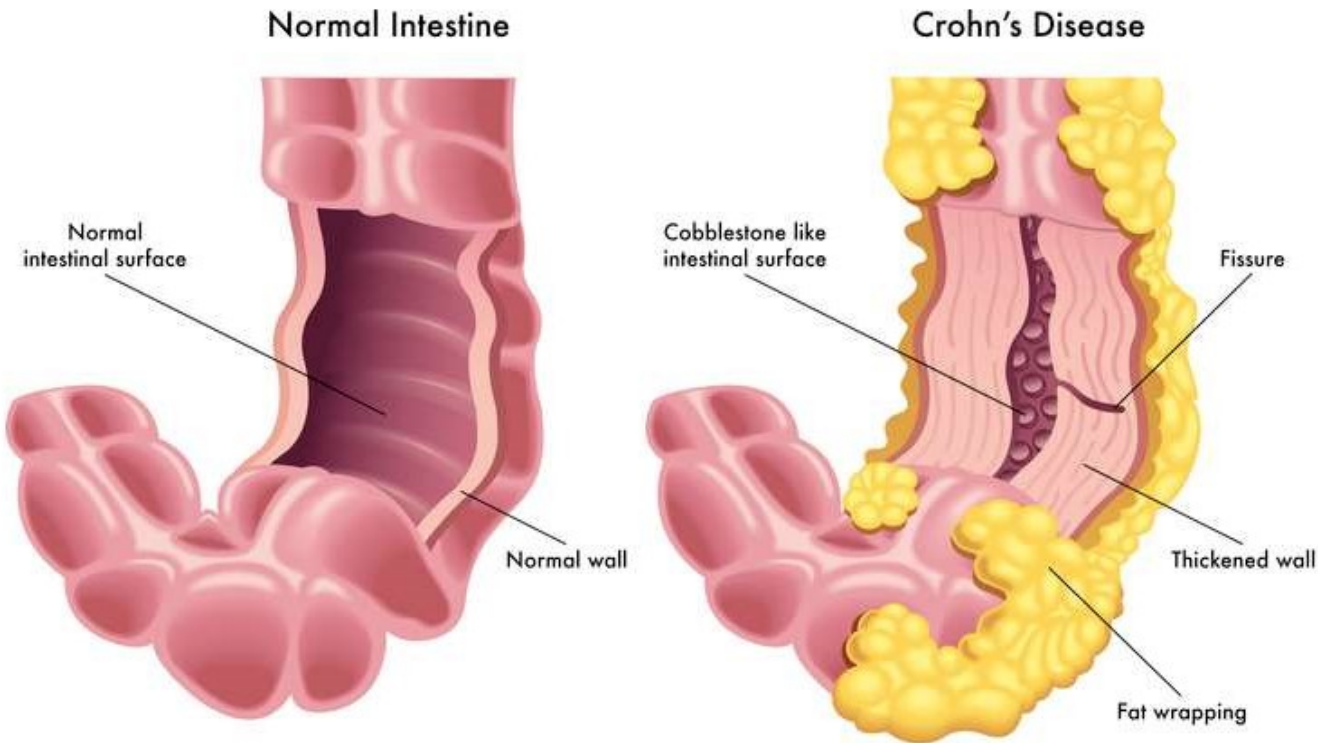
11/10/20

4. Autoimmune Diseases

- The immune system attacks the body's OWN cells
 - Ex. Multiple Sclerosis (MS)
 - Destruction of myelin sheath on nerve cells
 - May lead to blindness, loss of motor function



- Ex. Crohn's disease
 - Immune system attacks intestinal lining
 - Leads to diarrhea, rectal bleeding, abdominal pain



Other examples:

- Rheumatoid arthritis
- Type 1 Diabetes
- Lupus
- Psoriasis