The Immune System

- **Immune System**
  the system that fights infection by producing cells to inactivate foreign substances to avoid infection and disease.
- **Immunity**
  the body's ability to fight infection through the production of antibodies by inactivating foreign substances.

2 Types of Defense Mechanisms

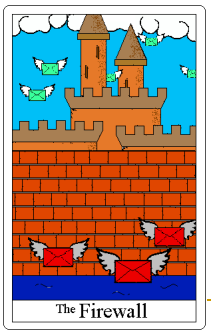
Nonspecific Defenses

- 1st & 2nd line defenses
  - Can not discriminate between invaders.

Specific Defenses

- 3rd line defense
  - specific defenses for specific pathogens.

Barriers to Defend Our Body From Pathogens



3 Lines of Defense

1st line defense

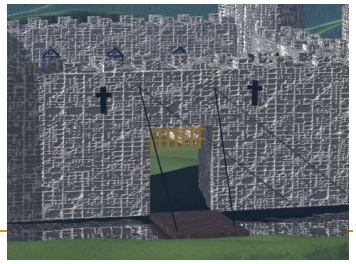
2nd line defense

3rd line defense

Lines of Defense

- **1st line of defense**
  - consists of ***barriers*** against invasion.

Ex: wall around a castle



Lines of Defense

- **2nd line of defense**
  - ***chemicals*** and ***cells*** that attack pathogens that get past the first "wall".

Line of Defense

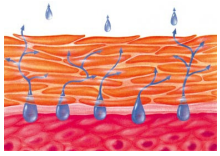
- **3rd line of defense**

- targets **specific** pathogens.

- responsible for identifying and remembering to attack the same pathogens in the future.

Ex: **soldiers**

The 1st Line Defense

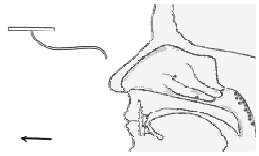


Physical Barrier

- **Skin**
- **Cilia**

Chemical Barrier

- **Sweat & oil glands**
- **Saliva**
- **Tears**
- ***Stomach acid/enzymes***



2nd Line Defense: Barriers

- **Pathogens** invade the 2nd line of defense.

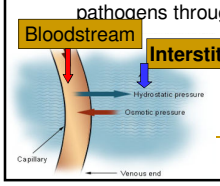
2nd Line of Defense Includes:

1. White blood cells destroy pathogens
2. Inflammatory response
3. Specialized proteins

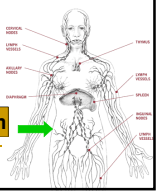
1. WBCs (leukocytes)

WBCs Attack!!!!! White blood cell destroy pathogens.

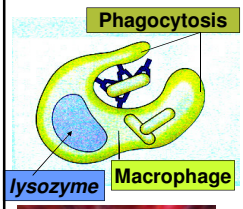
- Travel the bloodstream, *lymphatic system,* and *interstitial fluid* attacking invaders.
- Macrophages & Neutrophils are WBCs – Attack pathogens through **phagocytosis**.

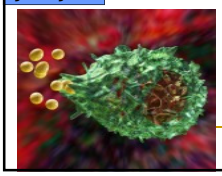


Lymphatic System



Destroying The Pathogen





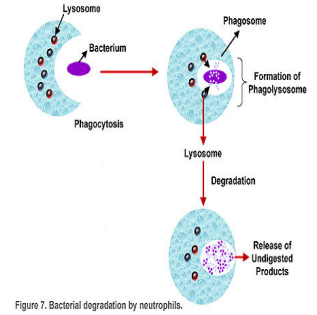
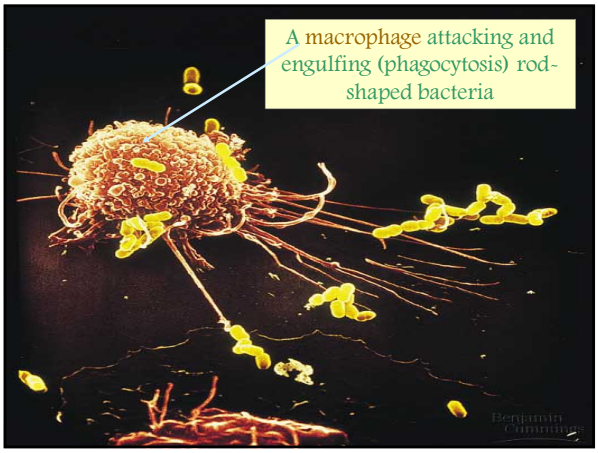


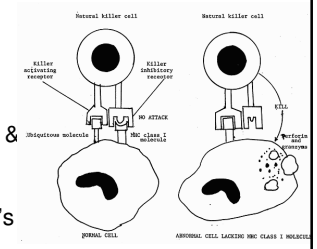
Figure 7. Bacterial degradation by neutrophils.

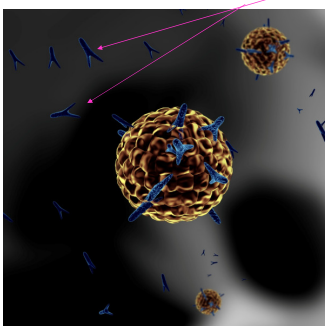


Natural Killer cells

(NK cells)

- DO NOT directly kill by phagocytosis.
- NK cells RECOGNIZE & LYSE (break) infected cells or cancer cells by poking holes in the cell's membrane.

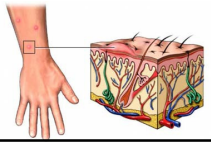




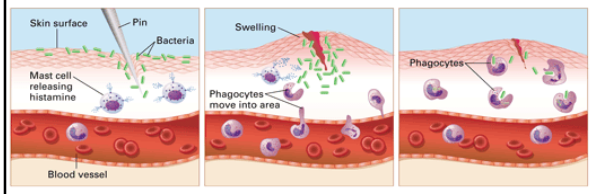
Natural Killer cells patrolling the fluid of the lymphatic system

2. Inflammatory Response

1. Injury to skin 
2. **Mast cells** secrete **histamine**, which dilate blood vessels to increase blood flow to site.
3. Plasma leaks into the vessels & enter the infected tissue. Causes swelling-becomes painful
4. This body reaction is called an **Inflammatory Response**
   (swelling, redness, warmth, and pain)



Injured Site & Inflammatory Response



Inflammatory Response

(>37.2 C or 99 F)

- A ***fever*** occurs when a pathogens travel the blood & the whole body responds.

Specialized Proteins

3. Specialized Proteins: **Interferon**
   - Interferons are made from infected healthy cell.
   - The cell becomes an antivirus –(a cell against a virus) to fight the virus.
   - "interfere" prevent the virus from replicating (multiplying).
   - Slows down progress of infection and allows immune system to respond.

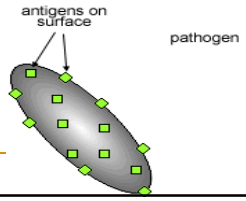
3rd Line of Defense: Targeted Defense

- Activated when the other 2 lines of defense did not work.
- **Antibodies** produced by the immune system.
- The immune system recognizes, destroys, and "remembers" each foreign invader.

Antigens

"antibody generating molecule"

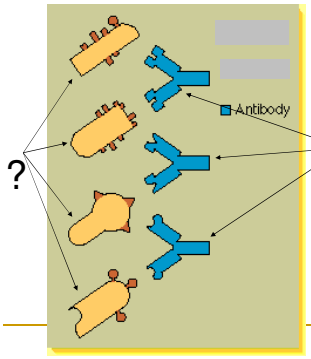
- **Mostly made of proteins**
- Specific proteins on pathogen's surface that cause (trigger) an immune response.
- 3D shape of bumps and knobs → **MARKERS**



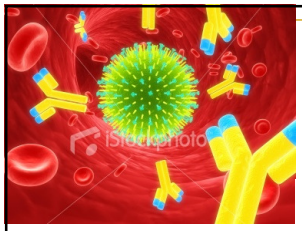
Antibodies
(proteins that help destroy pathogens)

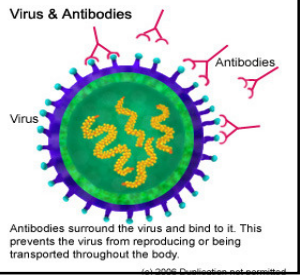
- Y – shaped proteins free-floating in blood to attach to antigens.
- Antigens bind at the Y tips.
- Y tips have different shapes (like keys).
- Made by B lymphocytes.

- A specific antibody attaches to a specific antigen.



Antibodies have a "Y" shape.



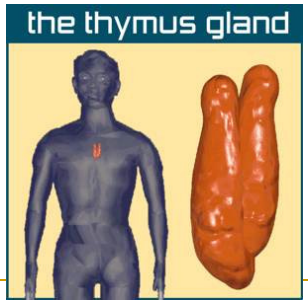


Two Types of Lymphocytes (WBC)

B LYMPHOCYTES (Humoral immunity)	T LYMPHOCYTES (Cell-mediate immunity)
Made in bone marrow & matures then released.	Made in bone marrow, mature in thymus gland, & released.
Attacks invading pathogens (bacteria and viruses).	Attacks cells infected with bacteria, viruses, fungi, protists, & cancerous cells
Produce memory B cells & plasma cells. Plasma cells produce antibodies for second exposure to antigen.	Helper T cells stimulate memory T cells & killer T cells. Killer T-cells destroy.

T- Lymphocytes (T = thymus)

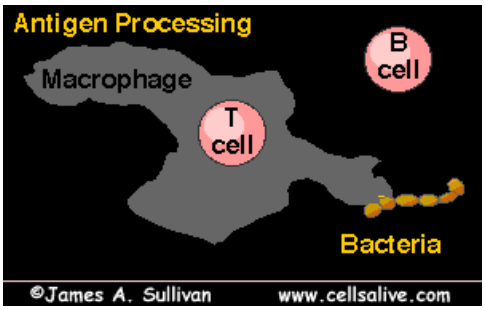
Location: center of chest, behind breastbone.



Handout: Diagram

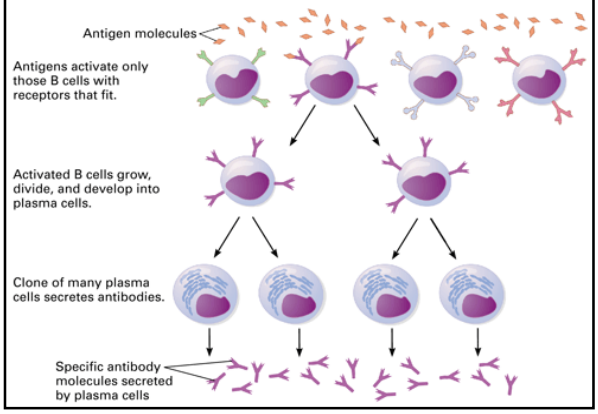
Humoral Immunity

Lymphocyte/ Antibodies Animation

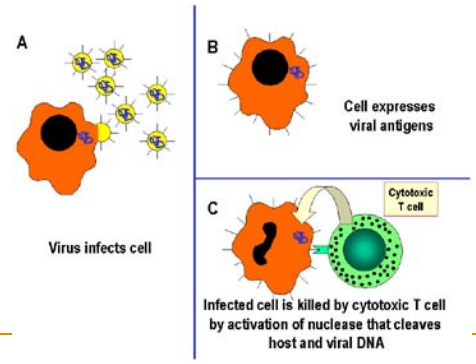


- http://www.cellsalive.com/antibody.htm

Humoral Immune Response

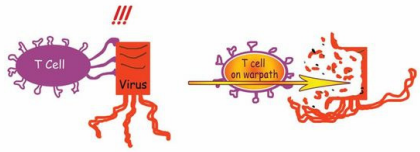


Cell Mediated Response



Attack!!!!!!!!!!

Your immune system is constantly patrolling your body on the lookout for hostile invaders like parasitic bacteria and viruses.

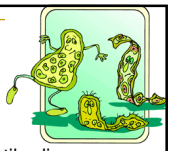


An immune system T cell recognizes the virus as something dangerous.

With no hesitation, the T cell destroys the invader.

http://depts.washington.edu/tumorvac/?p=5

2 Types of Immune Response



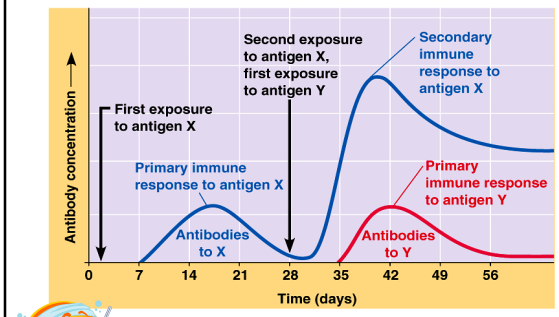
1. Primary Immune Response

- First 5 days, no large amount of antibodies are present.
- Next 10-15 days, antibodies increase.

2. Secondary Immune Response

- A faster immune response occurs, if exposed to same antigen in the future.
- Antibodies attack antigen within 1-2 days after infection.

2 Types of Immune Response



Why Could People Who Receive Organs Reject Them?

Organ Transplants

- **Transplanted organs** have protein markers on surface & immune system RECOGNIZES to be **FOREIGN**!!!!!!!
- **Killer T cells** want to ATTACK!!!!!!!!
- So doctors look for donors that have similar cell markers to reduce chance of **ORGAN REJECTION**.
- Patients are on drugs for life to prevent organ rejection.

As of February 2nd, 2012……..

Waiting list candidates- 112,838

As of January 11, 2011……..

Waiting list candidates- 110,179

- **Transplants** Jan. – Oct. '10 → 23,955
- **Donors** Jan. – Oct. '10 → 12,088

http://www.organdonor.gov/