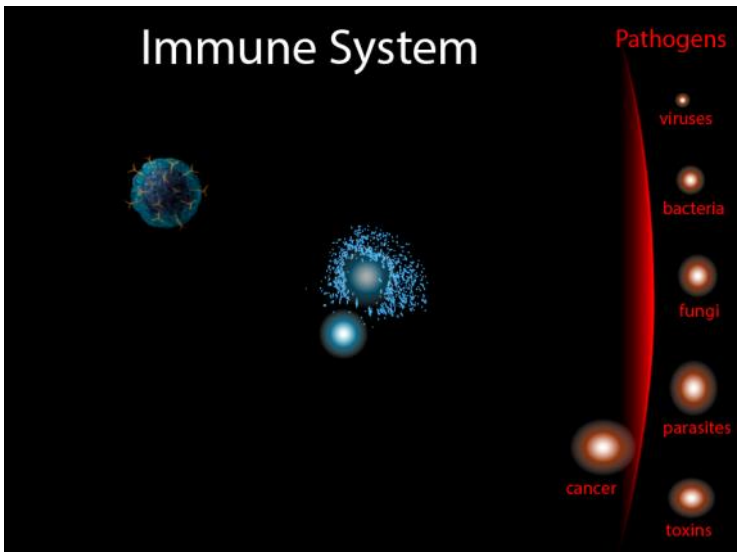
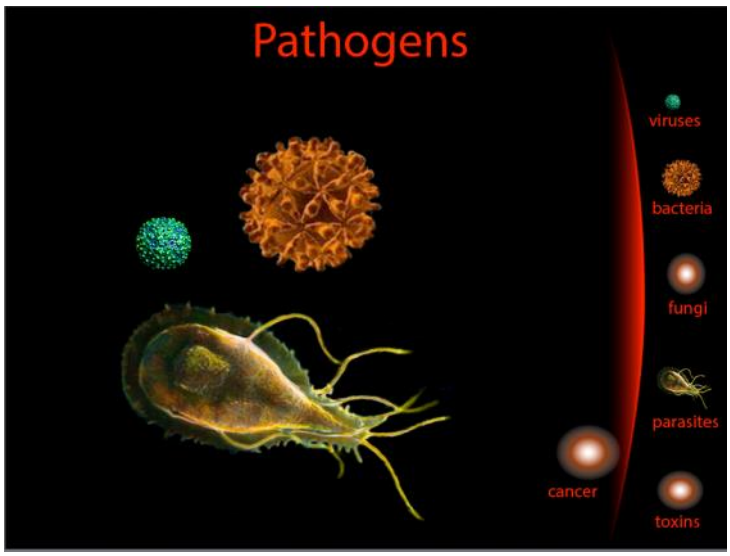
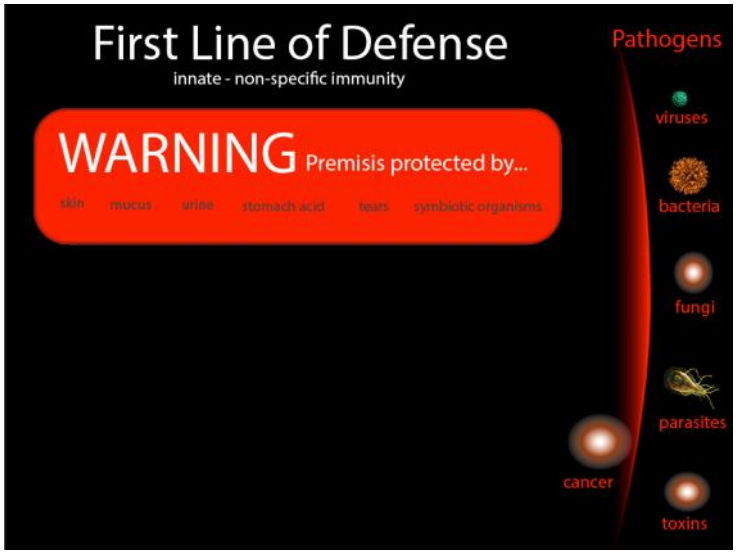
Lymphatic System Pt2

Sunday, May 27, 2012
10:24 AM

VoiceThread	http://voicethread.com/share/4199511/
Swf playable	http://justabitmoore.weebly.com/immune-system---high-school.html
YouTube	http://www.youtube.com/watch?v=T1DJaXZd7HQ

Slide	Notes
 Illustrations for this slide are still in development	1 The systems of the body interact quite a bit. This is especially evident when discussing immunity. Many of the things that give us immunity are not a part of the lymphatic system. Instead, they are part of another system and simply aid the lymphatic system in its job.
 Each one will be highlighted seperately. The bloank area to the right can be used for imagery needed for each pathogen.	2 - 7 Pathogens: Pathogens are organisms that can make us sick. Pathogens come in several forms. **Bacteria can be pathogenic**. Pathogenic bacteria are the ones that give you sinus infections, infected cuts, menengitis, etc. But not all bacteria are pathogens. We couldn't live without some of them. There are **pathogenic fungi**. Most of the pathogenic fungi are the single-celled fungi which are commonly called yeast. Pathogenic yeast can cause athlete's foot, thrush on the tongue, vaginal yeast infections, and so on. There are **parasites** such as pinworms, round worms, tapeworms, etc. There are also **viruses**. A virus is a bit of either DNA or RNA that is wrapped in its own protein coat. Since it has none of its own cellular machinery, it invades a cell and hijacks the cell's machinery to make proteins and makes copies and copies of itself. In the end, the cell gets so filled with these copies the cell ruptures releasing the pathogen to take over new cells in the body. There are also **cancers. These** are actually our own cells that have been damaged and can no longer control their functions. Instead, they perform uncontrolled mitosis making the tumor grow until surrounding tissue is crowded out and become damaged. Though not an organism, there are **toxins** that can harm the body as well.



3 Innate, Non-Specific Immunity

The first line of defense is our non-specific immunity system. What that means is that the defense is not targeted against a specific invader. Instead, it is an innate defense against a variety of pathogens. We will take a look at skin, mucus, urine, stomach acid, tears, and symbiotic organisms.

The systems in this section act as the first line of defense. They either keep pathogens out (as is the case with the skin), or they try to trap or kill pathogens before they get very far in the body (as is the case with mucus and gastric juice). The vast majority of pathogens get stopped by the first line of defense.

An immune response that is the same regardless of the pathogen or toxin encountered — Innate immunity

Additional ones would be to show a sweating man in front of a rotating fan.

4 Skin

Skin is a part of the integumentary system.

The keratin in skin cells makes skin waterproof, and it allows the skin to act as a barrier, keeping foreign invaders out of the body.

Sweat washes the surface of the skin. It also helps to lower the pH of the skin. Low pH environments inhibit the growth and activity of many pathogens.

The sebaceous glands secrete oil, which contains antibacterial substances.

---

provides a barrier against infection — skin

wash the skin and lower the pH — sweat glands

contain antibacterial agents — sebaceous glands

First Line of Defense - Mucus:

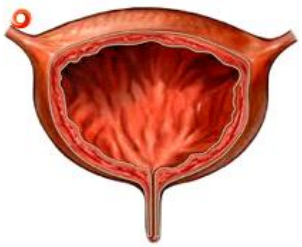
Some epithelial tissue, such as that found in the sinuses, trachea, and cervix secrete mucus. This mucus traps and catches microorganisms so that they cannot go anywhere.

Once the pathogens are trapped in the mucus, the body needs to get rid of them. That is accomplished by cilia on certain cells that line the mucus-producing epithelium. These cells beat their cilia, moving mucus towards the mouth or nose. We can then blow our nose, cough, or swallow the mucus so as to get rid of it.

The cervical mucus is a nonspecific defense against infection. In addition, cervical mucus contains antibodies, which are a part of the acquired immune system. Thus, cervical mucus is a mixture of nonspecific and specific defense.

---

traps foreign materials — mucus

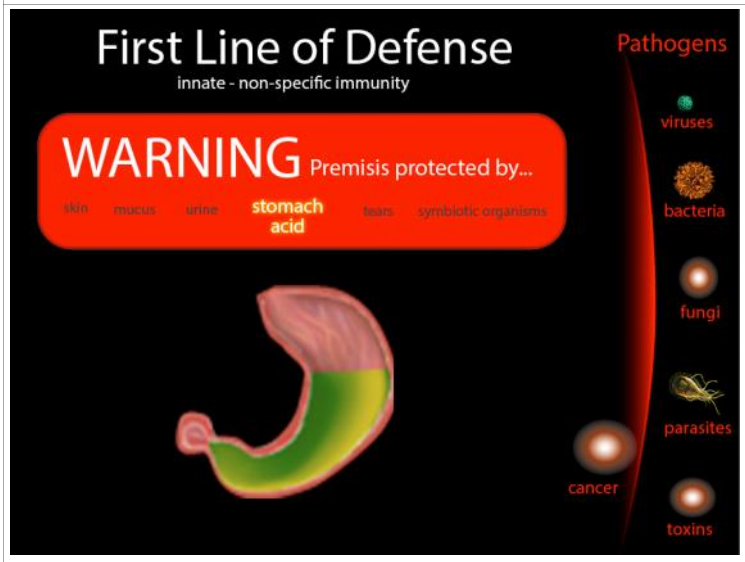


First Line of Defense - Urine:

U**rine** is also a very important first line of nonspecific immunity. Any opening to the outside is a potential place for infection. Urine washes out the tract that leads to the outside. This helps fight off any organism attempting to enter the body that way.

---

washes out the urinary tract — urine



First Line of Defense - Gastric Juice:

The acid in the gastric juice kills most pathogens. Thus, swallowing our own mucus helps us kill pathogens which are stuck in that mucus. If we eat food that contains bacteria (most food does), the gastric juice in our stomach kills those bacteria before they can do any damage.

---

kills pathogens in stomach — gastric juice

First Line of Defense - Tears:

Tears contain an enzyme called **lysozyme**. This enzyme breaks down the cell walls of many bacteria. The term "lyse" actually means "to break," so "lysozyme" is an enzyme that breaks cell walls. Lysozyme is the main reason that we rarely get eye infections. The tears bathe the eye in lysozyme, killing bacteria which try to infect it. However, sometimes even the lysozyme in tears is not enough to kill the bacteria invading the eye. When that happens, the eye does get infected. The most common bacterial infection of the eye is known as **pinkeye**.

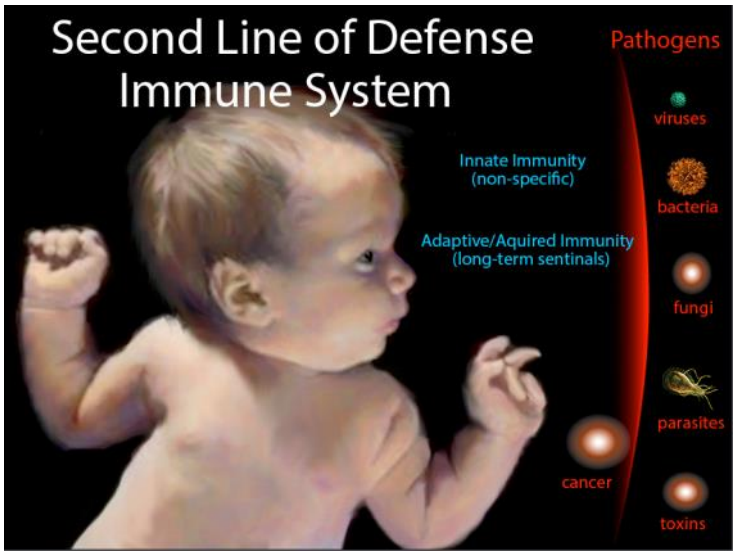
---

contain lysozyme, which kills foreign cells — tears

First Line of Defense - Symbiotic Organisms:

There is one more first line of innate immunity: **symbiotic organisms**. There are a host of symbiotic organisms which live throughout the body. Bacteria in our intestines, for example, produce vitamin K and, in return, we provide food for them and a place for them to live. Those symbiotic bacteria flourish in our intestines, and their population can actually "squeeze out" populations of pathogenic bacteria and fungi which might get past the stomach. In addition, symbiotic bacteria and fungi that live on our skin and consume our sweat produce lactic acid, which fights off both pathogenic bacteria and fungi.

"squeeze out" populations of pathogens and secrete lactic acid — symbiotic organisms



Second Line of Defense - Innate and Acquired Immunity:

Now we are to our Second line of Defence, the immune system.

There are two big divisions in the immune system: **innate immunity** and **acquired immunity**.

Innate immunity - This is a non-specific immune response because it is the same regardless of the pathogen or toxin encountered. You have this as soon as you are born. You cannot get distemper., for instance, because you have an innate immunity to this disease common to dogs.

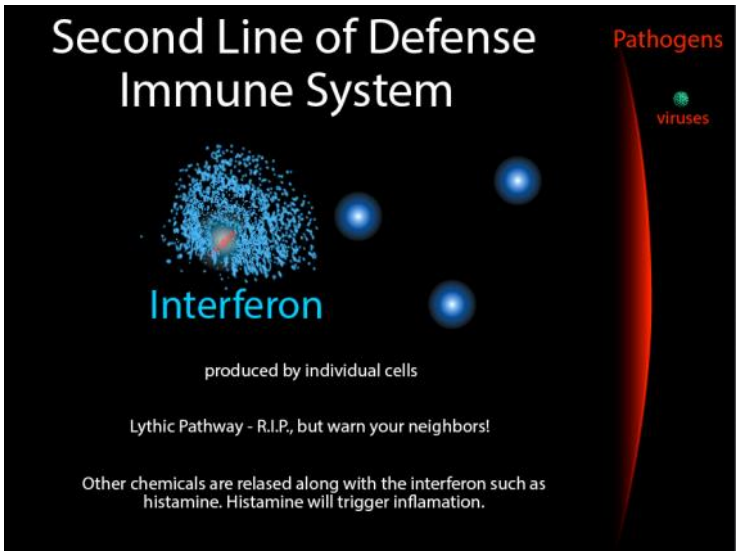
Acquired immunity - An immune response targeted at a specific pathogen or toxin. When we catch and then recover from a certain disease, we might become immune to *that specific disease*. However, that immunity will not help us fight off another disease. For example, chicken pox immunity won't help you against measles. The immunity we acquire once we get chicken pox is specific only to the chicken pox virus.

The immune tactics we will now look at will target a specific type of invader. It could be a whole group such as bacteria or viruses or be very specific to a particular pathogen such as the chicken pox virus.

Identify each of the following as a part of innate immunity or acquired immunity:

B-cells	acquired immunity
antibodies	acquired immunity
natural killer cells	innate immunity
interferon	innate immunity
Skin	innate immunity
T-cells	acquired immunity
mucus	innate immunity
vasodilation	innate immunity
urine	innate immunity

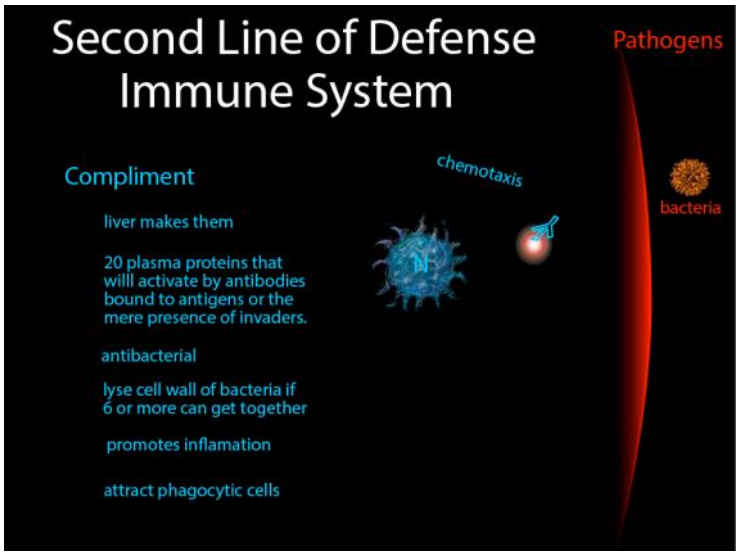
An immune response targeted at a specific pathogen or toxin	Acquired immunity



☑ Interferon

Interferon is a protein produced by a cell infected by a virus. There's really no hope for a cell once the virus enters the lytic pathway. However, as it's being attacked by the virus, the cell will produce interferon. The interferon won't save *that* cell, but it will affect neighboring cells and signal them to strengthen themselves against viral attacks.

Proteins secreted by cells infected with a virus. These proteins stimulate nearby cells to produce virus-fighting substances.	Interferon
signals other cells to defend against viral infections	interferon



☑ cc'd: Complement

Complement are involved in fighting foreign *cells*, which are generally bacteria.

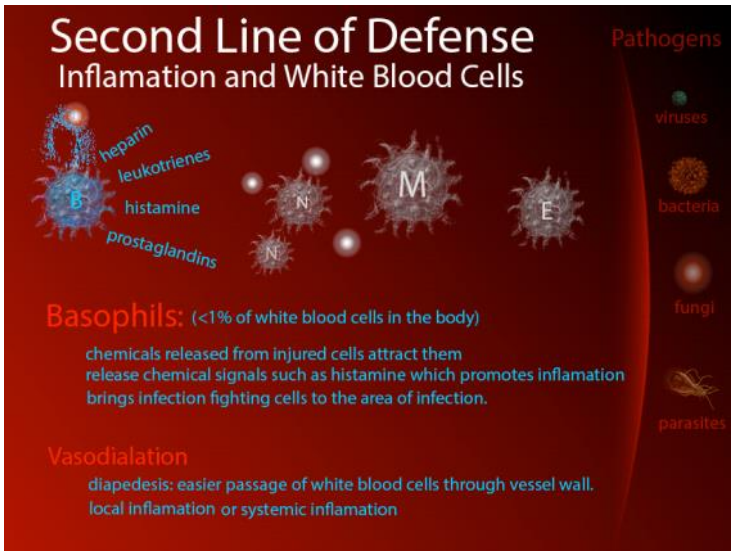
Complement is made up of 20 plasma proteins made by the liver which is then released to the bloodstream. Like blood coagulation factors, these proteins stay inactive in the blood serum until something activates them. The foreign invader itself can activate the proteins or the presence of antibodies bound to antigens can do the activation. Either way, this happens only when foreign cells are present.

They can lyse bacteria. The complement proteins combine to form a hole in the plasma membrane of the foreign cells, particularly bacteria. This causes the bacteria's components to leak out, killing the bacteria! Not only can the complement proteins lyse bacteria, but they can also attract phagocytic cells. The phagocytic cells can then destroy the bacteria by eating them.

These proteins can help promote inflammation. You might think inflammation is bad, but it can be a very good thing. Inflammation is a sign that there is a war going on between your body's defenses and an invader. This signal can “rally the troops,” bringing more disease-fighting mechanisms to bear.

A series of 20 plasma proteins activated by foreign cells or antibodies to those cells. They (1) lyse bacteria, (2) promote phagocytosis, and (3) promote inflammation.	Complement

kills bacteria — complement



Inflamation - Basophils

When the body's cells are under attack, they send out chemical signals that are picked up by the basophils which are attracted to those signals. The basophils in turn release a variety of chemicals. leukotriene, prostaglandin, heparin, and histamine. Heparin inhibits clotting allowing the wound to wash out any foreign matter that may have been introduced during the injury.

Histamine triggers inflammation or vasodilation. Vasodilation is when the vessels dilate. This brings in additional blood flow to the area so the area has additional resources for fighting the infection. In addition, the dilation makes it easier for white blood cells to squeeze between the vessel cells to enter into the tissue that is damaged and infected. This process is called diapedesis.

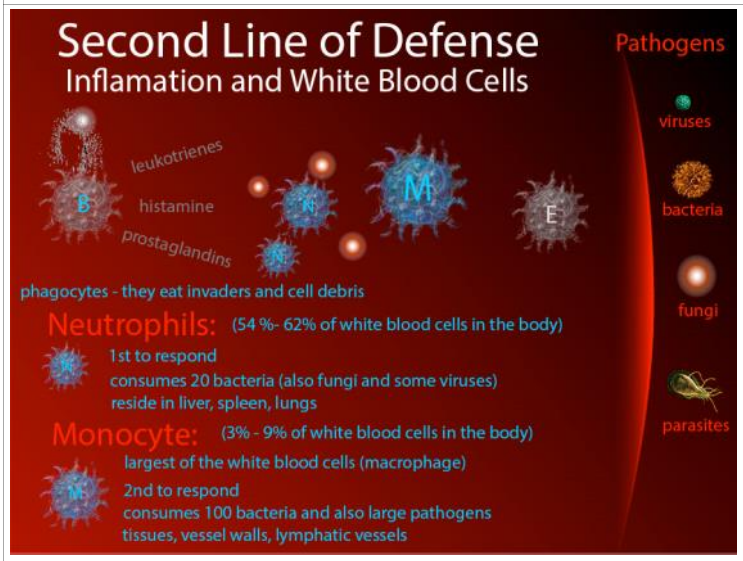
If the infection stays contained to that one location it is a local inflammation. If it escapes into the bloodstream and spreads throughout the body, it triggers a systemic inflammation.

There are many types of white blood cells that will become active in fighting an infection. The basophil is merely the first type. We learn more about the other types in a moment.

---

promote inflammation — basophils

increases blood flow and allows monocytes easier access to the tissues — vasodilation



Inflamation - Neutrophils and Monocytes

Any bacterium or any virus can potentially be attacked by white blood cells, so they are non-specific. White blood cells generally have about a 12 hour life span and they are produced in the bone marrow.

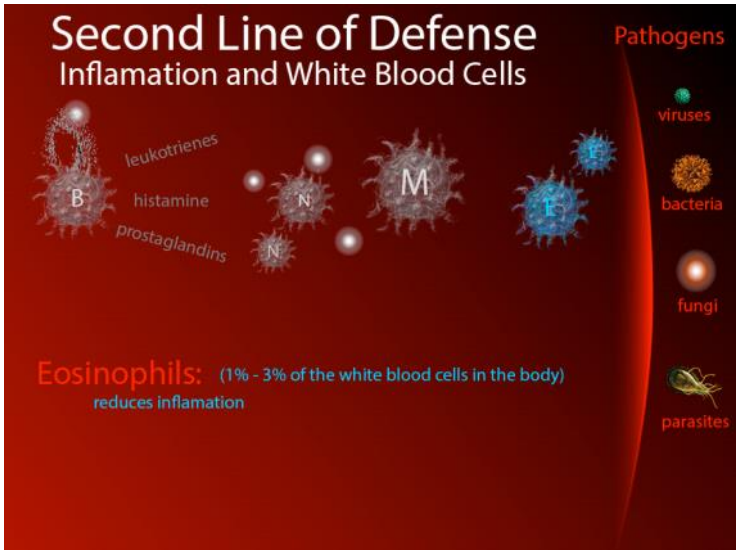
The neutrophils and monocytes are phagocytes. That means they can chew up cells.

Neutrophils are typically the 1st of these two phagocytotic white blood cell s to respond. They are not very large and can only consume about 20 bacteria before they reach the end of their lifespan. They can consume fungi and some viruses as well. They hang out in the liver, spleen, and lungs until needed.

The next to respond are the **monocytes**. These are the larger phagocytic white blood cells - the big eaters. Once they enter the tissues, they are called macrophages. These big boys can consume about 100 bacteria in their life span. They also tackle the really large pathogens such as parasites. These will hang out in the tissues, near vessel walls, and around the lymphatic vessels.

---

engulf foreign substances — neutrophils and monocytes

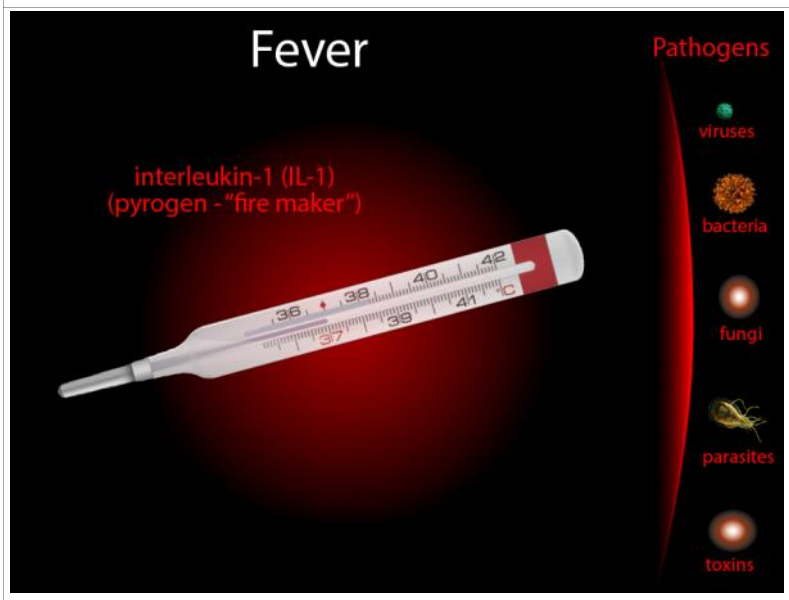


☑ Inflamation - Eosinophils

Eosinophils (e-o-sin-o-phil) are also a part of our innate immune response. These cells reduce inflammation. Why would the body have one type of cell that promotes inflammation and another type that reduces it? Well, inflammation can be a good thing, but too much inflammation can be very bad. Thus, the inflammation must stay under control. Eosinophils contain enzymes that tend to break down inflammatory agents,

---

reduce inflammation to keep it in check — eosinophils



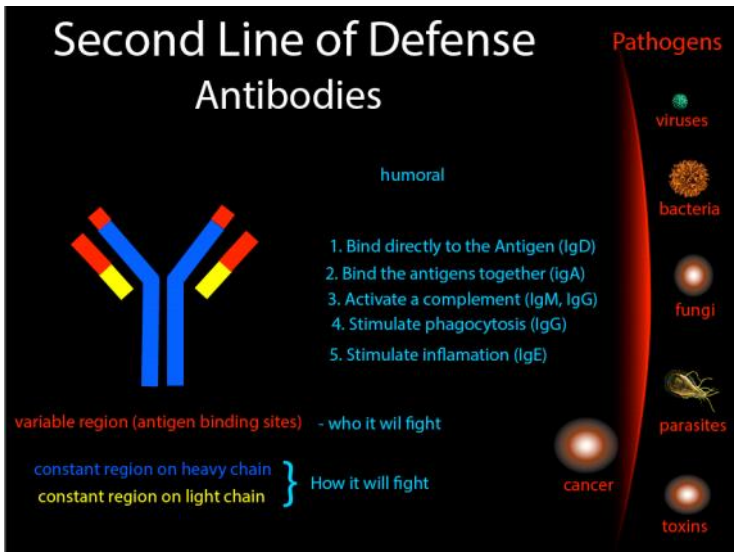
☑ Fever -

Pyrogens - Chemicals which promote fever by acting on the hypothalamus

Sometimes, your own white blood cells will release pyrogens in order to start a fever. These pyrogens travel through the body and affect the hypothalamus. The hypothalamus controls body temperature.

Chemical reaction rates *increase* with increasing temperature, a fever speeds up the immune system. The mitosis of the white blood cells goes faster, increasing the white blood cell population. Also, a higher temperature is often not good for the invading microorganism. Bacteria especially like cooler temperatures.

Chemicals which promote fever by acting on the hypothalamus — Pyrogens



☑ Humoral Antibodies

Humoral immunity - Immunity which comes from antibodies in blood plasma

Since humoral immunity comes from the actions of antibodies, we should first concentrate on *what* antibodies are. First of all, antibodies are proteins.

Basically, antibodies are made of four polypeptide chains: two identical heavy chains and two identical light chains. These chains are arranged in a "Y" shape. The parts that you see in red are variable regions. These designate what invaders it will fight. They are antigen binding sites that allow them to grab on to invaders. It is like a key fitting in to a lock.

The parts in blue and yellow are constant regions. They will determine how the antibody will fight. Each antibody class will fight in a different way.

Antibodies, then, have several means by which they can fight antigens:

1. Bind directly to the antigen. This will be the immunoglobulin D class
2. Bind the antigens together in groups, immoglobulin A
3. Activate complement, immunoglobulin M . Scientist have found that immunoglobulin G can do this as well.
4. Stimulate phagocytosis, immunoglobulin G
5. Stimulate inflammation, immunoglobulin E

Which letter best represents the shape of an antibody?

Choose one answer.
- a. T
- b. I
- c. B
- d. Y

What part of an antibody determines whether it is an IgG, IgA, IgM, IgD, or IgE antibody?

Choose one answer.
- a. Antigen Binding Sites
- b. Constant Region
- c. Variable Regions

In what five ways do antibodies fight antigens? Choose 5 answers.

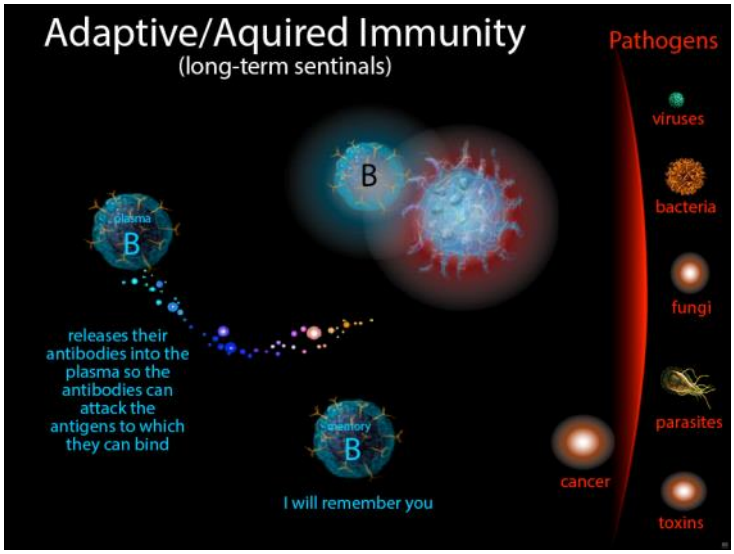
Choose at least one answer.
- [x] a. Inactivate antigens by activating complement
- [x] b. Inactivate antigens by binding to them.
- [x] c. Inactivate antigens by stimulating inflammation
- [x] d. Inactivate antigens by stimulating phagocytosis
- [ ] e. Produce a primary response
- [x] f. Inactivate antigens by binding them together in groups
- [ ] g. Produce a secondary response

- [x] MHC -

We need to point out one more thing about the production of antibodies. Remember that a person cannot produce antibodies against antigens which he or she has in his or her own cells. For example, if you have type A blood, you cannot produce the antibody against the A antigen. However, if you suddenly are exposed to type B blood, you will immediately start producing antibodies against the type B antigen. Thus, your lymphatic system "knows" your blood type and "knows" how to spot an erythrocyte from another blood type. How does the lymphatic system "know" your blood cells from other blood cells?

There are about 20 specific glycoproteins which exist on the cell membrane of every cell in your body. This collection of proteins is called the **major histocompatilibity complex (MHC)**. The structure of these proteins is determined by twenty genes in your DNA, each of which has more than *fifty* alleles. Thus, there are literally billions of combinations of these alleles, and each combination produces a unique MHC. As a result, it is virtually impossible for two people to have identical MHC's, unless they are identical twins. The MHC, then, is a "fingerprint" for your cells. Any cell that has your MHC will not be attacked by your lymphatic system, because the cell has the correct "fingerprint".

- [x] B-Cells -



Antibodies are produced by **B-cells**, which are specialized lymphocytes. Like all blood cells, these lymphocytes are formed from stem cells in the bone marrow.

They are formed with antigen binding sites on their plasma membranes. When exposed for the first time to the antigen for which they are specific, these sites bind to the antigen, and the B-cells begin to proliferate. The proliferation produces two types of B-cells:

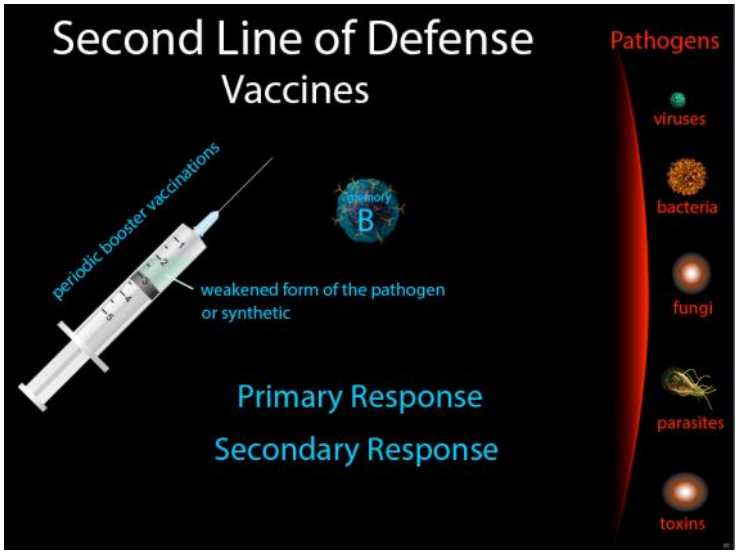
plasma B-cells release their antibodies into the plasma so that the antibodies can attack the antigens to which they can bind.

After the infection, most B-cells die, but he memory B-cells are long-lived B-cells which do not release their antibodies. Instead, they circulate in the body waiting for the *next* attack by the antigen. This allows the body to respond quickly to any subsequent infection by the same antigen.

Immunity which comes from antibodies in blood plasma — Humoral immunity

release antibodies — Plasma B-cells

remember the infection so that they can respond to the next infection — Memory B-cells



Vaccines

Memory B-cells are the means by which vaccinations provide immunity to certain pathogens. There are two basic types of vaccines. The first type contains a weakened form of the pathogen itself. Since the pathogen is weakened, your body's immune system will destroy it before it can overtake your body. Thus, even though the vaccine actually contains a disease-causing pathogen, the vaccine is safe because the pathogen is so weak that your immune system will destroy it.

The other type of vaccine contains a synthetic chemical that makes the body react the same as if a certain pathogen has entered the body. This type of vaccine, then, "mimics" a real pathogen, causing the immune system to react and produce antibodies as well as memory B-cells.

Even though memory B-cells are long-lived, they do not last forever. Thus, some vaccines require a booster to boost the memory of the infection.

When the body is first exposed to a pathogen, the B-cells will produce a **primary response**. This response fights the infection and produces memory B-cells. The memory B-cells will then produce a **secondary response** if the pathogen infects the body again.

Which cell lives longest?

Choose one answer.

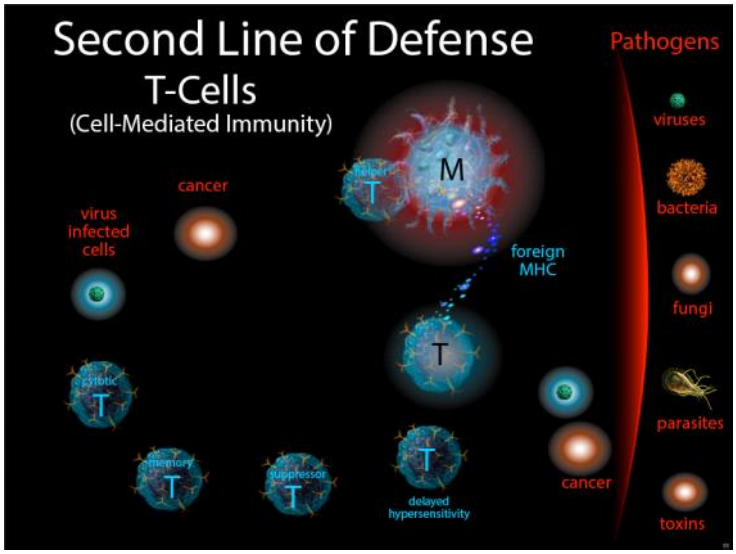
- a. Memory B-cells
- b. T-cells
- c. Plasma B-cells

T-Cells: Cell-Mediated Immunity

Cell-mediated immunity - Immunity which comes from the actions of T-lymphocytes

T-cells deal primarily with cells found in the body such as cancerous cells or cells harboring viruses.

T-lymphocytes respond to the chemicals released by the macrophages. T-cells originate in the bone marrow, but they mature in the thymus gland



T-cells: Cell-Mediated Immunity

Cell-mediated immunity - Immunity which comes from the actions of T-lymphocytes

T-cells deal primarily with cells found in the body such as cancerous cells or cells harboring viruses.

T-lymphocytes respond to the chemicals released by the macrophages. T-cells originate in the bone marrow, but they mature in the thymus gland (the "T" in T-cells stands for "thymus"). T-cells, like B-cells, have antigen receptors. However, these receptors are not associated with antibodies. Instead, they simply allow the T-cell to recognize molecules which are on the plasma membrane of other cells. This helps the T-cells distinguish between cells which belong in the body and cells which do not.

When a cell has been invaded, it often produces MHC proteins that are not a part of the "fingerprint" for the body's cells. Thus, this makes the cell look foreign to the T-cells, and the T-cells react. Even cancerous cells usually produce aberrant MHC proteins, which once again causes the T-cells to react.

They divide and specialize into …

Cytotoxic T-cells puncture any cells in the body that are infected with viruses or are cancerous.

Helper T-cells connect to macrophages via a Major Histocompatibility Complex, and greatly increase the rate of cell division of all lymphocytes, helping the defense system cope with more pathogens. The well-publicized disease known as **AIDS** (Acquired Immune Deficiency Syndrome) is caused by the human immunodeficiency virus (HIV). This virus destroys helper T-cells. As the population of helper T-cells in the infected person diminishes, pathogens which would normally not be able to get through the immune system are able to take hold, because B-cell and cytotoxic T-cell production is limited.

Cytotic or killer T cells and Helper T Cells are classified as effector T-cells.

Memory T-cells store the chemical composition of pathogens and the attacks against them.

Suppressor T-cells shut down the immune response in case the attack is against the body itself (an autoimmune response), or when the immune response is over.

Another type of effector T-cell is the **delayed hypersensitivity T-cell**. This kind of T-cell responds to antigens by releasing chemicals which promote inflammation. They also promote phagocytosis by attracting macrophages through chemotaxis. These cells are particularly active in allergic reactions. For example, the burning and itching sensation caused by poison ivy is a delayed hypersensitive T-cell response to antigens produced by skin cells which interact with poison ivy.

---

remember the infection for the next time — memory T-cells

Immunity which comes from the actions of T-lymphocytes — Cell-mediated immunity

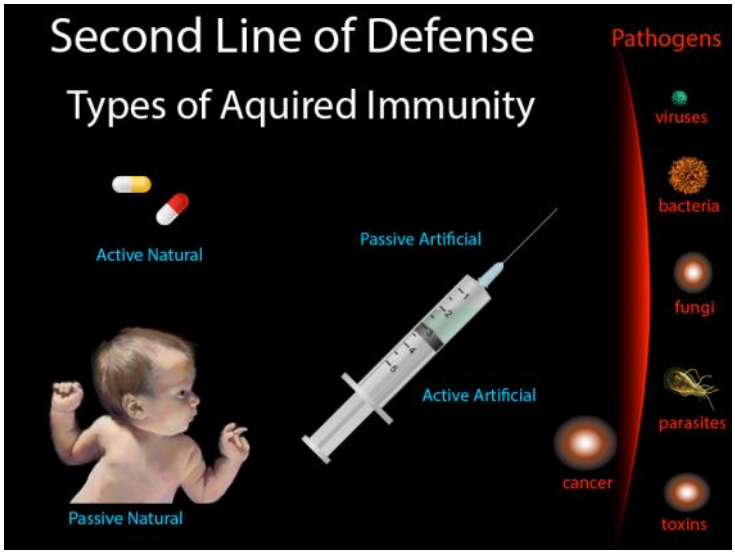
attack and lyse foreign cells — Cytotoxic T-cells

promote the proliferation of cytotoxic T-cells and B-cells — helper T-cells

Types of Acquired Immunity

Active Natural Immunity -

There are four basic ways that acquired immunity can be stimulated in the body. The first and most obvious is **active natural immunity**. This is the acquired immunity which comes from being exposed to a pathogen. For example, when you are first exposed to the chicken pox virus, you get sick.



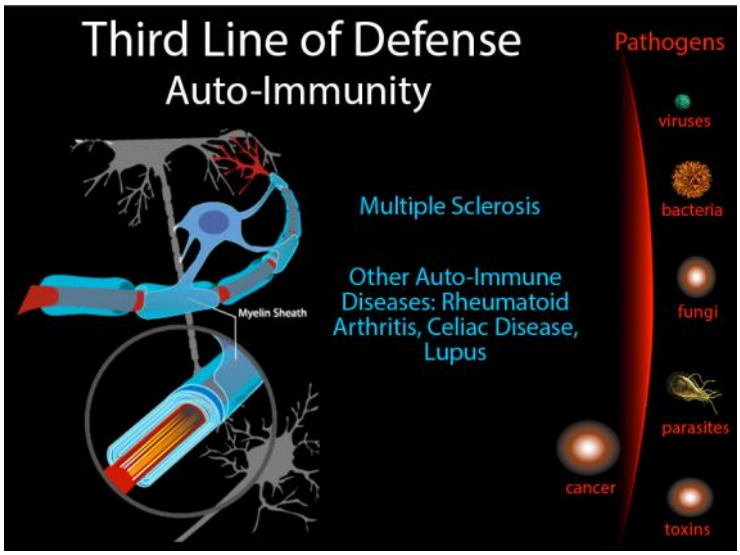
Active Natural Immunity -

There are four basic ways that acquired immunity can be stimulated in the body. The first and most obvious is **active natural immunity**. This is the acquired immunity which comes from being exposed to a pathogen. For example, when you are first exposed to the chicken pox virus, you get sick. Your body must fight off the virus. However, after that, you don't get sick from the chicken pox virus again, because your body has the memory B-cells or T-cells which will produce a quick and effective secondary response.

You can also receive acquired immunity artificially, which is referred to as **active artificial immunity**. This is the immunity you receive from a vaccine. The vaccine causes your immune system to react, forming memory B-cells or T-cells. This gives you acquired immunity to that disease, but the immunity is artificially induced.

Passive natural immunity occurs between the mother and the baby. IgG (Immunoglobulin G) antibodies can travel across the placenta during pregnancy, providing the baby with the same immunity which the mother has. In addition, IgA (Immunoglobulin G) antibodies are found in breast milk. Thus, the baby receives immunity from diseases to which the mother is immune by breastfeeding.

The final means by which acquired immunity can occur is **passive artificial immunity**. In this situation, a *different* individual is exposed to a pathogen and thus creates antibodies. Those antibodies are then removed from the individual and transferred to someone else. This provides immunity to the pathogen. Although this procedure is often done using another human, that is not always necessary. Sometimes, an animal such as a horse can be injected and then the horse's antibodies can be transferred to the person who needs immunity. This is only a temporary fix, however, since the antibodies will be removed from the person who received them in a relatively short amount of time. Examples of this procedure include treatments to fight rabies and tetanus in people who are not vaccinated against these diseases but are exposed to them.



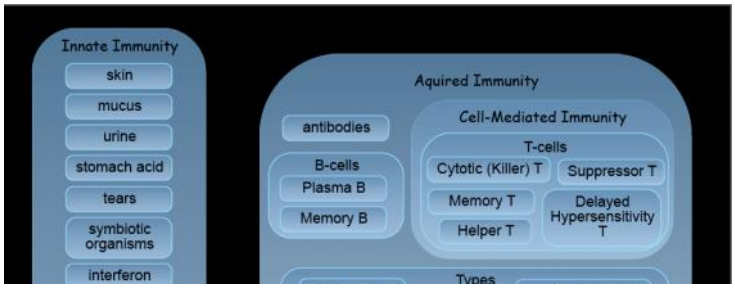
Auto-Immunity -

One type of immunity which is not good is **autoimmunity**. In autoimmunity, the body cannot differentiate between the MHC (Major Histocompatibility Complex) of its own cells and that of others. Thus, it starts attacking its own cells. Multiple sclerosis, for example, is an autoimmune disease. The lymphatic system cannot distinguish between the neuroglia of the body and foreign neuroglia. As a result, the lymphatic system begins attacking the myelin sheaths of the nerves. This causes a loss of control of the skeletal muscles and a loss of sensation.

How does the immune system recognize its own body's cells?

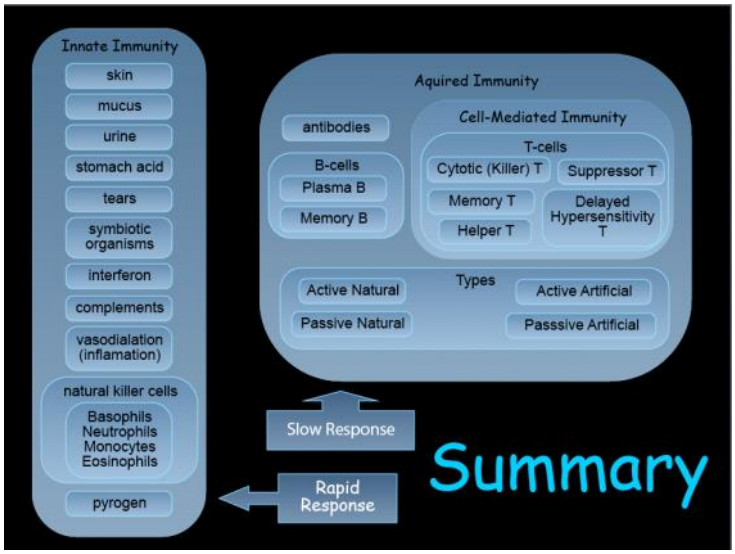
Choose one answer.

- a. 20 proteins on the cell membrane that make up the MHC
- b. Cell-mediated immunity
- c. Plasma B-cells
- d. Memory B-cells
- e. Humoral immunity



Summing Up

The body's defenses are designed much like that of a well-built fortress. The blood is regularly checked and cleaned by both the lymph vessels and lymph nodes as well as the spleen. In addition, the body has two lines of innate defense against pathogens, each of which has several different components. Finally, the body has an incredible means of acquiring immunity to specific diseases and remembering that immunity so the pathogen can never successfully cause another infection. Finally, each cell in the body produces an elaborate display of proteins which tells the body whether or not the cell is native to the body or a foreign cell which must



Summing Up

The body's defenses are designed much like that of a well-built fortress. The blood is regularly checked and cleaned by both the lymph vessels and lymph nodes as well as the spleen. In addition, the body has two lines of innate defense against pathogens, each of which has several different components. Finally, the body has an incredible means of acquiring immunity to specific diseases and remembering that immunity so the pathogen can never successfully cause another infection. Finally, each cell in the body produces an elaborate display of proteins which tells the body whether or not the cell is native to the body or a foreign cell which must be destroyed. Indeed, this world is a dangerous place in which to live, but the body's Designer has given us all that we need to stay well protected!

Identify each of the following as a part of innate immunity or acquired immunity:

antibodies	acquired immunity
interferon	innate immunity
urine	innate immunity
natural killer cells	innate immunity
T-cells	acquired immunity
B-cells	acquired immunity
Skin	innate immunity
vasodilation	innate immunity
mucus	innate immunity