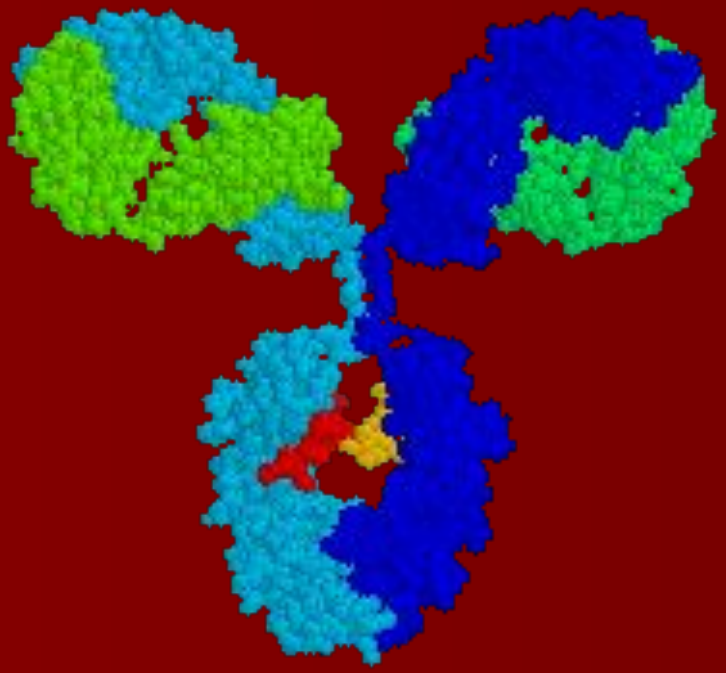


Immunity

- The first person to identify microbes as causing disease was Robert Koch.
- We still use Koch's Postulates in disease identification.

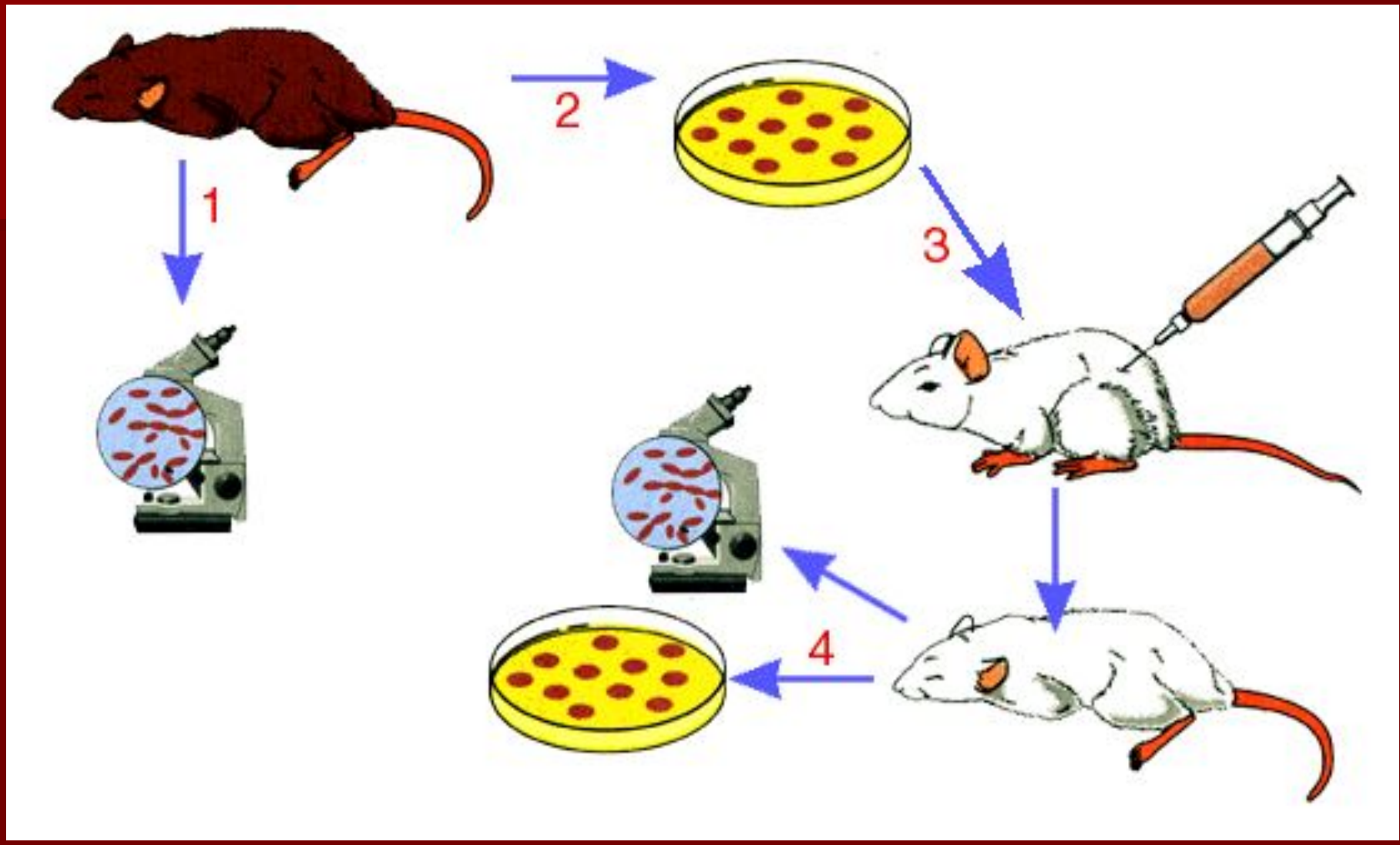
Koch's Postulates

1. Pathogen must be found in the host in every case.

2. Pathogen must be isolated from the host and grown in pure culture.

3. When placed in a healthy host, pathogen produced in pure culture must cause the disease in the host.

4. Pathogen must be isolated from the new host and shown to be the original pathogen.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- *Endemic diseases* are those found normally in a population.

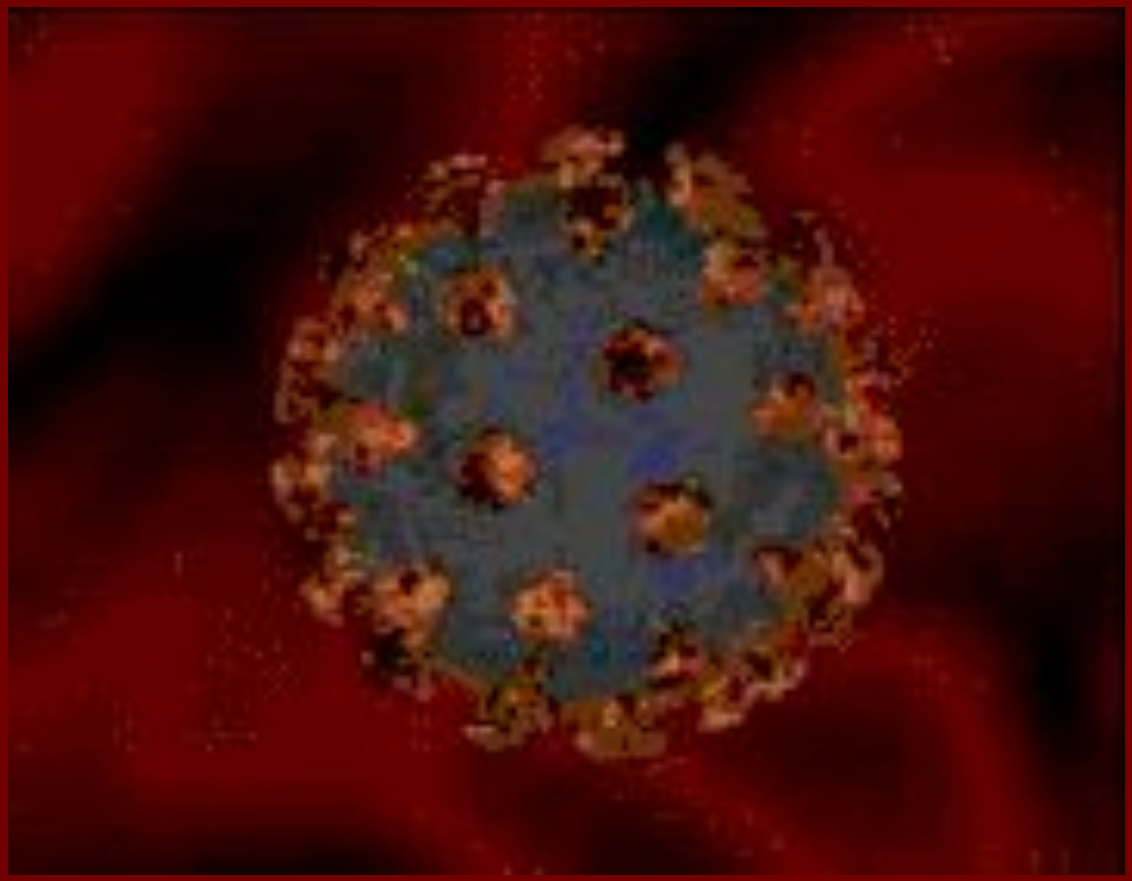
- For example…….

- An *epidemic disease* is a disease that many people acquire over a short period of time.

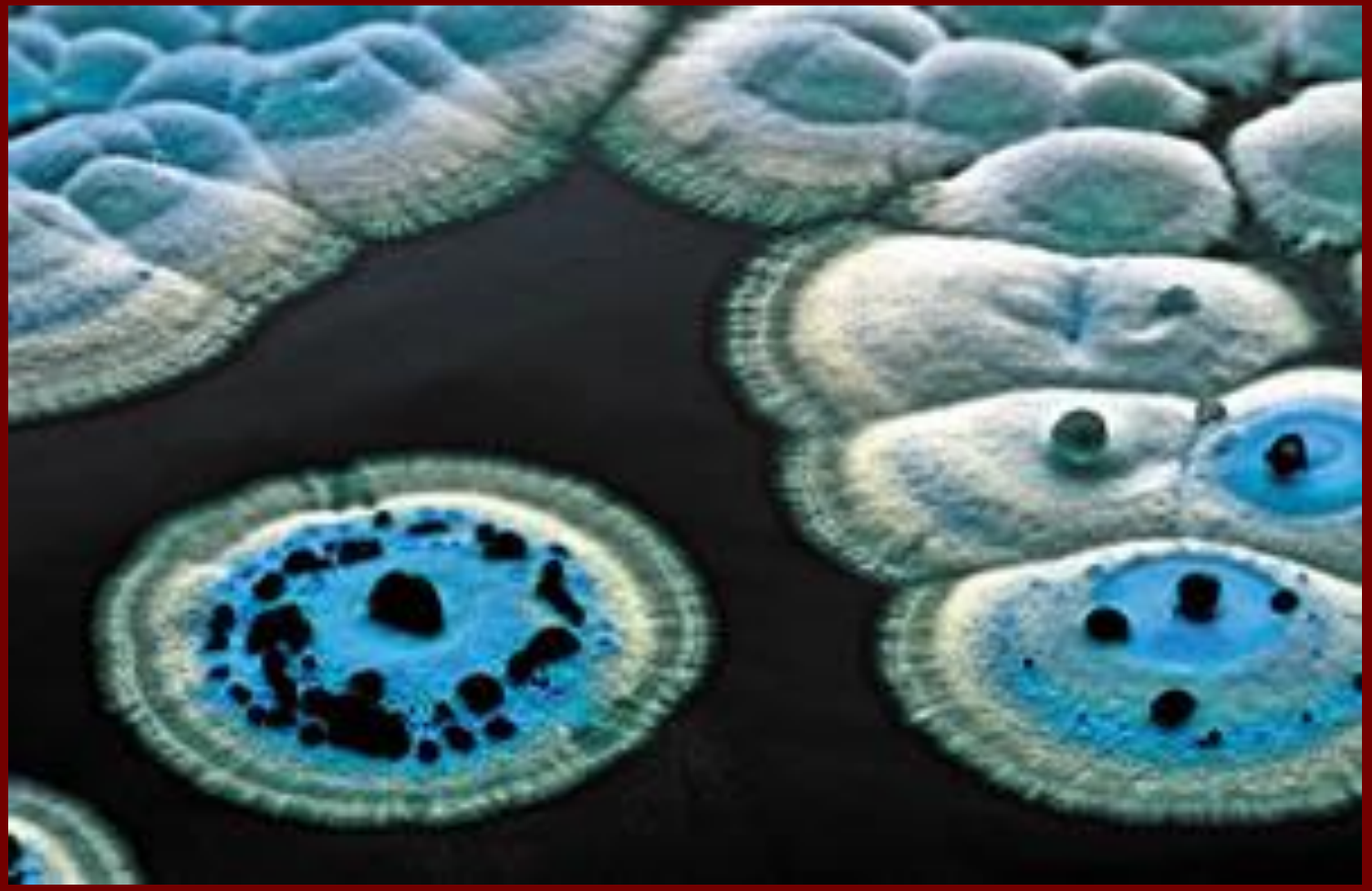
- For example……

- A *pandemic disease* is a world-wide epidemic disease.

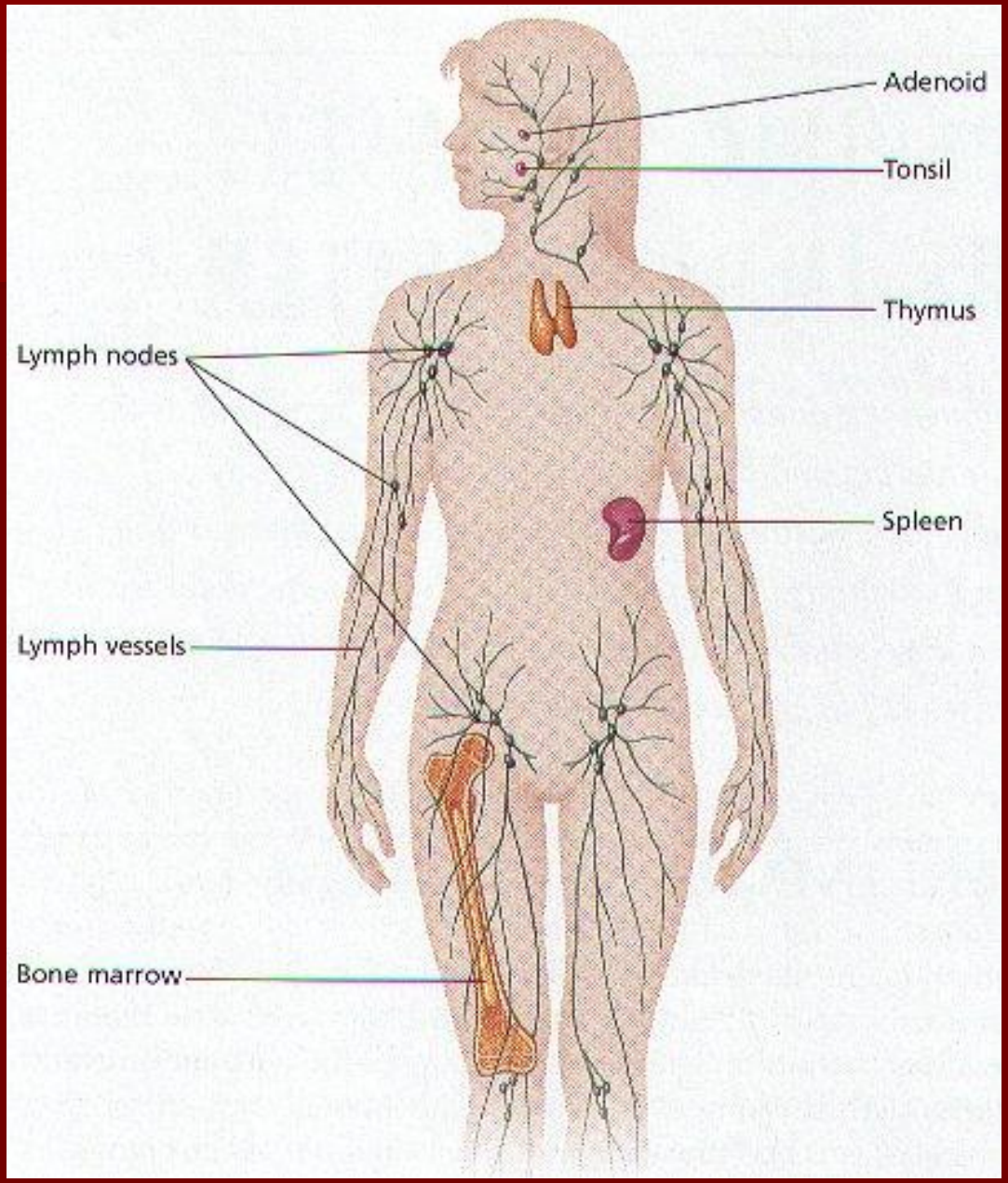
- For example…….



- An *antibiotic* is a chemical substance derivable from a mold or bacterium that kills microorganisms and cures infections.



The Immune System - includes all parts of the body that help in the recognition and destruction of foreign materials. White blood cells, phagocytes and lymphocytes, bone marrow, lymph nodes, tonsils, thymus, and your spleen are all part of the immune system.


Adenoid
Tonsil
Thymus
Lymph nodes
Spleen
Lymph vessels
Bone marrow

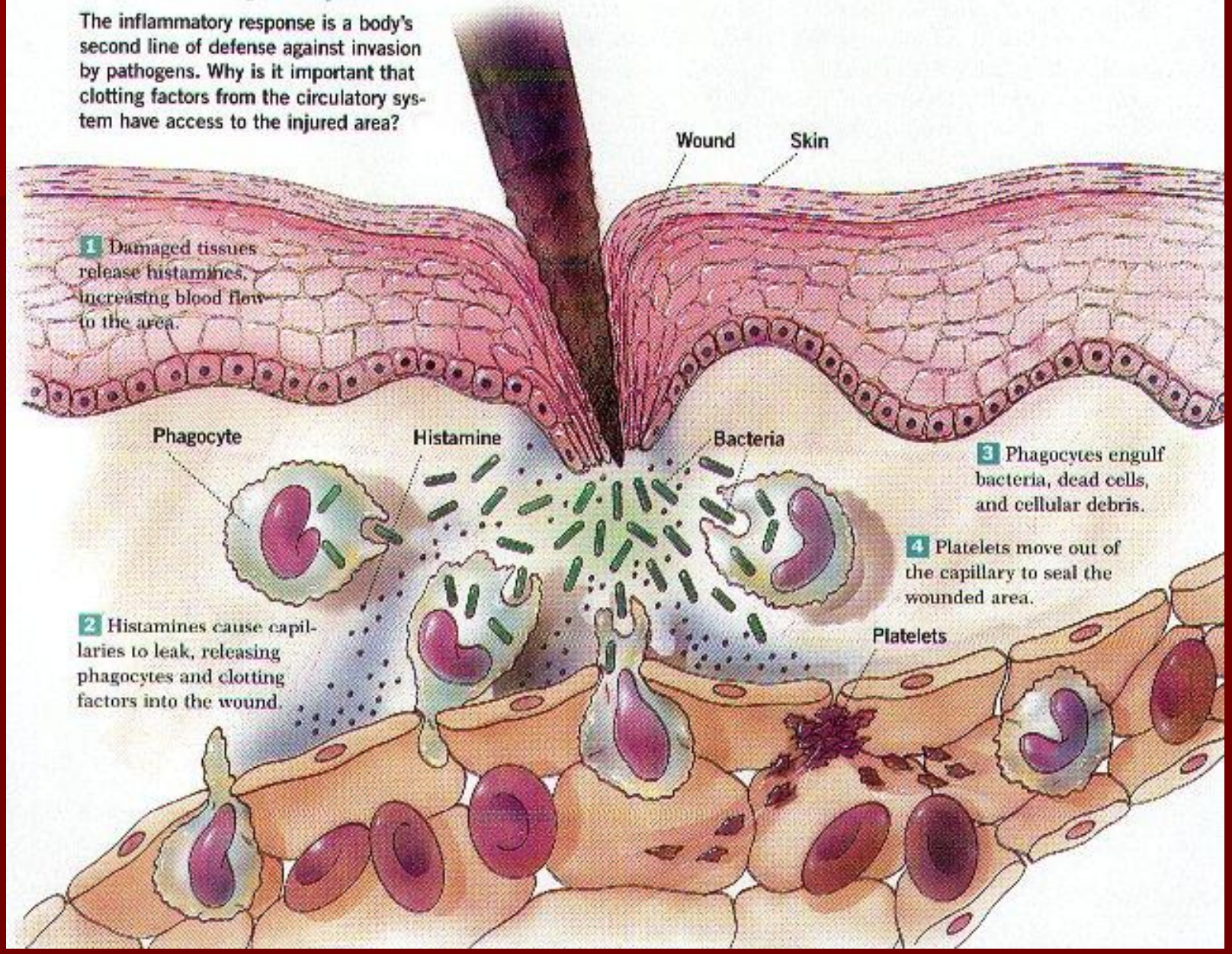
- ***First-Line Defenses / Innate Immune System-*** The body's first line of defense against pathogens uses mostly physical and chemical barriers such as
- Skin – acts as a barrier to invasion
- Sweat – has chemicals which can kill different pathogens.
- Tears - have lysozyme which has powerful digestive abilities that render antigens harmless.
- Saliva – also has lysozyme.
- Mucus - can trap pathogens, which are then sneezed, coughed, washed away, or destroyed by chemicals.
- Stomach Acid – destroys pathogens

- ***Second-Line Defenses*** - If a pathogen is able to get past the body's first line of defense, and an infection starts, the body can rely on it's second line of defense. This will result in what is called an……

- ***Inflammatory response*** causes
- Redness - due to capillary dilation resulting in increased blood flow
- Heat - due to capillary dilation resulting in increased blood flow
- Swelling – due to passage of plasma from the blood stream into the damaged tissue
- Pain – due mainly to tissue destruction and, to a lesser extent, swelling.

Steps of the Inflammatory Response

The inflammatory response is a body's second line of defense against invasion by pathogens. Why is it important that clotting factors from the circulatory system have access to the injured area?



- ***Third-Line Defenses*** - Sometimes the second line of defense is still not enough and the pathogen is then heading for the body's last line of defense, the immune system.

- The immune system recognizes, attacks, destroys, and remembers each pathogen that enters the body. It does this by making specialized cells and antibodies that render the pathogens harmless.

- Unlike the first line and second line defense the immune system differentiates among pathogens.

- For each type of pathogen, the immune system produces cells that are specific for that particular pathogen.

- An **antibody** is a protein produced in response to an antigen.
- **Antigens** are macromoleculesare macromolecules that elicit an immune response in the body. The most common antigens are proteinsare macromolecules that elicit an ir
The most com
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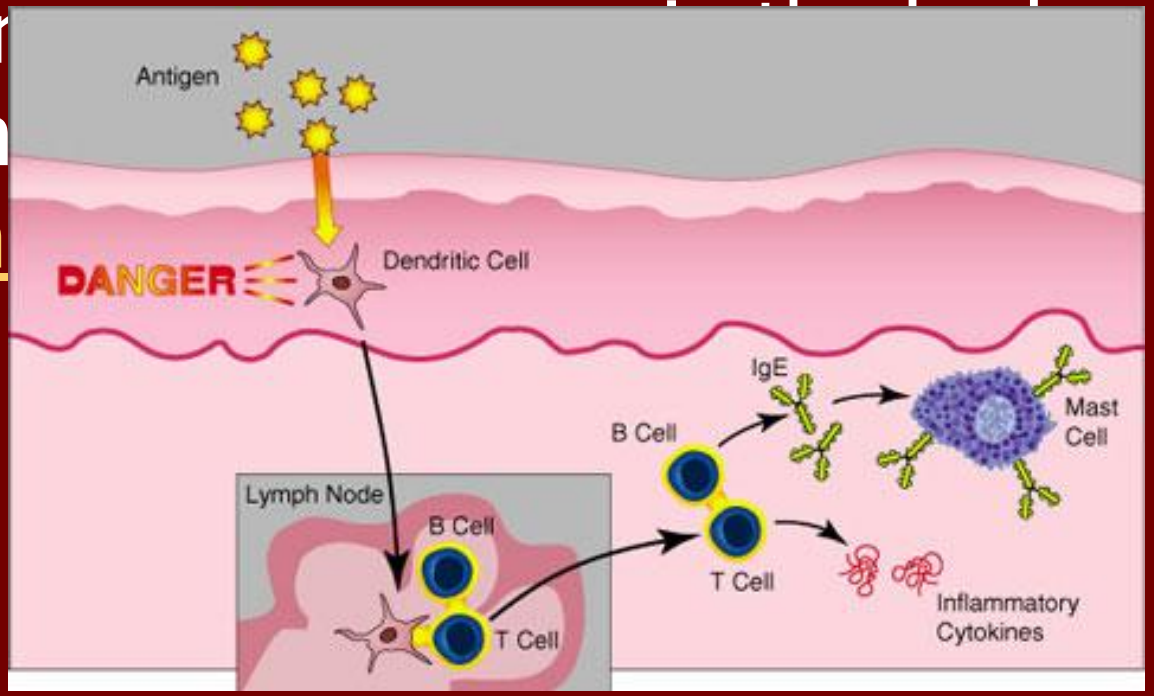


- Antigens can enter the body from the environment. These include

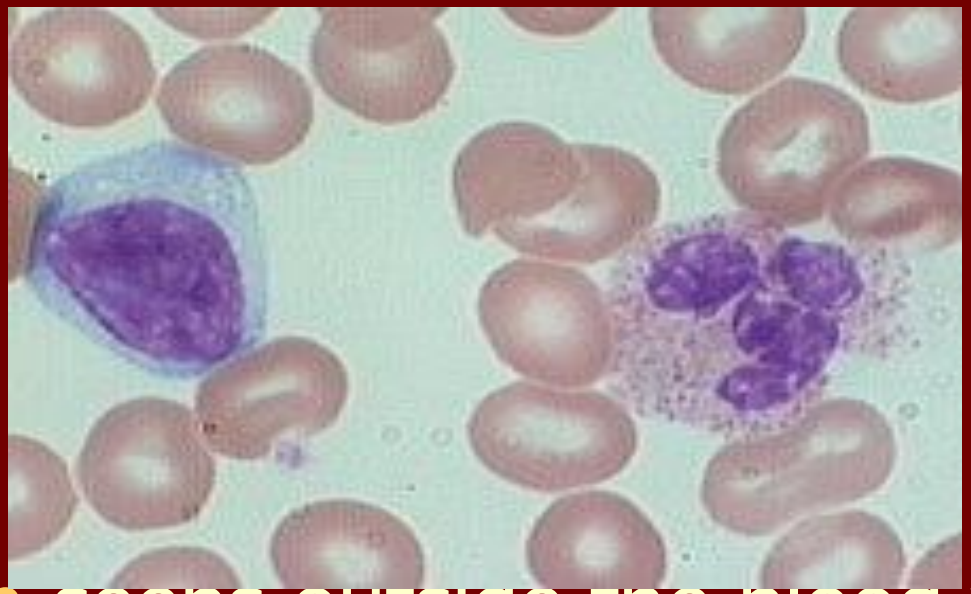
- inhaled macromolecules (e.g., proteins on cat hairs that can trigger an attack of asthma in susceptible people)

- ingested macromolecules (e.g., shellfish proteins that trigger an allergic response in susceptible people)

- molecules that are introduced beneath the skin (e.g., on a splinter or in an injected vaccine)

- antigens can be generated within the cells of the body. These include
- proteins encoded by the genes of viruses that have infected a cell
- aberrant proteins that are encoded by mutant genes; such as mutated genes in cancer cells

- **Lymph** is a milky body fluid that contains a type of white blood cells, called lymphocytes, along with proteins and fats.



- Lymph seeps outside the blood vessels in spaces of body tissues and is stored in the lymphatic system to flow back into the bloodstream.

- Through the flow of blood in and out of arteries, and into the veins, and through the lymph nodes and into the lymph, the body is able to eliminate the products of cellular breakdown and bacterial invasion.

- There are more than 100 tiny, oval structures called **lymph nodes**. These are mainly in the neck, groin and armpits, but are scattered all along the lymph vessels.

- They act as barriers to infection by filtering out and destroying toxins and germs. The largest body of lymphoid tissue in the human body is the spleen.

- As the lymph flows through lymph vessels, it passes through lymph nodes.

- White blood cells called **macrophages** trap and engulf cell debris and pathogens. Other white blood cells, called

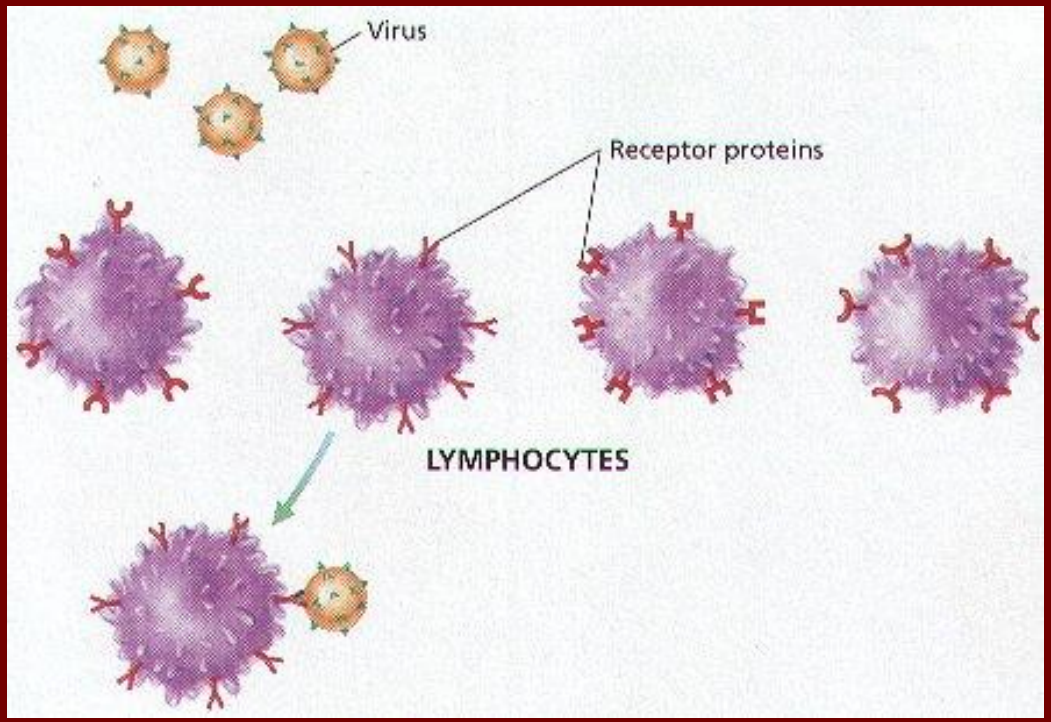
- **Lymphocytes** - are a type of white blood cell capable of producing a *specific immune response* to unique antigens. They produce antibodies which are chemicals that mark pathogens for destruction.

The scanning electron micrograph above, shows a human macrophage (gray) approaching a chain of *Streptococcus pyogenes* (yellow). Riding atop the macrophage is a spherical lymphocyte. Both macrophages and lymphocytes can be found near an infection, and the interaction between these cells is important in eliminating infection.

- Once a white cell has left the blood vessel and migrated to the enemy, the next job is to EAT the microbe.

- The macrophage is a large phagocyte. A **phagocyte** is an eating cell (phago = "eating", cyte = "cell") which engulfs invaders.

- Immunity is the result of the action of two types lymphocytes, the *B lymphocytes* and the *T lymphocytes*.
- B cells produce antibodies that are secreted into the blood and lymph.
- T cells attack the cells that have antigens that they recognize.

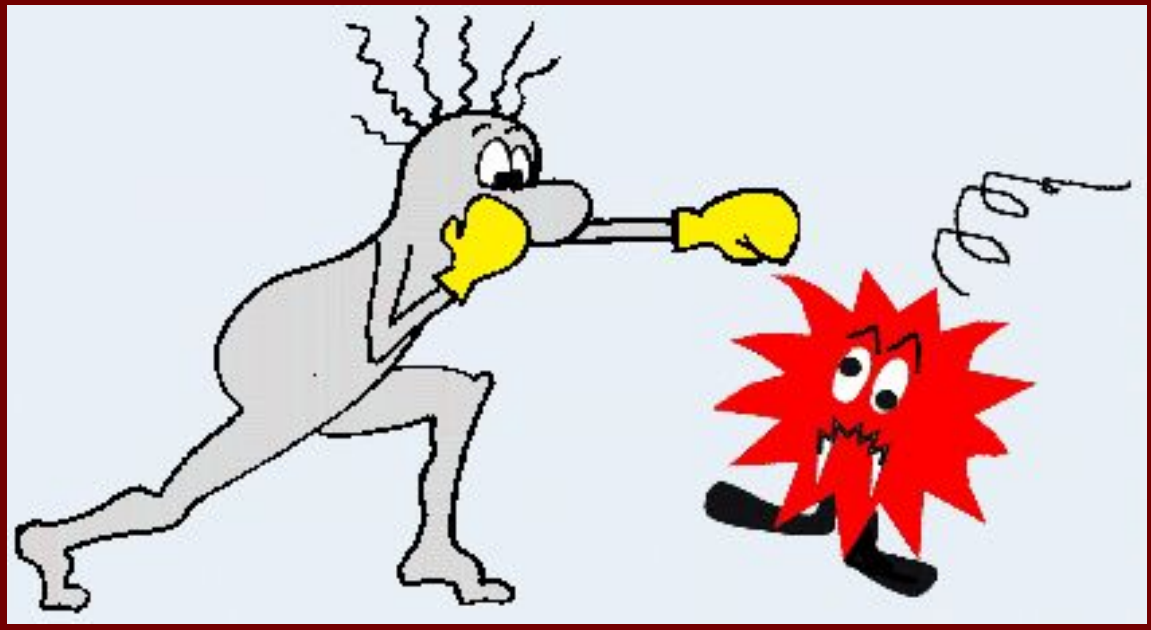


- **Killer T Cells** (lymphocytes) recognize surface markers on other cells labeled for destruction. They, Killer T Cells, help to keep virus-infected or malignant cells in check.

- Here, a smaller Killer T Cell (arrow) is attacking and killing a much larger flu virus-infected target. The sequence represents 30 minutes elapsed time.

- It has been estimated that during our lifetime, we will encounter a million foreign antigens capable of causing disease, and our bodies need the same amount of lymphocytes to defend against them.

- There will always be a different type of lymphocyte for each possible antigen.



- **Active Immunity** occurs when when one makes his/her own antibodies. This type of immunity is long term.

- **Getting the disease** : If you get an infectious disease (like Chicken Pox), often times, that stimulates the production of MEMORY cells which are then stored to prevent the infection in the future.

Vaccination: A vaccination is an injection of a weakened form of the actual antigen that causes the disease. The injection is too weak to make you sick, but your B lymphocytes will recognize the antigen and react as if it were the "real thing". Thus, you produce MEMORY cells for long term immunity.

Passive Immunity occurs when the antibodies come from some other source. This type of immunity is short term.

Breastmilk : Milk from a mother's breast contains antibodies. The baby is acquiring passive immunity. These antibodies will only last several weeks.

Gamma Globulin: A Gamma Globulin shot is purely an injection of antibodies to provide temporary immunity. You might receive an Gamma Globulin shot if you travel outside of the country.