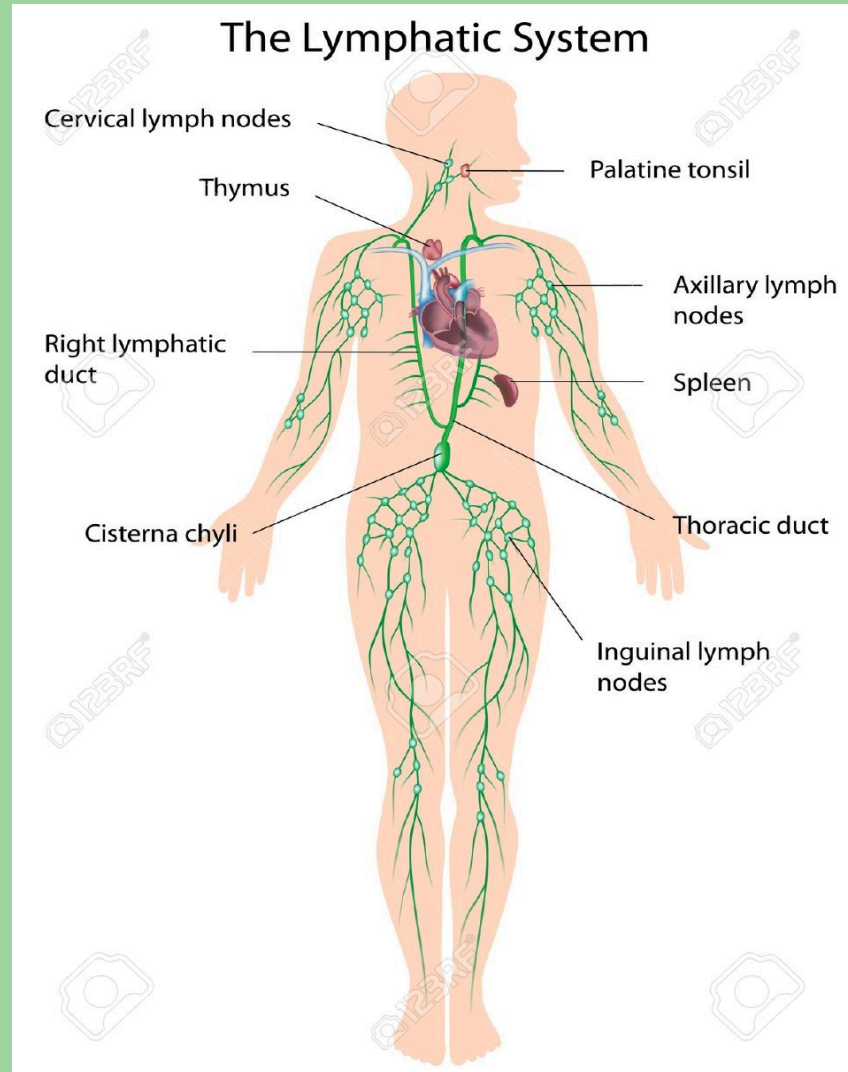
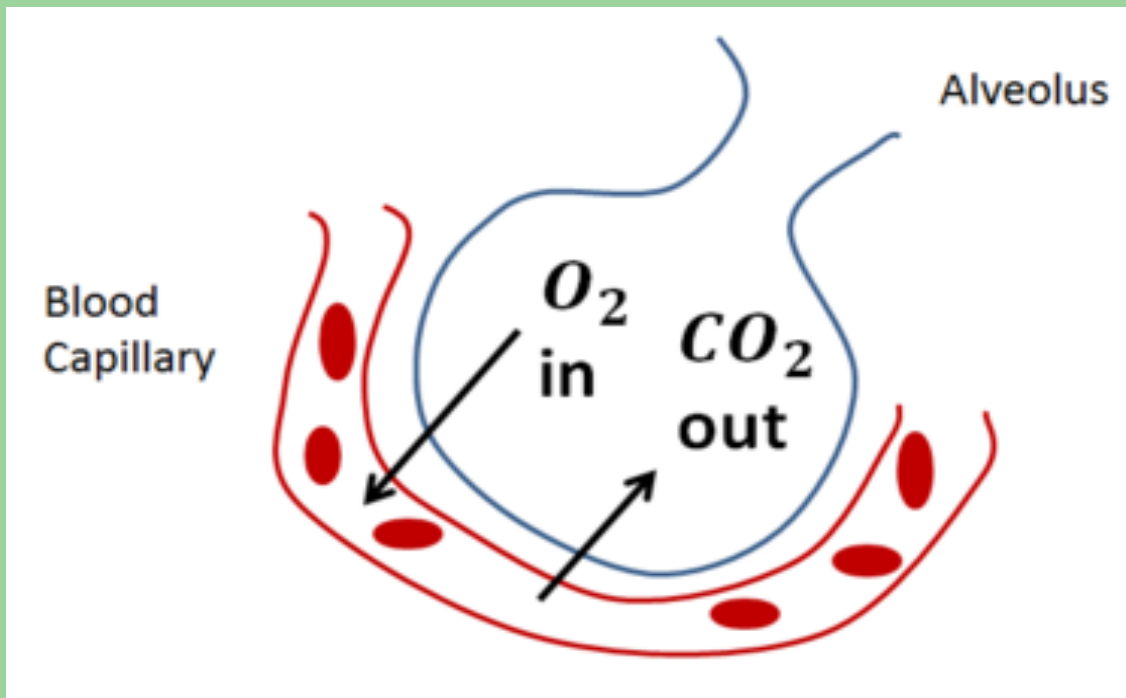


The Lymphatic System



What we know so far...

- The role of **blood circulation** is to carry substances, (gases and nutrients) to and from the cells.
 - Oxygen and nutrients to the cells.
 - Carbon dioxide and wastes away from the cells.

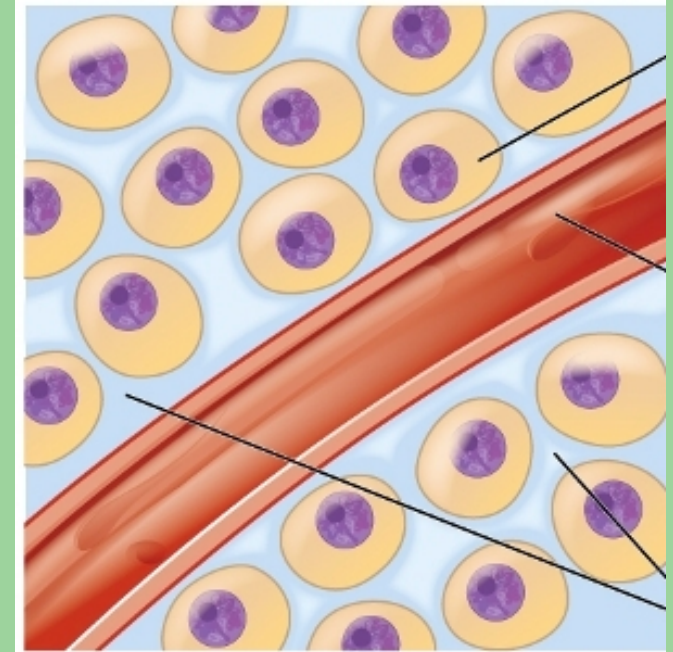


What's new...

- The exchanges between the blood and the cells do not occur directly.
- There is a space between blood vessels and cells.
- Substances are transferred out of the blood into a fluid that surrounds the cell. This is called **extracellular fluid**.

Extracellular Fluid

- Extracellular fluid is a clear liquid that surrounds our cells.
- Extracellular fluid contains:
 - Water from plasma.
 - White blood cells.

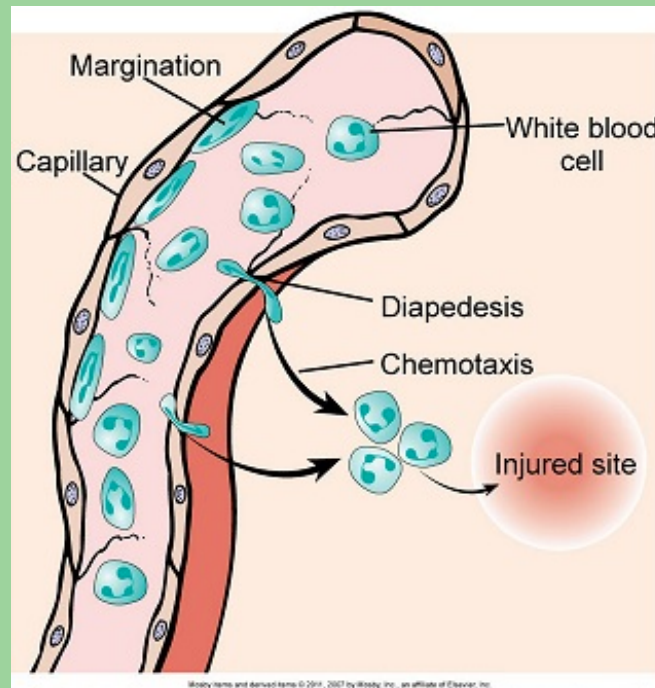


Extracellular Fluid

- The capillaries in our bodies have tiny holes in them. Through these tiny holes, **water from plasma** and **white blood cells** are able to escape the bloodstream and enter into the extracellular fluid.

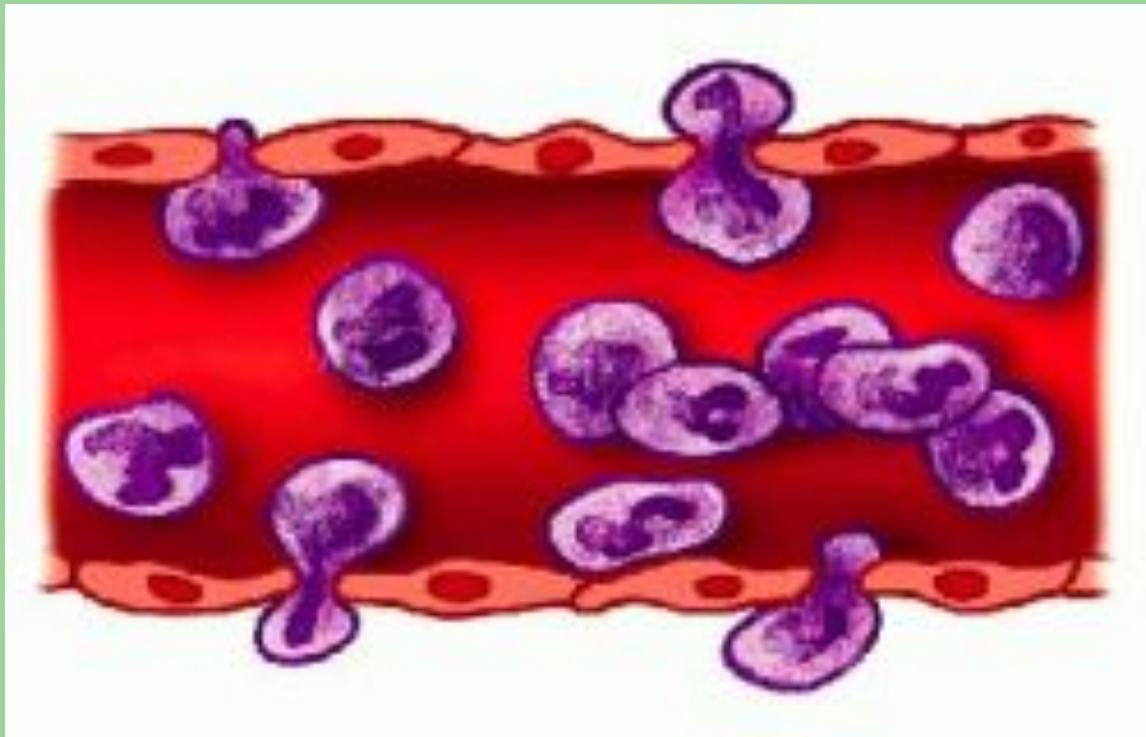
How do WBC get there??

- White blood cells are usually too large to pass through these tiny holes in the capillaries. In order to leave, the white blood cells alter their shape in a process called **diapedesis**.



Diapedesis

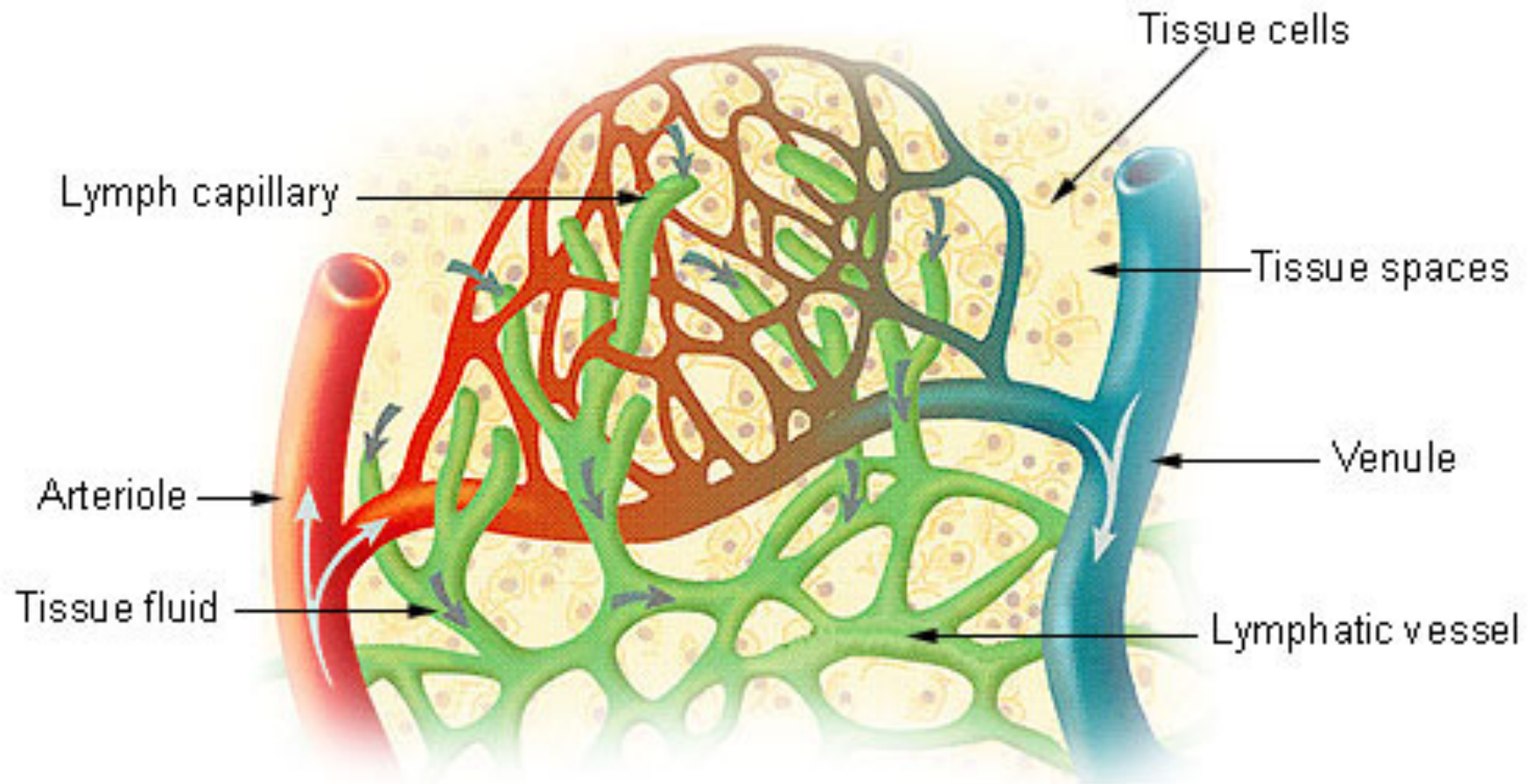
- A process by which white blood cells are able to exit the capillaries by altering their shape.



Lymph and Lymphatic Circulation

- **Lymph:** Extracellular fluid that finds its way into the lymphatic vessels. It is mostly made up of **water and WBC's**.
- **Lymphatic vessels:** Vessels that carry lymph from the capillaries where it escaped, and brings it back into the bloodstream.
- Lymphatic circulation occurs in order to salvage escaped substances from the blood. It is not pumped by the heart, but instead moves due to muscle contractions and valves.

Lymph Capillaries in the Tissue Spaces



Lymphatic System and Immunity

- The lymphatic system plays another role: immunity and defense against invaders, (bacteria or viruses).
- When an invader enters the body, it usually stays localized to one place. This means that it is located in the tissues surrounding the blood vessels and not in the blood itself.

So, how do the white blood cells attack these invaders?

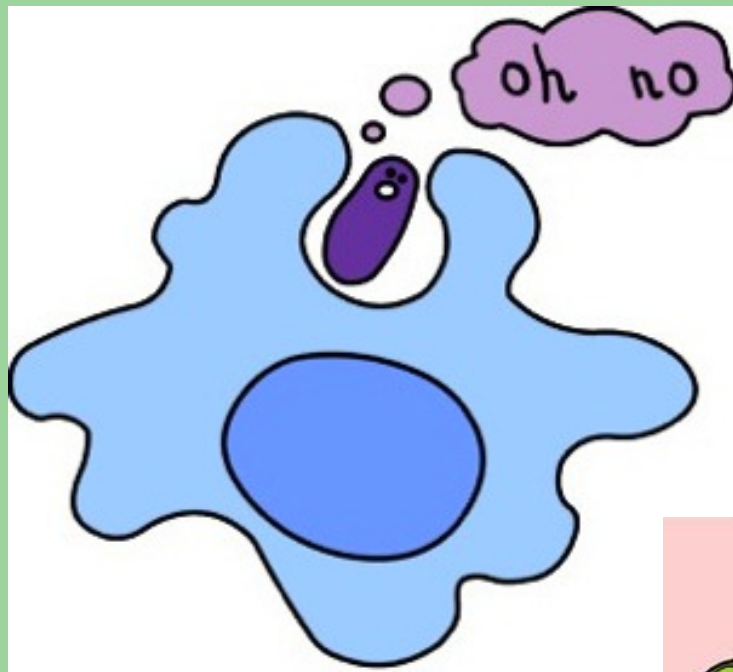
- The invaders will get swept into the lymphatic system and carried by the lymph. Some invaders will be attacked by the WBC's in the lymph, but the others will be carried to a site where there is a high concentration of WBC's...lymph nodes.

There are two ways that WBC's attack invaders:

- Ingest them through phagocytosis.
- Neutralize them by secreting antibodies.

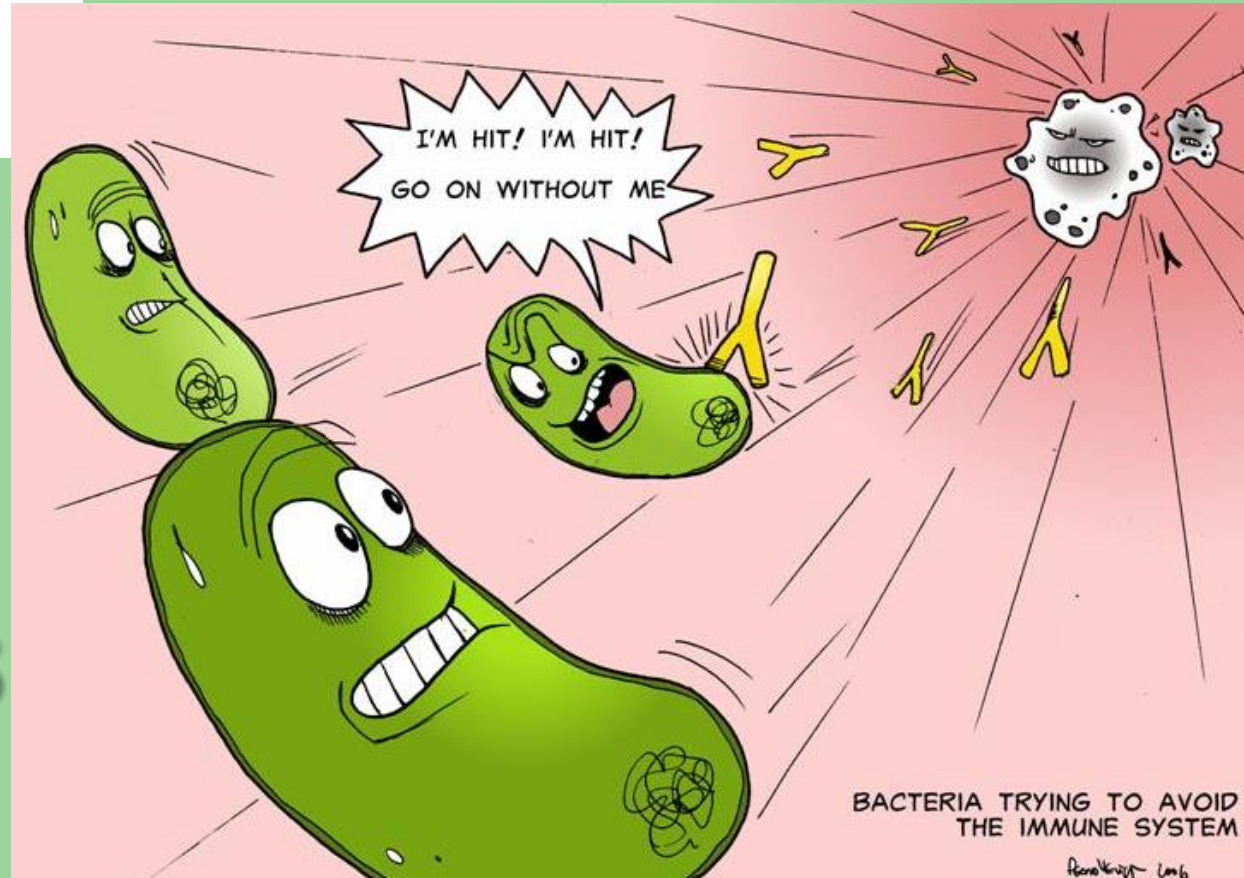
Definitions

- **Phagocytosis:** WBC's ingest and destroy invaders or antigens.
- **Antibody:** A substance secreted by the WBC to neutralize an invader or antigen.
- **Antigen:** A substance recognized as foreign by the body. AKA an invader.



Phagocytosis

Antibodies



Features of Antibodies

- The antibodies produced by our WBC's have two features:
 - **They are specific:** They can only attack the antigens for which they were produced. Every antigen requires a different antibody.
 - **They are immunizing:** The WBC remembers, sometimes for life, how to produce a specific antibody. This is why we only get certain diseases like chicken pox and measles once in a lifetime.
- **Immunization:** A vaccine whereby your body is given the specific antibodies needed to fight threatening diseases.