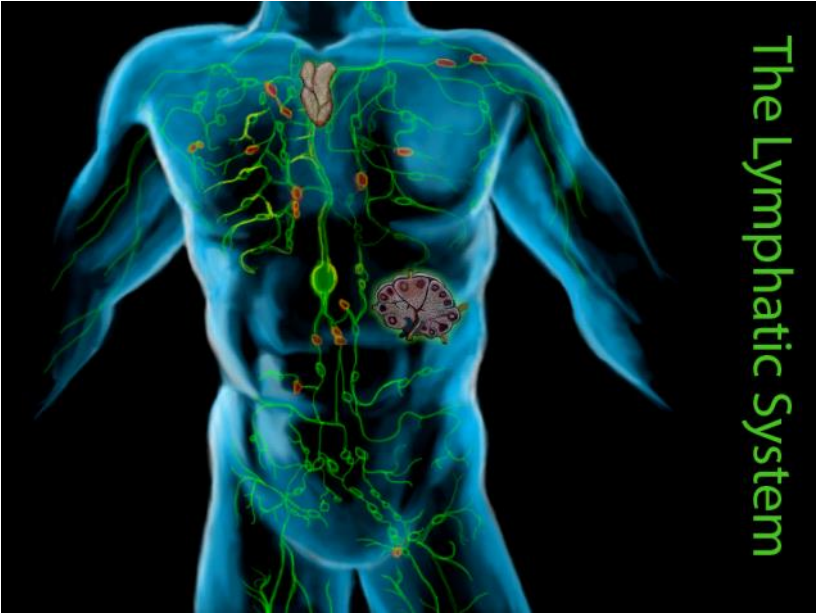

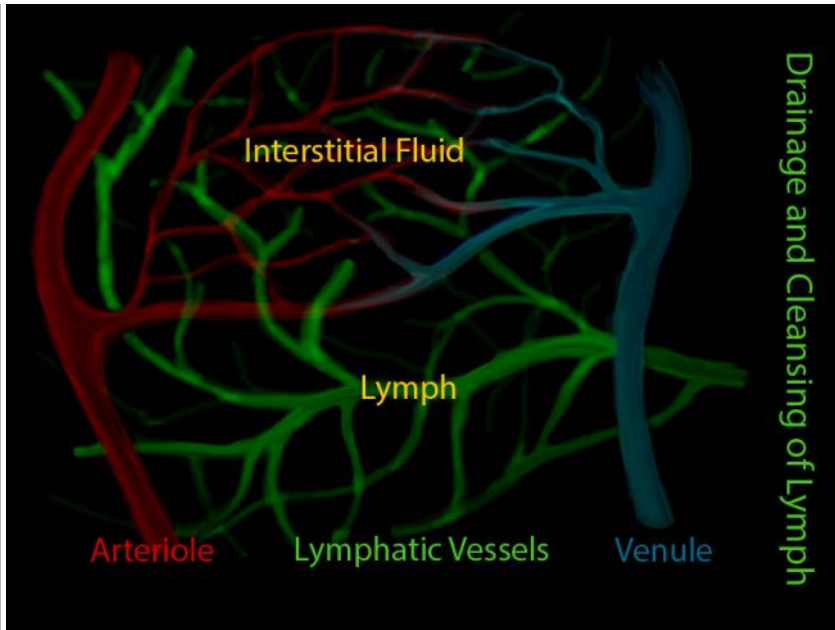


# Lymphatic System, Pt1

Sunday, May 27, 2012  
10:24 AM

VoiceThread	NA
YouTube (MP4)	<a href="http://youtu.be/BX8fBlme9vQ">http://youtu.be/BX8fBlme9vQ</a> and <a href="http://www.youtube.com/watch?v=BX8fBlme9vQ">http://www.youtube.com/watch?v=BX8fBlme9vQ</a>
swf	<a href="http://justabitmoore.weebly.com/high-school-level-lymphatic.html">http://justabitmoore.weebly.com/high-school-level-lymphatic.html</a>

Slides	Notes
<p>Project Dimensions: 880x660 (4:3 aspect ratio)</p> 	<p>Slide: Title</p> <p>Audio: The Lymphatic System</p> <p>Lymph vessels are found in all tissues except the central nervous system, the bone marrow, and tissues without blood vessels such as cartilage. Lymph system vessels are as extensive as the vessels of the circulatory system.</p>
	<p>Slide: Function of the Lymphatic System</p> <p>Audio: The lymphatic system serves several functions ...</p> <ul style="list-style-type: none"><li>• It controls fluid balance by draining and cleansing the fluids that leave the circulatory system to deliver nutrients and gasses to the tissues</li><li>• It interacts with the villi in the digestive system to absorb and deliver fats to the circulatory system</li><li>• Immunological protection from viruses, bacteria, fungi, and cellular debris that could damage the cells of the body.</li></ul> <p>-----</p> <p>What are the three basic functions of the lymphatic system? Choose 3 answers.</p> <p>Choose at least one answer.</p> <ul style="list-style-type: none"><li><input checked="" type="checkbox"/> a. immunological defense</li><li><input checked="" type="checkbox"/> b. fat absorption</li><li><input type="checkbox"/> c. Store blood</li><li><input type="checkbox"/> d. Filter blood</li><li><input checked="" type="checkbox"/> e. fluid balance</li></ul> <p>The process by which the body protects itself from pathogenic invaders such as bacteria, fungi, parasites, and foreign substances <span style="float: right;">Immunological defense ▾</span></p>



Group: Drainage/Cleansing of Fluids  
Slide: Lymphatic Vessels

Audio:

From your understanding of the circulatory system, you know that the blood passes through the arteries, arterioles, and then the capillaries. The capillary walls allow the fluid portion of the blood to exit the capillaries into the surrounding tissues. Once the fluid leaves the capillaries, it is called interstitial fluid. About 90% of this fluid will diffuse back into the capillaries because of the difference in concentrations of the fluid. However, about 10% of the fluid will enter the open-ended lymph vessels. Once the fluid has entered the lymph vessels, it is now called lymph.

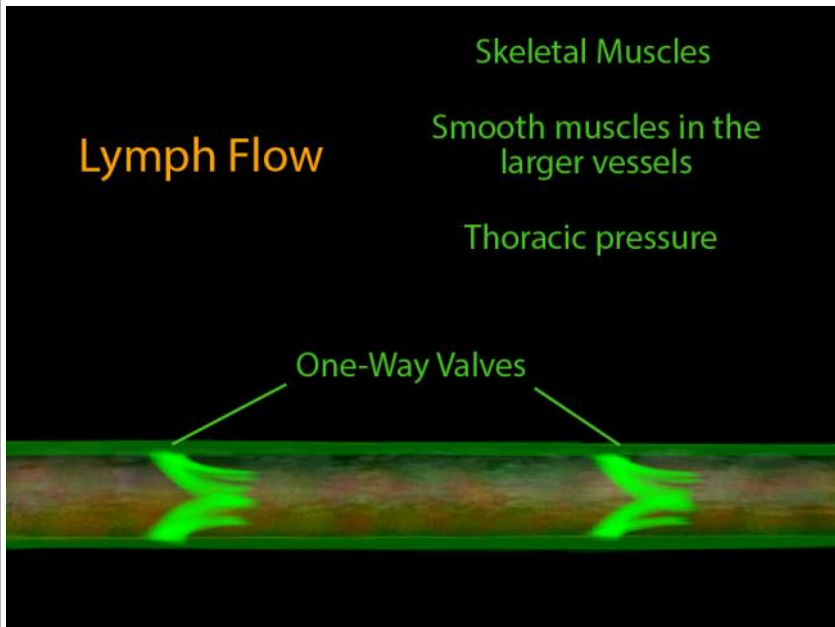
These vessels eventually deliver the lymph to locations where the lymph can be cleansed of debris and checked for the presence of pathogenic organisms. How it gets the lymph there is pretty amazing. There is no heart for this system of vessels to pump the lymph around. So, how does the lymph get to the locations it needs to be delivered to?

Watery liquid formed from interstitial fluid and found in lymph vessels

porous, blind beginnings of Lymph vessels

Interstitial fluid becomes lymph. What happened to the interstitial fluid to make it lymph?

- Choose one answer.
- a. the fluid entered a blood vessel
  - b. the fluid entered the spleen
  - c. the fluid entered a lymph vessel



Group: Drainage/Cleansing of Fluids  
Slide: Lymph Flow

The lymph moves through your body when you move your skeletal muscles. The contraction of skeletal muscles squeezes the nearby lymph vessels, "pumping" them. This pushes lymph through the vessels.

In addition to the contraction of skeletal muscles, there are two other means by which lymph travels through the lymphatic system. There are smooth muscles in the larger lymph vessels. The contraction of these smooth muscles adds to the force provided by the skeletal muscles. Also, when we breathe, pressure changes occur in the thoracic region. When the thoracic pressure drops, that tends to "pull" lymph into the thoracic duct.

One-way "valves" prevent the lymph from flowing backwards when the skeletal muscles relax.

How does interstitial fluid get into the lymph vessels? How does it get pumped through those vessels? Put the process in order

It is pushed through the lymph vessels by contractions of the skeletal muscles,

Interstitial fluid enters a lymph capillary through pores in between the overlapping cells in the lymph capillary,

contractions of smooth muscles in the larger lymph vessels, and by slightly lower pressure in the thoracic cavity.

Image -  
Add skeletal muscles, smooth muscles in larger lymph vessels, thoracic pressure  
This slide has flow and valve open and close animation (effect: zigzag set up in a linear path with forward and a slight backward flow).

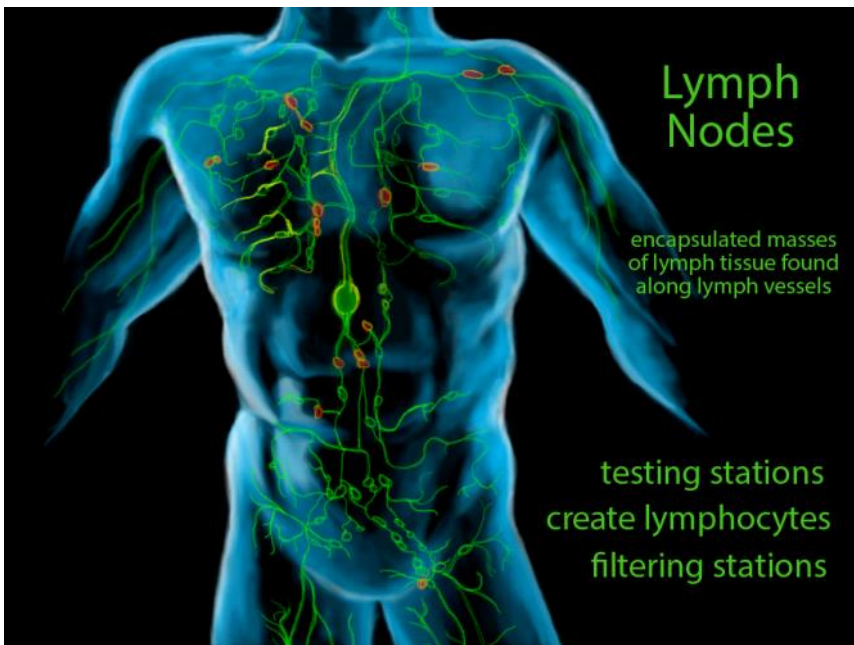
Group: Drainage/Cleaning of Fluids



Slide 5: Elephantitis

The function of fluid balance is seen best perhaps when it goes awry. When the lymphatic system is prevented from doing its job, the fluids build up in the tissues. Edema is the term given to this medical condition. Mild edema can occur during pregnancy when the weight of the baby slows the ability of the vessels to move the lymph up the body. More serious levels of edema can occur in a tropical disease called elephantitis in which parasites block the vessels and the edema that is produced looks like they have legs of an elephant.

- A buildup of excess fluid in the tissues, which can lead to swelling
- tropical disease where legs swell and become huge



Group: Drainage/Cleansing of Fluids  
Slide: Lymph Nodules

Some lymph tissue is very diffuse with no clear boundaries. You can actually feel some when you rub your inner lip with your tongue. Others are more organized into groups and these are called lymph nodes.

Lymph nodes have three real functions. First, they are testing stations. They monitor the blood by receiving "samples" of the blood plasma. Second, if the "sample" is rife with foreign invaders, they produce lymphocytes and send them into the bloodstream to try to destroy the invaders. In addition, the lymph nodes filter the lymph that they have, so that they return only "clean" fluid back to the blood.

Eventually, the lymph is returned to the circulatory system via the right and left subclavian veins in the shoulders just above the heart level.

- Concentrations of lymphatic tissue with no clear boundaries
- Groups of lymphocytes and other cells which support the lymphocytes
- Encapsulated masses of lymph tissue found along lymph vessels
- filtering the lymph with macrophages
- testing the lymph for foreign invaders
- adding lymphocytes to the blood

Group: Drainage/Cleansing of Fluids  
Slide: Tonsils

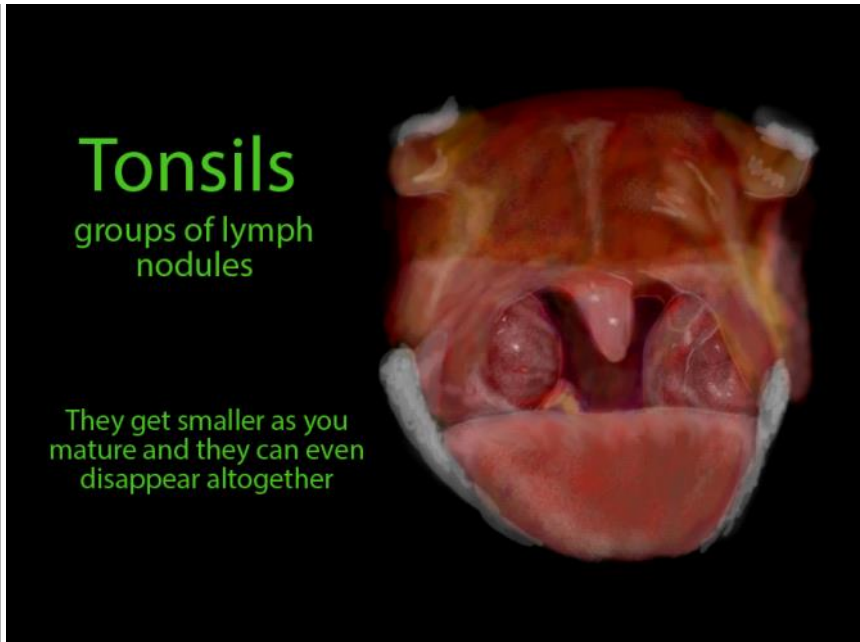


Image -

Lymph nodules can be found as single structures in the body, or they can be grouped together in small clumps. That's what the **tonsils** are. They are groups of lymph nodules under the mucous membrane in the throat or on the back of the tongue. These lymph nodules form a protective ring around the throat, strategically located to protect the body from foreign invaders.

If the tonsils get infected, they can become inflamed and abnormally enlarged as you see here. This condition is called **tonsillitis**. If the condition is chronic, the tonsils can be removed in a **tonsillectomy**. Tonsils tend to get smaller as a person matures, and they can actually disappear altogether in an adult.

---

What are tonsils?

Where are tonsils found in the body?



Image -

Group: Drainage.Cleaning of Fluids  
Slide: Peyer's Patches

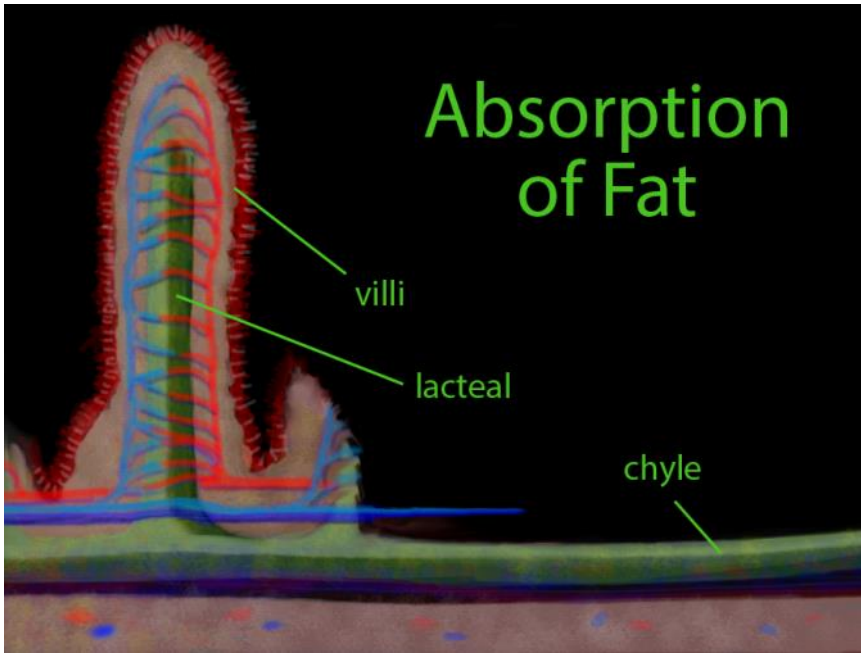
**Peyer's (pie' yers) patches** are very similar to tonsils. They're groups of lymphocytes in lymph nodules that are in the small intestine. Typically, they are found in the last third of the small intestine. Once again, they're strategically located to deal with foreign invaders.

---

What are Peyer's patches?

Where are Peyer's patches found in the body?





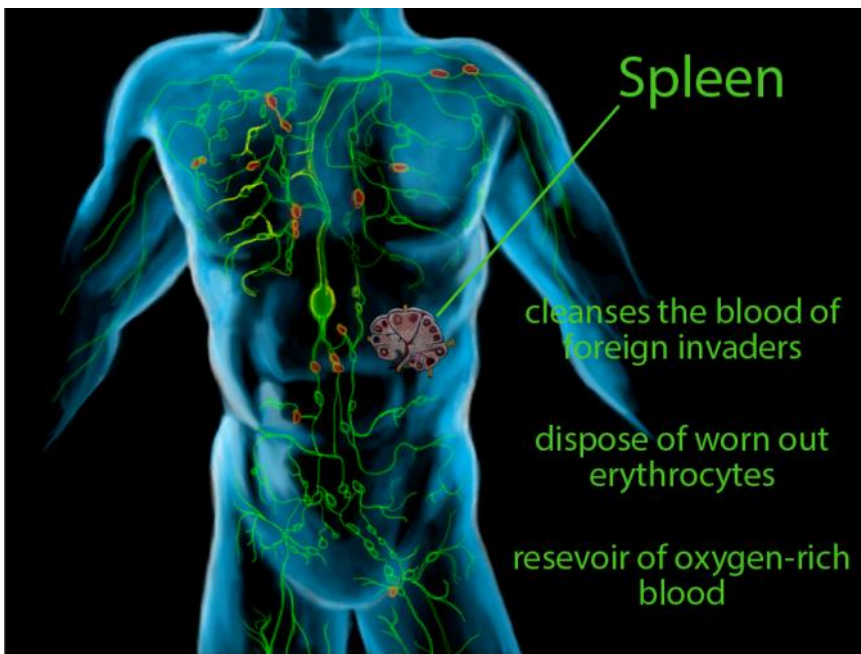
Group: Absorption of Fat  
Slide: Absorption of Fat

The lymphatic system's 2nd function takes place here in the small intestine as well, the absorption of fats. We will discuss this more in depth under the topic of digestion, but for now know that there are specialized lymph vessels called lacteals in the intestinal villi. These pick up fats that are released from digested food and absorbed in to the villi tissue. The liquid in the vessel takes on a milky color. Instead of being called lymph, this fluid is called chyle.. The chyle eventually gets dumped into the subclavian vein, just like lymph. That is how the fats enter the circulatory system.

liquid inside the vessels takes on a milky-white color

Is lymph the same throughout the lymphatic system?

Choose one answer.  
 a. No  
 b. yes



Intro to the spleen

Spleen Function:

The spleen is a significant lymphatic structure, but it has much in common with the smaller nodes throughout the body. Unlike lymph nodes, the spleen *does not* filter lymph. It is a part of the lymphatic system, however, because it *filters the blood*. As the blood passes through the white pulp of the spleen, foreign invaders stimulate a response from the diffuse lymphatic tissue or the lymph nodules.

The spleen also works to clean the blood of worn-out erythrocytes. Remember, red blood cells have a short life span. As a result, roughly *two million* erythrocytes die every second. They must be removed from the blood, and that's another one of the spleen's functions. Before the blood leaves the spleen through the veins, it passes through the red pulp. Macrophages in the red pulp engage in phagocytosis to remove both foreign substances and worn-out red blood cells.

The third function of the spleen is to act as a reservoir for oxygen-rich blood. The spleen actually holds more blood than is necessary for its own metabolism. Therefore, its extra blood contains oxygen and nutrients. This serves as a "backup supply" of blood in case of blood loss. If the body detects blood loss due to hemorrhage, the sympathetic division of the ANS stimulates the smooth muscle in the capsule of the spleen to contract. This pushes the "backup supply" of blood into the bloodstream, compensating for the blood loss.

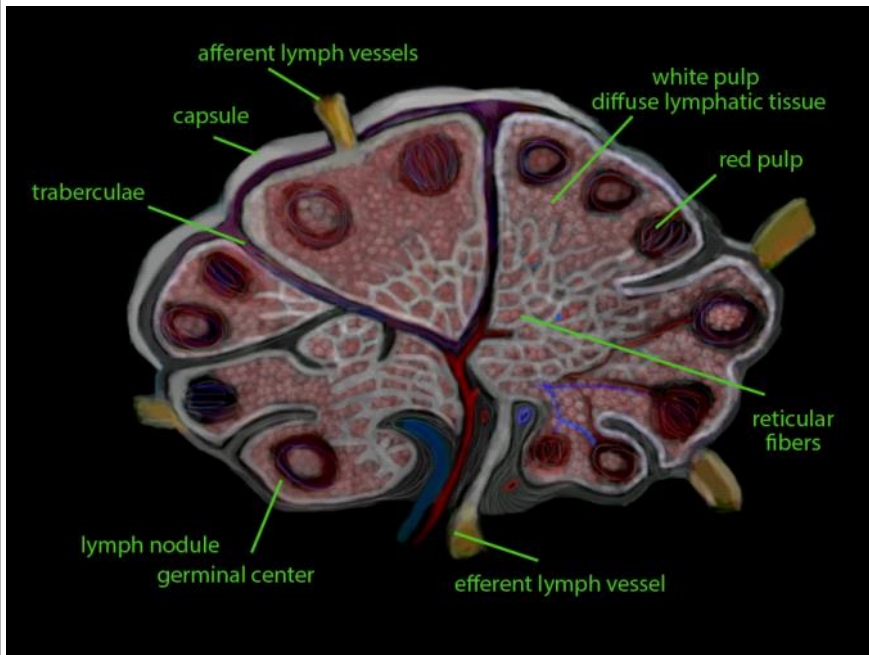
Although the backup supply of blood in the human spleen is rather minor, it is a *major* factor in the physiology of some other mammals. Seals use the spleen as a built-in oxygen tank. When the seal dives, it conserves its oxygen as much as possible. However, when it is running low and cannot get to the surface, the smooth muscles of the spleen contract, sending the oxygen-rich blood stored there into the bloodstream. This gives the seal more time before it must surface to breathe.

Although the spleen is a part of the lymphatic system, you can live without it. If your spleen is ruptured due to injury, it can be removed in a **splenectomy** (splee nek' toh mee). This is often necessary in order to stop internal bleeding, because the spleen is so vascular. Once your spleen is removed, tissues in the liver as well as other lymphatic tissues in the body take over the first two tasks of the spleen. Of course, the overall function is not as good as when the spleen is present in the body. As a result, people who have their spleens removed are more susceptible to infection and more sensitive to hemorrhage.

dispose of worn-out erythrocytes

to be a reservoir of oxygen-rich blood

to cleanse the blood of foreign invaders



### Spleen Structure

The **spleen** is roughly the size of a clenched fist.

Unlike lymph nodes, however, the capsule, or outer cover, of the spleen contains smooth muscle tissue. Extensions of this capsule, called **trabeculae** (truh bek' you lay), make up the "skeleton" of the node.

The lymph nodes are fed by several **afferent lymph vessels**. However, lymph exits through just one **efferent lymph vessel**.

**Reticular fibers** extend from the trabeculae, forming a net of connective tissue throughout the lymph node.

Inside the spleen, there are two types of tissue: **red pulp** and **white pulp**. The white pulp is composed of diffuse lymphatic tissue and lymph nodules, much like a lymph node. This white pulp surrounds the arteries which enter the spleen. The red pulp is made up of twisted veins and reticular fibers which are full of blood cells which were in the capillaries of the spleen.

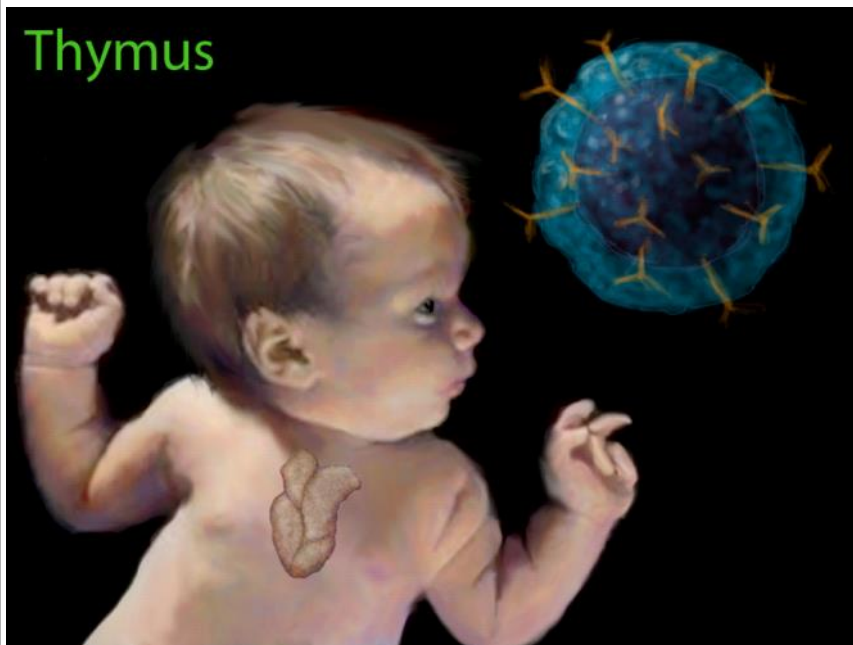
Lymph nodules contain **germinal centers**, where rapid mitosis of lymphocytes can take place in response to a foreign invader found in the lymph. Lymphocytes produced in the germinal centers are released into the lymph and eventually reach the bloodstream, where they can be transported to the tissues. The lymph nodules are surrounded by diffuse lymphatic tissue.

For a given lymph node, are there more afferent lymph vessels or more efferent lymph vessels?

**efferent lymph vessels**

**afferent lymph vessels**

The spleen's anatomy is also a required outcome. See the interactive drag and drop activity for this one.



### Thymus Gland

Another lymphatic system structure is the thymus gland. Like the tonsils, the thymus gland changes as a person matures. When a person is young, the thymus gland is large in proportion to the body size. During this stage of life, it is mostly lymphatic tissue. After puberty, it decreases in size and becomes mostly fibrous and fatty tissue.

What does the thymus gland do? Like many things in the human body, the scientific community is still rather puzzled by the thymus gland. We know that while a person is young, immature lymphocytes known as T-lymphocytes leave the bone marrow (remember - blood cells are made in the bone marrow) and travel to the thymus. Through a remarkable maturation process sometimes referred to as "thymic education," T-lymphocytes that are beneficial to the immune system are spared, while T-lymphocytes that might evoke a detrimental immunological response are eliminated. For example, if you have type A blood, T-lymphocytes which attack the A antigen are destroyed. However, T-lymphocytes which attack the B antigen are allowed to mature and enter the bloodstream.

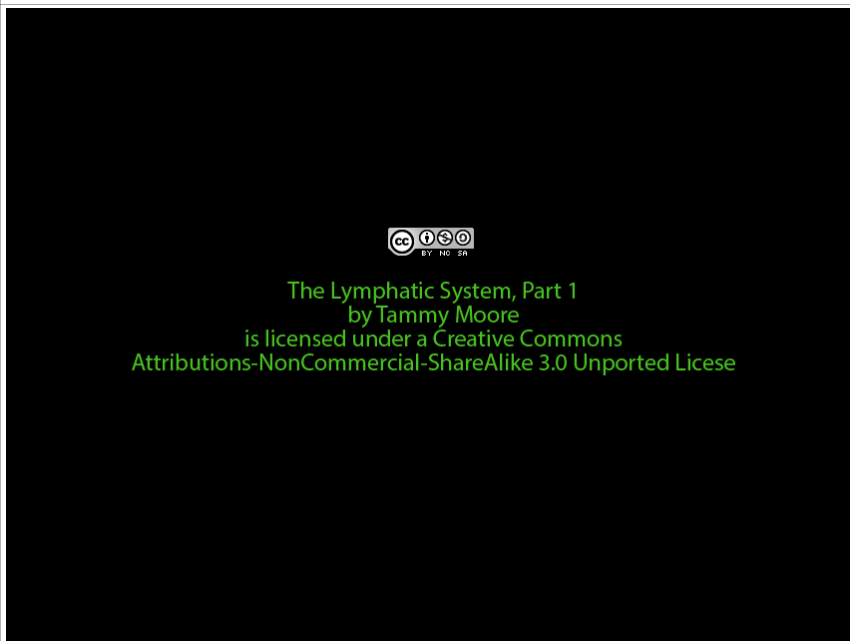
is the place where T-lymphocytes mature



Notice that this one is called a gland. That means that one of its functions is to secrete hormones making it also a part of the endocrine system as well as the lymphatic system. It produces hormones, principal among them is the hormone thymosin. What does thymosin do in the body? We are not really sure. We know that it affects the immunological response of the body. However, the way that this is done remains unclear. One prevalent thought is that thymosin stimulates the activity of lymphocytes to migrate to other lymphatic tissues.

secretes thymosin

thymus gland



Credits:

All illustrations by Tammy Moore

Creative commons embed code:

```
<a rel="license" href="http://creativecommons.org/licenses/by-nc-sa/3.0/">
</a><br />
<span xmlns:dct="http://purl.org/dc/terms/"
href="http://purl.org/dc/dcmitype/InteractiveResource" property="dct:title"
rel="dct:type">The Lymphatic System, Part 1</span> by <a
xmlns:cc="http://creativecommons.org/ns#"
href="http://www.virtualhomeschoolgroup.com" property="cc:attributionName"
rel="cc:attributionURL">Tammy Moore</a> is licensed under a <a rel="license"
href="http://creativecommons.org/licenses/by-nc-sa/3.0/">Creative Commons
Attribution-NonCommercial-ShareAlike 3.0 Unported License</a>.
```