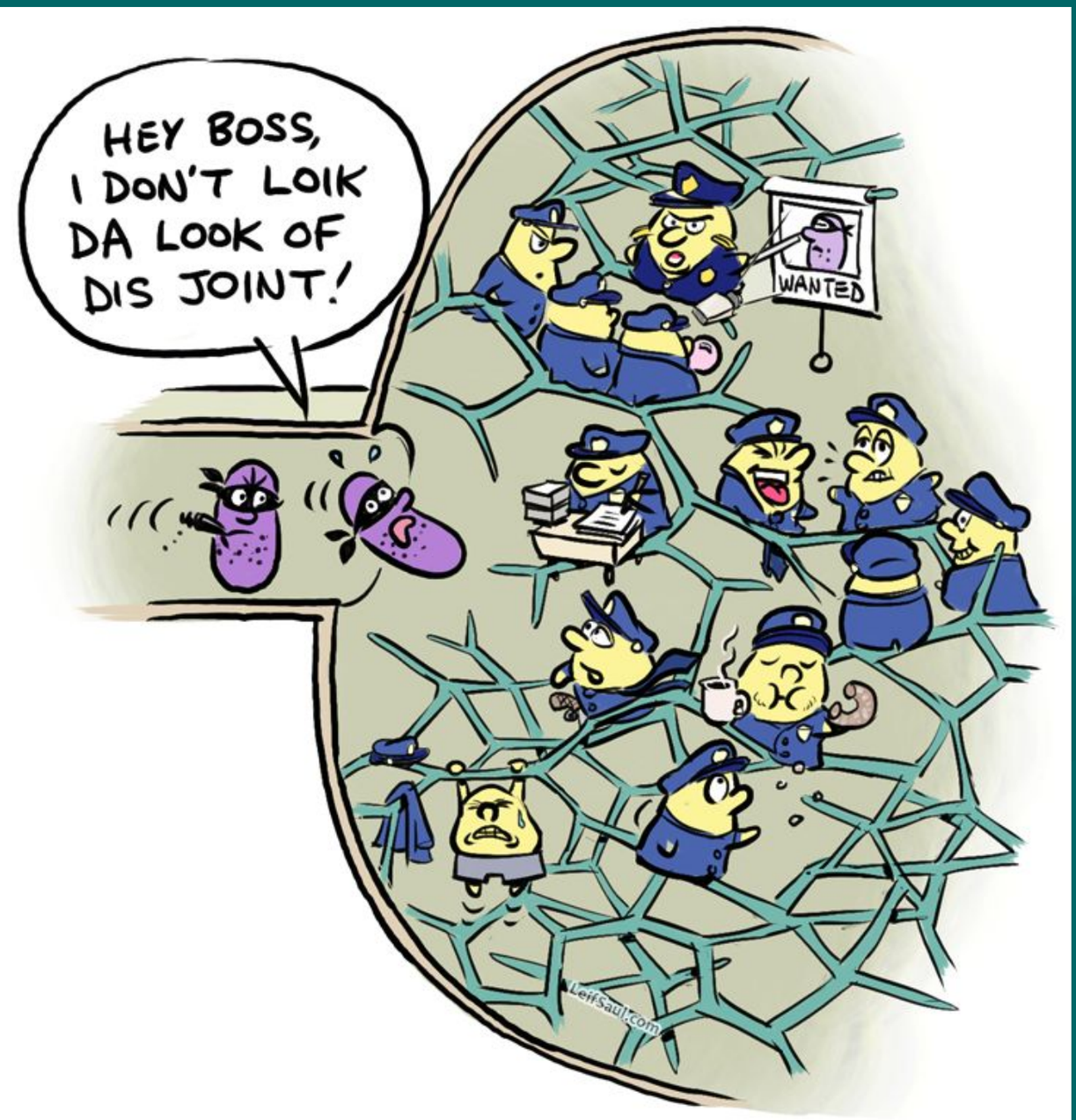


Learning Intention:

To understand how the lymphatic system serves as a transport system for antigen-presenting cells to facilitate antigen recognition.

Success Criteria:

-I can state the role of the lymphatic system in the immune response as a transport network

I can explain the role of lymph nodes as sites for antigen recognition by T and B lymphocytes

Study design point:

the role of the lymphatic system in the immune response as a transport network and the role of lymph nodes as sites for antigen recognition by T and B lymphocytes

Warm up

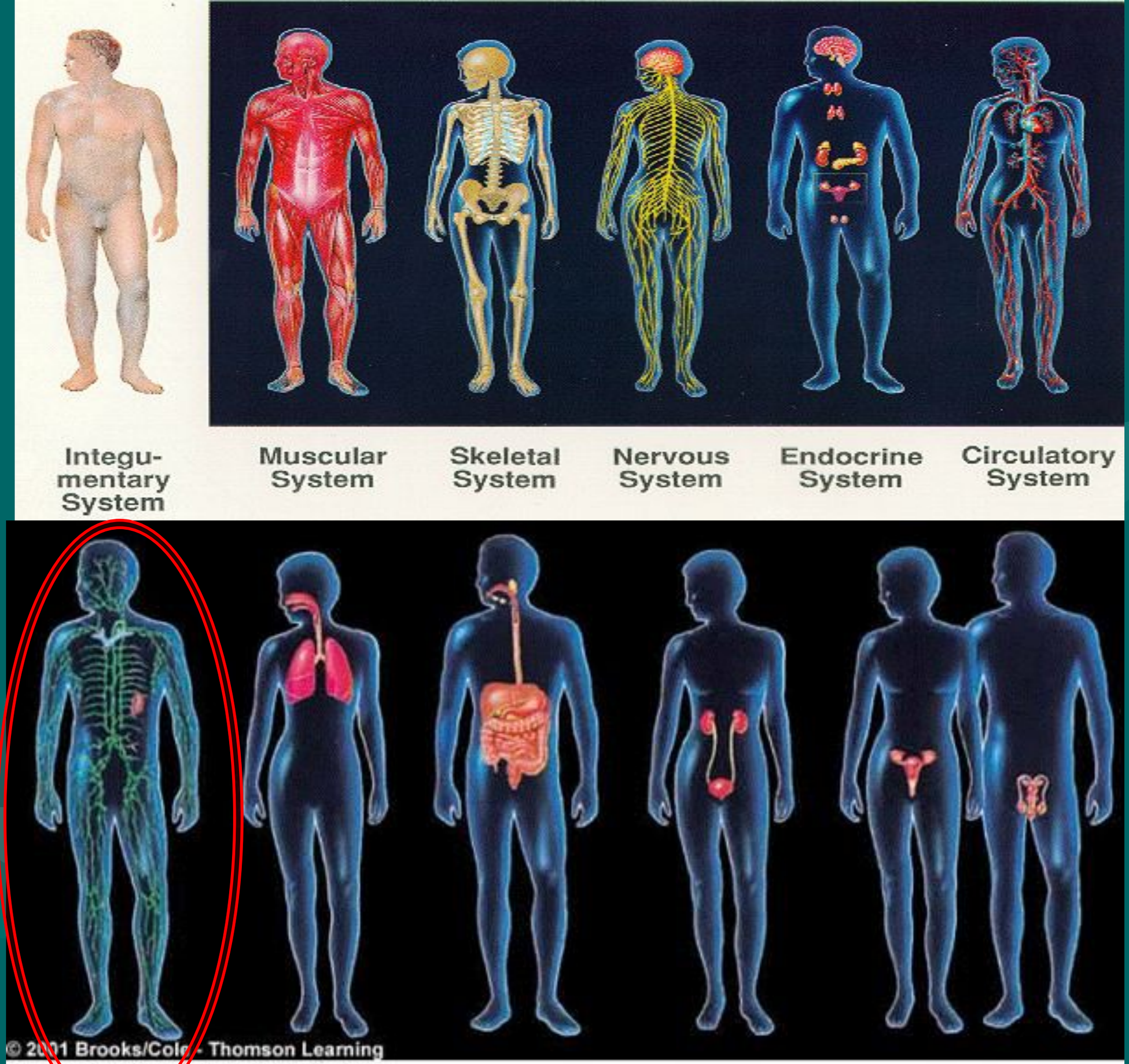
What will you see if you got pricked with a needle full of pathogens?
Draw a labelled diagram and include:

- Skin cells
- Cytokines
- Mast cells
- Histamines
- Dendric cells
- Macrophages
- Neutrophils

From the crash course video on the lymphatic system

https://www.youtube.com/watch?v=I7orwMgTQ5I

- What does the lymphatic system do?
- What are lymph nodes?
- What would swollen tonsils or lymph nodes suggest?


Integu-
mentary
System
Muscular
System
Skeletal
System
Nervous
System
Endocrine
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Circulatory
System
LYMPHATIC
SYSTEM
RESPIRATORY
SYSTEM
DIGESTIVE
SYSTEM
URINARY
SYSTEM
REPRODUCTION
SYSTEM
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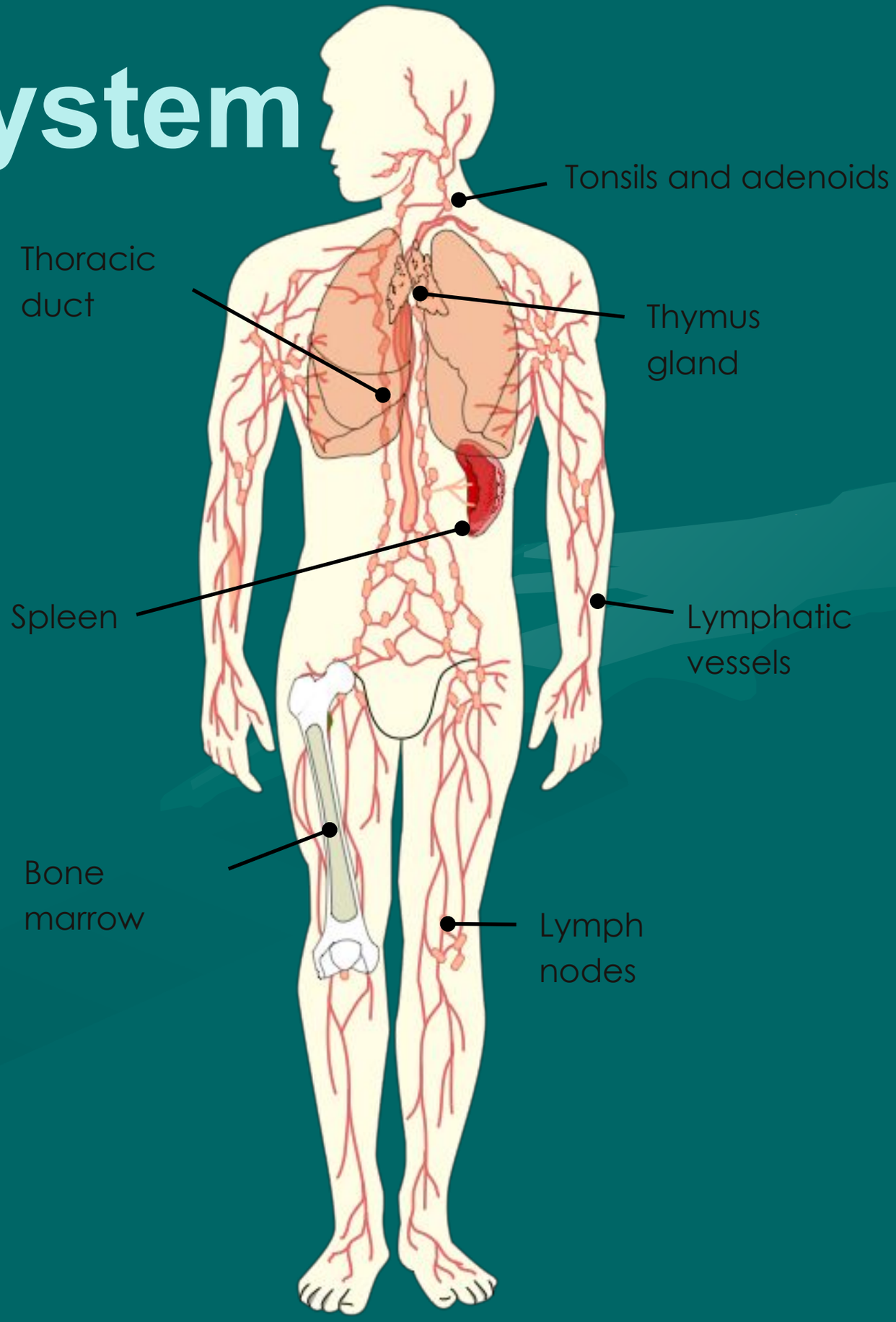
The Lymphatic System

A network of vessels and organs across the body that fight infection

<u>Two Primary functions:</u>

- to act as a transport system for antigen-presenting cells and pathogens
- to serve as the location of clonal selection (the process in which B and T cells encounter an antigen that matches their antigen-binding site, and then generate many copies of themselves)



Antigen-presenting cell- A subgroup of phagocytes that display the antigens from consumed pathogens on their surface and interact with the adaptive immune system.

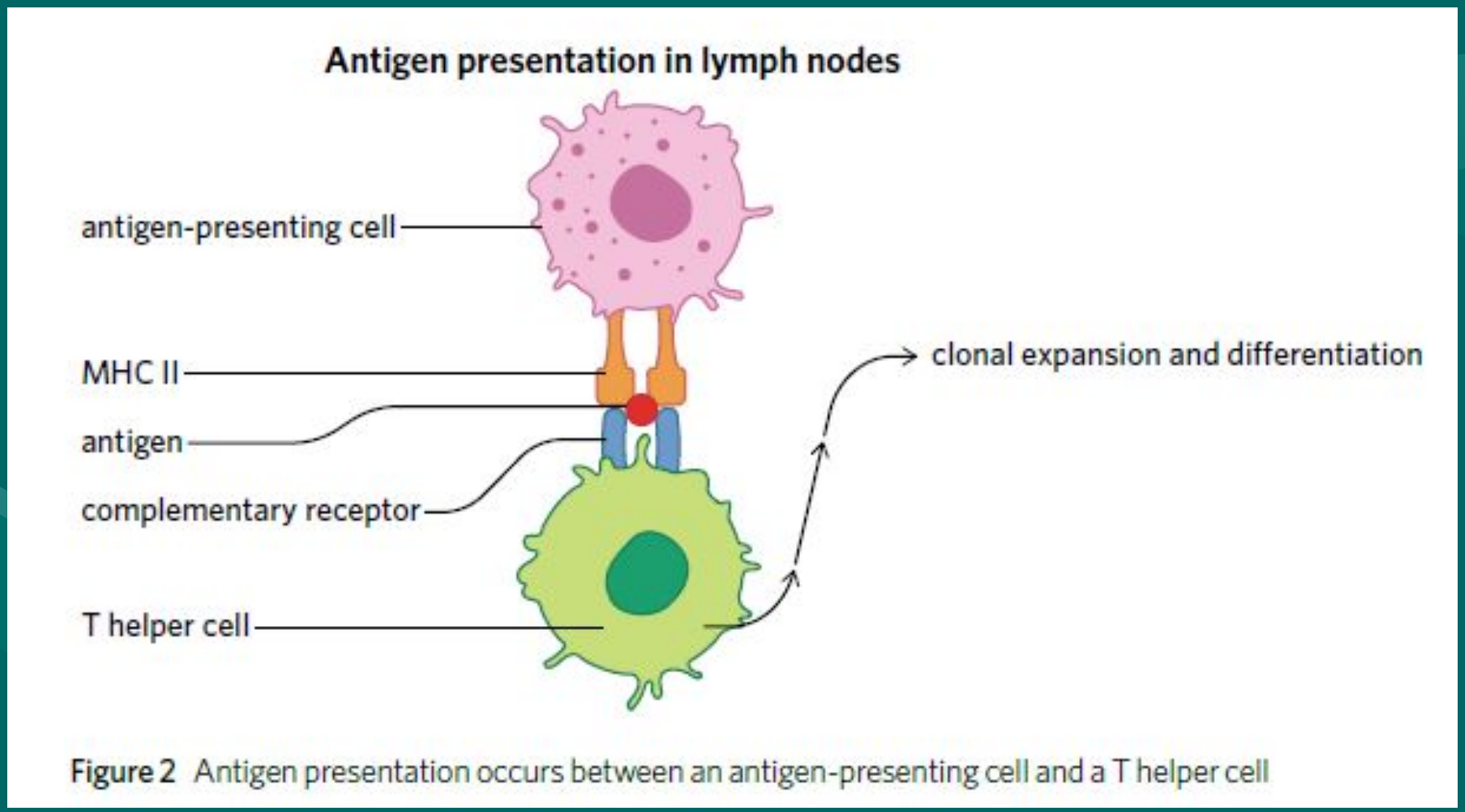
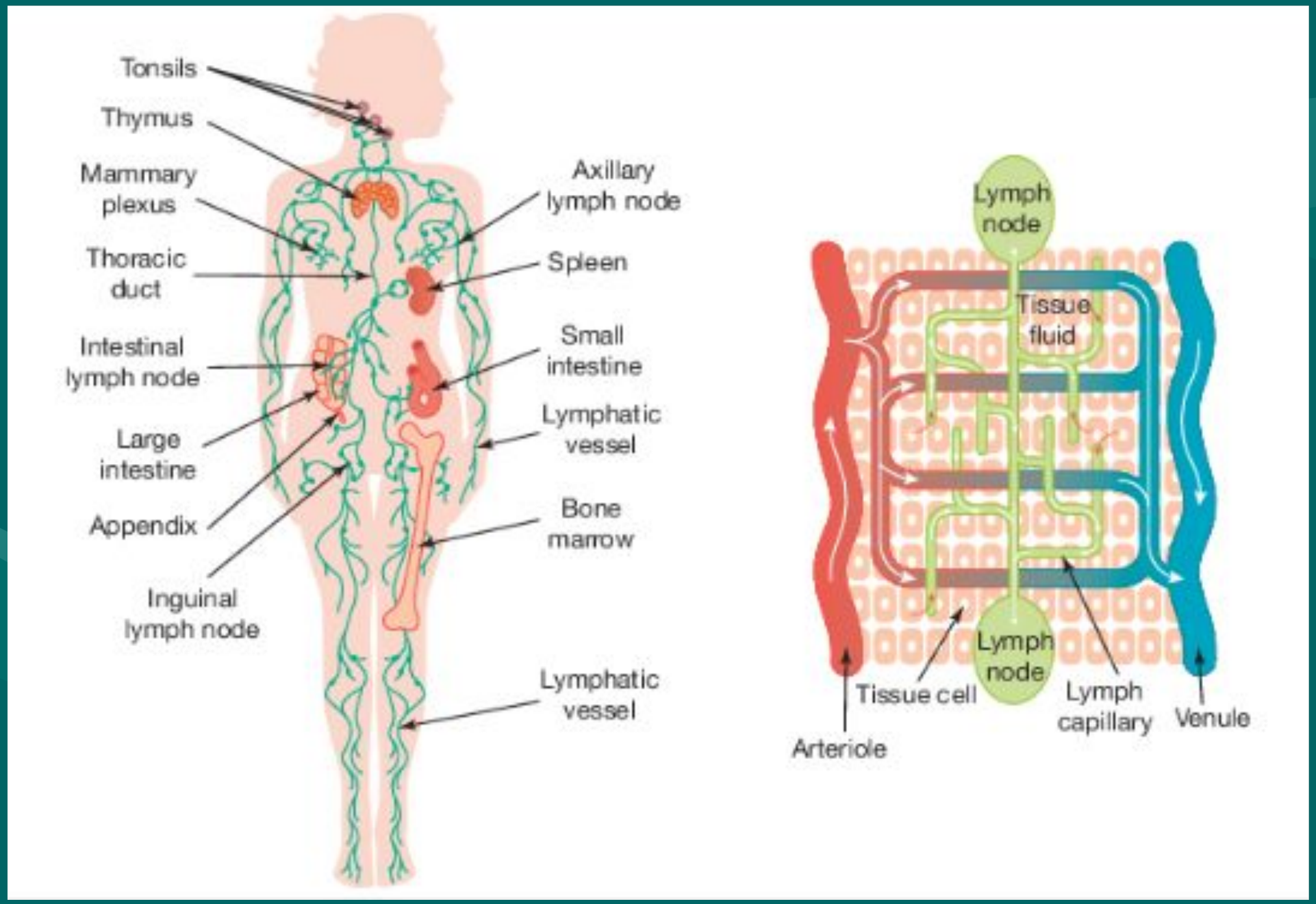


Figure 2 Antigen presentation occurs between an antigen-presenting cell and a T helper cell

Functions of Lymphatic system

- transportation of antigen-presenting cells to secondary lymphoid tissues for antigen recognition and initiation of the adaptive immune response
- production of leukocytes, including lymphocytes in primary lymphoid tissues
- removal of fluid from tissues around the body
- absorption of fatty acids from the digestive system.



Components of Lymphatic system

The lymphatic system consists of:
- lymph
- lymphatic vessels
- **primary lymphoid organs**
- **secondary lymphoid organs** (including lymph nodes).

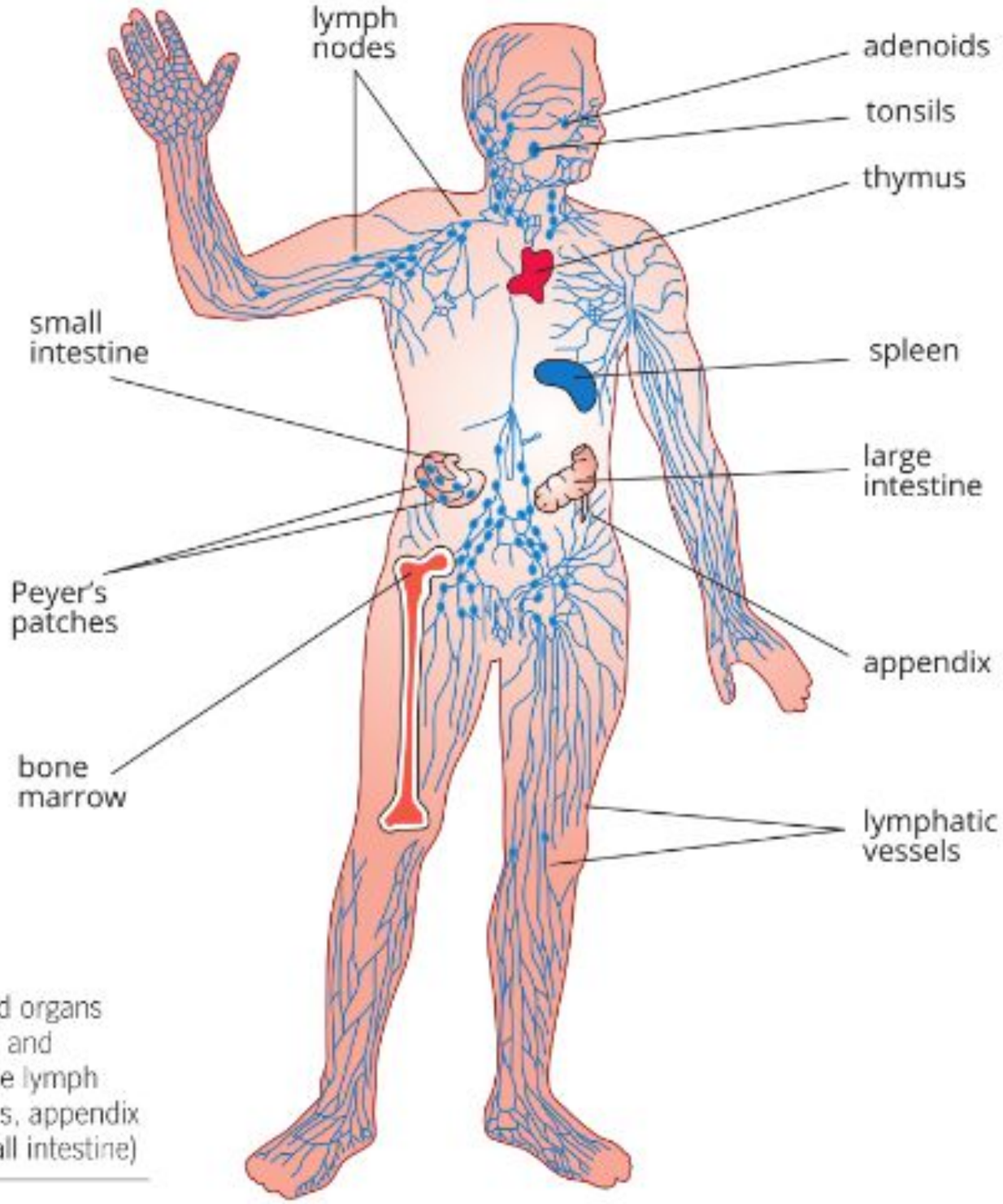
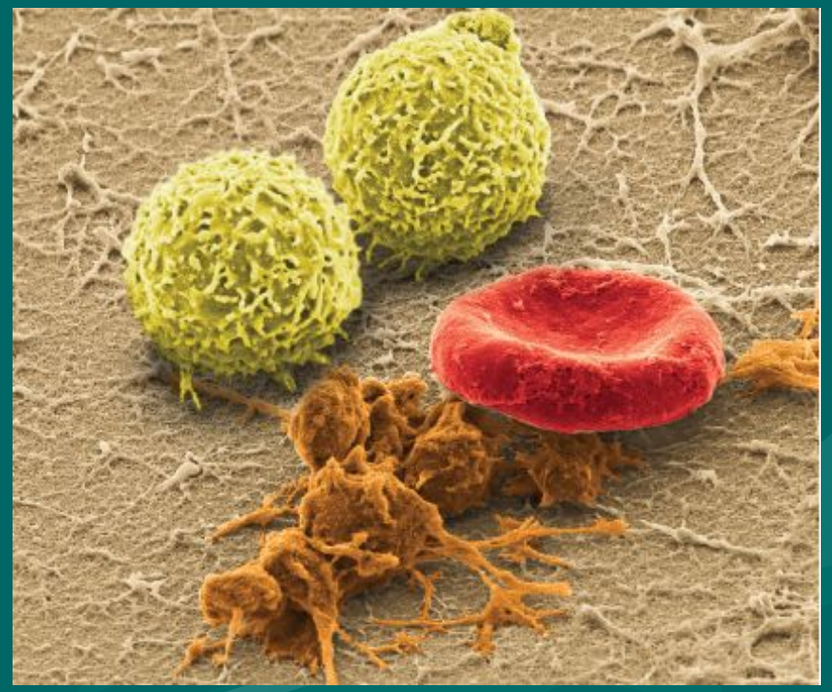


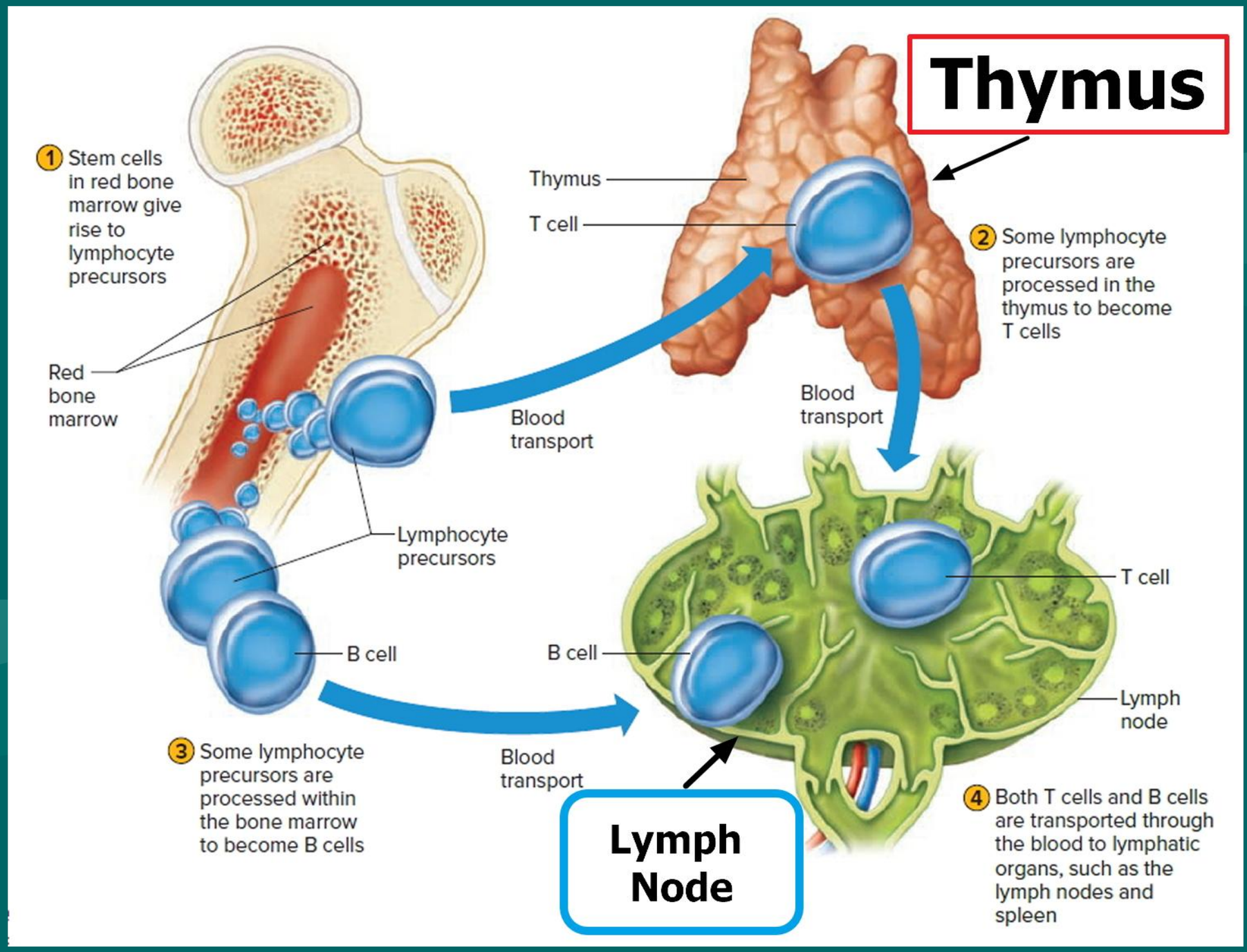
FIGURE 9.1.2 Primary lymphoid organs (the thymus and bone marrow) and secondary lymphoid organs (the lymph nodes, spleen, tonsils, adenoids, appendix and Peyer's patches of the small intestine)

Lymph Fluid

- Definition: interstitial fluid containing lymphocytes (WBCs)
- Fluid leaks from capillaries and tissues into lymph vessels
- Similar to **plasma and interstitial fluid**

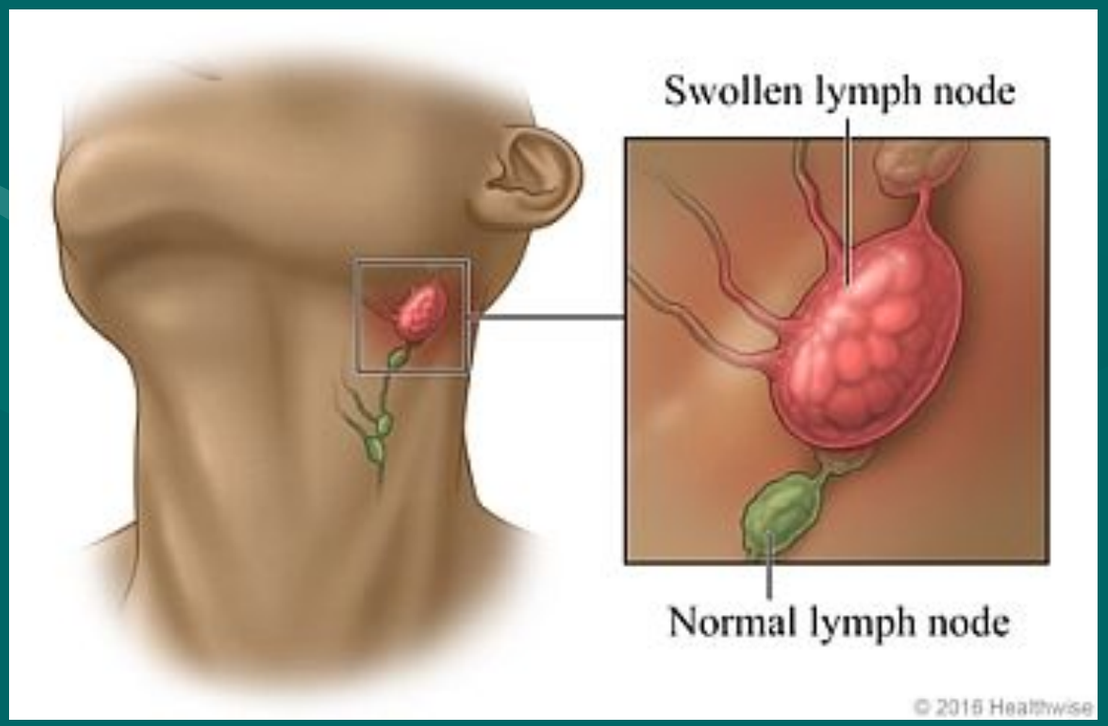


Primary lymphoid tissue- Component responsible for the production and maturation of lymphocytes. Depending on where a lymphocyte matures, it is possible to determine what type of lymphocyte it will be. B lymphocytes remain in the bone marrow to mature further, T lymphocytes travel to the thymus to mature. Primary lymphoid tissue includes bone marrow and the thymus.



Secondary lymphoid tissue- Components of the lymphatic system that are responsible for the maintenance of mature lymphocytes and the activation of the adaptive immune response.

Includes lymph nodes (e.g. tonsils) and the spleen. Lymphocytes are activated in secondary lymphoid tissues, where they recognise and respond to non-self antigens that are specific to their receptors. B-lymphocytes that identify an antigen undergo clonal expansion and differentiation to plasma cells. Antibodies are released into the bloodstream to travel throughout the body. Cytotoxic T cells are activated, proliferate, and travel through the bloodstream to sites where they are needed.



Lymphatics: Upper Body

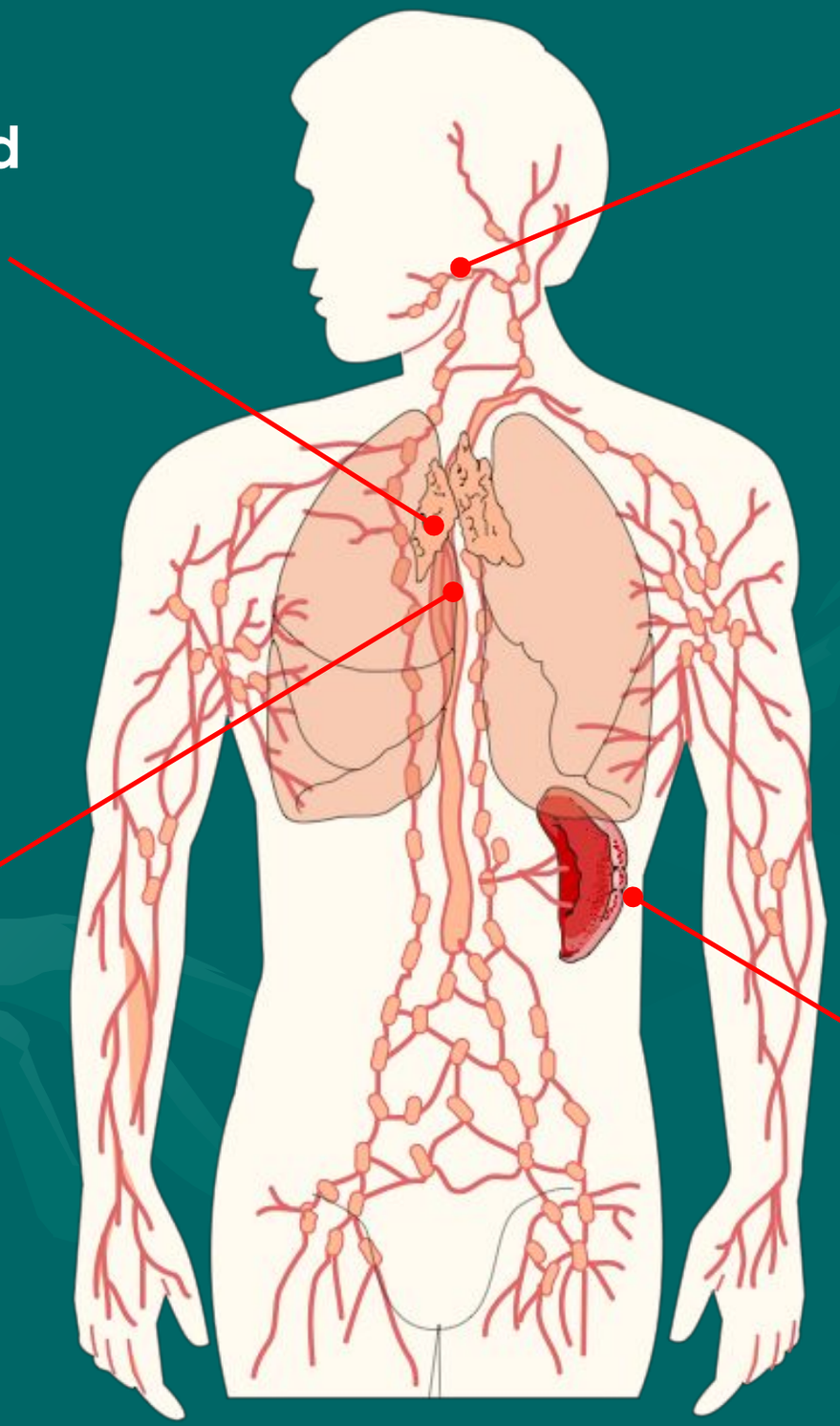
The Upper Body

Thymus gland

Produces T cells

Tonsils/adenoids

Produces lymphocytes and protect against incoming pathogens.



Thoracic duct

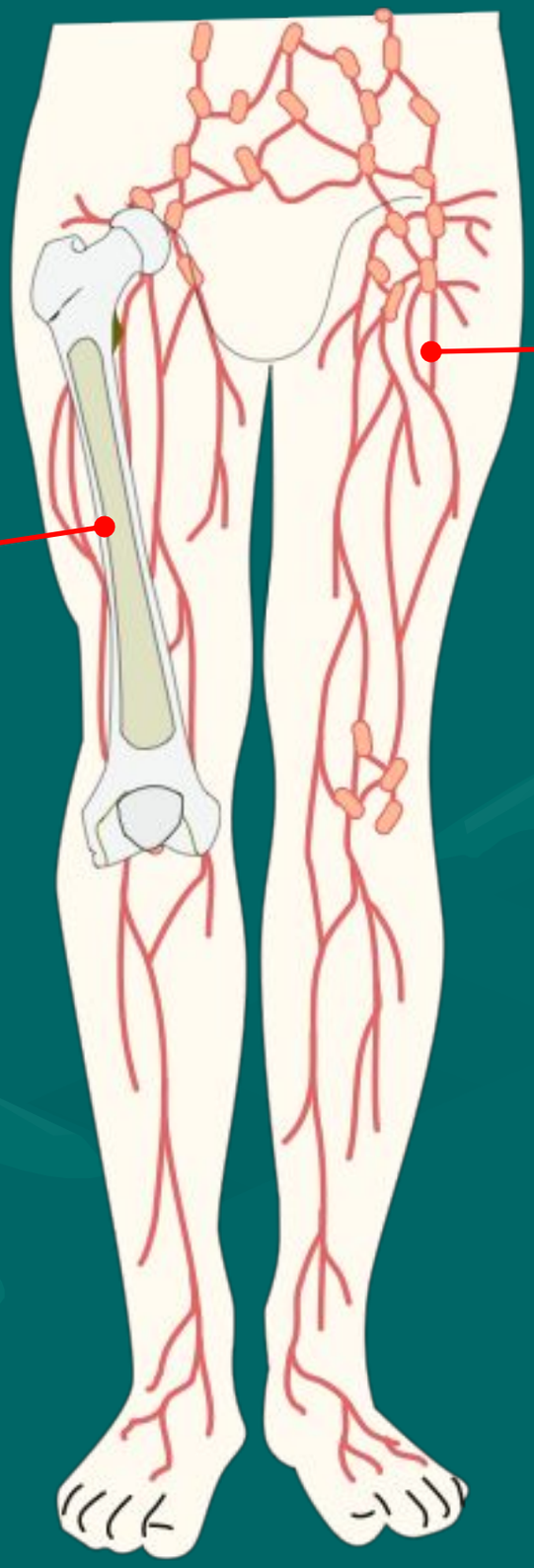
Main collecting duct

Spleen

Stores blood, produces B cells

Lymphatics: Lower Body

The Lower Body



Bone marrow

Source of multipotent stem cells.

Produces RBCs and leukocytes (WBCs). Leukocytes differentiate into:

- **monocytes** (and macrophages)
- **neutrophils**
- **eosinophils**
- **basophils**
- **lymphocytes** (B cells and T cells)

Lymphatic vessels

When tissue fluid enters the lymph capillaries, it is called **lymph**.

The lymph passes along **lymphatic vessels** to a series of lymph nodes.

These vessels contain one-way valves that move the lymph towards the heart and reintroduce it into the blood circulatory system via the subclavian veins.

The lymphatic system as a transport network

Lymphatic system is to serve as a transport network for the transportation of antigen-presenting cells to lymph nodes for antigen presentation and the initiation of the adaptive immune response.

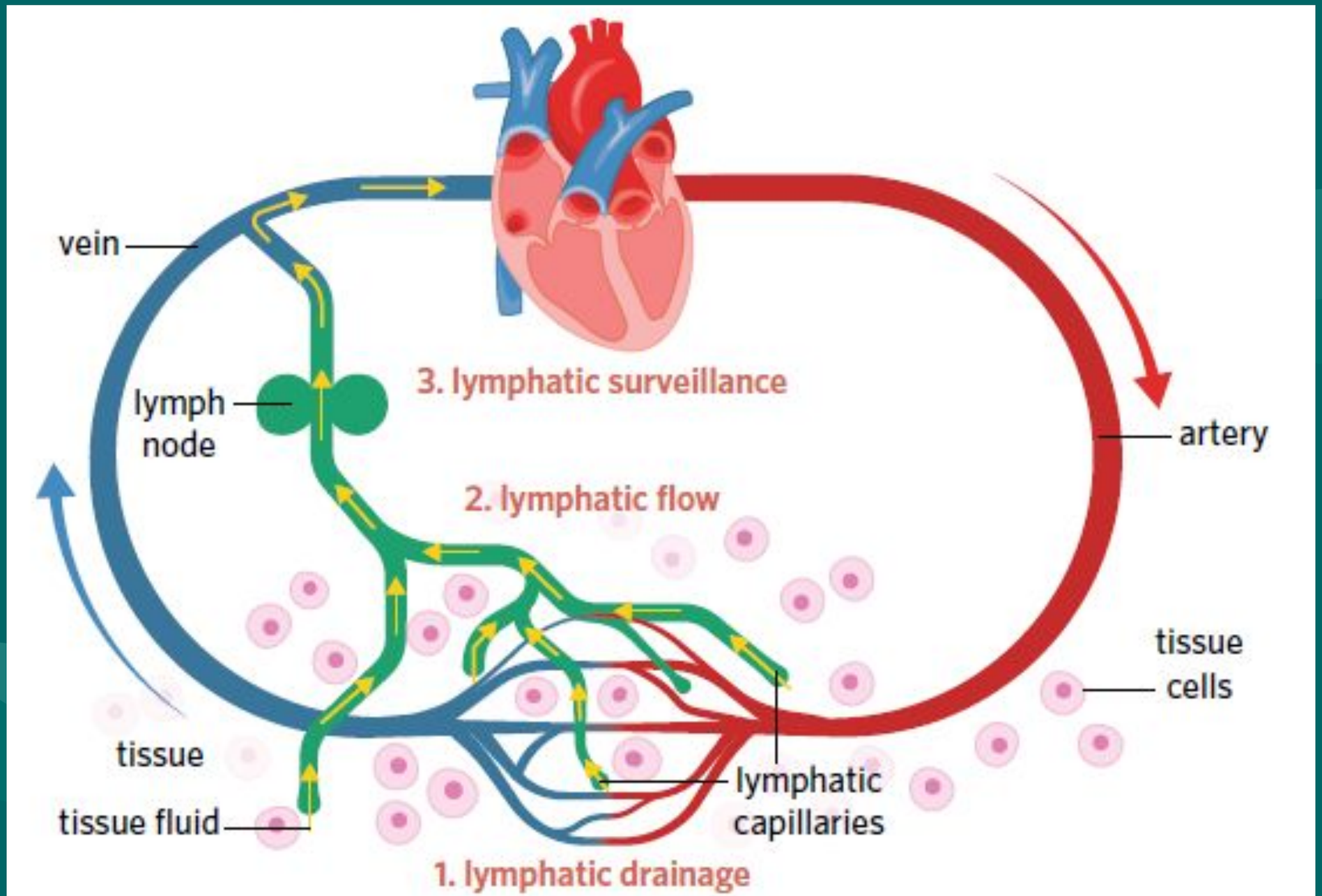


Figure 4 How the lymphatic system works, in three stages

1. Lymphatic drainage- Fluid from blood vessels constantly leaks into the tissues of the body. Lymphatic capillaries collect fluid in tissues as well as any pathogens that might be present. The fluid is now known as lymph and is carried away into the lymphatic system, where it eventually arrives at a lymph node.

2. Lymphatic flow- The small lymphatic capillaries throughout the body gradually join together to form larger vessels that contain an increasing amount of lymph. Lymph vessels feature a number of one-way valves. These ensure the fluid moves in one direction only – away from the tissues and towards the lymph nodes.

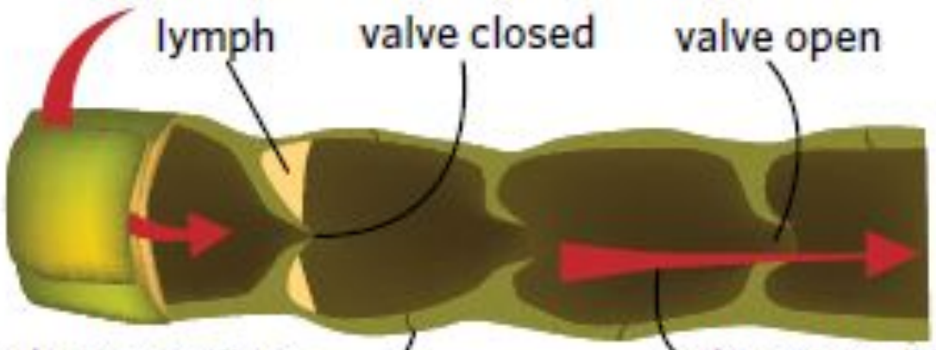


Image: Sakurra/Shutterstock.com

Figure 6 One-way flow of lymph fluid via valves prevents the backflow of lymph

3. Lymphatic surveillance- the fluid drained from tissues arrive at lymph nodes via afferent lymphatic vessels. It is here that lymph travels through clusters of B and T cells. Here antigen-presenting cells and pathogens are most likely to meet with a lymphocyte that has a matching antigen-binding site and stimulate the process of clonal selection. **An adaptive immune response is initiated**, antibodies and activated cytotoxic T cells will be transported in the lymph away from the lymph nodes via efferent lymphatic vessels. This lymph is then returned into circulation in blood back to the heart, to be pumped around the body.

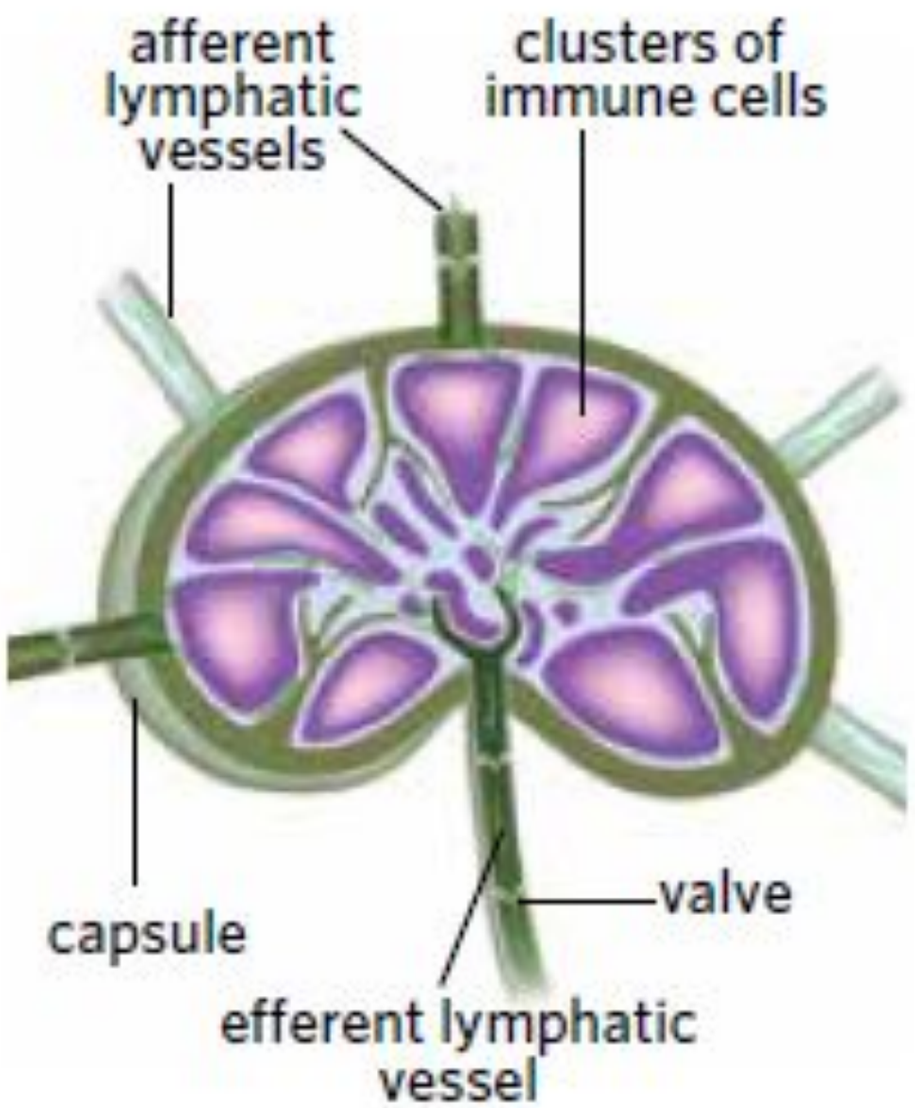


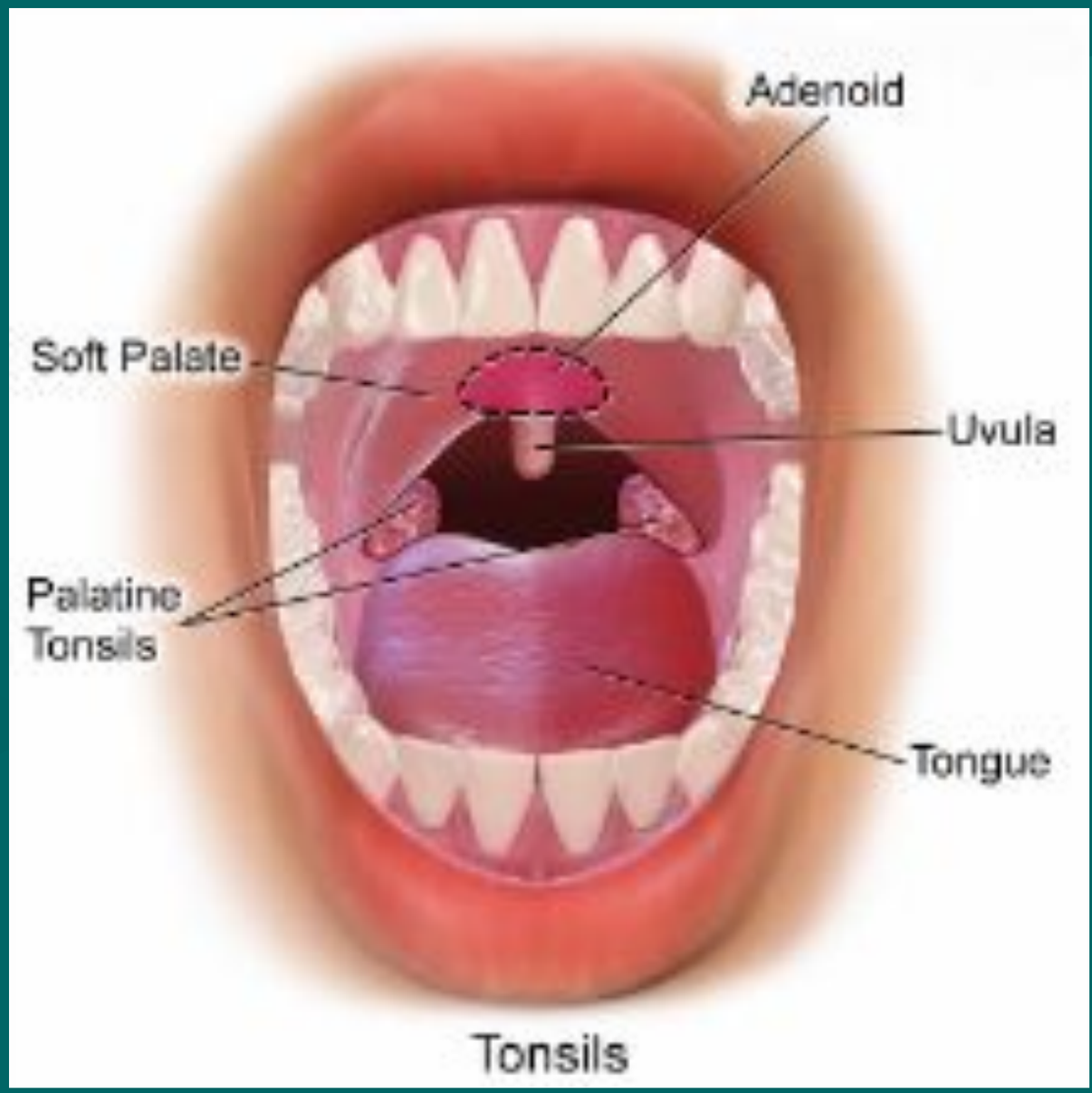
Image: Alila Medical Media/Shutterstock.com

Figure 7 Structure of a lymph node

Remembering lymphatic organs

The Tonsils Become Swollen And Tender

- T – thymus
- T – tonsils
- B – bone marrow
- S – spleen
- A – adenoids
- T – thoracic duct



Summary

- The lymphatic system produces lymphocytes and transports them to the lymph nodes to elicit the immune response.
- Some lymphocytes live in lymphoid organs and others circulate in the blood and lymphatic system.
- All the cells of the immune system originate as stem cells in the bone marrow.
- Primary lymphoid organs are sites where immune cells are produced and mature. They include bone marrow and the thymus.
- Secondary lymphoid organs are the sites where immune cells are activated by meeting antigens and where immune responses occur. They include lymph nodes and the spleen.
- Lymph nodes are the site of antigen recognition, in which T and B lymphocytes come into contact with their specific antigens. This results in clonal selection and expansion

https://www.youtube.com/watch?v=rp7T4IItbtM

https://www.youtube.com/watch?v=HUSDvSknIgI

Activity

Edrolo 7E Q 5-9, 14

Reflection

What role the lymph nodes and the lymphatic system play in immunity?
(paragraph response)