Routes of Defense

Trace how immune cells and lymph connect distant organs.

HS-AP9-2 "Analyze the relationship of the components of the lymphatic system with bone marrow and the thymus gland."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline where immune cells are made or mature, circle where they encounter foreign material, and draw arrows in the margin to connect each cell's origin to a place it can work.

From a Splinter to an Immune Response

1. A splinter in a finger can let bacteria cross the skin. Nearby blood vessels release fluid into the tissue as part of inflammation. Excess fluid between cells enters tiny lymphatic capillaries, becoming lymph. Lymph travels through larger vessels toward the chest, where it returns to the bloodstream. Along the way, lymph passes through lymph nodes. These small organs filter material carried in lymph, including bits of bacteria. Immune cells in a node can recognize those bits and respond. The route connects a local injury with immune cells stationed farther from the finger.

2. Where do the node's immune cells come from? Inside bone marrow, stem cells produce blood cells, including immature lymphocytes. B lymphocytes, or B cells, mature in the bone marrow. Other immature lymphocytes leave the marrow in the blood and travel to the thymus, an organ in the upper chest. There they mature into T lymphocytes, or T cells. The thymus does not collect lymph from the injured finger. Instead, it prepares T cells before those cells move through the blood to lymph nodes and other immune tissues. Marrow and thymus supply cells, while nodes provide places for those cells to meet foreign material.

3. At the node draining the finger, immune cells that detect bacterial material help start a targeted response. Some activated B cells produce antibodies that bind to parts of the bacteria. Helper T cells can signal to other immune cells, and some T cells can kill infected body cells if an infection involves them. Activated cells may leave the node and travel through lymph and blood to other sites. The spleen performs a related screening job, but it filters blood rather than lymph. Marrow-derived B cells can work there, too. Lymph nodes sample material from tissues, while the spleen checks material circulating in blood.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does the route of excess fluid from the injured finger bring bacterial material to immune cells?

2. How do bone marrow and the thymus contribute different cells to a lymph node?

3. If the thymus could not mature T cells, how might a response at the node change?

4. How can marrow-derived B cells work in both lymph nodes and the spleen, even though those organs screen different fluids?

3 YOUR TURN

Your own words

A virus enters through a scratch on an ankle. In one paragraph, explain how bone marrow, the thymus, lymph vessels, and a lymph node could work together, then contrast the spleen's role if viral material reaches the blood.

ANSWER KEY

Routes of Defense

HIGH SCHOOL · HS-AP9-2

PART 1 · READ AND MARK

Underline where immune cells are made or mature, circle where they encounter foreign material, and draw arrows in the margin to connect each cell's origin to a place it can work. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does the route of excess fluid from the injured finger bring bacterial material to immune cells?	**Excess tissue fluid enters lymphatic capillaries as lymph. Lymph vessels carry it through a node, where immune cells can encounter bacterial material.**
2	How do bone marrow and the thymus contribute different cells to a lymph node?	**B cells mature in bone marrow. The marrow also produces immature cells that travel to the thymus and mature into T cells; both cell types can reach a node.**
3	If the thymus could not mature T cells, how might a response at the node change?	**The node would have fewer mature T cells to help signal other immune cells or kill infected body cells.**
4	How can marrow-derived B cells work in both lymph nodes and the spleen, even though those organs screen different fluids?	**B cells mature in bone marrow and can work in either organ. Nodes screen material carried in lymph from tissues, while the spleen screens blood.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Bone marrow produces immature lymphocytes. B cells mature there, while some immature lymphocytes travel to the thymus and mature into T cells. Excess tissue fluid carrying viral material can enter lymphatic vessels near the ankle and move through a lymph node. There, B and T cells can recognize viral material and take part in a response. Some activated B cells can make antibodies, and some T cells can kill infected body cells. If viral material reaches the blood, the spleen screens the blood rather than draining lymph.

Accept responses that distinguish where B and T cells mature from where they encounter foreign material. Students should identify lymph nodes as screening lymph and the spleen as screening blood.