## 🔬 Lesson Plan: Circulation and immunity

**Grade Level:** 8
**Subject:** Life Science
**Duration:** 45–60 min
**NGSS MS-LS1-3:** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

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### 🎯 Learning Objectives

By the end of this lesson, students will be able to:

- **Describe** how the heart, blood vessels, and blood interact as subsystems that keep every cell in the body supplied.
- **Trace** the path of blood through the two loops of circulation, from the heart to the lungs




pumps.
- **Capillary:** A tiny blood vessel that connects arteries to veins. Its wall is only one cell thick, so oxygen and food can pass out to the surrounding body cells and wastes can pass back into the blood.
- **Vein:** A blood vessel that carries blood back to the heart. Pressure from the heart is low by the time blood reaches the veins, so veins contain flaps called valves that keep blood from flowing backwards.

- **Plasma:** The liquid part of blood, made mostly of water. Plasma makes up over half of blood and carries digested food, vitamins, minerals, and cell wastes; the proteins dissolved in it also help fight disease and form clots.
- **White blood cell:** A disease-fighting blood cell produced in the bone marrow. Phagocytes surround and break down invaders during the inflammatory response, and lymphocytes — the T cells and B cells — go after one specific invader during the immune response.
- **Antibody:** A protein made by B cells that attaches to a specific marker molecule on an invader. Once attached, the antibody tags that invader so the body can destroy it.
- **Pathogen:** An organism that causes disease when it gets into the body. The major groups that infect humans are bacteria, viruses, protists, and fungi, and each pathogen causes one specific disease.

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**Materials Needed: (all links are included in this PDF)**




the heart pushing blood one way through a vessel

- A stopwatch or clock with a second hand for the 15-second pulse count in the Introduction
- Washable glitter gel for one volunteer's palm, used to trace how a pathogen spreads by handshake

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**Lesson Procedure**

**Step 1: Introduction (5 minutes)**

- Open by asking: 'Your body is made of trillions of cells, and not one of them can go get its own oxygen or food. So how does every single cell get what it needs?'
- Have students place two fingers on the wrist or the side of the neck, find a pulse, and count the beats for 15 seconds; point out that each beat pushed blood past their fingertips.
- Tell students the lesson will build an evidence-based argument that the body works as a set of cooperating subsystems: one delivers materials to the cells, another defends those cells from disease.

**Step 2: Direct Instruction (15 minutes)**

- Use the Study Guide to walk through heart structure: the septum separating the right and left sides, the upper atria and lower ventricles, and the valve that keeps blood moving in one direction. (https://newpathworksheets.com/api/guide/study-guide-science-grade-8-circulation-and-immunity-1.pdf)
- Demonstrate one-way flow by squeezing a turkey baster into clear tubing filled with red-tinted water so students see fluid pushed forward in pulses and never drawn back — exactly the job of a heart valve.




wall as the evidence. (https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-circulation-and-immunity-1-0.pdf)

- Trace the three lines of defense in the Study Guide: skin, mouth, stomach, and breathing passages as barriers; the inflammatory response that sends phagocytes into damaged tissue; and the immune response run by T cells and B cells. (https://newpathworksheets.com/api/guide/study-guide-science-grade-8-circulation-and-immunity-1.pdf)

- Model how a pathogen spreads: put washable glitter gel on one volunteer's palm, have that student shake hands down a row, then have the class find the glitter on hands and desks and explain why the skin barrier and hand-washing matter.

**Step 4: Independent Practice (15 minutes)**

- Have students complete Practice Worksheet 1 on the components of blood, the four blood types and their marker molecules, and the job of the lymphatic system and lymph nodes. (https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-circulation-and-immunity-1-1.pdf)
- Assign Practice Worksheet 2 on infectious and noninfectious disease, the inflammatory response, and the roles of phagocytes, lymphocytes, and antibodies. (https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-circulation-and-immunity-1-2.pdf)
- Ask each student to write a two-sentence argument, citing evidence from the worksheets, for why a person whose heart valves leak would also be short of breath and tired.




- Challenge students to argue that the circulatory and lymphatic systems are one cooperating pair, using the Study Guide's account of fluid leaking from vessel walls and returning as lymph filtered through lymph nodes, then predict what happens when a node is blocked.
- Have students reason out from the blood-type marker rules why a person with type O blood carries no A or B markers, and why clumped blood clogging vessels made early transfusions fail.

**For learners needing support:**

- Give students a pre-labeled heart diagram with the atria, ventricles, septum, and valve already named, and have them draw arrows for the one-way path body to heart to lungs to heart to body.
- Provide a three-card vessel sort set (artery, capillary, vein) printed with wall thickness and flow direction, so students can place worksheet statements onto the correct card before writing answers.

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### Extension Activities

- Pulse investigation: count resting pulse for 30 seconds, do one minute of step-ups, count again, then explain the increase in terms of the body's larger oxygen demand and the group of cells in the right atrium (the pacemaker) that speeds the heart.
- Build a one-way valve from a plastic bottle, a length of tubing, and a flap cut from a balloon, then show the class that water passes in only one direction just as it does through the heart.




grade-8-circulation-and-immunity-1-2.pdf)

- Vocabulary PDF 1 (https://newpathworksheets.com/api/vocabulary/vocabulary-science-grade-8-circulation-and-immunity-1-1.pdf)
- Vocabulary PDF 2 (https://newpathworksheets.com/api/vocabulary/vocabulary-science-grade-8-circulation-and-immunity-1-2.pdf)
- Vocabulary PDF 3 (https://newpathworksheets.com/api/vocabulary/vocabulary-science-grade-8-circulation-and-immunity-1-3.pdf)
- Vocabulary PDF 4 (https://newpathworksheets.com/api/vocabulary/vocabulary-science-grade-8-circulation-and-immunity-1-4.pdf)

- Vocabulary PDF 5 (https://newpathworksheets.com/api/vocabulary/vocabulary-science-grade-8-circulation-and-immunity-1-5.pdf)
- Vocabulary PDF 6 (https://newpathworksheets.com/api/vocabulary/vocabulary-science-grade-8-circulation-and-immunity-1-6.pdf)
- Vocabulary PDF 7 (https://newpathworksheets.com/api/vocabulary/vocabulary-science-grade-8-circulation-and-immunity-1-7.pdf)


PREVIEW

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# CIRCULATION AND IMMUNITY

## The Circulatory System

The circulatory system, otherwise known as the cardiovascular system, consists of the heart, blood vessels, and blood. This important system is a large network of highways delivering blood throughout the body.

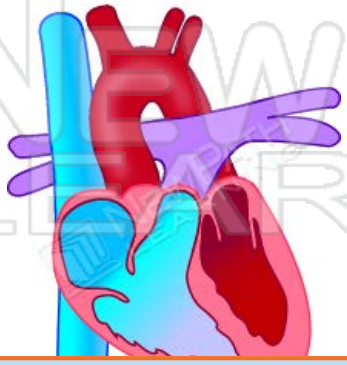
The circulatory system brings many different materials to all the cells of the body and picks up waste from the same cells.




beats, blood is being pushed through all of the different blood vessels of the body.

The structure of the heart keeps the blood flowing in one direction, in a path from body to heart to lungs to heart and back to body. The heart has two separate sides, the right and left, which are separated by the septum. The **septum** prevents oxygen-rich blood from mixing with oxygen-poor blood.

There is an upper and lower chamber on each side of the heart. The upper chambers are known as the atria, and the lower chambers are known as the ventricles. Each atrium receives blood into the heart and each ventricle pumps blood out of the heart. The structure that divides the atria from the ventricles is called a valve. The **valve** prevents blood from flowing backwards in the one-way direction of the circulatory system.






In the right atrium, there are a group of cells that send out signals that cause the heart to contract called the **pacemaker**. The pacemaker receives information about the body's need for oxygen. Immediately after leaving the heart, the blood travels through the blood vessels.

## Blood Vessels

There are three types of blood vessels in the human body: arteries, capillaries, and veins.

- The **arteries** are blood vessels that move blood away from the heart and out to the body.
- The **capillaries** are small blood vessels that connect the arteries to the veins and where substances are exchanged between the blood and body tissues.
- The **veins** are blood vessels that carry blood back to the heart muscle.

## Blood Flow

There are two loops in the circulatory system. One has oxygen-rich blood and one has oxygen-depleted blood. The blood flows from the heart to the lungs and back to the heart in the first loop. The blood




returns to the heart.

- During the **second loop**, the blood leaves the left atrium and is pumped out of the left ventricle to all of the cells in the body. The blood drops off oxygen to the cells and picks up carbon dioxide and other wastes.

***Lesson Checkpoint:***
***What is the difference between the two loops of the circulatory system?***

# Arteries, Capillaries and Veins

Blood leaves the heart through arteries. The right ventricle pumps blood to the lungs through arteries and the left ventricle pumps blood out to the body through an artery called the aorta. The **aorta** is the largest artery in the human body. All of the cells in the body receive materials from blood that travels through the arteries. The heart itself receives materials from blood through structures called the **coronary arteries**.

## Structure of an Artery

The walls of arteries are thick and consist of three different layers. The inside layer is made up of epithelial cells that are very smooth, which helps to increase the blood flow. The middle layer is smooth muscle. The outside layer is made up of connective tissue. The artery structure is very flexible and strong allowing the arteries to hold high pressure created by the pumping of the heart.



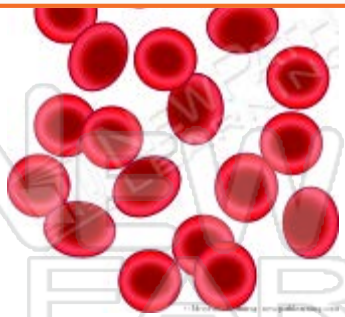

The **veins** carry the blood that is loaded with waste back to the heart. Veins are made of three layers of tissue with the center tissue being made of muscle. The pressure created by the heart is low by the time that the blood reaches the veins. Blood must flow in one direction, so valves help the blood from flowing backwards.

## Components of Blood

If you were to take blood out of your body and put it into a test tube, the blood would separate into its **four components**.

The top layer would be the liquid part of the blood called **plasma**. The second layer would be white blood cells and platelets and the last layer



Red blood cells are made of a protein the binds together with oxygen molecules called **hemoglobin**.

**White blood cells** are also produced in the bone marrow and are the disease fighters of the body. If a white blood cell recognizes a disease, virus, or bacterial cell it will sound the alarm so the body is aware of the invader. There are white blood cells that produce chemicals that kill the invaders and others that actually attack the invader. There are fewer white blood cells than there are red blood cells in the blood and the white blood cells are much bigger.


PREVIEW

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## Blood types

If a person were to ever lose a lot of blood from a wound, that person may be given a blood transfusion. A **blood transfusion** is a medical procedure that transfers blood from one person to another.

In the early 1900's, this procedure often failed, and doctors did not understand why at the time. It wasn't until a physician tried mixing the blood of several different patients in a glass jar that the problem was revealed. The blood would clump together when some patients' blood was mixed and mix together smoothly when other patients' blood was mixed. The clumping after a blood transfusion caused certain patients to die because the clumped blood was clogging the blood vessels. This led to the discovery of the four types of blood.

Once the fluid is within the lymphatic system it is called **lymph**. Lymph is put back into the veins through lymphatic vessels. As the liquid passes through the lymphatic system, it enters structures call




person, a contaminated object, and the environment around you. Infectious disease can be spread from one person to another directly through physical contact such as hugging and shaking hands, and indirectly by inhaling materials in the air from another person's sneeze.

Objects can become contaminated if an infected person touches the object; then that disease can be spread if another person were to touch that object. Many pathogens live in our environment. They live in soil, food, and water.

# Noninfectious Disease

**Noninfectious diseases** are diseases that are not spread from one person to another. These include diabetes, allergies, and cancer.

**Diabetes**: The pancreas is an organ that produces the chemical insulin. **Insulin** allows the body to take in glucose from the blood and use the glucose for energy. **Diabetes** is a noninfectious disease that occurs when the body is unable to use insulin or the pancreas does not produce insulin. When a person has diabetes, they have high levels of glucose in their blood, and the glucose is excreted in the urine rather than used by the body. This drastically reduces the glucose that is available for the cells to produce energy. A person with diabetes must monitor the amount of glucose that is in their blood on a strict schedule to keep his or her body systems in balance.

**Allergy**: An allergy is a disorder caused when the immune system is




- The **mouth** and **stomach** both produce chemicals that will destroy pathogens.
- Mucus that is produced in the **breathing passages** will trap pathogens and cilia slowly remove the trapped pathogens.

However, even with these defenses against invading pathogens, sometimes disease invades the body.

The **second line of defense** is a response to damaged tissue called the inflammatory response. The **inflammatory response** causes the body to release chemicals and white blood cells into the tissue near the damaged tissue so that the chemicals and white blood cells can fight the invading pathogens. The response is the same no matter what the invader is. The white blood cells involved with the inflammatory response are called **phagocytes**.

## Function of a phagocyte

A **phagocyte** is a white blood cell that surrounds the invading pathogen and breaks it down. The area that is affected by an inflammatory response becomes red and swollen because the blood vessels widen to allow the fluids and blood to get to the area damaged. The area affected by the inflammatory response is normally warmer than the surrounding tissue because of the repairing that is occurring.




destroy the different types of pathogens.

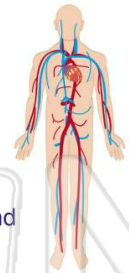
Antigens and antibodies attack pathogens together. The antigen will attach to the pathogen and the antibody attaches to the antigen. This will mark the invading pathogen to be destroyed.

# Circulation and immunity

Sci H

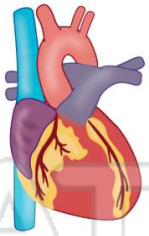
Name_____ Class_____ Date_____

1 What is the function of the **circulatory system**?



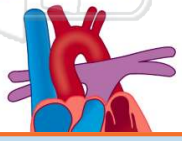
**A** to help the legs move.
**B** to give the body support and shape
**C** to break down nutrients
**D** to transport oxygen in and wastes out of cells

2 The **heart** is made of _____ muscle.



**A** cardiac
**B** epithelial
**C** connective
**D** smooth

3 What structure **separates** the right and left sides of the heart?



**A** aorta
**B** septum
**C** valve
**D** ventricle

4 What is the function of a **heart valve**?

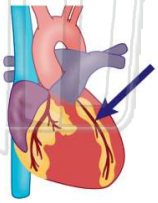
**A** to monitor how much blood is entering the heart
**B** to increase the flow of blood through the heart
**C** to prevent blood from flowing

5




7

9 The **coronary arteries** bring oxygen to the _____ cells.



**A** muscle
**B** brain
**C** heart
**D** lung

10 How **thick** are the walls of capillaries?

**A** one cell
**B** three layers
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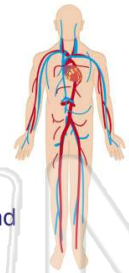

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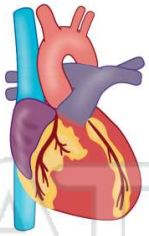

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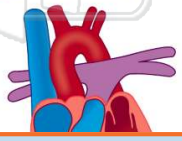

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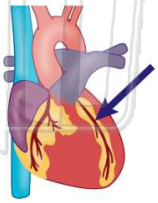

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Sci H

Name_____ Class_____ Date_____

1 Which is not a **component** of blood?

**A** red blood cells
**B** plasma
**C** white blood cells
**D** plates

2 **Over half** of the blood consists of _____.

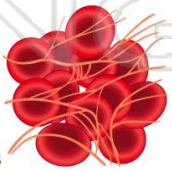
**A** red blood cells
**B** plasma
**C** white blood cells
**D** platelets

3 _____ is a **protein** in red blood cells that binds together with oxygen molecules.

**A** Hemoglobin
**B** Fibrin
**C** Plasma

4 What is **fibrin**?

**A** a protein the binds together with oxygen molecules
**B** a protein that weaves a net that covers a cut




PREVIEW

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the blood
**D** break down nutrients

system
**D** structures that filter lymph

9 _____ is an **organism** that causes disease.

**A** A pathogen
**B** A phagocyte
**C** An antigen
**D** An antibody

10 An **infectious disease** is a disease that can be spread from one organism to another.

**A** true
**B** false

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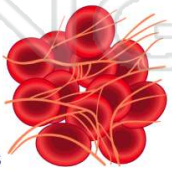

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1 **Insulin** allows the body to take in glucose from the blood for energy. What **disease** requires a person to use insulin as a medicine?

**A** cancer
**B** allergies
**C** asthma
**D** diabetes

2 Which structure is part of the **first line of defense**?

**A** stomach
**B** liver
**C** small intestine
**D** large intestine

3 During **inflammatory response**, one type of **white blood cell** called _____ move into damaged tissue so they can fight the invading pathogens.

**A** pathogens
**B** phagocytes

4 Why does the tissue affected by an **inflammatory response** becomes red and swollen?

**A** damaged cells grow
**B** pathogens have taken over


PREVIEW

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5

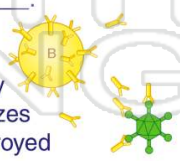
7

**D** recognize one pathogen

9 The chemicals produced by the **B cells** are called _____.


**A** antigens
**B** antibodies
**C** pathogens
**D** phagocytes

10 Antigens and antibodies fit together to attack **pathogens**. When they attach to the pathogen, _____.




**A** it slows down
**B** all three leave the body when the person sneezes
**C** it is marked to be destroyed
**D** it has more energy

# Circulation and immunity

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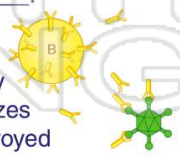



C

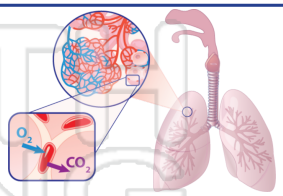
# Circulation and immunity

Name_____ Class_____ Date_____

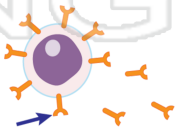
**Match each of the following terms to its definition:**

| | | | |
|---|---|---|---|
| B cells | Aorta | Bile | Arteries |
| Blood transfusion | Antibodies | Alveoli | Antigen |

**1.** - small sacs within the lungs that specialize in the exchange of gas between the blood and air



**2.** - a specific protein produced by B lymphocytes that attaches to an antigen and leads to its removal



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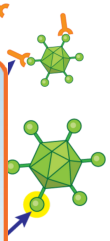

**4.**




**5.** and ou

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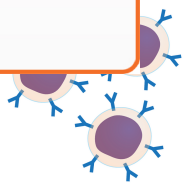
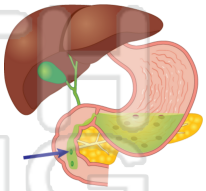
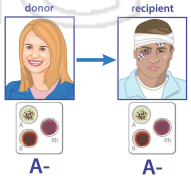


**7.** - a chemical produced by the liver and stored temporarily in the gall bladder that is released into the intestines to help in fat digestion



**8.** - a medical procedure that transfers blood from one person to another



# Circulation and immunity

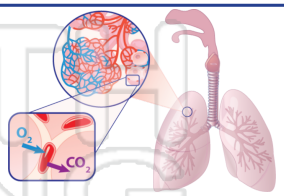
Sci H

Name_____ Class_____ Date_____

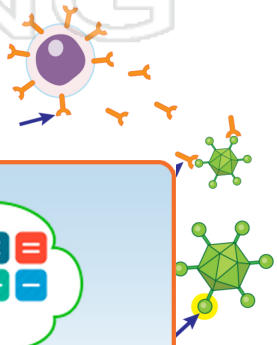
**Match each of the following terms to its definition:**

| | | | |
|---|---|---|---|
| B cells | Aorta | Bile | Arteries |
| Blood transfusion | Antibodies | Alveoli | Antigen |

**1. alveoli** - small sacs within the lungs that specialize in the exchange of gas between the blood and air



**2. antibodies** - a specific protein produced by B lymphocytes that attaches to an antigen and leads to its removal



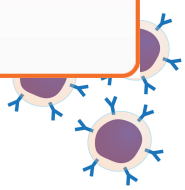
**3. ant**
body c

**4. aor**

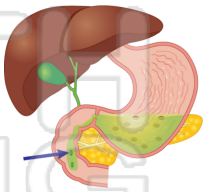



**5. art**
the bo

**6. B c**
differe



**7. bile** - a chemical produced by the liver and stored temporarily in the gall bladder that is released into the intestines to help in fat digestion



**8. blood transfusion** - a medical procedure that transfers blood from one person to another