

# Teacher Guide: Circulatory System



## Learning Objectives

Students will...

- Identify the four chambers of the heart.
- Trace the path of blood through the heart and lungs.
- Explain where oxygen enters the bloodstream.
- Describe how blood is carried through the body.
- Compare the functions of arteries, capillaries, and veins.
- Identify the components of blood. (Extension)
- Explain where various substances (carbon dioxide, urea, glucose) are added or removed from the bloodstream. (Extension)



## Vocabulary

artery, atrium, blood vessel, capillary, circulatory system, heart, platelet, pulmonary artery, pulmonary vein, red blood cell, urea, ventricle, vein, white blood cell

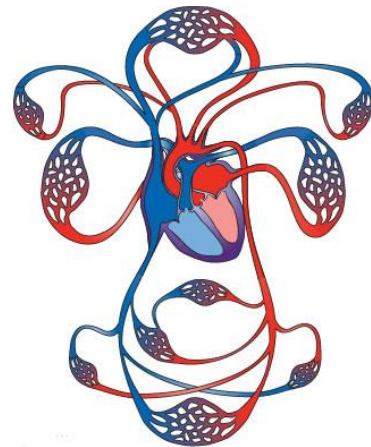


## Lesson Overview

The *Circulatory System Gizmo™* allows students to trace the flow of blood through the heart and blood vessels. Students can take blood samples to analyze the composition of blood.

The Student Exploration sheet contains two activities and an extension:

- Activity A – Students trace the flow of blood through the heart and lungs.
- Activity B – Students identify and compare the three types of blood vessels.
- Extension – Students investigate blood composition.



The circulatory system



## Suggested Lesson Sequence

1. **Pre-Gizmo activity: Heartbeats** (🕒 15 – 20 minutes)

In the classroom help your students find their pulses. One's pulse can be found on the side of the neck, on the wrist, or between the bicep and triceps muscles on the upper arm. Count heartbeats per minute while resting and then count again after vigorous exercise like jumping jacks. The more your students exercise, the faster their pulses will be. Ask them why the heart needs to pump more rapidly during exercise.

If you can, purchase or borrow a stethoscope and have students take turns listening to their heartbeat through the stethoscope. (Inexpensive stethoscopes can be purchased from science-supply companies.) If the room is very quiet, students will be able to hear the distinct "lub-dub" sound of a heartbeat. The fainter "lub" sound is produced by the contraction of the atria, while the stronger "dub" is the contraction of the ventricles.

2. **Prior to using the Gizmo** (🧠 10 – 15 minutes)

Before students are at the computers, pass out the Student Exploration sheets and ask students to complete the Prior Knowledge Questions. Discuss student answers as a class, but do not provide correct answers at this point. Afterwards, if possible, use a projector to introduce the Gizmo and demonstrate its basic operations. Demonstrate how to take a screenshot and paste the image into a blank document.

3. **Gizmo activities** (🧠 15 – 20 minutes per activity)

Assign students to computers. Students can work individually or in small groups. Ask students to work through the activities in the Student Exploration using the Gizmo. Alternatively, you can use a projector and do the Exploration as a teacher-led activity.

4. **Discussion questions** (🧠 15 – 30 minutes)

As students are working or just after they are done, discuss the following questions:

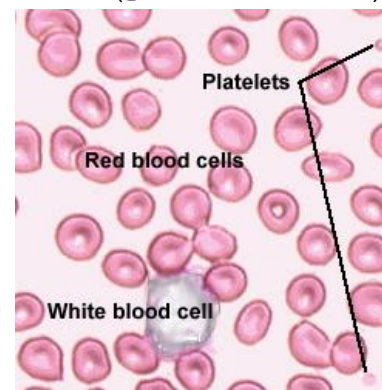
- Which structures prevent blood from flowing in the wrong direction?
- Why is the right atrium and ventricle on the left side of the diagram? (Note: The diagram shows a person lying face-up, so directions are reversed.)
- How is the oxygen level of blood related to its color?
- What is the only vein that carries oxygenated blood? What is the only artery that carries blood with low oxygen levels?
- Which organs add sugar and urea to the blood? How can you tell?
- Suppose a person has too much urea in her blood. Which organ isn't functioning properly? How do you know?

5. **Follow-up activity: What's in your blood?**

Obtain prepared slides of human blood (available in most science supply catalogs). As students view the blood cells under high magnification, ask them to identify and sketch the three solid components of human blood: red blood cells, white blood cells, and platelets.

Red blood cells make up the vast majority of cells in the slide and are easily identified by their pink color and central dimple. White blood cells are larger than red blood cells, irregular in appearance, and often stained purple. Tiny platelets are hardest to spot. Review the roles each of these components play in transporting oxygen, fighting disease, and forming blood clots.

(🧠 10 – 20 minutes)



**Blood cells**



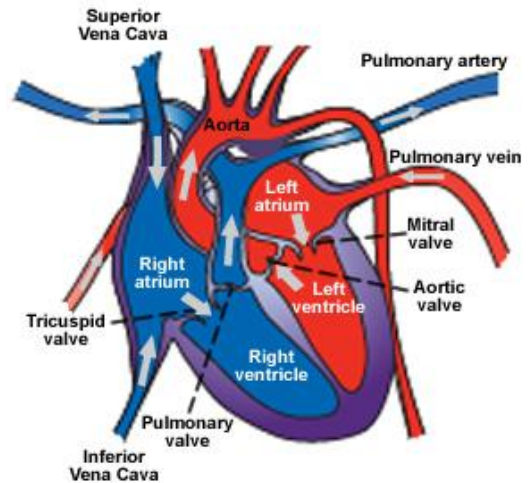
### Scientific Background

The circulatory system is responsible for transporting oxygen, nutrients, and chemical messages to body cells. It is also responsible for transporting wastes from cells, such as carbon dioxide and urea. The complexity and durability of the human circulatory system are astounding:

- End to end, the blood vessels in a single person would wrap around the world four times!
- During an average lifetime, the heart beats over two billion times without ever resting!

De-oxygenated blood is returned to the **right atrium** of the heart by two large veins, the **superior vena cava** (SVC) and the **inferior vena cava** (IVC). When the right atrium contracts, blood is pushed through the **tricuspid valve** to the **right ventricle**. (The valves in the heart and other blood vessels allow blood to flow in only one direction.)

When the right ventricle contracts, blood is forced through the **pulmonary artery** to the lungs, where carbon dioxide is released and oxygen is absorbed into the blood. Each red blood cell contains an iron-rich protein called **hemoglobin**. Oxygen bonds to the hemoglobin and turns it bright red. The now oxygenated blood returns to the **left atrium** via the **pulmonary vein**.



**Anatomy of the heart**

From the left atrium, oxygenated blood is pumped into the **left ventricle** and then out of the heart through the **aorta**. The aorta splits into many branches leading to different parts of the body. The **carotid artery** carries blood to the head, while the **brachial arteries** and **femoral arteries** service the arms and legs, respectively. Other arteries bring blood to the liver, intestines, kidneys, and other organs.



### **Health connection: Healthy hearts**

The heart is an amazingly durable organ, but it doesn't last forever. Heart disease is the leading cause of death in the United States, killing a person nearly every 30 seconds. The most common form of heart disease is **coronary heart disease** (CHD), which is caused by a buildup of plaque (gunk) on the walls of the **coronary artery**, the artery that provides the heart itself with blood. A **heart attack** occurs when the plaque ruptures, causing the blood to clot. This cuts off the flow of blood and oxygen to the heart muscle.

One way to detect coronary heart disease is to analyze an **angiogram**. An angiogram is created by injecting a special dye into the arteries around the heart and then taking an x-ray image. The dye appears on the x-ray, outlining the blood vessels and allowing blockages to be detected.

The risk of heart attack is dependent on both genetic factors and lifestyle choices. Exercising, maintaining a healthy weight, and avoiding smoking are simple ways reduce risk. Dietary supplements such as aspirin, red wine, and omega-3 fatty acids have also been claimed to reduce the risk of heart attacks, although many of these claims are still controversial.



### **Selected Web Resources**

Heart animation: [http://library.med.utah.edu/kw/pharm/hyper\\_heart1.html](http://library.med.utah.edu/kw/pharm/hyper_heart1.html)  
NOVA "Cut to the Heart:" <http://www.pbs.org/wgbh/nova/heart/>  
About your heart: <http://www.smm.org/heart/heart/top.html>  
How the heart works: <http://health.howstuffworks.com/adam-200083.htm>  
Angiograms: <http://yourtotalhealth.ivillage.com/coronary-angiogram.html>  
Heart rate math: [http://media.nasaexplores.com/lessons/01-005/k-4\\_3.pdf](http://media.nasaexplores.com/lessons/01-005/k-4_3.pdf)  
Observing blood: [http://www.funsci.com/fun3\\_en/blood/blood.htm](http://www.funsci.com/fun3_en/blood/blood.htm)