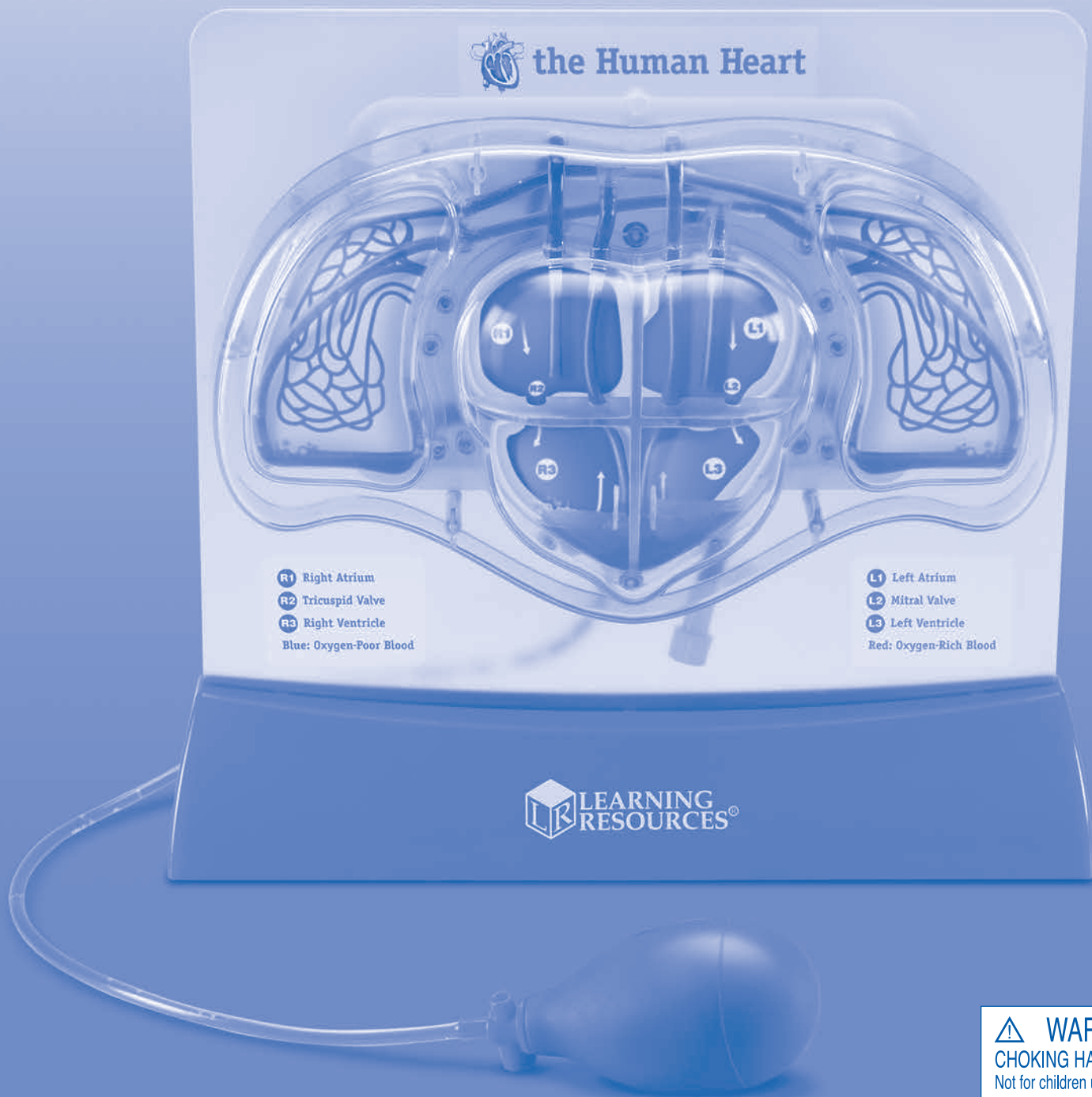


# Pumping Heart Model

## Activity Guide



 **WARNING:**  
CHOKING HAZARD - Small parts.  
Not for children under 3 years.

The Pumping Heart Model helps students visualize blood flow through the heart and into the lungs for oxygenation. The model's reverse side displays a summary of how the heart works. Use the model along with the reproducible pages in this guide to reinforce anatomical structure and key vocabulary.

**Note:** Two extra stopper screws are included with the model.

## Putting Water into the System

### **Caution:**

- For best results and to prevent mold, use distilled water
- Work over a sink or water-safe area
- Use care with the red powder; avoid contact with clothing to prevent staining
- The model is designed to use 75 ml of water. The model must contain at least 40 ml of water, but do not exceed 120 ml in the unit to ensure correct performance
- The red powder is a safe, food-grade dye, but is not for consumption; avoid contact with eyes
- Only use the dye provided with this model; do not add food coloring

1. Add (1) packet of dye to 75 ml of water and mix to dissolve. Wash hands immediately to avoid transfer of dye to hands or clothing.
2. Remove the rubber hand pump from its connection point without pulling on the tubing.
3. Carefully pour the red water mixture into the empty hand pump (pour over a sink or bucket).
4. Carefully reassemble the hand pump.
5. Wipe the hand pump and model with paper towel to dry.



## How to Use

- Gently squeeze the hand pump and fully depress the bulb
- Release and allow the hand pump to reinflate

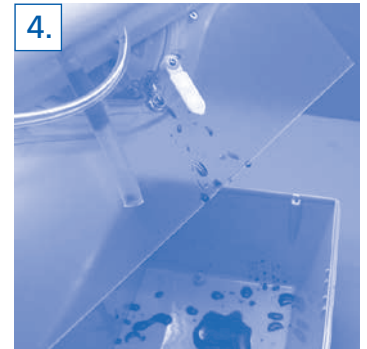
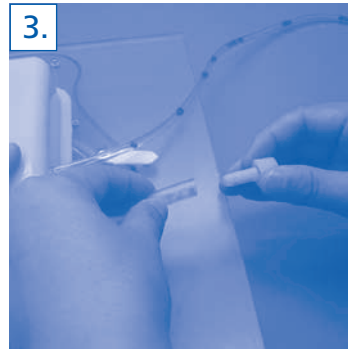
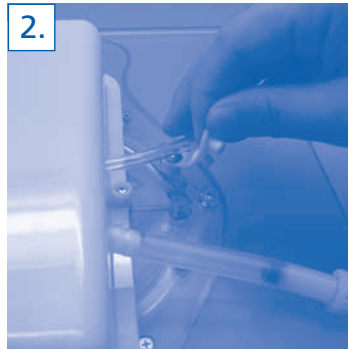
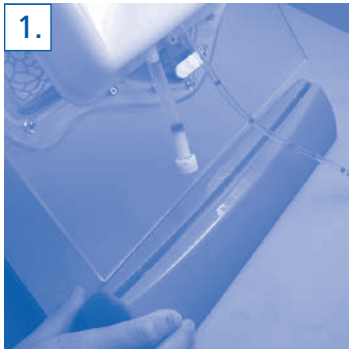


## Removing Water from the System

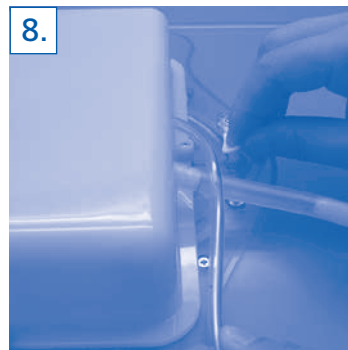
### Caution:

- Drain water from the model before storing for long periods
- Draining the system will require a small Phillips screwdriver
- Drain the water in a sink or bucket; avoid contact with clothing to prevent staining

1. Remove the model from its base and lay face down.
2. Use a small Phillips screwdriver to remove the screws from the rubber stopper on the back of the model. Carefully remove the rubber stopper.
3. Twist and pull the white plug out from the back tubing.  
Note: The white plug has a very tight fit.
4. Squeeze the hand pump repeatedly to empty the system; tip the board to assist this process.



5. Remove the rubber hand pump from its connection point and empty remaining liquid from the bulb.
6. Add clean water to the hand pump, reconnect, and repeat steps 4–6 until the system is flushed.
7. If preparing for long-term storage, allow the model to air dry for several days before reinserting the rubber stopper and white plug.
8. **Be sure the rubber stopper (with screws) and the white plug are in place before adding new dyed water into the system.**



## Model Care

Clean the outer surface of the model with a damp, soft cloth.

Do not use cleaning solvents on the model.

Do not squeeze the hand pump with excessive force; gentle, consistent force works best.

Do not bend, crimp, or pull on the tubing as this may disable the flow of liquid.

Do not attempt to access the inner casing of the model.

Do not store the model in direct sunlight.

If internal condensation occurs, tilt and allow liquid to help clear the model walls.

If condensation is extreme, flush the system with clean water.

## Pumping Heart Model

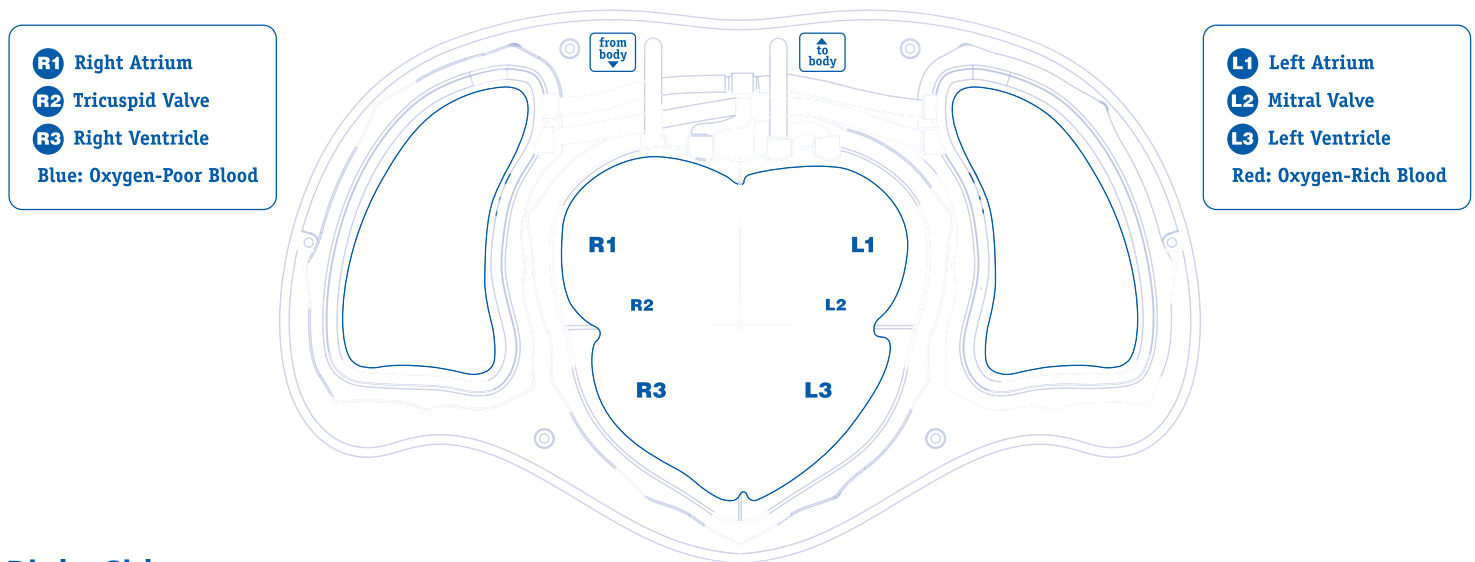
The Pumping Heart Model is a very simplistic representation of the human heart and its four chambers. Your actual heart does not have air bubbles in its veins, arteries, or chambers. Blood does not pool in the bottom of healthy lungs. Your brain tells your heart to beat automatically. In reality, your heart is much more complex than the Pumping Heart Model could ever demonstrate.

Use the reproducible cross-section diagram on page 7 of this guide to see the human heart in more detail and compare it to the Pumping Heart Model.

The reproducible blank diagram on page 8 can be used as a quiz.

## How the Heart Works

It's important to understand that with each heartbeat, your heart is pumping blood two ways at once. Half of your heart fills and pumps blood with poor levels of oxygen to the lungs to get fresh oxygen. At the same time, the other half of your heart is working to pump blood that has fresh oxygen to the rest of your body. The right and left sides of your heart work together and pump at the same time.



### Right Side:

- Oxygen-poor blood returning from your body enters the right side of your heart into the chamber called the right atrium (R1).
- The atrium contracts when your heart beats, and the oxygen-poor blood is pumped from the right atrium through the tricuspid valve (R2) into the chamber called the right ventricle (R3).
- When both the right atrium and right ventricle chambers are filled with blood, the tricuspid valve closes to prevent blood from flowing backward.
- The right ventricle contracts when your heart beats and pumps the oxygen-poor blood to the lungs where it receives new oxygen and gets rid of carbon dioxide.

### Left Side:

- Oxygen-rich blood from the lungs enters the left side of the heart into the chamber called the left atrium (L1).
- The oxygen-rich blood passes from the left atrium through the mitral valve (L2) into the chamber called the left ventricle (L3).
- When both the left atrium and left ventricle chambers are filled with blood, the mitral valve closes to prevent blood from flowing backward.
- The left ventricle contracts when your heart beats and pumps the oxygen-rich blood back out to the rest of your body so that it can use the oxygen.

## About the Human Heart

- Your heart is about the size of your clenched fist.
- An adult female's heart weighs about 8 ounces; an adult male's heart weighs about 10 ounces.
- Your heart is located in the center of your chest between your lungs. People often think the heart is located in the left side of the chest. The bottom of the heart is tilted slightly more toward the left side of the body, so you often feel your heart more on the left.
- Your heart is not directly below your skin. Your heart is protected by your breastbone (sternum) and the bones of your rib cage.
- Your heart is made of smooth muscle called cardiac muscle. Cardiac muscle is a type of involuntary muscle. This means we do not have to think about making our heart beat like we do when we want to use muscles to throw a ball or run. The brain automatically sends electric signals along nerves to make the heart beat.
- The average adult heart beats about 100,000 times each day. By the time you reach the age of 70, your heart will have beaten well over 2 billion times.
- The rate at which your heart beats depends on your activity level. The more you move, the faster your heart beats.
- The resting rate of your heart decreases with age. An infant's resting heart rate can be as high as 120 beats per minute. A child's resting heart rate is about 90 beats per minute. Adults have resting heart rates between 70–80 beats per minute.
- Your heart has four chambers that collect and pump blood. All birds and mammals have four-chambered hearts. Fish hearts have just two chambers. Amphibians have three-chambered hearts.
- Your heart is a very strong muscle. To get an idea of how hard your heart squeezes every time it beats, try squeezing a tennis ball hard enough to make it bend inward. That's about the force your heart uses every time it contracts and beats.
- When you listen to your heartbeat using a stethoscope, the "lub-dub" sounds you hear are made by the valves of your heart opening and closing.

## About Blood

- Blood is carried to and from your heart by a system of blood vessels. Arteries generally carry oxygen-rich blood away from your heart to your body. Veins generally return blood from your body to your heart. If all the blood vessels (arteries and veins) were stretched out end to end, they would measure over 60,000 miles—long enough to wrap around the world over two times!
- Blood is bright red when it is rich in oxygen or comes in contact with oxygen. For this reason, when you cut yourself or have a nosebleed, you generally see bright red blood as it hits the air.
- Blood may look blue through your skin, but it isn't. Blood is always either dark red or bright red, depending on how much oxygen it contains at the time. Like many models of the heart and blood vessels, the Pumping Heart Model uses the color blue to represent blood that is poor in oxygen.
- Adults have about 4–6 liters of blood in their bodies, depending on body size.
- When your body is at rest, it takes about one minute for blood to circulate through your body and back to the heart. When you exercise, blood can circulate in as little as 10 seconds.
- Blood is 75% water. Blood is made by bone marrow located in the middle of your bones.
- Blood also carries nutrients provided by your digestive system to all parts of your body. Blood also plays a critical role in helping fight germs and disease in your body.
- Laughing can send 20% more blood flowing through your body. That's why people often say laughter is the best medicine. It helps increase blood flow, which promotes healing in your body and decreases stress.



## About the Lungs

- Oxygen gives all the cells in our body energy. Lungs help our body take in oxygen and also get rid of carbon dioxide, a gas that our body does not use.
- When you inhale, you breathe in air to fill your lungs. When you exhale, you breathe air out of your lungs.
- Your lungs breathe in about 2,100 to 2,400 gallons (8,000 to 9,000 liters) of air each day.
- An adult's lungs contain about 600 million alveoli, which are tiny, spongy, air-filled sacs that exchange oxygen gas for carbon dioxide gas and help pass the oxygen into the blood stream.
- The work of breathing is actually done by the diaphragm, which is a sheet of muscles located between the chest and stomach area. The muscles of your diaphragm contract (squeeze) when you breathe in (inhale). This causes your lungs to expand and take in air. When you breathe out (exhale), the muscles of the diaphragm relax and let your lungs release air.

## Key Vocabulary

**aorta** largest artery in the body; carries oxygen-rich blood from the left ventricle to the rest of the body, except for the lungs

**alveoli** tiny, air-filled sacs in the lungs that exchange oxygen gas for carbon dioxide gas and help pass the oxygen into the blood stream

**chamber** area of the heart like a pocket or cave that collects blood; the human heart has four chambers (right atrium, right ventricle, left atrium, left ventricle)

**contract** the action of a muscle squeezing and becoming tight; you feel your heart beat when it contracts

**exhale** the act of breathing out to get rid of carbon dioxide gas

**inferior vena cava** large vein that carries oxygen-poor blood from the lower body into the right atrium

**left atrium** upper-left chamber of the heart that pumps oxygen-rich blood from the lungs into the left ventricle

**left ventricle** lower-left chamber of the heart that pumps blood from the left atrium through the aorta to the entire body, except for the lungs

**inhale** the act of breathing inward to take in oxygen

**mitral valve** separates the left atrium and left ventricle, preventing blood from flowing in the wrong direction

**pulmonary artery** the only artery that carries oxygen-poor blood from the heart directly to the lungs

**pulmonary valve** prevents blood from flowing in the wrong direction

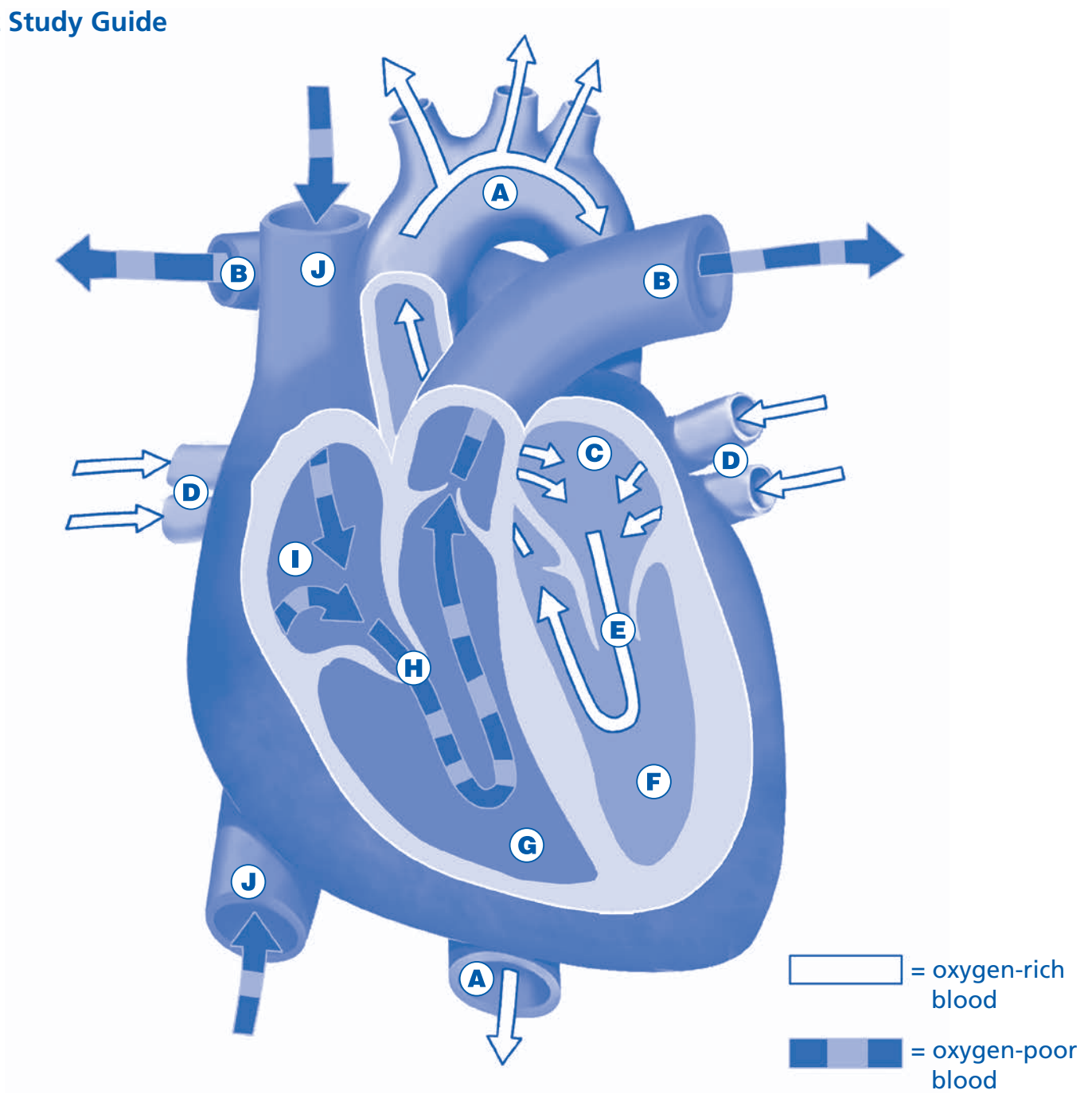
**right atrium** upper-right chamber of the heart that directs oxygen-poor blood from the superior and inferior vena cava to the right ventricle

**right ventricle** lower-right chamber of the heart that collects oxygen-poor blood from the right atrium, pumping it through the pulmonary valve into the pulmonary artery

**superior vena cava** large vein that carries oxygen-poor blood from the upper body into the right atrium

**tricuspid valve** separates the right atrium and right ventricle, preventing blood from flowing in the wrong direction

## Heart Study Guide



**A.** Aorta (to body)

**B.** Pulmonary arteries (to lungs)

**C.** Left atrium

**D.** Pulmonary veins (from lungs)

**E.** Mitral valve

**F.** Left ventricle

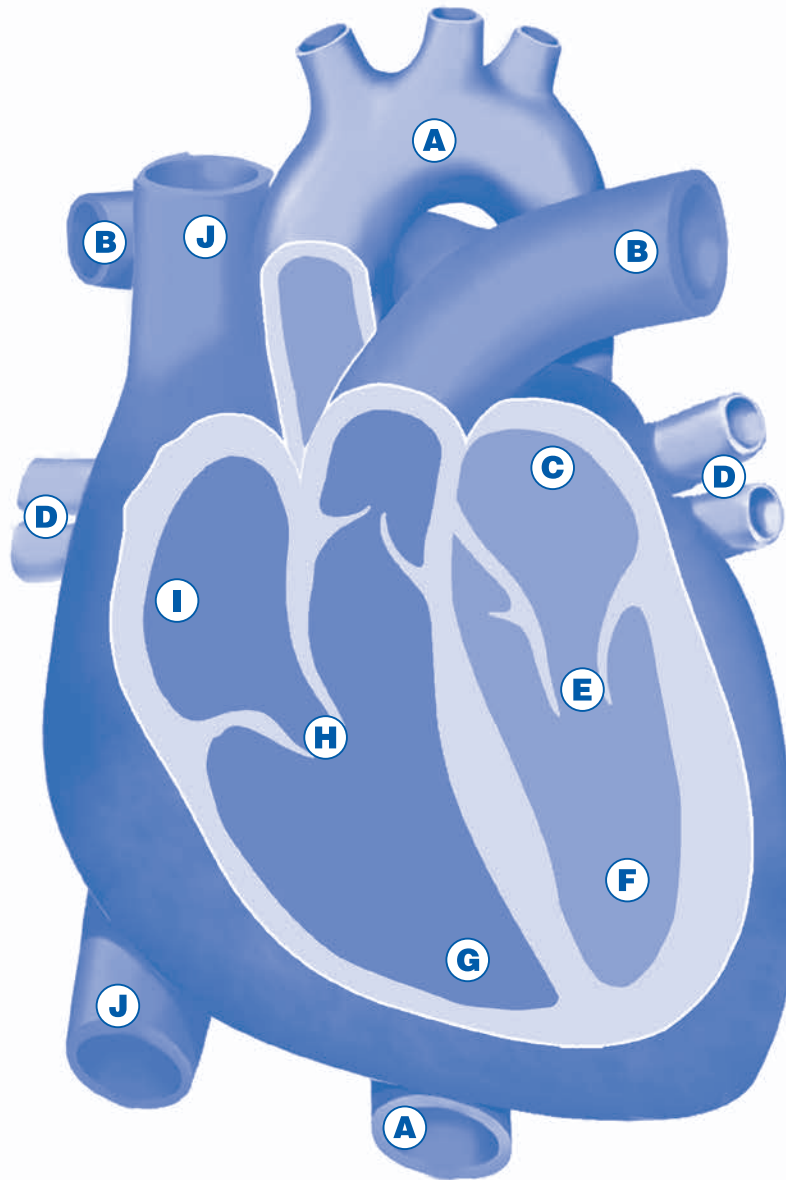
**G.** Right ventricle

**H.** Tricuspid valve

**I.** Right atrium

**J.** Veins (from body)

## Heart Quiz



A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

E. \_\_\_\_\_

F. \_\_\_\_\_

G. \_\_\_\_\_

H. \_\_\_\_\_

I. \_\_\_\_\_

J. \_\_\_\_\_



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**ATENCIÓN: PELIGRO DE ASFIXIA.**  
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