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YOUTH DEVELOPMENT THROUGH VETERINARY SCIENCE 4

You've Got To Have Heart

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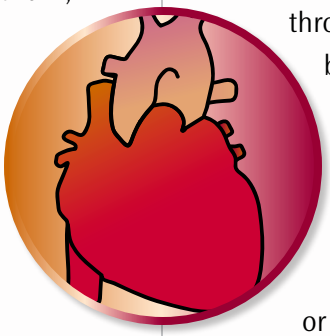
Subject Overview and Background Information

The **cardiovascular system** includes the **heart**, **lungs**, **blood,** and **blood vessels**. The heart serves as the "engine" of the system by rhythmically contracting to pump blood through vessels to the lungs and the rest of the body. The heart in birds and mammals (reptiles, amphibians, and fish differ) has four discrete chambers: the right atrium, the right ventricle, the left atrium, and the left ventricle. The **right atrium** receives blood from the body. The blood then flows into the **right ventricle,** where it is pumped to the lungs. The blood enters the **left atrium** when it returns from the lungs. The blood then flows into the **left ventricle,** where it is pumped to the rest of the body.



The purpose of the blood is to carry **oxygen** and nutrients to all parts of the body. Oxygen is needed to break down nutrients for energy. The waste product of this process is **carbon dioxide**, which must be removed from the body through the lungs.

Blood flows through pathways called blood vessels. Vessels going toward the heart are called **veins**, and vessels going away from the heart are called **arteries**. Oxygen leaves the blood and goes into the cells through very small blood vessels called **capillaries**. At the same time, carbon dioxide must leave the cells through the capillaries and enter the blood stream.

Oxygen enters the blood in the lungs. When an animal **inhales**, the chest expands and the lungs fill up with air. The oxygen-rich air in the lungs enters into the blood through the capillaries. Carbon dioxide also leaves the blood through the capillaries in the lungs. When the animal **exhales**, carbon-dioxide-rich air is expelled.

The **respiration rate** is the number of breaths taken in 1 minute. It can be determined by watching the rise and fall of an animal's chest or by moistening one's finger and holding it in front of the animal's nose to feel the exhaled air from each breath. The **heart rate** is the number of heartbeats per minute. One can count heartbeats by listening to the heart with a **stethoscope**. Another way is to find the **pulse**, the rhythmic throbbing of the arteries caused by the heartbeat. In humans, one can feel the pulse on the palm side of the wrist or on either side of the neck.

Variations in an animal's normal heart rate or respiration rate can be signs of health problems. For example, an animal who is panting (breathing heavily and rapidly) may be overheated, stressed, or suffering from a disease that affects the heart or lungs. On the other hand, a weak pulse or slow heart rate may be caused by illness as well. Whenever a caretaker notices these or other changes associated with an animal's cardiovascular system, it is important to consider consulting a veterinarian.

Activity Concepts and Vocabulary

- **Blood**: The fluid that is pumped from the heart through vessels and moves throughout the body.
- **Carbon dioxide (kahr-buhn dahy-ok-sahyd)**: A colorless, odorless gas that is breathed out of the body.
- **Exhalation (eks-huh-ley-shuhn)**: The act of breathing air out of the lungs.
- **Heart rate**: The number of times the heart beats in a certain amount of time.
- **Heart**: An organ that pumps blood throughout the body.
- **Inhalation (in-huh-ley-shuhn)**: An intake of air through the nose or mouth into the lungs.
- **Left atrium**: The upper left chamber of the heart.
- **Left ventricle**: The lower left chamber of the heart that receives blood from the left atrium.
- **Lungs**: The organ that transfers oxygen and removes carbon dioxide from the blood, allowing animals to breathe and function properly.
- **Oxygen (ok-si-juhn)**: A colorless, odorless gas that is essential for animals to stay alive.
- **Pulse**: The regular expansion and contraction of the artery (vessel carrying blood) caused by the heart pumping blood throughout the body.
- **Respiration rate (res-puh-rey-shuhn)**: The frequency of breathing, expressed as the number of breaths per minute.
- **Right atrium (ay-tree-uhm)**: The upper right chamber of the heart.
- **Right ventricle (ven-tri-kul)**: The lower right chamber of the heart that receives blood from the right atrium.
- **Stethoscope (steth-uh-skohp)**: An instrument that is used to listen to breathing, heartbeats, and other sounds made by the body.

Life Skills

- **Head**: Learning to learn, problem solving, critical thinking, keeping records
- **Heart**: Communication, cooperation, social skills, sharing
- **Hands**: Contributions to group effort, teamwork

Subject Links

Science, Language Arts, and Math

State Science Standards Supported

Science

- Grade 5
  - *Life Sciences: 2a, 2b*

Language Arts

- Grade 3
  - *Listening and Speaking Strategies: 1.5, 1.8*
- Grade 4
  - *Listening and Speaking Strategies: 1.7, 1.8*
- Grade 5
  - *Listening and Speaking Strategies: 1.5*
- Grade 6
  - *Listening and Speaking Strategies: 1.5*

Math

- Grade 3
  - *Statistics, Data Analysis, and Probability: 1.3*

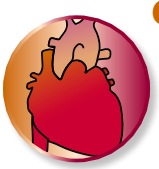
Purpose of Activities

The purpose of the activity is to learn about and understand the cardiovascular system and the important components of this system.

ACTIVITY 1

You've Got to Have Heart

Overview of the Activity



In this activity, youth will try to figure out how the cardiovascular system works, with particular attention to the heart. Youth will learn the important components of this system, the function of the heart, and how to take a pulse and determine the rate of respiration.

◆ Time Required

60 to 70 minutes

◆ Suggested Groupings

Small groups of 3 to 4

◆ Materials Needed for Each Group

*(*Materials provided in curriculum)*

- Flip chart paper
- Markers or writing utensils
- Watch with a second hand
- Scissors (enough for each group)
- Blue and red markers (enough for each group)
- Stethoscope
- *Body/heart cards
- *Blood pathway diagram
- *Heart diagram

◆ Getting Ready

- Make one copy of the body/heart cards, blood pathway diagram, and heart diagram for each group.
- Provide each group a sheet of flip chart paper and markers to answer questions.
- Divide youth into small groups for opening questions.

Opening Questions

Ask the youth to respond to each question below by sharing their ideas verbally and/or by recording them on the flip chart paper provided.

1. What do you know about the heart? What do you know about how a heart works?
2. What do you know about different ways you can detect (find) your heartbeat?
   - **Volunteer Tip**: *A pulse can be detected by holding your hand over your heart, by placing two fingers lightly on the inside of your left wrist just to the left of the arm's midline, or by placing two fingers lightly on the left side of your neck just below the angle of your jaw.*

Procedure (Experiencing)

1. Provide each group with a set of body/heart cards.
2. Have the youth cut out the body/heart cards. Allow the youth to organize the cards on a sheet of flip chart paper in the order they think blood flows through them.
3. Ask the youth to indicate the movement of blood with a marker, drawing the blood with a lot of oxygen in red and the blood with little oxygen in blue.
   - **Volunteer Tip**: *To help the youth start this process, have them think about what happens when they breathe in through their nose.*

Sharing, Processing, and Generalizing

1. Have the groups share their diagrams.
2. Follow the lines of thinking developed through general thoughts, observations, and questions raised by the youth as they share and compare their thoughts and ideas relative to the flow of blood through the heart, lungs, and body. If necessary, use more targeted questions as prompts to get to particular points, such as:
   - *What do you know about blood and the purpose it serves? Please explain.*
   - *What do you know about how blood is pumped through the body? Please explain.*
3. Give each group a copy of the blood pathway diagram and the heart diagram. Using the blood pathway diagram as a guide, have the youth trace the pathway of the blood into, through, and out of the heart on the heart diagram.
4. Ask the following questions and have groups write their ideas on flip chart paper.
   - *What do you think your heart rate tells you? Please explain. If you wanted to find out what your heart rate is, how would you go about finding it?*
   - *What do you think your breathing rate tells you? Please explain. If you wanted to find out what your breathing rate is, how would you go about finding it?*
5. Have the groups share their thoughts and ideas relative to these two questions.
6. Go over the terms **heart rate** and **breathing rate**. Introduce the stethoscope (if available) and allow each group to spend some time listening to their own and each other's hearts.

7. Ask the youth to try to find their pulse. Note that the youth may need help. Have the youth count their heartbeats for 6 seconds. Tell the youth when to start and stop counting. Add a 0 to the end of the number they counted to get their heart rate per minute. (For example, if they count 7 beats in 6 seconds, their heart rate will be 70 beats per minute.) Normal heart rates for humans are
   - *Newborn infants: 100 to 160 beats per minute*
   - *Children 1 to 10 years: 70 to 120 beats per minute*
   - *Children over 10 and adults (including seniors): 60 to 100 beats per minute*
   - *Well-trained athletes: 40 to 60 beats per minute*
8. Ask the youth to determine their breathing rate at rest while seated. Have them count the number of breaths they take for 6 seconds. Tell them when to start and stop counting. Add a 0 to the end of the number they counted to get their breathing rate per minute. (For example, if they count 3 breaths in 6 seconds, their breathing rate will be 30 breaths per minute.) Normal breathing rates for humans are
   - *Normal range for newborn infants: 30 to 60 breaths per minute*
   - *Normal range for young children: 20 to 40 breaths per minute*
   - *Normal range for older children: 15 to 25 breaths per minute*
   - *Normal range for adults at rest: 15 to 20 breaths per minute*

Concept and Term Discovery/ Introduction

Volunteers need to ensure that youth understand the **basic heart anatomy** (ventricles and atria), that **gas exchange** occurs between the blood and lungs and the blood and the body (which way oxygen and carbon dioxide are going), and what **heart** and **respiration rates** are and how to record them. Additionally, make certain that the key vocabulary terms—**heart, right atrium, right ventricle, left atrium, left ventricle, lungs, blood, oxygen, carbon dioxide, inhalation, exhalation, respiration rate, heart rate, pulse, and stethoscope**—have either been discovered by the youth or introduced by the volunteer volunteer.

- **Note**: The goal is to have the youth develop these concepts through their exploration and define the terms using their own words.

References

Dyce, K. M. 2002. Textbook of veterinary anatomy. Philadelphia: Saunders.

MedlinePlus. Pulse. MedlinePlus Web site, http://www.nlm.nih.gov/medlineplus/ency/article/003399.htm.

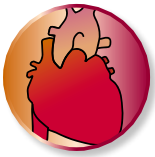
Microsoft Encarta Encyclopedia Deluxe. 2001. Circulatory system. CD-ROM. Seattle: Microsoft.

Sherwood, L. 2007. Human physiology: From cells to systems. 6th ed. Belmont, CA: Brooks/Cole.

University of Alabama at Birmingham Health System. Vital signs (body temperature, pulse rate, respiration rate, blood pressure). UAB Health System Web site, http://www.health.uab.edu/14939/.

ACTIVITY 2
Map the Heart!

Overview of the Activity



This is an interactive activity in which the youth will physically model how blood is moved from the heart to the lungs and from the heart to the body.

Time Required

45 to 60 minutes

Materials Needed

*(*Materials provided in curriculum)*

- Large open space outside (blacktop with a four-square court is ideal) or inside (gymnasium or multipurpose room)
- Grocery-size paper bags
- Watch with a second hand
- Four shoe boxes or similar small containers
- *Heart rate and breathing rate charts
- *Heart rate and breathing rate graphs
- *Oxygen and carbon dioxide templates
- *Map the heart activity diagram
- *Daily heart rate chart

Getting Ready

- Make a copy of the heart rate and breathing rate charts and the heart rate and breathing rate graphs for each youth.

- Make two copies of the oxygen template and two copies of the carbon dioxide template for each youth.
  - **Volunteer Tip:** *Red and blue paper or plastic plates may be substituted for the copies of the Oxygen and Carbon Dioxide Templates.*
- Make a copy of the daily heart rate chart for each group (concept application).
- See the "Map the Heart Activity Diagram." Use a "four-square" court on a playground or paper bags to set up the boundaries of the heart chambers.
- Label the chambers. A good way to do this is to write the names of the heart chambers on the paper bags and place them in the corresponding chambers with small rocks to hold them down. You can also map out the different areas with chalk if permitted.
- Mark a separate space and label it as the lungs.
- Mark another space for the body.
- Set up two shoe boxes in the body area and two shoe boxes in the lung area. In each area, label one shoe box "Carbon Dioxide" and the other "Oxygen."
- Cut out the templates of oxygen and carbon dioxide and place them in the appropriate shoe boxes.

Opening Questions

Ask the youth to respond to each question below by sharing their ideas verbally and/or by recording them on the flip chart paper provided.

(**Note**: If you are doing this activity and Activity 1 on the same day, you can skip these opening questions).

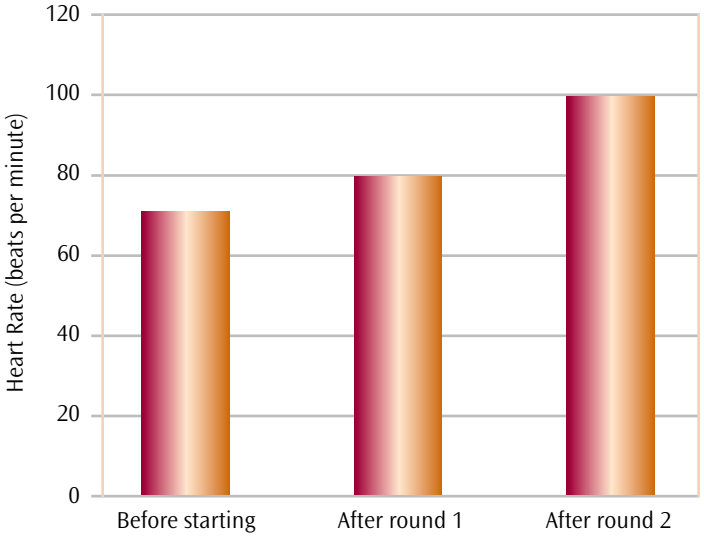
1. What do you know about why animals need to breathe?
2. What do you know about the heart? What do you know about how a heart works?
3. What do you know about different ways you can detect your heartbeat?
   - **Volunteer Tip:** *A pulse can be detected by holding your hand over your heart, by placing two fingers lightly on the inside of your left wrist just to the left of the arm's midline, or by placing two fingers lightly on the left side of your neck just below the angle of your jaw.*

Procedure (Experiencing)

The purpose of this exercise is to allow youth to simulate blood flow as detailed in the worksheets "Blood Pathway Diagram" and "Map the Heart Activity Diagram." Youth will pick up oxygen from the shoe box in the lungs and move to the heart. From there, carrying their oxygen, they will move out to the body, where they will exchange oxygen for carbon dioxide and then move back to the heart. They will end back at the lungs, dropping off the carbon dioxide in the shoe box. Have the youth do the activity at a walk the first time and at a run the second time. They will compare their heart rates between walking and running using the heart rate and breathing rate charts to further develop an understanding of heart rates.

1. Explain the following rules to the youth.
   - *The object of the game is to get the oxygen into the body and to get the carbon dioxide out of the body.*
   - *The youth will be blood cells. They will start in the lungs since this is where blood cells pick up oxygen when a person inhales. The game ends in the lungs when the person exhales, releasing carbon dioxide.*
   - *Using what they learned in the Activity 1, the youth will move 2 to 3 at a time through the blood pathways, exchanging oxygen and carbon dioxide when appropriate.*
   - *Each youth may hold only one oxygen or one carbon dioxide at a time.*
   - *Each time the youth leave the heart they may exchange either oxygen or carbon dioxide only once.*
   - *As each group of youth moves through the blood pathway, they may not pass each other.*
2. Before starting, provide each youth with the heart rate and breathing rate charts and have them record their own heart and breathing rates.
3. Round 1.
   - *Volunteers place* **one oxygen** *for each youth in the oxygen shoe box in the lungs.*
   - *Volunteers place* **one carbon dioxide** *for each youth in the carbon dioxide shoe box in the body.*
   - *Tell youth they must walk (not run) through the pathway.*
   - *Let youth begin, with a small interval of time between when each group starts.*
   - *The round ends when all oxygen is in the body and all carbon dioxide is in the lungs.*

4. As soon as each youth completes the pathway they should immediately determine their own heart rate and breathing rate and record these on their heart rate and breathing rate charts.
5. Round 2.
   - *Volunteers place* **two oxygen** *for each youth in oxygen shoe box in the lungs.*
   - *Volunteers place* **two carbon dioxide** *for each youth in the carbon dioxide shoe box in the body.*
   - *Tell the youth they may jog through the pathway.*
   - *Use the same rules as round 1 and let round 2 begin.*
   - *The activity ends when all oxygen is in the body and all carbon dioxide is in the lungs.*
6. As soon as each youth completes the pathway they should immediately determine their own heart rate and breathing rate and record these on their heart rate and breathing rate charts.
7. Once inside, have youth take the data from their heart rate and breathing rate charts and create bar graphs of their data on the heart rate and breathing rate graphs (see example below).



Sharing, Processing, and Generalizing

Follow the lines of thinking developed through general thoughts, observations, and questions raised by the youth as they share and compare their thoughts and observations. If necessary, use more targeted questions as prompts to get to particular points, such as:

1. Why do you think the blood cells have to switch oxygen and carbon dioxide in the lungs? In the body? Please explain.
2. How many times did the blood cells (youth) have to go through the heart in one complete circulation? Why do you think this was necessary? Please explain.
3. Why do you think the rate of blood flow is faster at some times and slower at others? Please explain.
4. What observations and comparisons can you make about your heart rate and your breathing rate before the activity, during round 1 and during round 2?
5. How can you explain the similarities or differences between the three measurements of heart rate? How can you explain the similarities or differences between the three measurements of breathing rate?

Concept and Term Discovery/ Introduction

Volunteers need to ensure that youth understand the **basic heart anatomy** (ventricles and atria), that **gas exchange** occurs between the blood and lungs and between the blood and the body (which way oxygen and carbon dioxide are going), and what **heart** and **respiration rates** are and how to record them.

- **Note:** The goal is to have the youth develop these concepts through their exploration and define the terms using their own words.

Concept Application

1. Using the daily heart rate chart, request that the youth record their heart rates at different times during the day. For example:
   - *morning before rising from bed*
   - *midday prior to lunch*
   - *afternoon after completing some type of activity (running; riding a bicycle; climbing a set of stairs)*
   - *after dinner*
   - *before bed*
2. Ask the youth to compare their heart rates at different times of the day. What similarities or differences do they notice? Ask them to explain their thoughts and ideas.

References

Microsoft Encarta Encyclopedia Deluxe. 2001. Circulatory system. CD-ROM. Seattle: Microsoft.

Sherwood, L. 2004. Human physiology: From cells to systems. 5th ed. Belmont, CA: Brooks/Cole.

BODY & HEART CARDS

Lungs

Take carbon dioxide from the blood and give it oxygen

Body

Takes oxygen from the blood and gives it carbon dioxide

Right Atrium of Heart

Receives blood with a lot of carbon dioxide

Blood from here needs to go to a pump

Right Ventricle of Heart

Pumps blood with a lot of carbon dioxide to the lungs.

Left Atrium of Heart

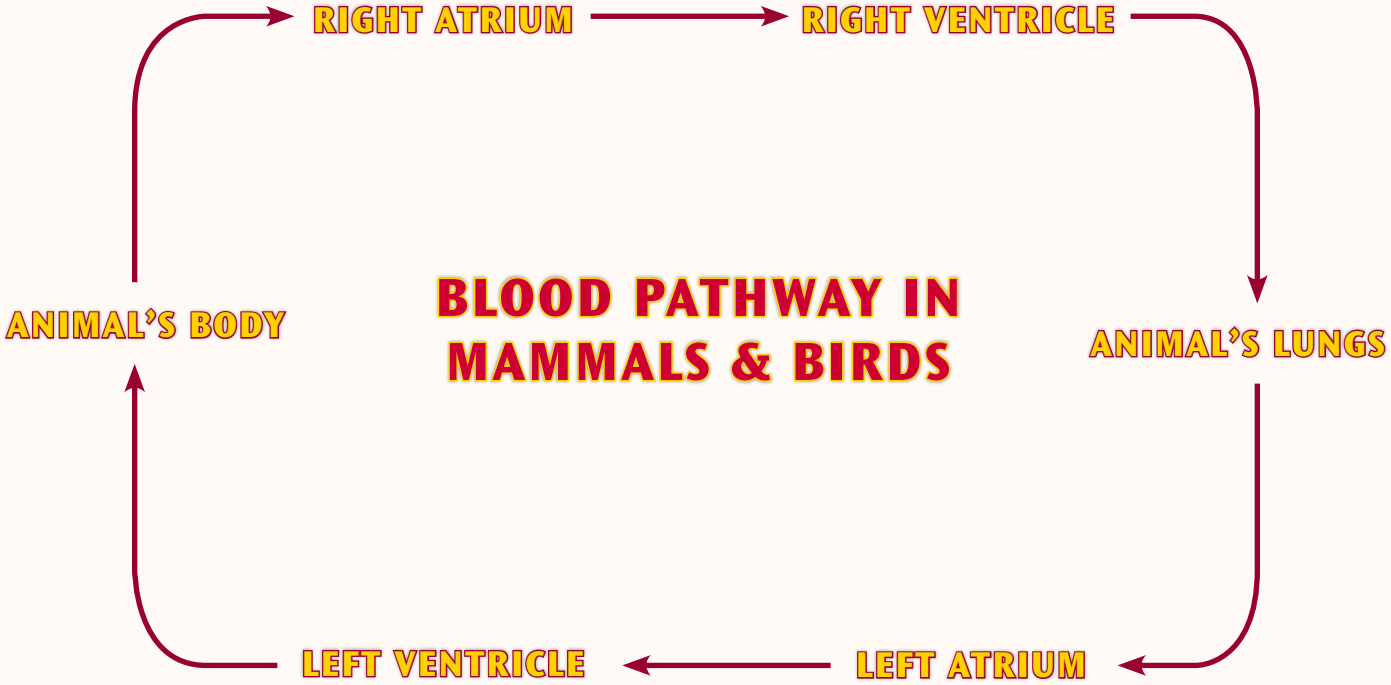
Receives blood with a lot of oxygen.

Blood from here needs to go to a pump

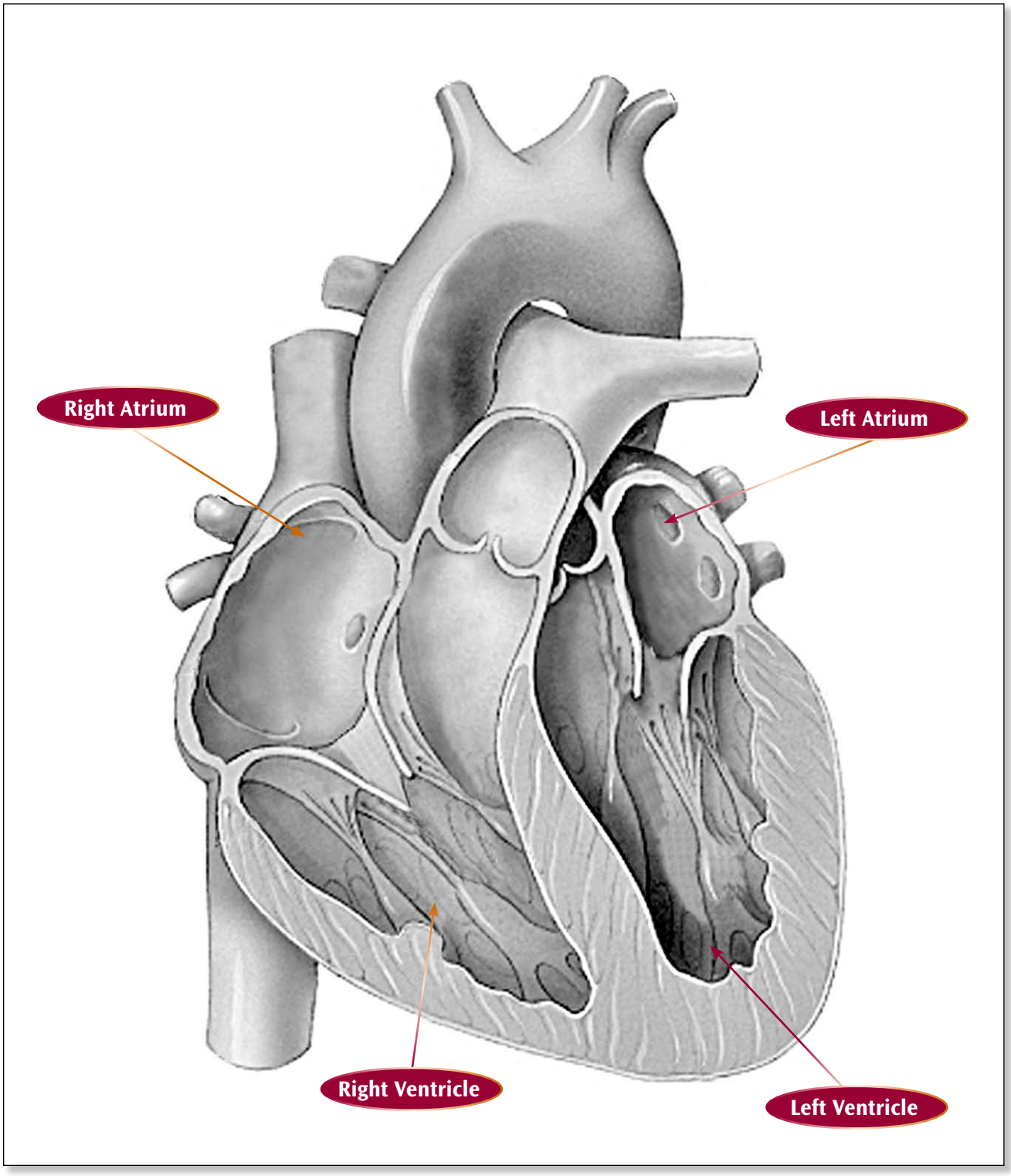
Left Ventricle of Heart

Pumps blood with a lot of oxygen to the parts of the body, such as the muscles, organs, and brain

BLOOD PATHWAY DIAGRAM



Interior View of the Human Heart



Adapted from http://www.biol.sc.edu/courses/bio102/Image9.gif

Heart Rate and Breathing Rate Charts

Heart Rate Chart

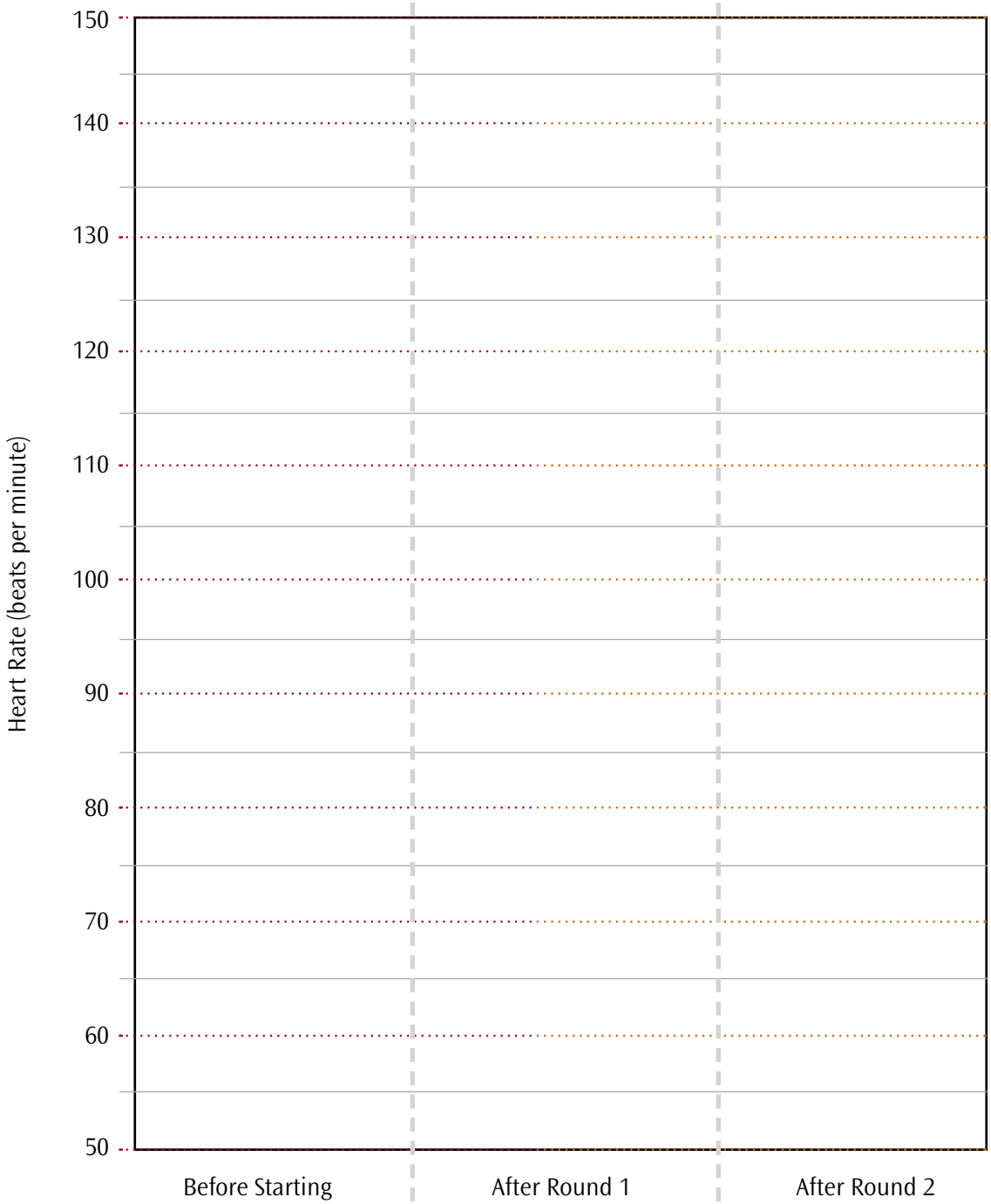
Time	Heart Rate
Before Round 1	
After Round 1	
After Round 2	

Respiration (Breathing) Rate Chart

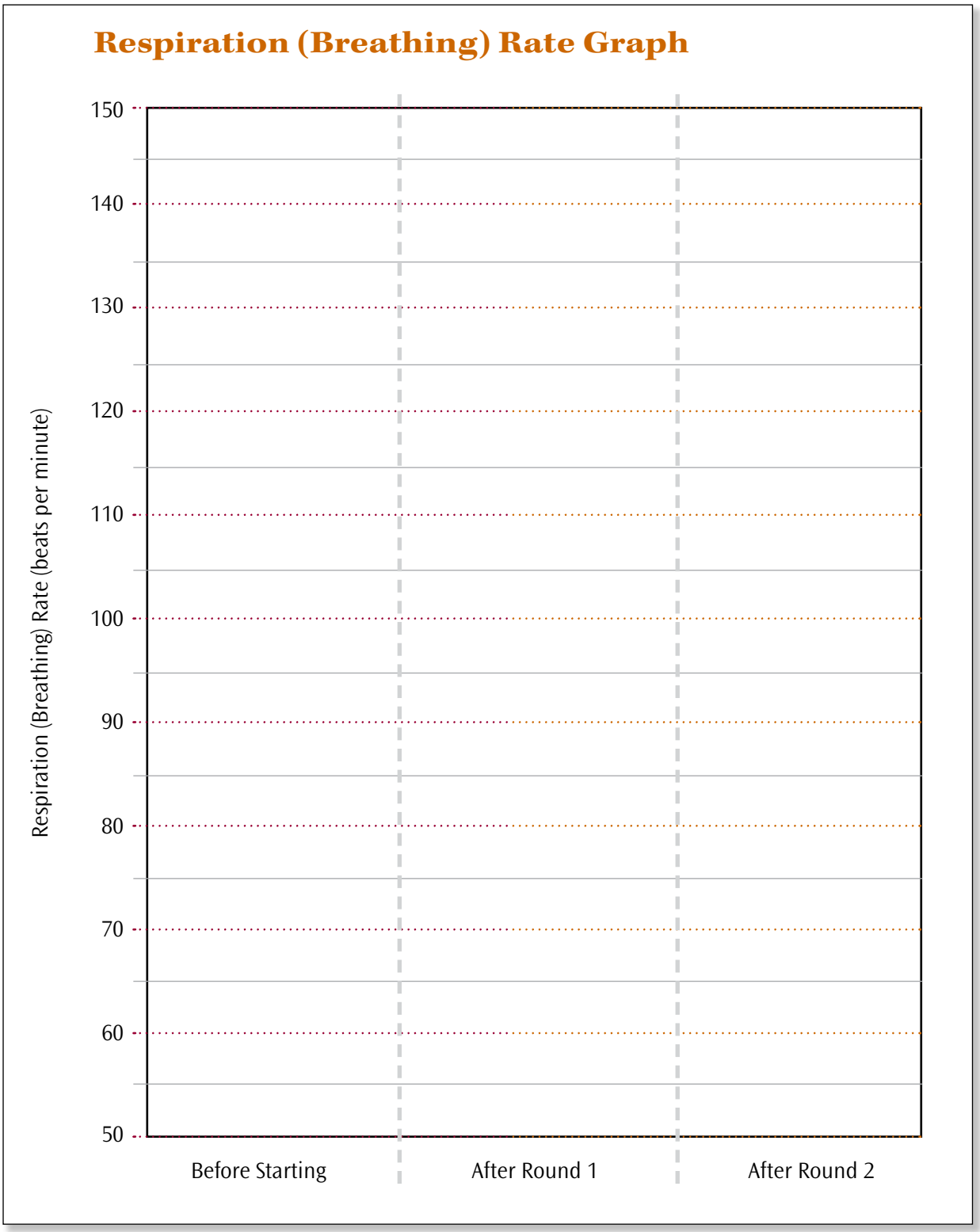
Time	Respiration (Breathing) Rate
Before Round 1	
After Round 1	
After Round 2	

Heart Rate and Breathing Rate Graphs

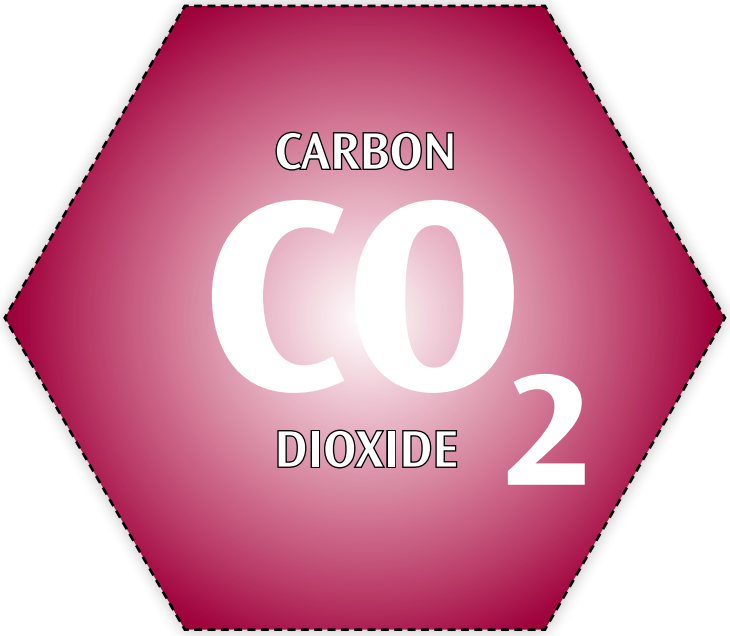
Heart Rate Graph

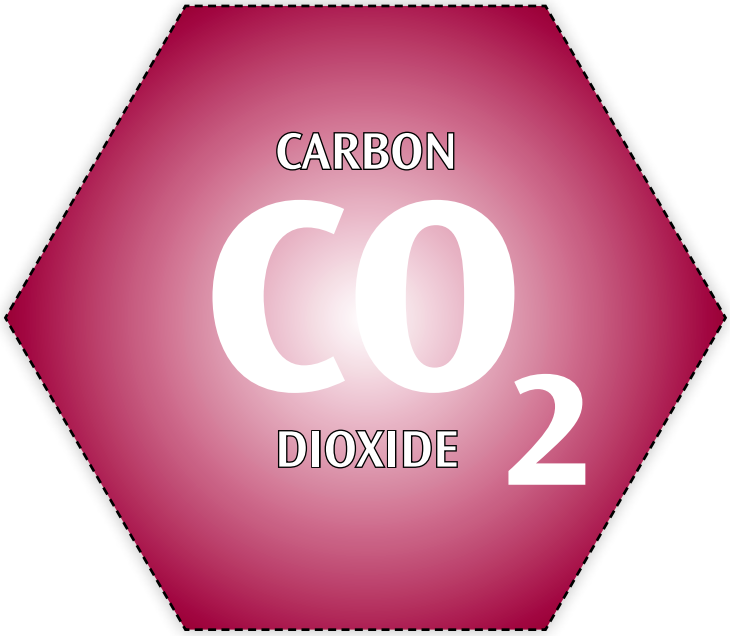


Respiration (Breathing) Rate Graph



Oxygen and Carbon Dioxide Templates





Map the Heart Activity Diagram

DIRECTIONS

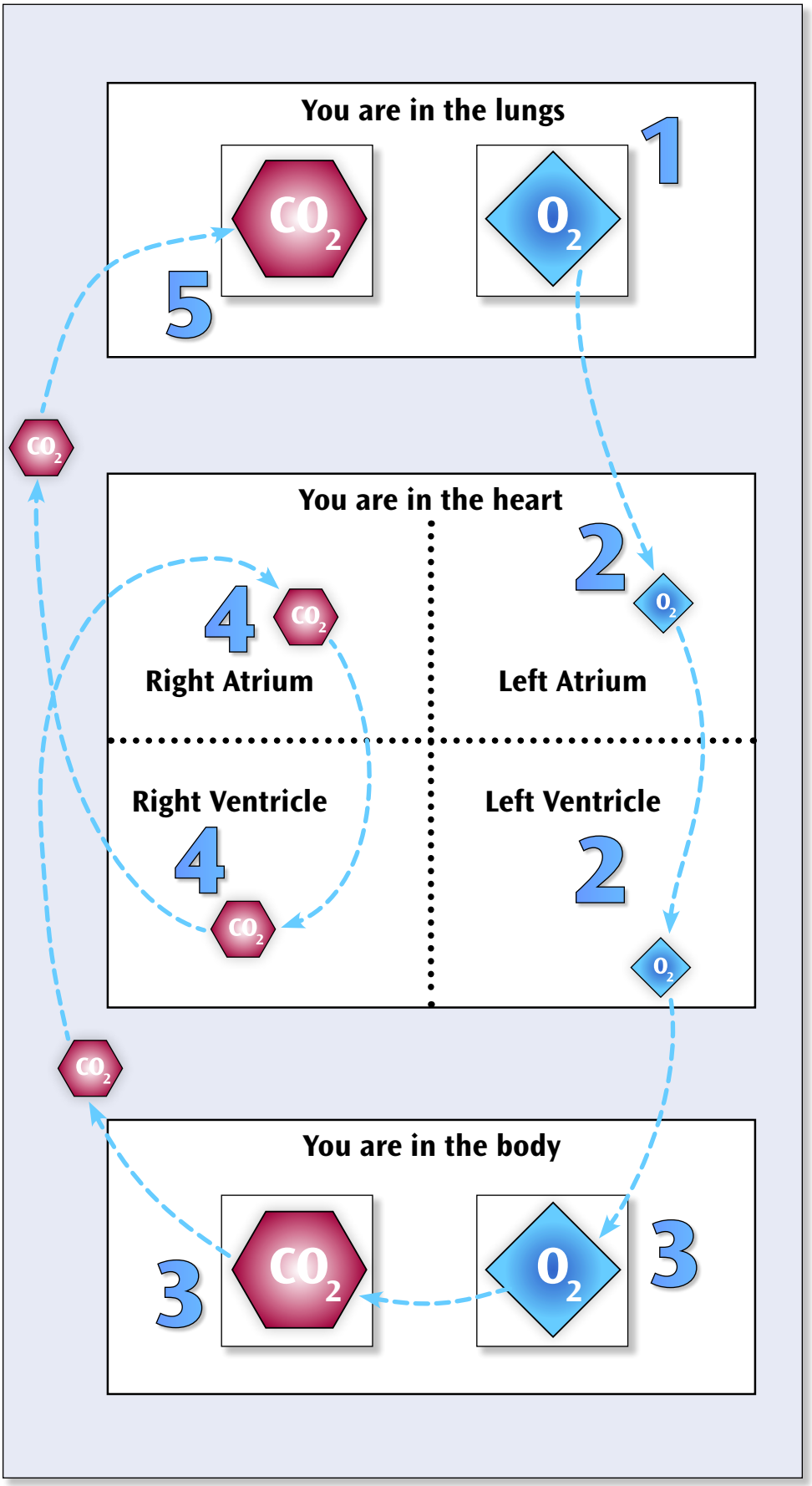
1 Start at the O_2 box. Pick up O_2 and head towards the **left atrium** of the **heart**.

2 Go through the **left atrium** and then the **left ventricle** out to the **body**.

3 Drop off O_2 and pick up CO_2. Head towards the **right atrium** of the **heart**.

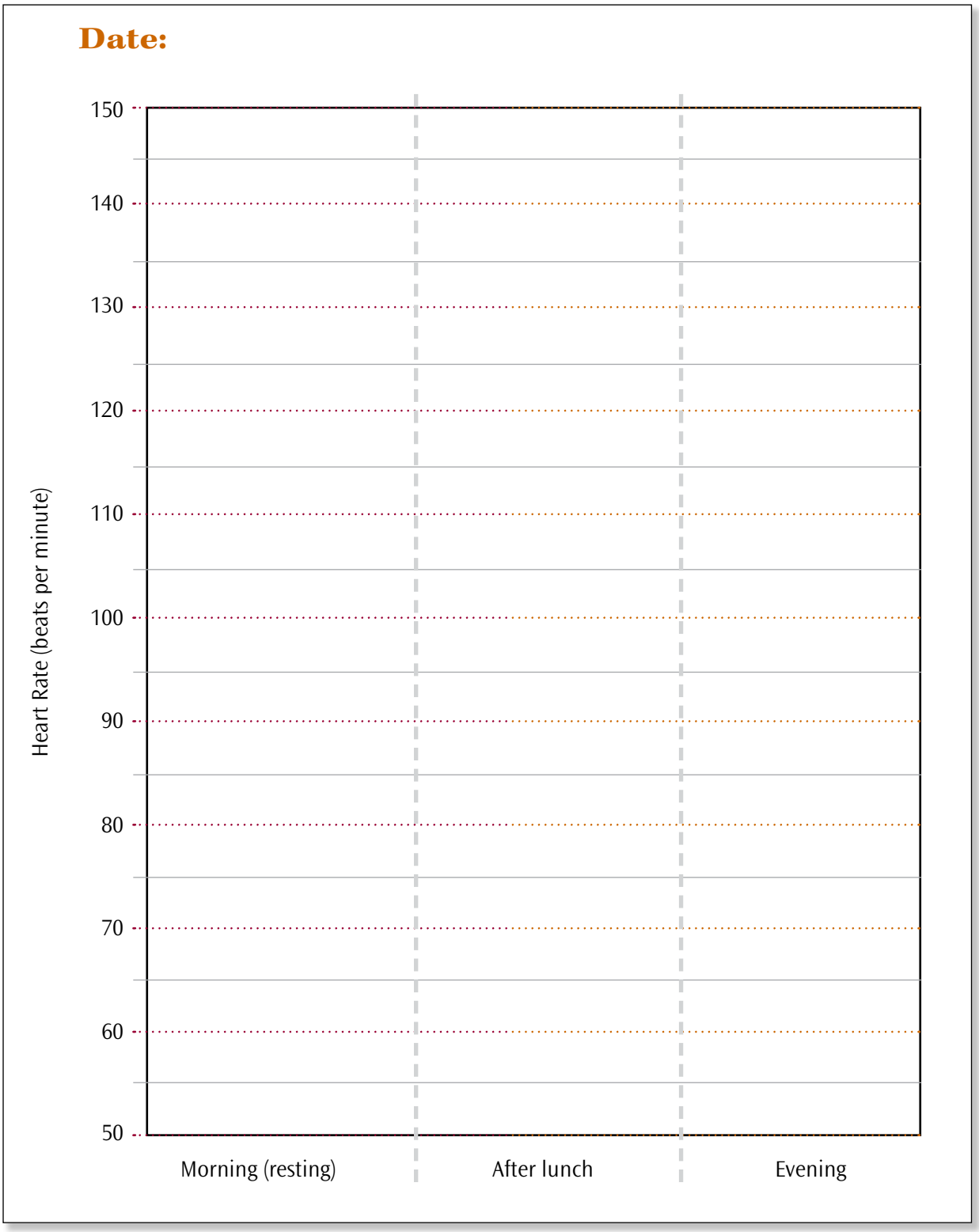
4 Enter through the **right atrium** and then the **right ventricle** out to the **lungs**.

5 Drop off CO_2 and repeat the cycle.



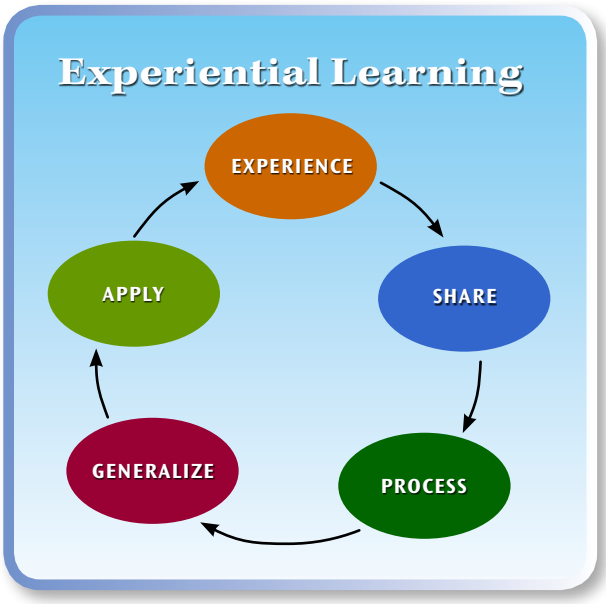
Daily Heart Rate Chart

Date:



APPENDIX

The activities in this curriculum are designed around inquiry and experiential learning. Inquiry is a learner-centered approach in which individuals are problem solvers investigating questions through active engagement, observing and manipulating objects and phenomena, and acquiring or discovering knowledge. Experiential learning (EL) is a foundational educational strategy used in 4-H. In it, the learner has an experience phase of engagement in an activity, a reflection phase in which observations and reactions are shared and discussed, and an application phase in which new knowledge and skills are applied to a real-life setting. In 4-H, an EL model that uses a 5-step learning cycle is most commonly used. These five steps—Exploration, Sharing, Processing, Generalizing, and Application—are part of a recurring process that helps build learner understanding over time.



For more information on inquiry, EL and the 5-step learning cycle, please visit the University of California's Science, Technology, Environmental Literacy Workgroup's Experiential Learning Web site, http://www.experientiallearning.ucdavis.edu/default.shtml.

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