Goals:

1. Compare closed and open circulatory systems.

2. Label the parts of the human heart.

3. Explain how blood travels through the heart; identify chambers where the blood is oxygenated or deoxygenated.

4. Distinguish between pulmonary and systemic circulation.

5. Distinguish between arteries, veins, and capillaries.

6. Identify the components of blood and how they are important to normal body functioning.

7. State illnesses associated with the cardiovascular system.

8. Explain how to maintain the health of the cardiovascular system.

9. Describe the process of gas exchange in a variety of animals.

10. Identify parts of the human respiratory system and explain their functions.

11. Explain the mechanisms that control breathing.

12. State illnesses associated with the respiratory system.

Vocabulary:

asthma  pulse  blood pressure  lymph system
atrium (atria)  ventricle(s)  heart  artery
vein  capillary  plasma  red blood cell
diastole  white blood cell  systole  platelet
hypertension  atherosclerosis  arteriosclerosis  arteriole
anemia  sickle cell anemia  respiration  breathing
Heart Blood Flow Activity

Directions:

1. *Neatly* label the following on your heart diagram:
   - right atrium
   - right ventricle
   - left atrium
   - left ventricle
   - aorta
   - valves (there are 4)
   - vena cava
   - pulmonary arteries
   - pulmonary veins

2. Draw in the lungs. You decide where they go, then ask your teacher to be sure you are correct.

3. Color code the following structures:
   - atria (red or blue depending on the side)
   - ventricles (red or blue depending on the side)
   - arteries (red or blue depending on the oxygenated or deoxygenated)
   - veins (red or blue depending on the oxygenated or deoxygenated)
   - valves (black)
   - lungs (orange)

4. Use arrows to show the blood flow through the heart and the lungs! Use red arrows to show where the blood is rich in oxygen and use blue arrows to show where the blood is deoxygenated.

   A. Write the names of structures, in order, involved in the pulmonary circuit.

   B. Write the names of the structures, in order, involved in the systemic circuit.

**HOMEWORK:**

5. In a paragraph, on a separate piece of paper, explain the path of a red blood cell from your right big toe, through the heart - lungs - heart, and back to your big toe. In your paragraph, identify where the blood is oxygenated or deoxygenated. Grammar, punctuation, and sentence structure are important considerations for grading, as well as accuracy.
## Components of Blood

*text p. 876 - 878*

<table>
<thead>
<tr>
<th>Component</th>
<th>Picture/Diagram</th>
<th>Function(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Label (using different colors) the systemic circuit and pulmonary circuit

Label (with colors) arteries, veins, capillaries

Label the four major chambers of heart
DIRECTIONS: Answer the following questions using complete sentences on a separate piece of paper. Outside sources may be necessary to determine the answers to some the questions.

1. Why are the ventricles of the heart more muscular than the atria?
2. What is the only oxygen-poor artery?
3. What is the only oxygen-rich vein?
4. Differentiate between atherosclerosis and arteriosclerosis.
5. Explain where and how a clot could form to cause a heart attack.
6. Explain how and where a clot could form to cause a stroke.
7. What is the difference between a heart attack and a stroke?
8. How is the heart rate controlled?
9. Why are arteries found deep with in the body and veins are found closer to the surface?
10. Why do arteries lack valves yet they are present in veins?
11. What is the primary function of the lymphatic system as it pertains to the circulatory system?
12. Why is it significant that our heart separates oxygen-rich and oxygen-poor blood?
13. What chambers of the heart contain oxygen-poor blood? Oxygen-rich blood?
14. Blood Circuits: Trace the path of a red blood cell from the toe, through the heart, lungs, back to the heart, and finally to the toe. Include all blood vessels, chambers of heart and organs along the route. (YES, do it again!!)
15. Why is it necessary for arteries to be elastic?
16. How would samples of blood differ between a healthy person and a person with leukemia? What cells are affected?
17. How would samples of blood differ between a healthy person and a person with sickle cell anemia? What cells are affected?
18. How would samples of blood differ between a healthy person and a person with a bacterial infection? What cells are affected?
19. Be able to draw and label a simple diagram of the heart, its chambers and major blood vessels.

FUN FACT: The entire volume of blood, 5 liters, is circulated through the body in only ONE minute!
Types of Respiration

When the carbon dioxide concentration in the blood rises, the respiratory center in the brain causes the rate of breathing to increase. The increase in breathing ensures that more oxygen enters the blood and more carbon dioxide is removed. When the carbon dioxide concentration in the blood decreases, the rate of breathing decreases.

The exchange of gases between lungs and the blood is called **external respiration**. The exchange of respiratory gases between the blood and the body cells is known as **internal respiration**. The use of oxygen by cells to break down glucose to produce ATP is called **cellular respiration**.

Questions:
1. What is the difference between internal respiration and external respiration?

2. What is the difference between internal respiration and cellular respiration?

Transport of Respiratory Gases

Oxygen from the air in the lungs diffuses through the membranes of the alveoli and enters the capillaries of the lungs. In the lungs, oxygen combines with the hemoglobin of the red blood cells to form oxyhemoglobin. The reaction between oxygen and hemoglobin is reversible. In the lungs, where the oxygen concentration is high, hemoglobin combines with oxygen. In the body tissues, where the oxygen concentration is low, hemoglobin releases the oxygen, which then diffuses out of the capillaries and into the body cells.

In the tissues, carbon dioxide is produced as a byproduct of cellular respiration. Carbon dioxide diffuses out of the cells, through the capillary walls, and into the blood. Most carbon dioxide is carried in the blood in the form of bicarbonate ions, HCO$_3^-$.

$$\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \rightleftharpoons \text{H}^+ + \text{HCO}_3^-$$

The majority of carbon dioxide dissolves in the blood plasma, while the remaining carbon dioxide combines with the hemoglobin to form carboxyhemoglobin.

Questions:
1. How is oxygen carried in the blood?

2. How is carbon dioxide carried in the blood? (hint: there is more than one way!)

3. Carbon monoxide (CO) more easily binds with hemoglobin than oxygen. Once CO is bound to hemoglobin, it stays there for the entire life of the red cell. What are the effects of someone who suffers from carbon monoxide poisoning?
Breathing
Breathing is the process by which air moves into and out of the lungs. During inhalation, the ribs move up and out by contraction of the intercostal muscles, the diaphragm moves down, thus increasing the volume of the chest cavity. The increased chest volume brings about a reduction in pressure within the chest cavity, so air is forced into the lungs by the low atmospheric pressure within the chest cavity. During exhalation, the diaphragm relaxes and moves up, the intercostal muscles relax and the ribs move down and in, and the volume of the chest cavity decreases. Thus, pressure within the chest cavity increases, and air is forced out of the lungs. (remember that molecules, including air, move from areas of high concentration to areas of low concentration!)

The process of breathing and the rate of breathing are mainly controlled by the respiratory center in the medulla region of the brain. Nerves extend from the respiratory center to the diaphragm and intercostal muscles. The respiratory center is sensitive to the concentration of carbon dioxide in the blood.

Questions:
1. Describe what happens to cause inhalation of air.
2. Describe what happens to cause exhalation of air.
3. How does your body know to increase the rate of breathing during exercise?
Respiratory System Thinking Questions

**DIRECTIONS:** Your group has 25 minutes to answer the following six questions. You may use your class notes, reading notes, textbook, and other reference materials to help answer the questions. Your group will also be assigned to present your response for one of the questions to the class.

1. Trace the path of a molecule of oxygen through the human respiratory system from the outside environment. Be sure to mention all structures encountered along the way in the correct order!

2. Explain how the structure of the lungs satisfies each of the four basic requirements for gas exchange.

3. Describe how and why breathing increases during exercise. (HINT: does it have anything to do with homeostasis??)
4. Explain how the intercostal muscles of the rib cage and the diaphragm function when you inhale and when you exhale.

5. Describe the effects of smoking on the organs of the human respiratory system.

6. Compare and contrast internal respiration, external respiration, and cellular respiration. Provide examples of each.
Enrichment Topic 31-3

The Rhesus factor, or Rh factor, is an antigen found in red blood cells. It was named for the rhesus monkey, in whose red blood cells the Rh factor was first discovered. The Rh factor, which is designated as Rh-positive (Rh+), is present in most of the human population. A small percentage of the human population is Rh-negative (Rh−) and lack the antigen. If an Rh− individual receives a blood transfusion from an Rh+ donor, the Rh+ blood causes antibody formation. If he or she receives Rh+ blood again, the antibodies will attack the red blood cells from the donor. Destruction of the red blood cells can cause severe illness and sometimes death.

Incompatible Rh factors can also create problems for pregnant women and their fetuses. The Rh factor is genetically dominant. If a mother is Rh− and the father is Rh+, the resulting fetus may be Rh+. This may result in erythroblastosis fetalis, also known as Rh hemolytic disease. In effect, the mother and fetus are allergic to each other. Erythroblastosis can develop if the fetal Rh factors enter the mother’s circulatory system. This may happen if there is a breach of the placenta during late pregnancy or during delivery. During delivery, there is sometimes a maternal-fetal blood interchange. If this occurs, the Rh− mother’s immune system creates antibodies against the Rh antigen. If the antibodies pass to the fetus, they will attack the fetus’s red blood cells. If antibodies are not produced until delivery, they may not affect the fetus. However, the resulting antibodies in the mother’s blood, however, could cause problems in a subsequent pregnancy. The anti-Rh antibodies will attack an Rh-incompatible fetus during gestation, causing erythroblastosis in the fetus or Rh hemolytic disease in the newborn infant. This development can be fatal for the fetus or infant.

An infant thus affected can be saved from potentially fatal anemia by an almost complete transfusion of Rh− blood. In addition, antibody formation in the mother often can be prevented with a vaccination after the birth of her first Rh-incompatible baby. The vaccine is an Rh immunoglobulin that reacts with the Rh factor in the mother’s blood, before her system begins to produce antibodies. The development of this vaccine has substantially lowered the numbers of infants affected by erythroblastosis.

Based on your reading, answer the following questions using complete sentences.

1. What is an Rh antigen? Do Rh- or Rh+ people have the antigen? How are antigens related to antibodies?

2. List several situations in which the maternal & fetal blood may mix, resulting in erythroblastosis.

3. What is the function of the Rh immunoglobulin vaccine? Who receives the vaccine? When?
INTERPRETING SCIENTIFIC ILLUSTRATIONS

Questions 1–7 refer to the figure below, which shows the human heart. Write the name of the structures indicated in the figure in the spaces provided.

1. ______________________

2. ______________________

3. ______________________

4. ______________________

5. ______________________

6. ______________________

7. ______________________

Questions 8-11 refer to the figures below.

Figure 1

---

16
8. Identify and describe the structure labeled A in Figure 2.

9. Compare and contrast the structure and functions of the vessels labeled C and F in Figure 1.

10. What process occurs at both site A and site B?
11. Compare and contrast the process of gas exchange that takes place at these two sites.