

Unit: Biology C - Circulation

LESSON 1.1 - AN INTRODUCTION TO THE CIRCULATORY SYSTEM

Overview:

Students will read about the circulatory system and answer probing questions to test their understanding.

Suggested Timeline: 1.5 hours

Materials:

- An Introduction to the Circulatory System (Student Handout)
- Teacher access to computer, projector and the Internet
- QUIZ – An Introduction to the Circulatory System (Student Handout)

Method:

INDIVIDUAL FORMAT:

1. Have students complete their vocabulary list, reading and questions on ‘An Introduction to the Circulatory System’ (Student Handout).
2. Set a date for the quiz on the material (‘QUIZ – An Introduction to the Circulatory System’ – Student Handout).

GROUP FORMAT:

1. Introduce the circulatory system by showing students the following online video clip:
http://pennhealth.com/health_info/animationplayer/cardiac_system.html
2. Have students complete their vocabulary list, reading and questions on ‘An introduction to the Circulatory System’ (Student Handout).
3. Set a date for the quiz on the material (‘QUIZ – An Introduction to the Circulatory System’ – Student Handout).

Assessment and Evaluation:

- Assessment of student’s understanding of material through review of questions
- Student grade on quiz

AN INTRODUCTION TO THE CIRCULATORY SYSTEM

VOCABULARY

blood vessel -

arteries -

veins -

capillaries -

blood -

plasma -

white blood cells -

red blood cells -

platelets -



WHAT IS CIRCULATION?

What messenger makes trillions of stops in just thirty seconds? Your blood!

In just under thirty seconds, your blood moves (circulates) through your entire body. It reaches every one of your trillions of cells.

Blood carries things to each cell that are needed. These things include oxygen and nutrients. In exchange, the blood picks up waste from the cells, including carbon dioxide, heat and excess water.

The heart pumps blood throughout the body through a closed system of tubes. These tubes that carry the blood are called **blood vessels**. There are three types of blood vessels: **arteries**, **veins**, and **capillaries**.

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Arteries carry blood away from the heart. This blood is rich in oxygen and nutrients. It is brought to the cells of the body.

Veins carry blood from the body cells back to the heart. This blood contains waste materials.

Capillaries connect arteries and veins and are very tiny. The majority of the blood vessels in your body are capillaries.

The circulatory system is made up of the heart, blood vessels, and blood. Circulation, or transport, is a vital function. Life cannot go on without it.

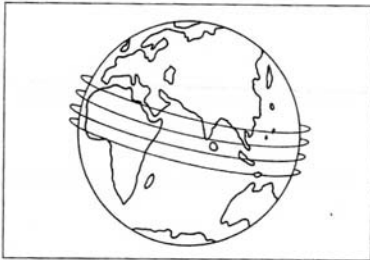


Figure A

Blood vessels are found in almost every part of the body.

If laid end to end, your blood vessels would stretch out to about 161,000 km! (About 4 times the distance around the equator!)

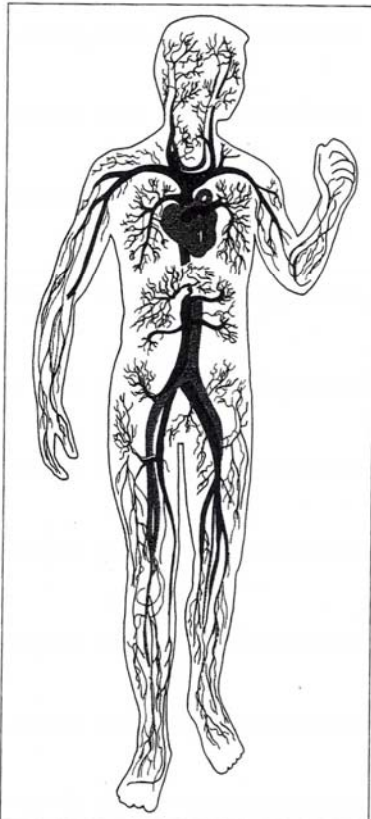


Figure B

Look at Figure B. It shows arteries and veins within the human body. Each artery and vein branches out to tiny capillaries.

Write the correct term in each blank to answer the questions or complete the sentence.

1. What pumps blood through your body?
_____.
2. Blood vessels that carry blood away from the heart are called _____.
3. Vessels that carry blood back to the heart are called _____.
4. Blood moves from arteries to veins through tiny blood vessels called _____.
5. The heart, blood vessels and blood make up the _____.

Examine the parts of Figure C, then answer the questions below.

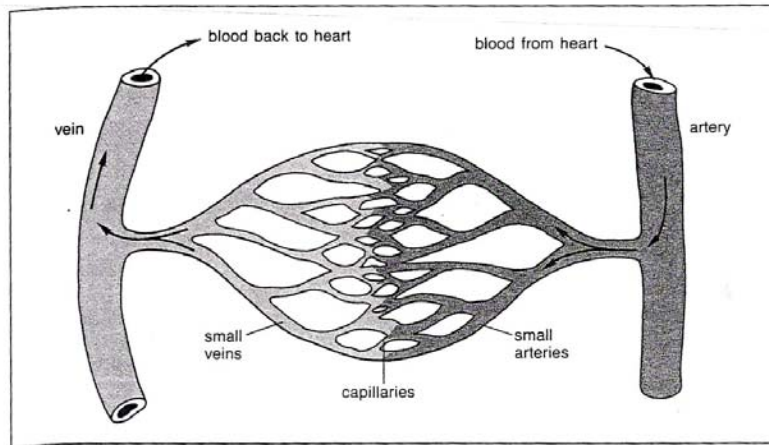


Figure C

1. Arteries branching away from the heart become _____.
(smaller and smaller OR larger and larger)
2. Veins leading back to the heart become _____.
(smaller and smaller OR larger and larger)
3. Most of our blood vessels are _____.
(arteries, veins or capillaries)

Match each term in Column A with its description in Column B. Write the correct letter in the space provided.

- Column A**
- _____ 1. circulation
 - _____ 2. heart
 - _____ 3. arteries
 - _____ 4. veins
 - _____ 5. capillaries

- Column B**
- a) carry blood away from the heart
 - b) pumps blood
 - c) connect arteries and veins
 - d) transport of materials in living things
 - e) carry blood back to the heart

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Complete each statement using a term or terms from the list below. Write your answers in the spaces provided. Some words may be used more than once.

heart circulation oxygen veins food
capillaries arteries blood vessel waste materials blood

1. The transport of materials in living things is called _____.
2. In humans, circulation is carried out by the liquid called _____.
3. Blood is pumped by the _____.
4. Blood brings to cells things like _____ and _____.
5. Blood picks up _____ from the cells.
6. Any tube that carries blood is called a(n) _____.
7. The three kinds of blood vessels are _____, _____, and _____.
8. Blood is carried away from the heart by _____.
9. Blood is carried back to the heart by _____.
10. Arteries and veins are connected by tiny blood vessels called _____.

TRUE or FALSE – In the space, write a ‘T’ or ‘F’

- _____ 1. Circulation is the transport of materials in living things.
- _____ 2. Life stops when circulation stops.
- _____ 3. Blood is pumped by the brain.
- _____ 4. Blood circulates through the body only a few times a day.
- _____ 5. Arteries carry blood away from the heart.
- _____ 6. Arteries transport carbon dioxide to the cells.
- _____ 7. Veins carry blood away from the heart.
- _____ 8. Veins pick up waste materials from the cells.
- _____ 9. Capillaries connect arteries and veins.
- _____ 10. Capillaries are the largest blood vessels.

A CLOSER LOOK AT BLOOD



Have you ever taken a first aid course? An important rule in first aid is: “Treat Serious Bleeding First.” If a person loses a lot of blood, they can die quickly.

Blood is the transport tissue in your body. It carries needed materials to the cells and carries waste materials away from the cells.

The liquid part of blood is called **plasma**. The solid part of blood is made up of different kinds of blood cells.

Plasma is 90% water and is beige in color. Plasma contains digested food, chemicals, and waste products. These substances are carried to and from the cells by the plasma.

The three kinds of blood cells that make up the solid part of blood are: **red blood cells**, **white blood cells**, and **platelets**.

Red blood cells contain hemoglobin. Hemoglobin is red and gives blood its color. It links up with oxygen and carries this oxygen to all parts of the body. The same hemoglobin in the red blood cells also picks up most of the carbon dioxide waste that is made by the cells.

White blood cells are larger than red blood cells fight infection and disease. They destroy harmful bacteria, viruses and other small invaders.

Platelets are pieces of cells that are small and colorless. They help to stop bleeding by giving off a chemical that helps blood to clot.

Figure A shows the what blood is made up of. Study Figure A, then answer the questions.

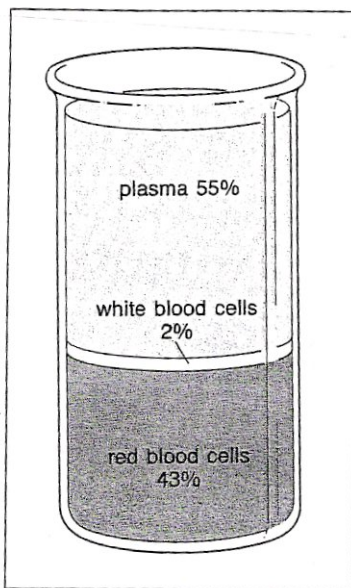


Figure A *Make-up of blood*

1. What percent of blood is liquid? _____
2. What is the name of the liquid part of blood?

3. a) The liquid part of blood is made up mostly of
_____. (Hint – look back to the reading.)
b) What percent? _____
4. All of the blood cells together make up _____% of blood.
5. Red blood cells make up _____% of blood; white blood cells make up _____%.

Study Figure B, then answer the questions.

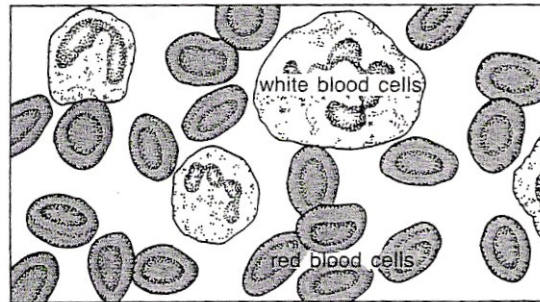
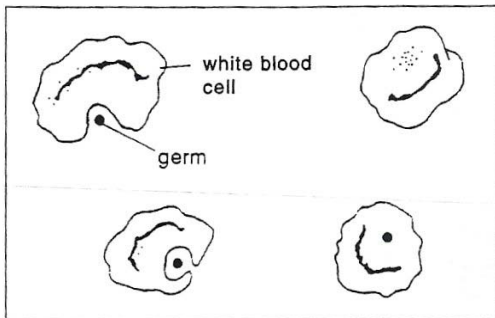


Figure B

1. Which blood cells are the largest? _____
2. Which type of blood cell is most numerous? _____
3. Which cells are shaped like 'pinched' disks? _____

Study Figures C and D, then answer the questions.



1. What kind of blood cells is shown?

2. Describe briefly what is happening in Figure C.

Figure C A white blood cell at work.

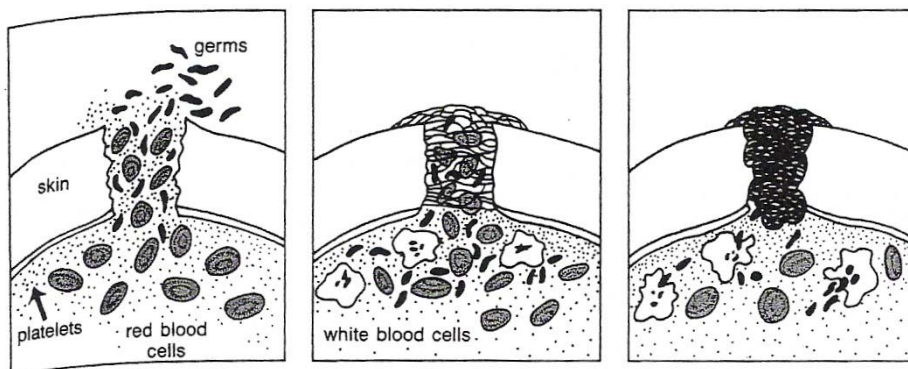


Figure D Blood clots when your skin is cut.

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3. When you cut yourself, which part of the blood helps you to stop bleeding?

4. White blood cells also come to the area of a cut. Why?

5. Take an educated guess at this one – What happens to the number of white blood cells when germs are in the body? _____

Answer the following questions about red blood cells.

1. Oxygen is _____.
(needed by cells OR a cell waste)
2. Which blood cells pick up and carry oxygen? _____
(red blood cells OR white blood cells OR platelets)
3. What substance in red blood cells joins with oxygen? _____
4. Where does the blood pick up this oxygen?
a) in the heart b) in the arteries and veins c) in the lungs
5. What gives blood its color? _____

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Ten substances carried by the blood are listed in the chart below. Indicate whether each substance is carried to the cells or away from the cells. Place a checkmark in the proper boxes.

| | SUBSTANCE CARRIED BY THE BLOOD | CARRIED TO THE CELLS | CARRIED AWAY FROM THE CELLS |
|-----|---|----------------------|-----------------------------|
| 1. | digested food | | |
| 2. | oxygen | | |
| 3. | carbon dioxide | | |
| 4. | enzymes | | |
| 5. | hormones (used by the cells to regulate chemical reactions) | | |
| 6. | heat | | |
| 7. | harmful chemicals | | |
| 8. | extra (waste) water | | |
| 9. | vitamins and minerals | | |
| 10. | proteins | | |

Some Interesting Facts About Blood

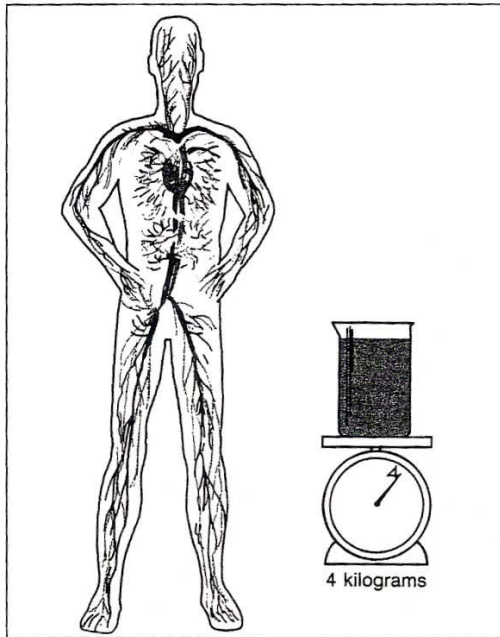


Figure E Blood makes up about 9% of a person's weight. If you weigh 45 kilograms (100 pounds), 4 kilograms (9 pounds) is blood.

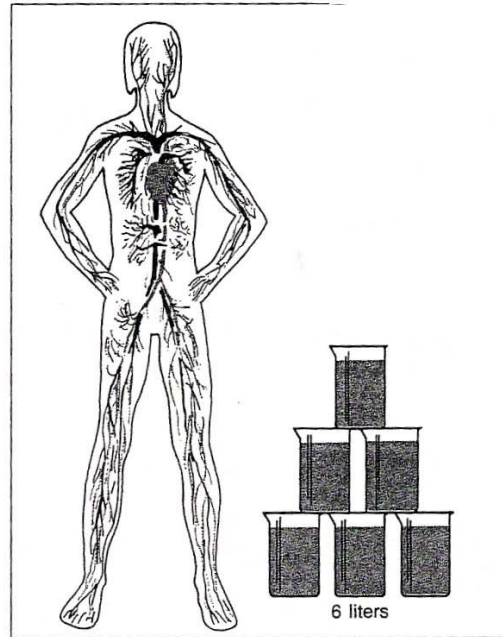


Figure F A grownup has about 5.7 liters (12 pints) of blood.

- Blood makes up approximately 9% of a person's weight. For example, if you weigh 100 pounds, 9 pounds is blood. (Can you figure out how many pounds of blood your body has?)
- An adult has about 5.7 liters of blood.
- There are about 600 times as many red blood cells as there are white blood cells. One drop of blood contains about 5 million red blood cells. That means that there are about 25 trillion red blood cells in the body of an average adult!
- Blood cells are produced in the marrow of bones – especially in the backbone, breast bone and ribs.
- Every *second*, from 1 to 2 million red blood cells die! New cells are made to take their place.
- Plasma carries red and white blood cells. White blood cells, however, can also move by themselves!

Adapted from *What is the Circulatory System? What is Blood Made Of?*, pp.70-80 *Biology Science Workshop Series*



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Name: _____ Date: _____ Period: _____

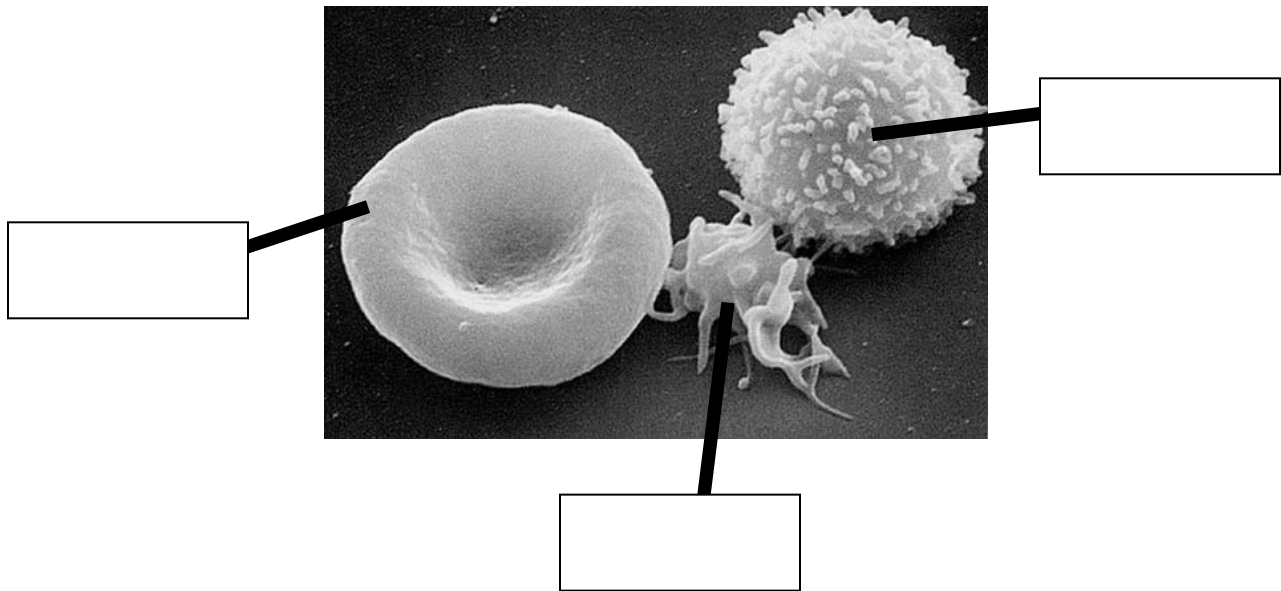
QUIZ - An Introduction to the Circulatory System

PART I – Fill in the Blanks – Choose a word from the word pool for each blank. Some words may be used more than once. Some words may not be used at all. **9 marks**

| | | | |
|-----------------|-------------|-----------|-------------------|
| veins | capillaries | arteries | heart |
| blood vessel | plasma | platelets | white blood cells |
| red blood cells | hemoglobin | | |

1. _____ carry blood away from the heart.
2. The structures in the blood that are used to fight disease are called _____.
3. The substance in the blood that gives it its red color is _____.
4. The name given to any tube that carries blood is a(n) _____.
5. The straw-colored part of the blood that is made up mostly of water is _____.
6. _____ carry hemoglobin that binds to oxygen and picks up waste carbon dioxide.
7. The smallest blood vessels are _____.
8. The pumping organ of the human body is the _____.
9. The part of the blood that helps a wound to stop bleeding is the _____.

PART II – Diagram – Label the three components of the blood in the photo below. The words used for labeling can be found in the word pool used in part I of this quiz. **3 marks**



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LESSON 1.2 - CORONARY EMERGENCIES

Overview:

Students will have the opportunity to learn about 9-1-1 calls, CPR and first aid from an expert or through an online individualized learning package.

Suggested Timeline: 1 hour

Materials:

- Coronary Emergencies (Student Handout – Individual)
- Coronary Emergencies (Teacher Support Material)

Method:

INDIVIDUAL FORMAT:

1. Using computers with Internet access, have students research information about coronary emergencies – dialing 9-1-1, CPR and the use of AEDs using ‘Coronary Emergencies’ (Student Handout – Individual) as a guide.

GROUP FORMAT:

1. Introduce 9-1-1 calls by starting a dialogue with students about their experiences and by reviewing the format for a 9-1-1 call (see ‘Coronary Emergencies’ – Teacher Support Material.) Alternatively, arrange with emergency services to place a mock 9-1-1 call over a speaker phone in the room.
2. Invite an EMT (Emergency Medical Technician) or certified CPR instructor to come in and either teach the basics on coronary emergencies or lead CPR certification.

Assessment:

- Group Format – Affective assessment of student learning through questioning
- Individual Format – Assessment of students’ answers to questions in handout

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Coronary Emergencies



Key Q: Raise your hand if you have ever had to dial 911. What was it for? How do you place a 9-1-1 call?

Go through the following information with students about 9-1-1 calls: (Source: <http://www.cpsp.gov.sk.ca/How-9-1-1-Works>)

How 9-1-1 Works

- Any emergency situation you cannot control warrants calling 9-1-1.
- Stay calm, and call 9-1-1. You will be connected to a call-taker at a Public Safety Answering Point (PSAP).
- When your call is answered, the call-taker will automatically see a display of your phone number and address or land location. If you are calling from a cellular phone you will have to provide this information.

Safety Tip: Speak clearly and do not hang up until asked to do so by the operator.

To ensure a proper response to the emergency, you will be asked:

- The nature of your emergency (do you need police, fire, or ambulance?)
- To verify the address or land location you are calling from (or where the emergency is)
- To verify the telephone number you are calling from.

By providing clear information about the nature of the emergency, you help ensure a fast and efficient response. It is very helpful if you can provide the call-taker with the following:

- Your name
- Your full street address or legal land description
- A description of your house or the location of the emergency
- Name of access road(s)
- Other landmarks

Stay calm. This will only take a moment.

The 9-1-1 call-taker will stay on the line. Within a few seconds you will be connected to the appropriate emergency service provider:

- Fire/Rescue
- RCMP/Local Police
- Ambulance/First Responders

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Safety Tip: Draw a simple diagram indicating the most direct route to your home or farm.

Also indicate distance and landmarks. Post this information close to your phone.

Other Helpful Information for the 9-1-1 operator: For Police Emergencies:

- Are you in danger?
- Is someone's life in danger?
- Can you provide a description of the offender, in the case of a crime?

For Medical Emergencies:

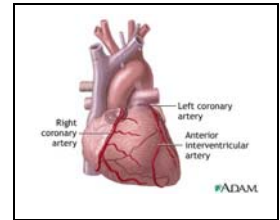
- What is the condition of the patient? Is the person conscious? Breathing?
- What is the main complaint or problem?
- Are you able to provide emergency first aid? Is it safe for you to do so?

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Coronary Emergencies

- “Hello operator! This is an emergency! I think that friend may have had a heart attack!”
- Can you imagine yourself in this situation? What would you do? What are you supposed to say?



- Every 7 minutes in Canada, someone dies from heart disease or stroke. Cardiovascular disease (heart disease, diseases of the blood vessels and stroke) accounts for the death of more Canadians than any other disease. (Source: <http://www.heartandstroke.sk.ca/site/c.inKMILNIEmG/b.3657463/#heartdisease>)

ONLINE ACTIVITIES:

1. Calling 9-1-1 in Saskatchewan:

Go to the website <http://www.cpsp.gov.sk.ca/How-9-1-1-Works> Read through the information to answer the following questions:

- a) Does 9-1-1 work from cell phones in Saskatchewan? _____
- b) If so, how is the information that you provide different than if you had phoned from a land line?

- c) When should you hang up from a 9-1-1 call? _____

- d) Who will the operator connect you to after you have confirmed your location?

- e) In the case of a medical emergency, what questions may you be asked?

- 2. While you are waiting for Emergency Responders (e.g., ambulance, fire truck, police), you may have to provide first aid or CPR. Go to <http://www.heartandstroke.com/site/c.ikIQLcMWJtE/b.3483921/> to find out more about CPR.

- a) What does ‘CPR’ stand for? _____

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- b) Who would get CPR? _____
- c) Why is it a good idea to get trained in CPR? _____

3. In order to administer CPR properly, you must have received training. There are many CPR and First Aid training opportunities provided by organizations in the province.
- a) Have you taken a first aid or CPR course? _____ If so, who did you take it from?

- b) Go to <http://www.firstaidtopics.com/saskatchewan-first-aid-training/> to find a list of organizations or businesses in the province that provide opportunities for CPR and first aid training. List one that is in your area. _____
4. In recent years, training to use an AED (Automatic External Defibrillator) has become available people other than health care professionals. Go to <http://www.heartandstroke.com/site/c.ikIQLcMWJtE/b.3484045/> to learn more about AEDs.
- a) What is an AED? _____

- b) Who should consider getting trained in the use of AEDs? _____

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LESSON 1.3 - ASSESSING YOUR CIRCULATORY SYSTEM

Overview:

Students will find and assess their pulse and blood pressure and interpret changes in these measurements that occur after exercise.

Suggested Timeline: 1 hour

Materials:

- Assessing the Circulatory System (Student Handout)
- stopwatch
- sphygmomanometer

Method:

Ask students to raise their hand if they have ever had their blood pressure taken.

- What does the reading mean?
- What is a normal reading?
- What kinds of things affect blood pressure?

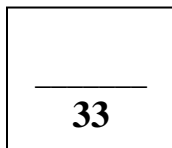
Tell students that they will have the opportunity to assess their own heart rate and blood pressure today in a laboratory activity.

Demonstrate the use of the sphygmomanometer.

In groups of two (if possible), have students complete ‘Assessing the Circulatory System’ (Student Handout) to investigate their pulse and blood pressure.

Assessment and Evaluation:

- Affective assessment of student’s work in a group setting
- Student grade on lab



Name: _____ Date: _____ Period: _____

Assessing the Circulatory System



VOCABULARY (7 marks)

pulse –

radial pulse –

carotid pulse –

blood pressure –

sphygmomanometer –

systolic pressure –

diastolic pressure –

PURPOSE:

In this activity, you will learn how to take measurements of your pulse and blood pressure. You will then compare your pulse rate and blood pressure before and after physical activity.

MATERIALS:

- stop watch
- sphygmomanometer

BACKGROUND INFORMATION:

Each beat of the heart sends blood through arteries, veins and capillaries. Day and night, the heart's rhythmic contractions send blood to all parts of the body. The blood brings nutrients and oxygen to body tissues, and picks up wastes and carbon dioxide. Cells will die if circulation stops for even a short period of time.

Every time that your heart contracts, blood is forced out of your heart and into your arteries. This force pushes blood through your arteries in spurts. With each spurt, a beat can be felt. This beat is called a **pulse**. When the heartbeat is felt in the radial artery of the wrist, it is called the **radial pulse**. When the heartbeat is found in the carotid artery in your neck, it is called the **carotid pulse**.

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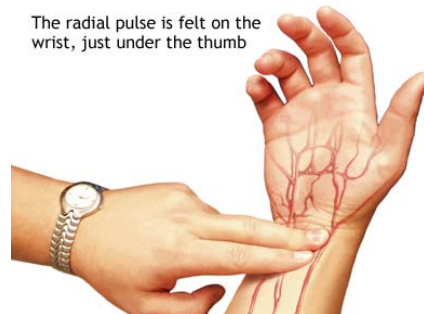
How fast does your heart beat? It depends on several things such as age, activity level or how calm or excited you are. When body movement increases, the cells need more nutrients and oxygen. As a result, the heart will beat faster to keep up with the demand. When body movement decreases, the heart rate will decrease.

Regular intense exercise will increase the size of the heart muscle. A larger heart works more efficiently than a smaller one because it holds more blood and each pump delivers more blood to the body. It therefore takes fewer heartbeats to circulate the blood through the body.

There are two parts to a heartbeat. The part where the heart is contracting is called **systole**. The part where the heart is relaxing is called **diastole**. **Blood pressure** is a measure of the force of the blood on the arteries. When the heart is contracting (during systole) the blood pressure is higher than when the heart is relaxing (during diastole). A **sphygmomanometer**, also known as a blood pressure monitor, is an instrument used to measure blood pressure.

PROCEDURE: Each blank is worth 1 mark. (16 marks)

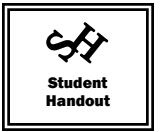
1. Sit quietly and relax for a couple of minutes before you begin. Using a stopwatch, take your radial pulse for 10 seconds. To count your pulse, turn one hand palm up. Place the second and third fingers of your other hand on the inside of your wrist. You should be able to detect your pulse here. Use the diagram below as a guide.



- a) What is your resting radial pulse for 10 seconds? _____
- b) Find your resting heart rate in beats per minute by multiplying your answer in a) by 6.

- c) The average adult resting heart rate is about 70 beats per minute for males and 75 beats per minute for females. Younger people usually have faster heart rates. If you are nervous, your heart rate may be higher. A person who is physically active will usually have a lower heart rate.

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What is your age? _____

How does your heart rate compare with the average adult heart rate for your gender?

If there is a difference, why do you think that this is so? _____

2. One's heart rate can also be taken in the carotid artery in the neck. As you did in taking your radial pulse, use your first two fingers to feel the heartbeat. Place your fingers on one side of your neck and count the number of beats in 10 seconds. Use this information to find the number of beats per minute.



- a) What is your heart rate, in beats per minute, when found using the carotid artery?

- b) How does your answer compare to your answer for 1 b)? _____

3. Engage in some form of mild exercise for three minutes (e.g., walking, body twists, side bends). At the three minute mark find your pulse in beats per minute (remember: take your pulse for 10 seconds and multiply by 6).

Heart rate in beats per minute after mild exercise: _____

4. Engage in some form of vigorous exercise for three minutes (e.g., jumping jacks, push-ups, sit-ups, running on the spot). At the end of the three minute mark, find your pulse in beats per minute.

Heart rate in beats per minute after vigorous exercise: _____

5. Blood pressure is measured with a sphygmomanometer. Sit comfortably in a desk. Be sure that you have been resting for a few minutes and are breathing normally. Place one arm on the desk and have a partner put the cuff of the sphygmomanometer snugly on your upper arm.

- a) Blood pressure reading at rest: _____ mm Hg (units of pressure)

- b) The average blood pressure reading for a healthy adult is 120/80 mmHg.



Which of these numbers, the top or the bottom, would be the systolic pressure?

Which of these numbers, the top or the bottom, would be the diastolic pressure?

- c) How did your blood pressure reading compare to the blood pressure reading for a healthy adult?

If there was a difference, suggest a reason for this difference. _____

6. For three minutes, engage in the same form of vigorous exercise as you did for step 4. At the end of the three minute mark, find your blood pressure.

a) Blood pressure reading after vigorous exercise: _____ mm Hg

- b) Explain why there is a difference in your blood pressure reading when a rest as compared to after vigorous exercise.

ANALYSIS QUESTIONS:

1. The average heart pumps about 80 mL of blood in each contraction.

a) If your heart rate was 70 beats per minute, calculate the volume of blood your heart pumps in one minute when you are resting. Show your calculation. (1 mark)

b) At this rate, how much blood would your heart pump in one hour? Show your calculation. (1 mark)

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2. You may have a relative who has been diagnosed with high blood pressure.
 - a) Why do you think that high blood pressure is not a good thing? (1 mark)

 - b) List three things that a person diagnosed with high blood pressure can do to try to lower his/her blood pressure. (3 marks)

CONCLUSION:

Sum up the results of your lab in the space below. In order to write an effective conclusion, re-read the purpose of the lab, but turn it into questions (e.g., How do you take measurements of your heart rate and blood pressure? What were the results when I compared my heart rate and blood pressure before and after physical activity?) (4 marks)

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LESSON 1.4 - A CLOSER LOOK AT THE HEART

Overview:

Students will learn about the structure and function of the heart through reading, questions and the dissection of a mammalian heart. If mammalian hearts are not available, students will investigate the parts of the heart through a virtual online heart activity.

Suggested Timeline: 2 hours

Materials:

- How Does Your Heart Work? (Student Handout)
- Heart Dissection (Student Handout)
- Virtual Heart Investigation (Student Handout)
- student access to computers with Internet access
- red and blue pencil crayons or crayons
- mammalian hearts (sheep or pig)
- dissecting trays
- scalpels
- dissecting scissors
- blunt probes
- latex gloves
- brass fasteners (5 per student)
- scissors

Method:

1. Show students an online healthy heart animation at http://www.columbiasurgery.org/pat/lvad/heart_anatomy.html to introduce the heart, its parts and its function or have students access this as a preview to the lesson.
2. Have students complete the vocabulary, reading and questions on 'How Does Your Heart Work?' (Student Handout).
3. Show students a ready-made cut-out heart as an example. Have students complete their cut-out heart activity for review of the heart (as found on their student handout).
4. If mammalian hearts are available for dissection, provide students with lab safety instructions before they begin the lab. In groups of two where possible, students should then complete 'Heart Dissection' (Student Handout) and submit their lab for grading.
5. If mammalian hearts are not available for dissection, allow students to work on computers with Internet access to complete 'Virtual Heart Investigation' (Student Handout). Students should submit their answers to questions when finished.

Assessment and Evaluation:

- Affective assessment of student's individual work habits and work in a group setting
- Student grade on lab or on online heart activity

How Does Your Heart Work?

VOCABULARY

atria –

ventricles –

valve –

septum –

Place your hand on your chest and feel your beating heart. Your heart is keeping you alive! It is made mostly of muscle tissue and pumps blood to all parts of your body.

The human heart is divided into four separate parts called chambers. There are two upper chambers and two lower chambers.

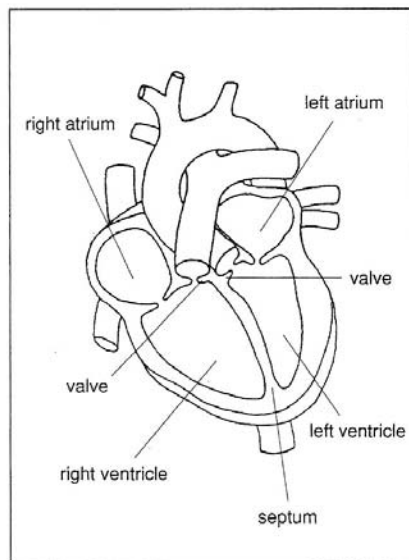


Figure A

The upper chambers of the heart are called the right and left **atria**. The singular of atria is atrium.

- The right atrium receives blood from all parts of the body. Blood in the right atrium is high in carbon dioxide and low in oxygen. Find the right atrium in Figure A.
- The left atrium receives blood from the lungs. Blood in the left atrium is high in oxygen and low in carbon dioxide. Find the left atrium in Figure A.
- Both atria fill with blood at the same time.

Unit: Biology C - Circulation



The lower chambers of the heart are the **ventricles**. The ventricles pump blood out of the heart.

- The right ventricle pumps blood to the lungs. This blood is high in carbon dioxide and low in oxygen.
- The left ventricle pumps blood to all parts of the body. Blood in the left ventricle is high in oxygen. It is low in carbon dioxide.
- Both ventricles pump blood out of the heart at the same time. Every time your heart beats, blood is being forced out of the ventricles.

The heart and veins have **valves** that keep the blood from flowing backward. A valve is a thin flap of tissue. Find the valves in Figure A.

A muscular wall divides the right side of the heart from the left side. This wall is called the **septum**. This is necessary to separate oxygen rich blood from oxygen poor blood. Find the septum in Figure A.

TRACING THE PATH OF BLOOD THROUGH THE HEART

Note: All heart diagrams are shown as if you were looking at the front of a person. The right side of the heart appears on the left side of the drawing. The left side of the heart appears on the right.

Remember: In a normal heart, both upper chambers (atria) fill with blood at the same time. Both lower chambers (ventricles) pump blood out at the same time.

Start with blood entering the right side of the heart.

Veins carry blood from all parts of the body to the heart. Using the information at the start of this handout and Figure A, answer the following questions.

1. Which chamber receives blood from all the body veins? _____
2. a) The blood passes from this chamber into the _____.
b) While this is happening, the valve between the right atrium and right ventricle is _____.
(open OR closed)
3. The blood in the right ventricle is high in _____ and low in _____.
(oxygen OR carbon dioxide)
_____.
(oxygen OR carbon dioxide)
4. The body _____ use this blood.
(can OR cannot)
5. Where must this blood go to get a fresh supply of oxygen? _____

Unit: Biology C - Circulation



The right ventricle contracts and squeezes blood out of it and to the lungs.

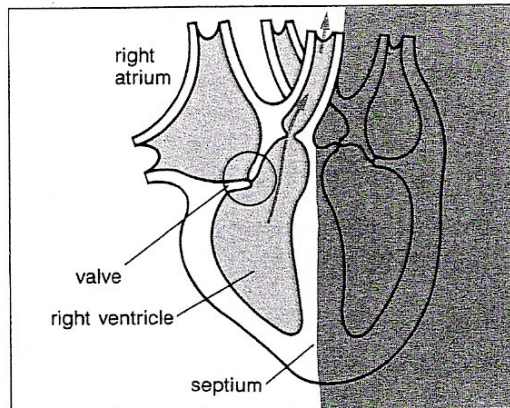
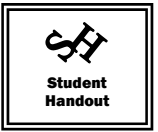


Figure B

6. a) When the right ventricle contracts, the valve between the upper and lower chambers is _____.
(open OR closed)
- b) What does this prevent?

7. Blood pumped out of the right ventricle goes _____.
(to the body OR to the lungs)
8. In the lungs, the blood gives up its _____ and picks up _____.
(oxygen OR carbon dioxide)
9. The blood _____ be used by the cells.
(can OR cannot)
10. Where must the blood go before it can be sent to the entire body?

Unit: Biology C - Circulation



Veins carry blood back to the heart from the lungs.

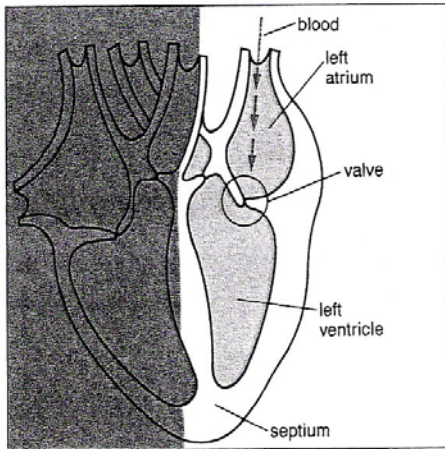


Figure C

11. Which chamber received fresh blood from the lungs? _____
(left atrium OR left ventricle)

12. a) The blood then passes into the _____.
(left atrium OR left ventricle)

b) While this is happening, the valve between the left chambers is _____.
(open OR closed)

The left ventricle contracts. This forces blood out of the heart to all parts of the body.

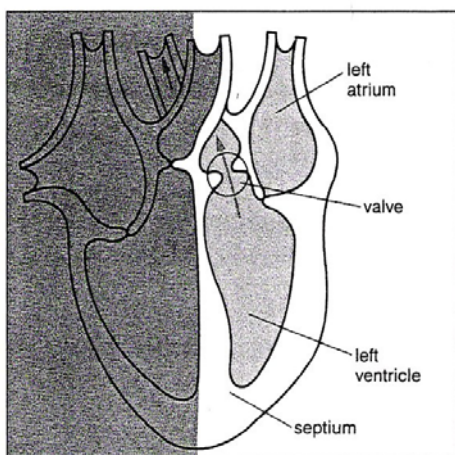


Figure D

13. a) As the left ventricle contracts, the valve between the left chambers is _____.
(open OR closed)

b) Why? _____

14. Where does blood leaving the left ventricle go? _____

15. THEN, what do you think happens to the blood? _____

TRUE OR FALSE – Write a ‘T’ or an ‘F’ beside each statement.

_____ 1. The heart is a muscle

_____ 2. The heart has many jobs.

_____ 3. A human heart has four chambers.

_____ 4. Heart chambers are called arteries and veins.

_____ 5. Blood moves from the atria to the ventricles.

_____ 6. Ventricles receive blood from veins.

_____ 7. Arteries carry blood away from the heart.

_____ 8. The right and left ventricles pump at the same time.

_____ 9. Your heart stops beating when you are asleep.

_____ 10. Your heart beats millions of times a year.

SHORT ANSWER – Use Figure H to help you to answer the questions.

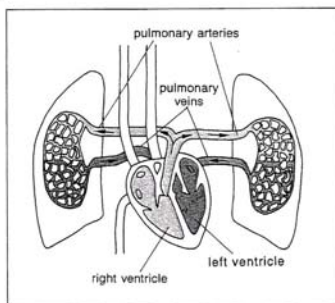


Figure H

1. Arteries carry ‘fresh’ blood. There is one exception. Which artery is the exception? _____

2. Veins carry ‘stale’ blood. There is one exception. Which is the exception? _____

Adapted from
How Does Your Heart Work?, pp. 82-88 *Biology Science Workshop Series*

Coloring for Review

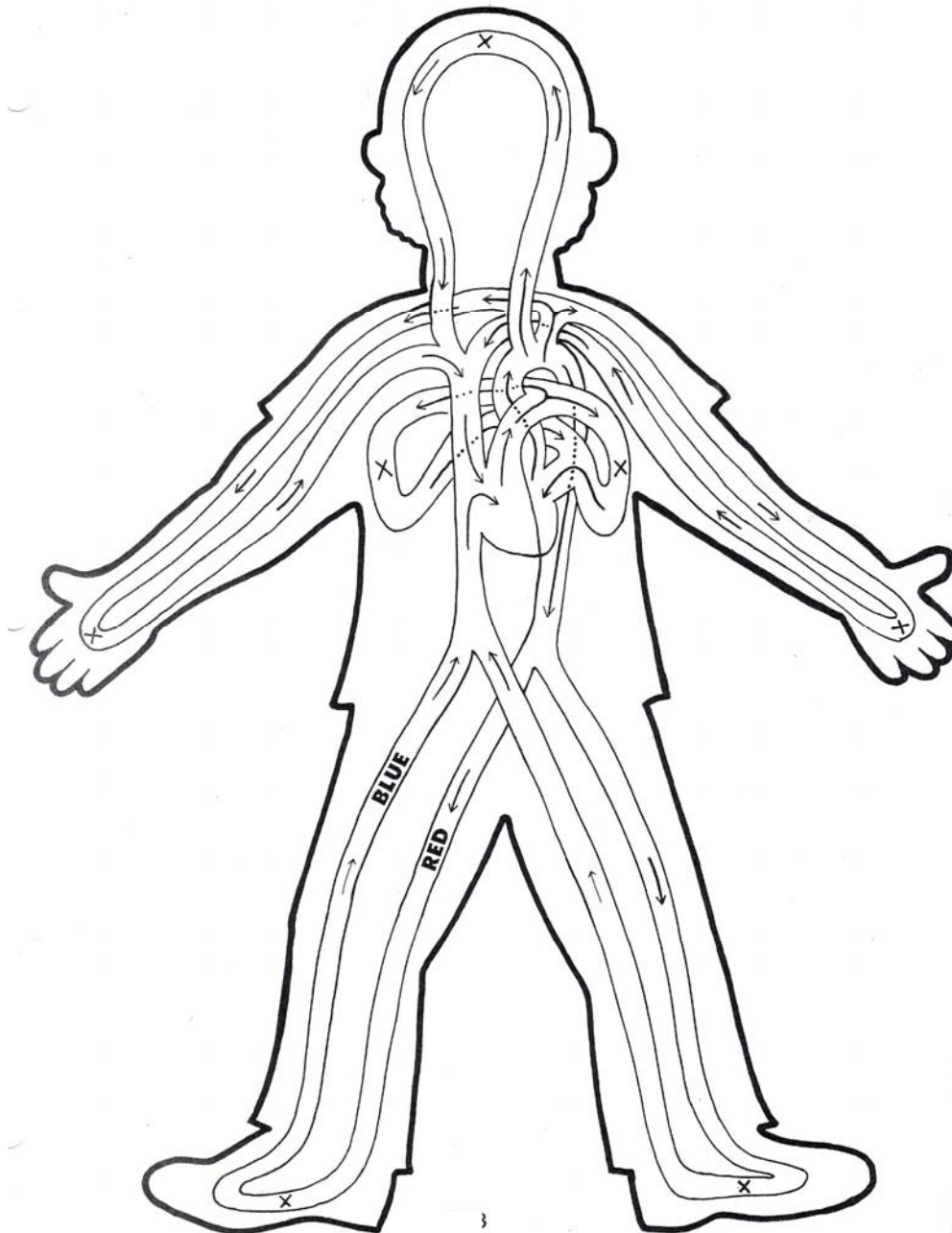


The following shows the heart and the major arteries and veins going into and coming out of it. You will need a blue and red crayon/pencil crayon to do this part.

Blue = oxygen-poor blood

Red = oxygen-rich blood

Start with oxygen-poor blood (blue) entering the right hand side of the heart (on YOUR left). Follow the arrows and color blue until you reach an 'x'. At this time, switch colors to red. Continue on with red until you reach another 'x' then switch to blue.





Heart Cutouts for Review

Materials: scissors, hole punch, 5 brass fasteners, transparent tape

Instructions

1. Cut out the following three sheets of heart parts.
2. Hole punch the black dots found on some pieces. Be sure to leave the numbers behind!
3. Fold the tab on the outside view of the heart along the dotted line. Tape this under the view of the inside of the heart. If you have done this properly, you should be able to turn back the view of the outside of the heart to reveal the inside of the heart.
4. Using a pencil, label the following: right atrium, right ventricle, left atrium, left ventricle, septum, valve.
5. As you read the following passage to trace the blood flow through the heart, assemble your heart as instructed.

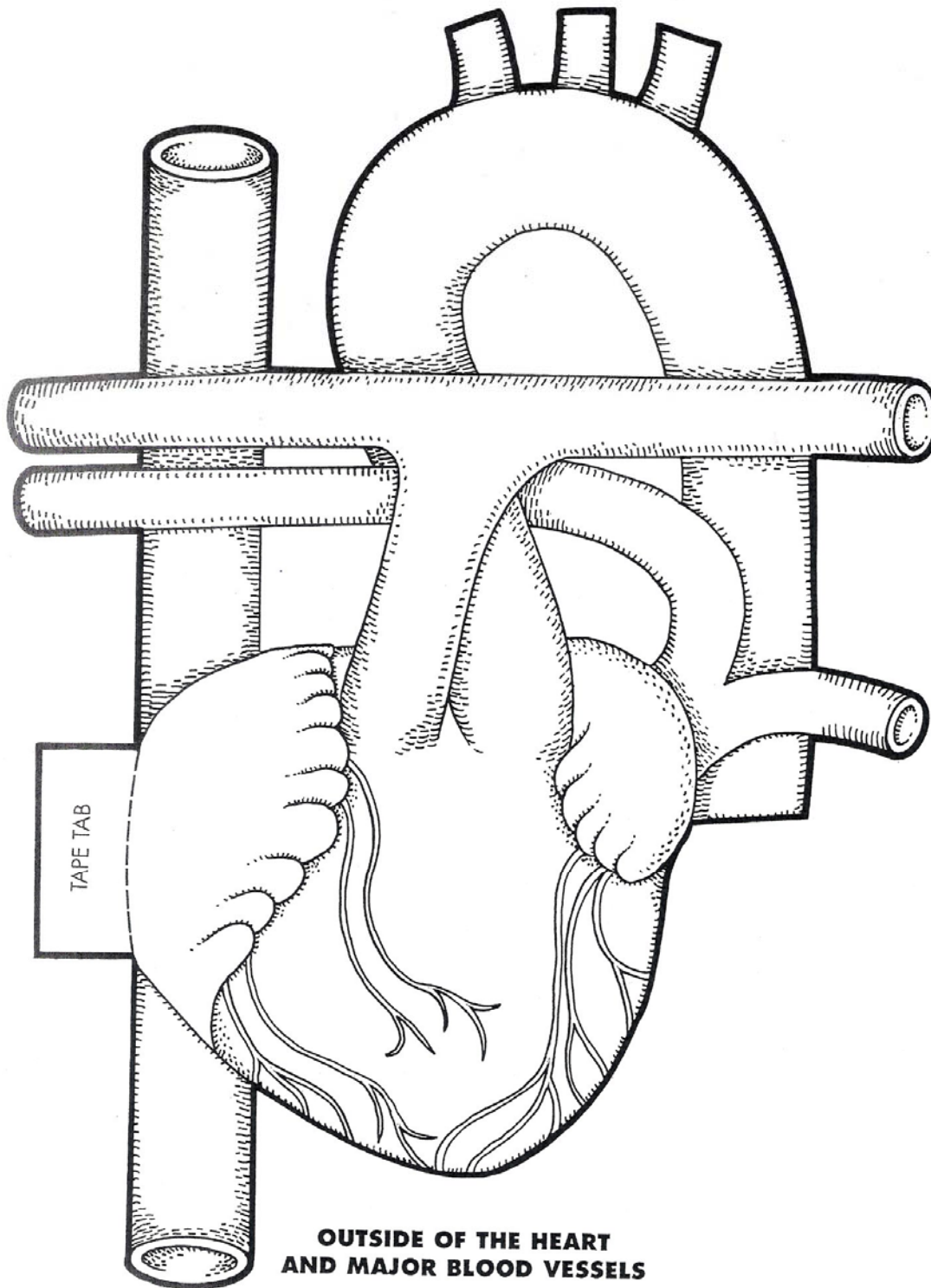
Oxygen-poor blood enters the heart from the body through two large veins. The **upper vena cava** brings in blood from the upper body while the **lower vena cava** brings in blood from the lower body. Both bring the oxygen-poor blood to the **right atrium**. *Use your brass fasteners to attach the upper vena cava and lower vena cava to the inside of the heart. Note how they connect to the right atrium.*

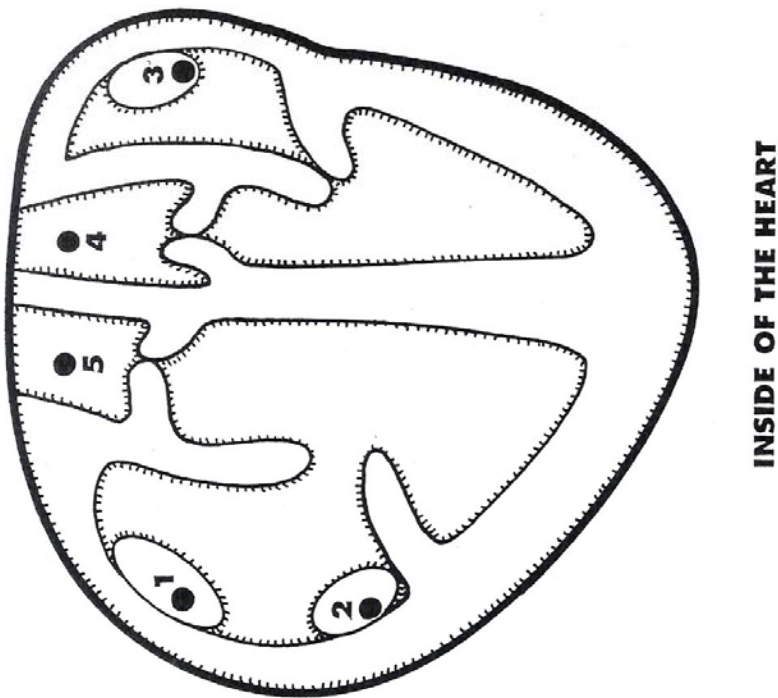
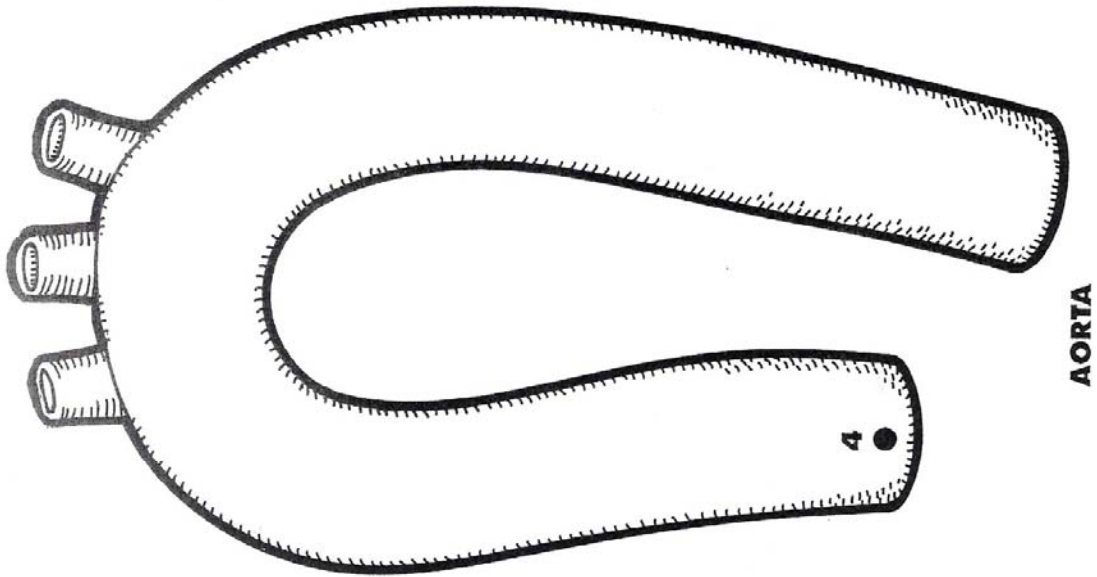
When the atrium contracts, the oxygen-poor blood travels through a **valve** to the **right ventricle**. The right ventricle then contracts and forces the blood through another valve and through the **right lung artery** and **left lung artery**. The right lung artery carries the oxygen-poor blood to the lungs to pick up oxygen and drop off carbon dioxide. The left lung artery does the same, except it travels to the left lung. *Use your brass fasteners to attach the right lung artery and left lung artery to the inside of the heart. Note how they connect to the left ventricle.*

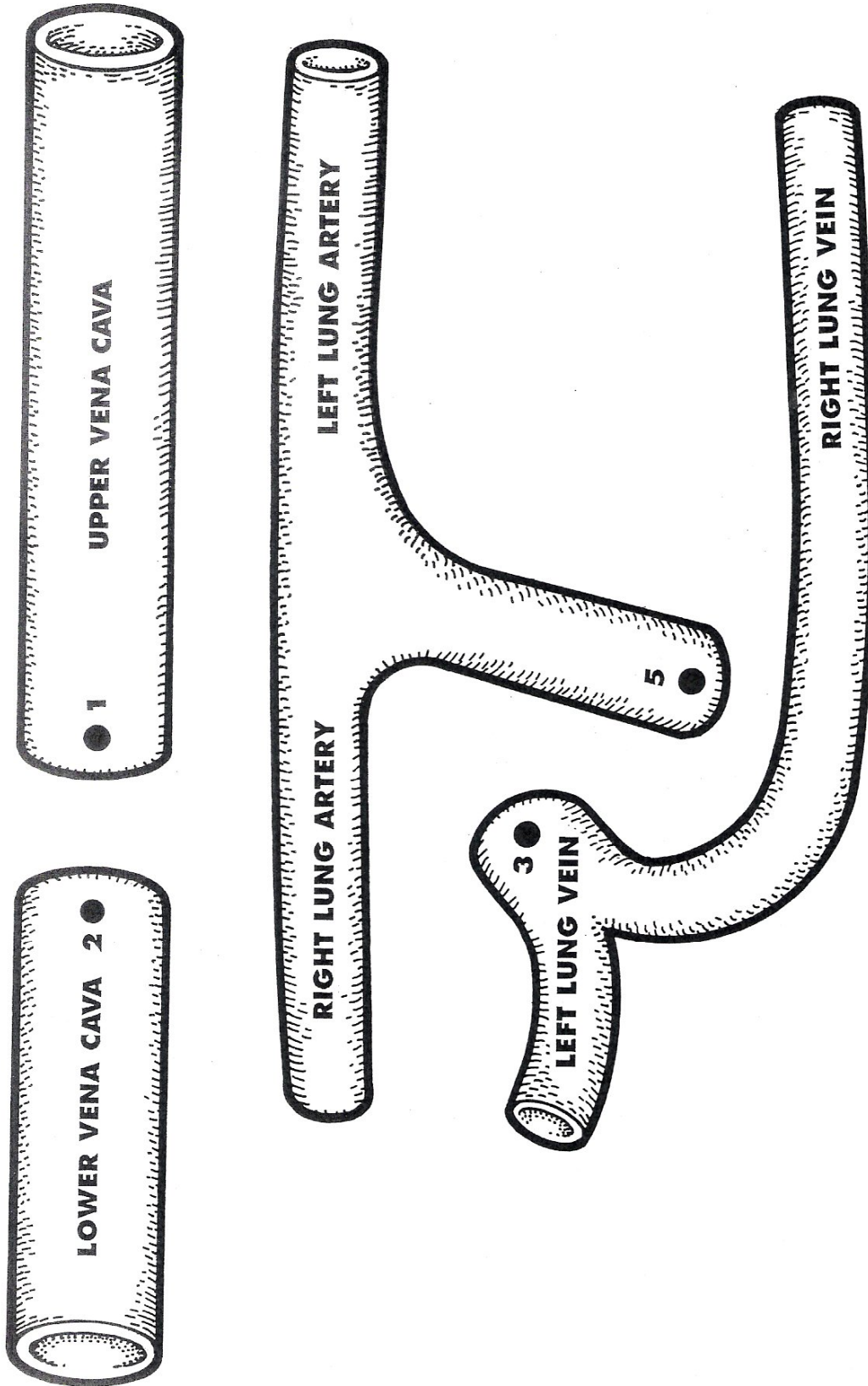
Now the blood returning to the heart from the lungs is oxygen rich. It enters the **left atrium** through the **right lung vein** and the **left lung vein**. *Use your brass fasteners to attach the right lung vein and left lung vein to the inside of the heart. Note how they connect to the left atrium.*

The oxygen-rich blood passes through a valve to the **left ventricle**. The left ventricle contracts and the blood is forced through another valve to the large artery called the **aorta**. The aorta will bring the oxygen-rich blood to the rest of the body. *Use your brass fastener to attach the aorta to the inside of the heart. Note how it connects to the left ventricle.*

Once the blood reaches the tissue, it will drop off oxygen and pick up carbon dioxide. The blood is now oxygen-poor and returns to the heart through the vena cava and the cycle continues.







13

NAME(S): _____ DATE: _____ PERIOD: _____

Heart Dissection



Purpose: To identify the main structures in a mammalian heart and be able to trace the path of blood flow through the heart.

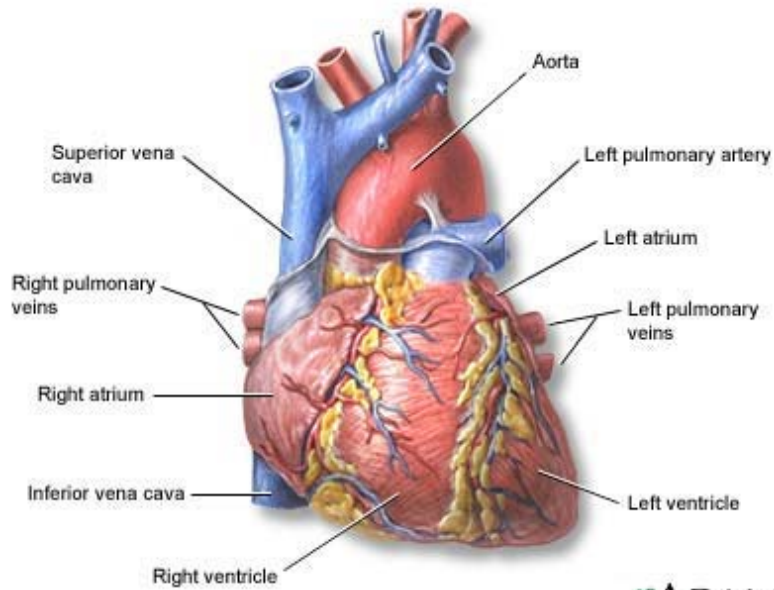
Materials:

| | | |
|-----------------|---------------------|-----------------------------|
| mammalian heart | dissecting scissors | pencil |
| dissecting tray | blunt probe | red and blue pencil crayons |
| scalpel | latex gloves | |

Procedure and Observations:

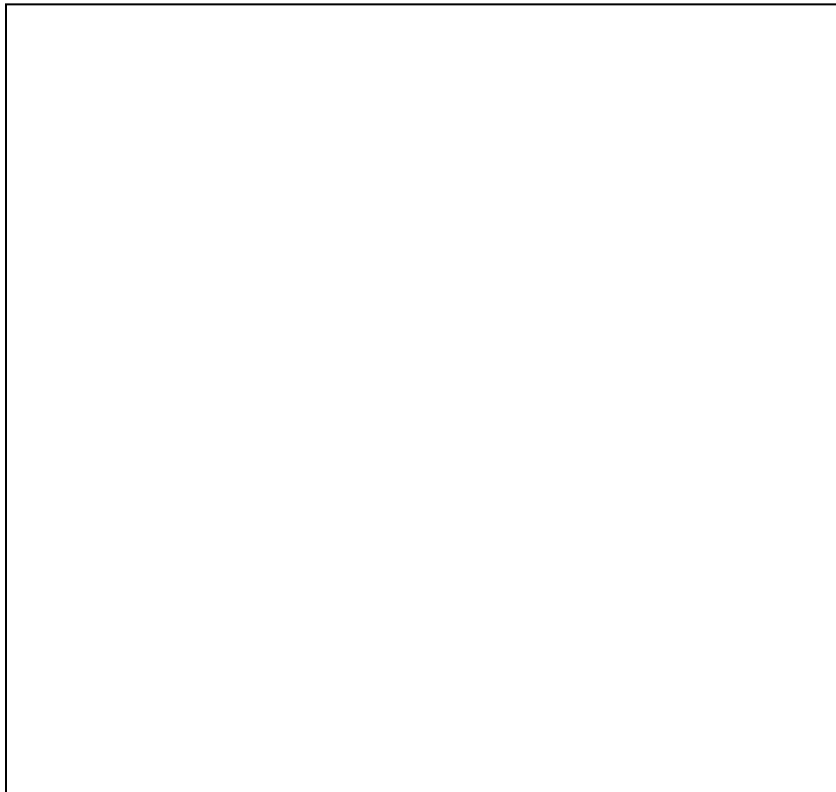
- 1 Line your dissecting tray with wet paper towel. Place the heart in the dissecting tray ventral side up (with the underside facing up). Put on your gloves.
2. Observe the outer surface of the heart muscle.
 - a) What color is it? _____ (1 mark)
 - b) Why do you think that this is so? (1 mark) _____

3. Observe the blood vessels that feed the heart as seen on the outside of the heart. These are the **right and left coronary arteries**.
4. Use the diagram below to identify the following heart structures:
 - left atrium
 - right and left pulmonary arteries
 - left ventricle
 - right and left pulmonary veins
 - right atrium
 - aorta
 - right ventricle
 - superior vena cava
 - inferior vena cava



5. Cut each chamber from top to bottom and identify the following structures:
 - pacemaker (found in the upper right atrium; a collection of nerve fibers)
 - atrioventricular valves (between the atria and ventricles)
 - aortic valve

6. Using pencil, draw a sketch of your heart, showing the inside of it. Label all of the terms from procedural steps 4 and 5. (14 labels x 0.5 marks each = 7 marks)



Unit: Biology C - Circulation



7. On your sketch, use ink to draw arrows that show the movement of blood through the heart and its associated blood vessels. (2 marks)
8. Use a blue colored pencil to shade in all regions of the heart that carry deoxygenated blood and a red colored pencil to shade in the regions that carry oxygenated blood. (2 marks)
9. Dispose of your heart, as instructed by your teacher. Clean all dissecting tools and return them to the appropriate spot.

NAME: _____ Date: _____ PERIOD: _____

16

Virtual Heart Investigation



Purpose: To identify the main structures in a mammalian heart and be able to trace the path of blood flow through the heart.

Materials:

- computer with Internet access
- pencil
- red and blue pencil crayons

Procedure and Observations:

1. Go to the following website:
<http://www.gwc.maricopa.edu/class/bio202/cyberheart/anthrt.htm>
2. Observe the outer structure of the heart muscle.
 - a) What color is it? _____ (1 mark)
 - b) Why do you think that this is so? (1 mark) _____

3. Explore the external parts of the sheep’s heart by dragging and clicking over the parts. Sketch a picture of the exterior of the heart in the box below and label the following: (6 labels x 0.5 marks each = 3 marks)

- | | |
|----------------|-------------------------|
| left atrium | interventricular septum |
| right atrium | apex of heart |
| left ventricle | right ventricle |

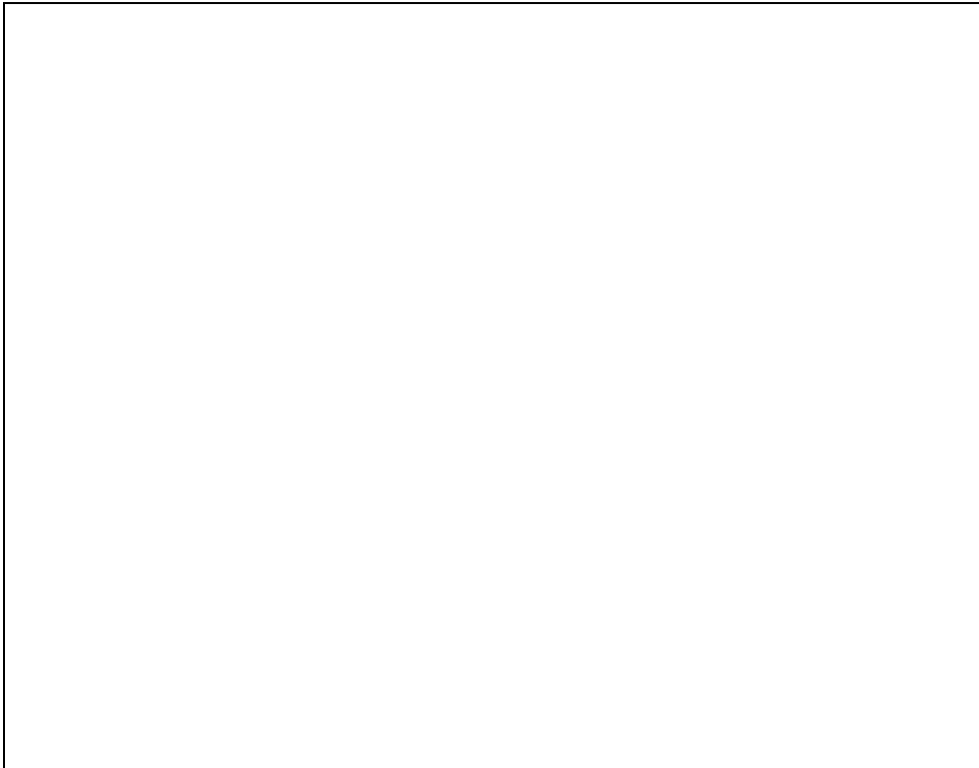


Unit: Biology C - Circulation



4. Click on the other views of the sheep heart until you are able to view the interior of the sheep heart. Sketch the interior of the sheep heart in the box below and label the following structures: (10 labels x 0.5 marks each = 5 marks)

| | | |
|-----------------|-------------------------|------------------------|
| right ventricle | tricuspid valve | opening to aorta |
| left ventricle | bicuspid (mitral) valve | aortic semilunar valve |
| right atrium | adipose (fat) | |
| left atrium | interventricular septum | |

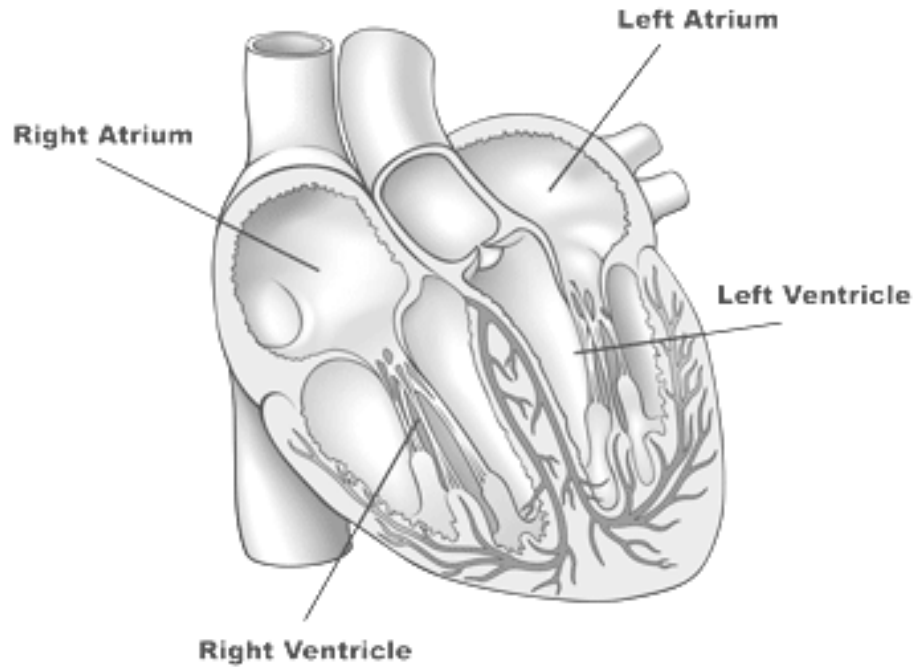


5. You are now finished with this website. Use any reliable Internet sites to answer the following questions:
- a) The heart is said to be 'self-excitable'. It generates its own contractions without having to be commanded to do so by the brain. This is achieved by the action of natural pacemakers in the heart – nodes of tissue that start the electrical impulses to get the heart to beat.

What is the name of the natural pacemaker that starts the heartbeat?

_____ (1 mark)

Where is it found? _____ (1 mark)



- b) On the diagram of the heart above, use arrows to show the pathway of blood through the heart and its associated vessels. (2 marks)
- c) Use a blue colored pencil to shade in all regions of the heart that carry deoxygenated blood and a red colored pencil to shade in the regions that carry oxygenated blood. (2 marks)

Unit: Biology C - Circulation

LESSON 1.5 - TECHNOLOGIES OF THE HEART

Overview:

Students will have the opportunity to learn about a technology used to diagnose or treat heart problems and present their findings orally or in the form of a classroom display.

Suggested Timeline: 3 hours research and preparation time + presentation time (if applicable)

Materials:

- Technologies of the Heart (Student Handout – Individual)
- Technologies of the Heart (Student Handout – Group)
- student access to computers with the Internet

Method:

INDIVIDUAL FORMAT:

1. Have students perform an online heart transplant by accessing the following website:
www.pbs.org/wgbh/nova/eheart/transplantwave.html
2. Introduce the research assignment by going through the handout ‘Technologies of the Heart’ (Student Handout – Individual).
3. Allow students several class periods for project preparation. Have each student put his/her research results on display for one week in the classroom.

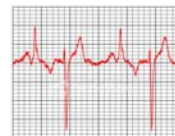
GROUP FORMAT:

1. Lead a brainstorming session on technologies used to assess the heart, treat heart problems or special equipment used specifically for heart surgery. Keep the list and add any items not already listed as ideas on the ‘Technologies of the Heart’ (Student Handout – Group) topic list.
2. Have students perform an online heart transplant by accessing the following website:
www.pbs.org/wgbh/nova/eheart/transplantwave.html
3. Introduce the research assignment by going through the handout ‘Technologies of the Heart’ (Student Handout – Group).
4. Allow students several class periods for project preparation and for presenting the results of their research to the class.

Evaluation:

- Evaluation of research assignment using the given rubric

Technologies of the Heart
A Science 21 Research Assignment



Your Task:

To research one of the heart technologies used today and present your information on a bulletin board display.

Topics:

You may choose one of the following technologies, or another technology that you choose, as long as it is approved by your teacher before you begin. You must sign up for your topic choice, as there is only one person per topic.

artificial pacemakers

artificial hearts

heart bypass machines

ECG

heart nuclear stress testing

ultrasound for the heart

coronary angiogram

CT scan for the heart

PET/CT scan for the heart

MRI for the heart

heart angioplasty

Expectations:

Your bulletin board should be as engaging and interactive as possible. Include a large and clear title, type your information in font large enough to read from a distance, and be creative! You must also display a list of *at least* three references on your bulletin board. (HINT – read the rubric closely so that ALL of the expectations are clear to you). Imagine that you are a passerby. Would you want to stop and learn from the bulletin board that you make?

Evaluation:

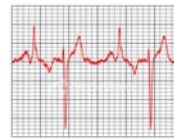
Your presentation will be graded according to the following rubric.

Technologies of the Heart Bulletin Board Display Grading Rubric

| CRITERIA | 15 | 9 | 4 |
|--|--|---|--|
| Scientific Accuracy and Clarity of Explanation <ul style="list-style-type: none"> accuracy of the presented information the extent to which the explanations given are clear, concise, and are explained in a way that another student in the class would understand <p style="text-align: center;">/15</p> | <ul style="list-style-type: none"> information given is accurate and explained very clearly at a level that another science 21 student would understand information given is summarized well and provides enough detail for a good understanding of the technology researched | <ul style="list-style-type: none"> most information given seems accurate it is likely that another science 21 student would not understand all of the information as it is presented too much or not enough detail given so that the reader's understanding would be lacking | <ul style="list-style-type: none"> the accuracy of much of the information is questionable it is likely that another science 21 student would not understand much of the information, since too much or not enough detail is given explanations are confusing |
| | 6 | 4 | 2 |
| Creativity and Presentation Style <ul style="list-style-type: none"> the extent to which the student displays the information in a way that is unique and 'grabs' the attention of the viewer how well the student adheres to the expectations for presentation format <p style="text-align: center;">/6</p> | <ul style="list-style-type: none"> title is large, centered, neat and descriptive information is typed or written clearly and large enough to read information is presented in a way that will surely attract attention and enhance ones understanding of the information at least 3 sources are cited clearly on the bulletin board | <ul style="list-style-type: none"> title is visible and fairly neat information could be typed or written clearer some creative elements present, but it is likely that the reader's understanding is not enhanced by these 2-3 sources cited clearly on the bulletin board | <ul style="list-style-type: none"> title is not large enough and/or lacks neatness information is not typed or written clearly it is unlikely that the method of presentation would attract a reader to the bulletin board 1-2 sources cited on the bulletin board |
| | 4 | 2 | 0 |
| Timing <ul style="list-style-type: none"> bulletin board is put up and taken down at the times designated by your teacher <p style="text-align: center;">/4</p> | <ul style="list-style-type: none"> bulletin board is put up AND taken down at the correct time (as set out by your teacher) all materials are taken home and the area is left clean of debris (e.g., staples, bits of paper) | <ul style="list-style-type: none"> bulletin board is EITHER put up or taken down at the correct time, but not both most materials are taken home and most debris is removed | <ul style="list-style-type: none"> bulletin board is NEITHER put up nor taken down at the correct time some materials and debris are left behind |

Technologies of the Heart

A Science 21 Research Assignment



Your Task:

To research one of the heart technologies used today and present your information to the class.

Topics:

You may choose one of the following technologies, or another technology of your choice, as long as it is approved by your teacher before you begin. You must sign up for your topic choice, as there is only one person per topic.

artificial pacemakers

artificial hearts

heart bypass machines

ECG

heart nuclear stress testing

ultrasound for the heart

coronary angiogram

CT scan for the heart

PET/CT scan for the heart

MRI for the heart

heart angioplasty

Expectations:

Your presentation should be 2-3 minutes long and should be as engaging and interactive as possible. Include a proper introduction of yourself and your topic choice, use props when possible and allow time for questions. Speak loudly, clearly and enunciate well. You must also submit a list of *at least* three references to your teacher. (HINT – read the rubric closely so that ALL of the expectations are clear to you). Imagine that you are in the audience and have to listen to yourself talk! Would you be interesting to listen to?

Evaluation:

Your presentation will be graded according to the following rubric.

Technologies of the Heart Presentation Grading Rubric

| CATEGORY | 15 | 12 | 8 | 4 |
|--|--|--|---|--|
| Scientific Accuracy the extent to which the technology is explained clearly and accurately | <ul style="list-style-type: none"> thorough understanding demonstrated through thoughtful descriptions student's answers to questions asked give clear evidence of deep understanding | <ul style="list-style-type: none"> satisfactory understanding demonstrated through the use of several concepts student answers questions asked with thoughtful answers that give evidence that adequate research has been done | <ul style="list-style-type: none"> some understanding demonstrated some of the 'science' clearly absent student answers most questions with a basic response | <ul style="list-style-type: none"> inadequate understanding demonstrated; some scientific concepts not included in explanation student unable to correctly answer most questions |
| | 5 | 4 | 3 | 2 |
| Introduction and Closure | <ul style="list-style-type: none"> student delivers opening and closing remarks that capture the attention of the audience, set the mood and summarize the main points of the presentation | <ul style="list-style-type: none"> student delivers effective and clear introductory and closing remarks | <ul style="list-style-type: none"> student delivers either an effective opening or closing remark, but not both | <ul style="list-style-type: none"> student delivers either an opening or closing remark |
| Category | 1.0 each | 0.75 each | 0.50 each | 0.25 each |
| Presentation | | | | |
| a) Body Language | <ul style="list-style-type: none"> movements seem fluid and help the audience to visualize | <ul style="list-style-type: none"> made movements or gestures that enhanced articulation and aided in emphasis of important points | <ul style="list-style-type: none"> some movements or gestures that could sometimes be considered useful in emphasis and articulation | <ul style="list-style-type: none"> very little movement or descriptive gestures |
| b) Eye Contact | <ul style="list-style-type: none"> hold attention of entire audience with the use of direct eye contact and animated eye expressions | <ul style="list-style-type: none"> consistent use of direct eye contact with audience; some eye expressions aid in information delivery | <ul style="list-style-type: none"> often uses direct eye contact with audience | <ul style="list-style-type: none"> displayed minimal eye contact with audience |
| c) Pacing and Voice | <ul style="list-style-type: none"> good use of drama student meets time guidelines (2-3 min) use of fluid speed, inflection and good enunciation to maintain the interest of the audience | <ul style="list-style-type: none"> delivery includes appropriate drama and pace, but does not quite meet time guidelines satisfactory use of inflection, but does not consistently use fluid speech and does not always enunciate well | <ul style="list-style-type: none"> delivery is in bursts presentation quite off from time guidelines displays some level of inflection throughout the delivery | <ul style="list-style-type: none"> delivery is either much too quick or too slow presentation far off time guidelines very little inflection monotone voice frequently mumbles speech is not fluid |
| d) Poise | <ul style="list-style-type: none"> student displays relaxed, self-confident nature about self with no mistakes | <ul style="list-style-type: none"> makes minor mistakes, but quickly recovers from them; displays little or no tension | <ul style="list-style-type: none"> displays mild tension; has trouble recovering from mistakes | <ul style="list-style-type: none"> tension and nervousness is obvious; has trouble recovering from mistakes |

Unit: Biology C - Circulation



| Creativity | 5 | 4 | 3 | 1 |
|---|---|---|--|---|
| the extent to which the student describes the workings of the object in an unpredictable manner that engages others | <ul style="list-style-type: none"> exceptionally unique approach to explaining how the object works that is engaging, captivating, unique and thoughtful | <ul style="list-style-type: none"> somewhat unique method of explaining information most students engaged and seemingly interested by method(s) of delivery | <ul style="list-style-type: none"> method chosen for presentation not unique or innovative, but some of the audience's interest and attention is still maintained | <ul style="list-style-type: none"> chosen method of delivery is predictable and mundane audience is not engaged and their attention wanes |
| References | 3 | 2 | 1 | 0 |
| | 3 or more sources cited | 2 sources cited | 1 source cited | no sources cited |