

Regulation of Human Heart Rate

copyright, 2005, Dr. Ingrid Waldron, Department of Biology, University of Pennsylvania¹

Part 1

Introduction

Why do you need to have a heart? Why do you need to have blood circulate to all the parts of your body?

How does your heart pump blood? What is a heart beat?

Does your heart always beat at the same rate?

List some activities or stimuli that you think may increase a person's heart rate. An activity is something a person does, and a stimulus is an input from the environment around a person.

Why would it be useful for the heart to beat faster during these activities or in response to these stimuli?

Are there any activities or stimuli that you think may decrease a person's heart rate?

Today, after you learn how to measure heart rate accurately, your group will design an experiment to test how a stimulus or activity affects heart rate. During the next laboratory period, you will carry out your experiment, analyze your data, and prepare a poster describing your experiment.

Measuring Heart Rate Accurately

Each time the heart beats, blood is pumped into the arteries. As the blood surges into the arteries during a heart beat, each artery stretches and bulges. This brief bulge of the artery is called a pulse. You will be measuring heart rate by counting the number of pulses in the artery in the wrist in a 30 second interval.

To feel the pulse, find the artery in your partner's wrist. Place the tips of the first two fingers of one hand on the palm side of your partner's wrist, over toward the thumb side of his or her wrist. You may need to press quite firmly in order to feel the pulse of blood which each heart beat sends through the artery. Don't use your thumb to feel the pulse in the wrist, because your thumb has a pulse of its own.

To measure heart rate, count the number of pulses in 30 seconds. Multiply that number by 2, and you will have the number of heart beats per minute.

¹ Teachers are encouraged to copy this student handout for classroom use. A Word file (which can be used to prepare a modified version if desired), Teacher Preparation Notes, comments, and the complete list of our hands-on activities are available at http://serendip.brynmawr.edu/sci_edu/waldron/.

After you have practiced taking heart rate, it is important to check the accuracy of your heart rate measurements. Work in a group of four using the following procedure to test and improve the accuracy of heart rate measurements.

(1) Choose one person in your group to be the subject, one person to measure the pulse count in the left arm, and one person to measure the pulse count in the right arm. The fourth person in the group will use the stop watch to time a 30 second interval, and will indicate when the count of beats should begin and end.

(2) Both people who are measuring pulse count should write down the number of beats for the 30 second interval before saying the number out loud.

Pulse count in 30 seconds _____

Next, compare the results found by the two different people who were measuring pulse counts. Did you both count about the same number of pulses in the 30 second interval? If you got different results, can you figure out why?

(3) Try to improve your technique, and repeat step 2 until both people who are measuring pulse counts get the same number of pulses in the 30 second interval (or within 1 or 2 of the same number).

(4) Once you have accurate readings, use the final, accurate set of measurements to calculate the heart rate for this subject (beats per minute).

Heart rate = _____ beats per minute

(5) After this, you should switch roles. The people who were measuring pulse counts should now be the subject and the timer, and the people who were the subject and the timer should now measure pulse counts. Repeat steps 2-3 until the heart rate measurements are accurate.

Designing Your Experiment

Discuss how you could test your ideas concerning activities or stimuli which may increase or decrease heart rate. Choose a hypothesis that your group would like to test in your next lab class. Write your hypothesis here.

Plan your experimental procedure.

Try to keep everything constant, except for the one stimulus or activity you want to test. This will allow you to measure the effect of the stimulus or activity you are testing, and minimize confounding effects due to any other factors that may influence heart rate. In designing your experiment, remember that heart rate can be affected by minor physical

activity such as changing seats, so you need to keep this type of factor constant in order to assess the effects of your experimental stimulus or activity.

Plan to have each person in the group be a subject in the experiment, in order to see whether different people have the same heart rate response to your stimulus or activity.

In the space below, describe the procedure for your experiment. Be specific about what you plan to do to your subjects (the stimulus) or what you want your subjects to do (the activity). Specify when and how often you will measure heart rate; you will need to measure resting heart rate two or three times before your stimulus or activity, and you will need to measure heart rate during and/or after your stimulus or activity.

List of Specific Numbered Steps in Your Procedure

Your teacher will check your plan for your experiment, and make any suggestions that could improve the experimental procedure. Discuss these suggestions and, if you decide to make any changes in your experimental procedure, incorporate these changes in your description of your procedure.

Getting Ready to Do the Experiment

If you need to bring anything to do your experiment next time, decide who will bring the necessary materials or equipment.

Make a data sheet to collect the data during your experiment next time. The data sheet should include places to record the

- names of each student in the group
- resting heart rates (pulse counts) for each subject before the stimulus or activity, as well as the heart rates during and/or after the stimulus or activity
- anything you notice which might affect the results, for example, other things which may be happening in the room during your experiment or changes in each subject's mood during the experiment.

If you complete these activities before the end of the period, you can begin the Hypothesis and Methods sections of your poster. (See below.)

Part 2

Doing Your Heart Rate Experiment

Review your experimental plan from last time, and carry out the experiment for each subject in your group. Record your data in the data sheets that you prepared.

Analyzing Your Results

Discuss the best way to analyze your data in order to test your hypothesis. You may want to use one of the following methods of analysis.

(1) For each subject, calculate the difference between the resting heart rate and the heart rate during or after the stimulus or activity. Make a table which shows these change in heart rate values. Calculate the average change in heart rate for all subjects in the experiment, and record this average in the table.

(2) For each subject, graph the resting heart rate and the heart rate during and/or after the stimulus or activity. Calculate the average resting heart rate and the average heart rate during and/or after the stimulus or activity. Graph these averages. Be sure to label both axes of any graph that you make.

Each student should analyze the data and attach the table or graphs you have prepared.

Do your results support your hypothesis? What conclusions can you draw from your experiment?

Poster

Each group should prepare a poster on their heart rate experiment. This poster should explain your hypothesis, the basic procedures you used, your main results (summarized in a graph and/or table), and your conclusions.