Bay Academy

Sixth Grade Summer Assignment

Choose one of the following to experiments to complete as your summer assignment. Be sure to read the background information and directions to the labs thoroughly. Choose the lab that sparks your interest the most! Be sure to complete all aspects of each lab including the graphs and conclusion questions. Check your work fully for any mistakes.

You will turn in the lab sheet (background information, materials, and procedure sheets are not needed)

Lab Option One: Running away with my heart.

Introduction

An average-sized adult has about 5.5 liters of blood in their body, which the heart *circulates* about three times every minute. Your heart is constantly beating—even before birth!—to keep the blood circulating. The heart of an average 65-year-old person has contracted more than 2.5 billion times. That is a lot of heartbeats! You can see a picture of a real human heart in Figure 1, below.

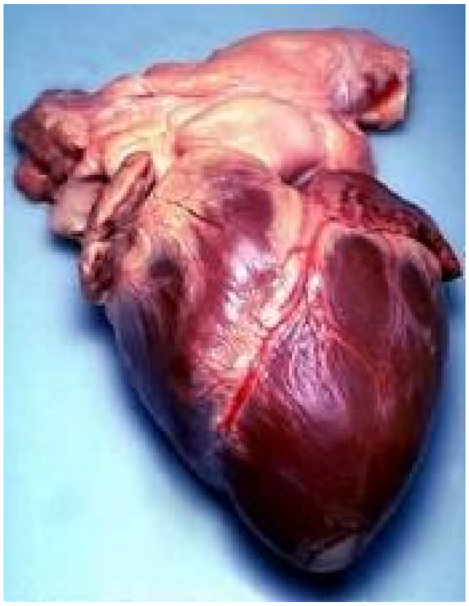

Figure 1. A human heart.

Experts on cardiac health tell us that the best ways to keep our hearts healthy are through a balanced diet, avoiding smoking, and regular exercise. Exercise that is good for your heart should elevate your *heart rate*. **Heart rate** is a measure of how many times a person's heart beats in a minute (technically measured in *beats per minute*, or *bpm*). But by how much, for how long, and how often should your heart rate be elevated? This has to do with how fit you are and your **maximum heart rate**, which is 220 bpm minus your age. For example, if you are 30 years old, your maximum heart rate would be 190 bpm (since 220 minus 30 equals 190). The American Heart Association recommends that you do exercise that increases your heart rate to between 50 and 85% of your maximum heart rate. This range is your **target heart rate zone**. They recommend getting at least 30 minutes of moderate to vigorous exercise most days (or a total of about 150 minutes a week).

What is your resting heart rate? What types of exercises work to elevate your heart rate? How do you feel when your heart is working at 50% of its maximum rate? How about when it is working at 75% of its maximum rate? This science project will help you answer all of these questions, and help you find fun activities that are good for your heart.

Materials and Equipment

- Clock or timer that shows seconds *or* a helper with a watch
- Comfortable exercise clothes
- Simple and fun exercise equipment. You will want to do at least three different types of exercises, but not all of them may require equipment. Some equipment you may need includes:
    - Jump rope
    - Bicycle
    - Hula-hoop
    - 1-kg weight
- Lab notebook
- Graph paper or a graphing program

Experimental Procedure

Measuring Your Heart Rate

1. Use the first two fingers of one hand to feel your radial **pulse** on the opposite wrist, as shown in Figure 2. You will find it on the "thumb side" of your wrist, just below the base of your hand. Practice finding your pulse until you can do it quickly. *Note:* Do not use your thumb, because it has its own pulse, which could throw off your count.

Figure 2. The photo shows how to feel your radial pulse.

1. Your heart rate is the number of beats per minute, but you do not have to count for a full minute to get an accurate heart rate. Counting the number of beats in either 10 or 15 seconds is fine. As practice, right now use a clock or timer to time your count, and write down the number of beats you counted on your lab sheet. Then calculate the number of beats per minute (bpm) to get your heart rate. If you counted for ten seconds what do you need to multiply by to get the number of beats per minute? How about if you counted for 15 seconds? That is it!

Activity and Heart Rate

1. Do your background research and make sure that you are knowledgeable about the terms, concepts, and questions in the Background section.
2. Measure your *resting heart rate* and record it on your lab sheet, along with the date and time of the measurement. Your **resting heart rate** is your heart rate when you are awake but relaxed, such as when you have been sitting still for several minutes.
    1. *Tip:* It is best to take your resting heart rate at the beginning of the day, right after you have woken up but before you have gotten out of bed.
    2. It is a good idea to do this several times, and at different times of day, so that you can get a reliable average. You will also get an idea of the normal range of variation for your resting heart rate.
    3. If you want, you can calculate how many times your heart beats during a day, a month, and a year, based on your resting heart rate.
3. You will be measuring your heart rate during different types of physical activity. Choose at least three different types of activities that you enjoy doing or that you think would be good exercises. You may want to choose at least one activity that you consider to be easy, and one that you think requires more energy to do. You can see some examples in Table 1.
    1. How do you think doing each activity will affect your heart rate? Do you think the activities will affect your heart rate differently?

Activity	Time											
	0 (rest)		1 min		2 min		5 min		10 min		15 min	
	beats 10 s	bpm	beats 10 s	bpm	beats 10 s	bpm	beats 10 s	bpm	beats 10 s	bpm	beats 10 s	bpm
Jumping rope												
Lifting a 1 kg weight												
Riding a bicycle												
Walking												
etc.												

1. Choose which activity you want to do first. Before starting it, make sure you have been resting for a few minutes and measure your resting heart rate. Your measured resting heart rate should be similar to what you measured in step 2.
2. Perform the activity for 15 minutes. In your data table, write down the number of beats you count in 10 seconds at the times indicated in Table 1 (after 1, 2, 5, 10, and 15 minutes of activity).
    1. Once you are done with the activity, also record on your lab sheet how you felt when you finished.
3. Calculate your heart rate after 1, 2, 5, 10, and 15 minutes of activity by multiplying the number of beats you counted (in 10 seconds) by six. This is your heart rate in beats per minute (bpm).
4. Repeat steps 4–6 for at least two more different activities.
    1. Leave enough time between activities so that your heart rate returns to around its normal resting level.
    2. It may take more than one day to make measurements for all of the activities you want to try, so be sure to plan ahead so that you have enough time to collect data.
5. Make line graphs of heart rate (on the y-axis (vertical), in bpm) vs. time (on the x-axis (horizontal), in minutes) for each activity. Use graph paper, a spreadsheet program (like Excel), or(http://nces.ed.gov/nceskids/createAgraph/) . Compare the graphs.

Name ______________________________ Class ___________ Date ___________

Activity	Time											
	0 (rest)		1 min		2 min		5 min		10 min		15 min	
	beats/10 s	bpm	beats/10 s	bpm	beats/10 s	bpm	beats/10 s	bpm	beats/10 s	bpm	beats/10 s	bpm
Jumping rope												
Lifting a 1 kg weight												
Riding a bicycle												
Walking												
etc.												

Graph 1

Graph 2

Name ______________________________ Class ___________ Date ___________

Graph 3

Graph 4

Questions

1. Which activity increased your heart rate the most (highest peak)? Which portion of your data supports your response?

2. Which activity increased your heart rate the fastest (greatest slope)? Cite evidence to support your response.

3. Which activities elevated your heart rate to the target heart rate zone (50-85% of maximum heart rate, where your maximum heart rate is 220 bpm minus your age)? Support your response with data from your lab observations.

4. Do you notice any consistent patterns in your heart rate graphs? Which patterns do you notice?

Lab Option 2: Swinging Away

Introduction

A **pendulum** is an object, hung from a fixed point, that swings freely back and forth under the action of **gravity**. A playground swing is an example of a pendulum. The swing is supported by chains that are attached to fixed points at the top of the swing set. When the swing is raised and released, it will move freely back and forth. The swing is moving due to the force of gravity on the swing. The swing continues moving back and forth until **friction** (between the air and the swing, and between the chains and the attachment points) slows it down and eventually stops it.

We see pendulums in other areas of our lives as well, such as in long-case clocks, commonly known as grandfather clocks. But pendulums can do more than entertain and help us tell time. Among other applications, they can show that the Earth is rotating! This was done in the mid-1800s C.E. using perhaps the most famous pendulum, **Foucault's pendulum**. However, pendulums were being used for centuries before this. One of the first known pendulum uses was around 100 C.E., when a Chinese scientist, Zhang Heng, used it to detect distant earthquakes in a device called a **seismometer**. Today, pendulums have many applications, including measuring local gravity and helping guide ships and aircrafts.

In this science fair project, you will investigate how the *period* of a pendulum is related to the pendulum's length. A pendulum's **period** is the time it takes the pendulum to swing back to its original position. In the example of a kid being pushed in the swings at a playground, this is the time it takes the kid to be pushed and then return back for another push. The period of a pendulum is mathematically related to the pendulum's length.

Terms and Concepts

- Pendulum
- Gravity
- Momentum
- Friction
- Foucault's pendulum
- Seismometer
- Pendulum period

Materials and Equipment

- Identical chairs (2)
- String or yarn

- Metal washers of identical size (10)
- Broom Stick or Handle
- Scissors
- Stopwatch accurate to 0.1 s
- An assistant
- Lab notebook

Experimental Procedure

1. Create two pendulums with different lengths.
    1. Place the two chairs back to back. Then space the chairs a little less than 1 meter apart.
    2. Lay the meter stick on the backs of the two chairs, centered on the back of each.
    3. Cut one piece of string to a length of 70 cm. Cut another piece of string to a length of 35 cm.
    4. Tie the two lengths of string to the meter stick, toward the middle of the stick. Space the strings about 20–30 cm apart.
    5. Attach 5 washers to the end of each string.
2. Time how long each pendulum swings.
    1. Hold the washers tied to the 70 cm long string in one hand and the washers tied to the 35 cm long string in the other hand.
    2. Pull the strings tight and hold the strings at the same angle from the meter stick.
    3. Have an assistant ready with a stopwatch.
    4. At the same time, drop the longer pendulum and have the assistant start the stopwatch. Have the assistant stop the stopwatch when the pendulum returns back to its original position. How long does it take the longer pendulum to swing back to its original position? This is called the **period** of the pendulum. *Note:* If the pendulum hit anything as it swung, such as the wall, readjust your setup and try timing the pendulum again.
    5. Complete the data table on your lab sheet below. Write down the period of your pendulum in your data table under "Period (s)."
    6. Time the period of the shorter pendulum by repeating steps 2a–2d above, but in step 2d drop the shorter pendulum instead of the longer pendulum. How long does it take the shorter pendulum to swing back to its original position? Write down your results in your table.
    7. For each pendulum, repeat steps 2a–2d above, but instead of then timing the period of each pendulum, let the pendulum swing until it stops moving. What is the total time that each pendulum swings? Write down your results in your table under "Total Time (s)."
3. For any experiment, it is important to do multiple trials to assure that your results are consistent. Repeat step 2 for at least five separate trials for each pendulum and record your results in your table.
    1. Calculate the average period for each pendulum and write this down in your table under "Average Period (s)."
    2. Calculate the average total time for each pendulum and write this down in your table under "Average Total Time (s)."

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Sample Data Table					
Pendulum Length (cm)	Trial (#)	Period (s)	Total Time (s)	Average Period (s)	Average Total Time (s)
35	1				
	2				
	3				
	4				
	5				
70	1				
	2				
	3				
	4				
	5				

Table 1.

1. Analyze your results. Did one pendulum have a longer period than the other? If so, why do you think this is?

2. Are the two periods different in the way that you expected them to be? Are you surprised by your results? Why?

3. Are the periods and total times for each pendulum consistent between your five trials, or do they vary a lot?