6th Grade Activity Six: “Pump it Up”

Learning goals:
After completing this exercise students should be able to:
- Participate in a scientific experiment led by the teacher and have modeled for them the process skills required at each step.
- Understand that heart rate increases with exercise because of the need to pump more blood to the active muscles.

Introduction:
The heart pumps blood to all the organs and tissues of the body. The heart does this by contracting and forcing blood into the blood vessels. For the average adult human, the heart contracts about 72 times every minute while they are resting. What if they are not resting? What if they are exercising? In this activity, we will perform a controlled experiment to test the effect of exercise on heart rate.

Question: What is the effect of exercise on heart rate?

Background Information:
In order to answer this question, we need to think about what we already know about the heart. The heart pumps blood to the rest of our body. The body needs blood because it carries things like oxygen and food. When we exercise, our muscles work much harder than when they are at rest. When muscles work harder, do you think they will need more food and oxygen, less food and oxygen, or the same? In order to do more work, the muscles will need more energy. To get more energy, they will need more food. Based on these facts, we could form a hypothesis – or educated guess – about what would happen to heart rate after exercise.

Hypothesis:
Exercise will cause heart rate to increase.

An important component of designing an experiment is identifying variables. The independent variable is the thing, which we will change or that differs in our experiment. The dependent variable is the thing, which we measure in our experiment too see if it was affected.

Variables:
Independent variable: exercise
Dependent variable: heart rate

Procedure:
We will test the effect of exercise on respiration rate (how fast you breathe in a given time) in the following way:

1.) Divide the class into groups of 3 or 4 people per group.
2.) You will perform the experiment once for every member of your group. If you have 3 people in your group, you will do the experiment 3 times. Each time you do the experiment, you will rotate roles in the group.

**Roles:**
- Group coordinator
- Technician
- Experimental subject

3.) The group leader should make sure your group has all of the following equipment:
- Computer
- USB link
- Heart rate sensor (either a clip-on sensor or a chest-belt sensor)
- Saline solution - if you are using a chest-belt sensor.

4.) The technician should prepare the computer and sensors for the experiment using the following steps.
   a.) Start the computer.
   b.) Connect the USB link to the computer.
   c.) Connect the heart-rate sensor to the USB link.
   d.) A window will appear on the computer display that says, “I found a new EKG Sensor. How would you like to use it?”
   e.) Click “Launch Data Studio”.
   f.) Close the “Digits” window by clicking the red circle in the upper left corner.
   g.) Click “OK” in the message dialog box.
   h.) Under “Display” in the top bar, pull-down menu, choose statistics.
   i.) Under “Experiment” choose sampling options.
   j.) Choose the “Automatic Stop” tab.
   k.) Click “Time”.
   l.) Enter 60.000 in the time window.
   m.) Click “OK”.

5.) The technician should measure the subject’s heart rate using the sensor. This is the subject’s control starting heart rate. The group leader will record this in the data table provided.

**Steps for measuring heart rate using the heart rate sensors:**
   a.) Connect the heart rate sensor to the experimental subject. If you are using the clip-on sensor, clip the sensor on the subject’s earlobe. If you are using a chest-belt sensor, spread saline solution on the subject’s chest, and position the belt according to the instructions that come with the sensor.
   b.) Click the “Start” button. The start button is in the top left corner and has a green triangle.
   c.) When your run is complete, look in the statistics window and locate the mean heart rate. Record this value in the data table on the Student Worksheet.

6.) Once the control starting heart rate has been recorded, the subject should sit quietly at her/his desk for 1 minute. The group leader will keep track of time.
7.) Using the sensor, the technician will measure the subject’s heart rate again. This is the subject’s control ending heart rate. The group leader will record this in the data table provided.

8.) The technician should measure the subject’s heart rate using the sensor for a third time. This is the subject’s experimental starting heart rate. The group leader will record this in the data table provided.

9.) The subject will do jumping jacks for 1 minute. The group leader will keep track of time.

10.) Immediately at the end of this 1-minute period, the technician should measure the subject’s heart rate using the sensor again. This is the subject’s experimental ending heart rate. The group leader will record this in the data table provided.

11.) Repeat the experiment with everyone exchanging roles, until everyone has had a chance to be in every role.