Laboratory Investigation Name _____

Physics@Frisch: Form L#.#A Date _____ Period _____

Energy and Power

Problem

How powerful are you?

Introduction

The power output of motors, cars, and other machines is often listed on the machine or in its owner's manual. What about the power output of the human body? In this investigation, you will: calculate the work and power output while lifting an object; describe the difference between energy and power; and compare your power output with that of a common electric light bulb.

Materials *(per group)*

Data Collector or stopwatch; Masking tape; Meter stick; Object for lifting [such as a small barbell, loaded backpack, brick, or heavy book]; Scale.

Procedure

1. Select a location along a wall where your group will lift an object. Using a meterstick, measure 1.5 meters up from the floor and mark this height on the wall with a piece of tape.

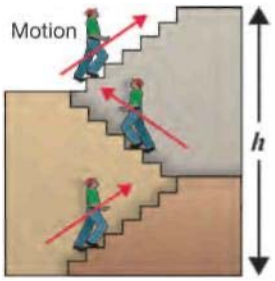
2. Measure the weight of the object in newtons and record the result in the data table on the next page.

3. Now lift the object from the floor until the bottom of the object is at a height of 1.5 meters, while another person measures the time (in seconds) that it takes to lift the object. You may choose to lift it quickly or slowly. Record your name and time it takes to lift the object in the data table on the next page.

4. Repeat step 3 until each person in your group has lifted the object and recorded the time.

5. This remainder of this investigation is done with your entire class. Select several people who know their weight to walk or run up a flight of stairs while others record their times. Record the names of the volunteers, and their weights in newtons. (1 pound = 4.45 newtons.) in the data table on the next page.

6. Locate a suitable stairwell and measure the vertical distance from one flight to the next by measuring the height of one stair and multiplying by the number of stairs students are climbing. Record the measurement in the data table on the next page.



7. Have each of the volunteers climb the stairs separately. Volunteers may climb the stairs slowly or quickly. Measure the time it takes for each of the volunteers to climb the stairs. Record the time it takes for each person to go up the flight of stairs in the data table on the next page.

Calculations

8. Calculate the work done in lifting the object in step 3. The force you should use is the weight of the object in newtons. Record the work done in the data table on the next page. Calculate each person's power in lifting the object. Record in the data table on the next page.

9. Calculate the work done and power output for each climber in step 7. Record the results in the data table on the next page.

OBSERVATIONS

Lifting an Object					
Student's Names	**Weight (N)**	**Distance (m)**	**Time (s)**	**Work (J)**	**Power (W)**
		1.5 m			

Climbing Stairs					
Student's Names	**Weight (N)**	**Distance (m)**	**Time (s)**	**Work (J)**	**Power (W)**

CONCLUSIONS

1. Why is the object's weight rather than its mass used in the calculation of work done? _____

_____

2. How did the amount of work done lifting the object by each person compare? Why? _____

_____

3. What made each person's power different? _____

4. A typical light bulb has a power of 75 watts. How does this compare to your power output while lifting the object? _____

_____

5. How did the work done by the different people climbing the stairs compare? In the first part of the Investigation, every group member did the same amount of work. Why was this not the case with the stairs? _____

_____

6. Which two factors determined each person's power when climbing the stairs? _____

_____

7. In physics, we usually measure work and energy in joules, but food energy is usually measured in Calories. One Calorie is equal to 4,186 joules. Select one of the people who climbed the stairs and calculate the work done in Calories. These Calories come from food that is "burned" by the person's body. You may be surprised by how small the number is. _____