lab 2.1
Who's Got the Power?

Objective

This lab explores the relationship between work and power. In Part 1, you will learn how to differentiate between the two. In Part 2, you will calculate how much work is required to use up the energy in a snack.

Approximate Time:
Part 1: 30 minutes
Part 2: 15 minutes
Analysis: 15 minutes

Part 1

Materials:

- Meter stick
- Stopwatch
- Stairs
- Calculator

Procedure

1. Your teacher will divide the class into groups. Fill in the data table below for member of the group as you do the calculations. Show your work throughout.

2. Find the vertical height in meters of the stairs that each member of your group will climb as part of this lab. Students will be going up and down the stairs to determine the amount of force, work, and power they used in climbing the stairs.

3. Determine the mass in kilograms of each person in your group or write down the weights assigned by your teacher

   Student 1:
   Student 2:
   Student 3:

4. Determine the force (in Newtons) each member of your group exerts on the floor.

   Student 1:
   Student 2:

Student 3:

5. Determine the work (in Joules) that each member of your group will do as he or she climbs the stairs.

6. Time each member of your group walking up the stairs. Repeat for a total of 3 walking trials per member of your group.

7. Time each member of your group running up the stairs. Repeat for a total of 3 running trials per member of your group.

8. Calculate the power output (in Watts) of each member of your group.

Data and Calculations

Formulas:

1 kg = 2.2 pounds
1 horsepower (hp) = 745 W
Force (N) = mass (kg) x acceleration (m/s^2)
Acceleration due to gravity = $9.8 m/s^2$
Work (J) = Force (N) x distance (m)
Power (W) = Work (J)/time (s)

Student 1 Name: _____

Walking	Distance (m)	Mass (kg)	Force (N)	Work (J)	Time (s)	Power (W)
Trial 1						
Trial 2						
Trial 3						
Average						

Running	Distance (m)	Mass (kg)	Force (N)	Work (J)	Time (s)	Power (W)
Trial 1						
Trial 2						
Trial 3						
Average						

Student 2 Name: _____

Walking	Distance (m)	Mass (kg)	Force (N)	Work (J)	Time (s)	Power (W)
Trial 1						
Trial 2						
Trial 3						
Average						

Running	Distance (m)	Mass (kg)	Force (N)	Work (J)	Time (s)	Power (W)
Trial 1						
Trial 2						
Trial 3						
Average						

Student 3 Name: _____

Walking	Distance (m)	Mass (kg)	Force (N)	Work (J)	Time (s)	Power (W)
Trial 1						
Trial 2						
Trial 3						
Average						

Running	Distance (m)	Mass (kg)	Force (N)	Work (J)	Time (s)	Power (W)
Trial 1						
Trial 2						
Trial 3						
Average						

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Analysis Questions

1. What is the relationship between the mass of a person and the amount of work he or she does?

2. What is the relationship between the speed at which a person climbs the stairs and the amount of work he or she does?

3. What is the relationship between the mass of a person and the person's power output?

4. What is the relationship between the speed at which a a person climbs the stairs and the person's power output?

5. Which student did the most work? Why did that student do more work than the others?

6. Which person generated the most power? Why was that person able to generate more power than the others?

7. 1 horsepower is equal to 760 Watts. Convert the power output of each person from W to hp. Show your work.

   Student 1:
   Student 2:
   Student 3:

   Which person has the greatest horsepower? Why?

8. Explain the difference between work and power.

Part 2

Background Information

One calorie is the amount of energy required to raise the temperature of one milliliter of water 1 degree Celsius. In the human body, the potential energy in the food consumed is converted into the kinetic energy of moving muscles. Food products list the calories in one serving, but these are actually Calories rather than calories. What is the difference? A Calorie is equal to 1,000 calories (1 kilocalorie).

Procedure

1. Choose one drink and one snack from the list.
2. Determine the number of Calories in each and calculate the total Calories of the two.
3. Convert Calories to calories.
4. Convert calories to Joules.
5. Calculate bodyweight in Newtons.
6. Determine how high a person of that weight would need to climb (in meters) to use up the energy selected.

Data and Calculations

Formulas:

1 Calorie= 1000 calories
1 calorie = 4.184 Joules
Force (N) = mass (kg) x acceleration (m/s^2)

Snack Calories	Drink Calories	Total Calories	calories	Joules	Weight (N)	Meters needed

Analysis Question

1. How high can a person of the weight selected climb using these calories? (Show your work.)

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Snack and Drink List

Snack Food	**Calories**
Granola bar	130
Donut, glazed	242
Donut, filled	307
French fries (large)	540
Crackers, cheese (18)	210
Crackers, Ritz (10)	175
Tortilla chips, 2 oz.	285
Potato chips, 2 oz.	302
Apple	65
Drink	
Soda (Coke, etc.)	120
Orange juice	180
Capri Sun	60