Power Lab

PSI Physics

Name:_____ Date:_____ Period:_____

Objectives:

- Apply concepts of conservation of energy, gravitational potential energy, work and power

Introduction:

What is power? What makes someone the most powerful? Is the strongest person the most powerful? Is the fastest person the most powerful? Well, you are going to find out.
You are going to have a group competition with the rest of the class. You're going to get into groups of about 5 people, and you will pick who you think is the most powerful. This person will be competing against the rest of the groups' representatives, and the team with the most powerful person will be crowned the victor.

Description:

To prove who the most powerful person is, students will be running up a set of stairs as fast as they can. As you may already know, power is defined as the amount of work done divided by the amount of time it takes to do the work. You will use your knowledge of this to figure out how powerful your representative is.

Group Roles (Preferably groups of 5):

Runner: will be running up the stairs
Recorder: call ready/set/go and will record times
Timers (3): will time the run

Materials:

- 3 Stop Watches
- Bathroom Scale (optional)

Procedure:

1) Decide each person's role.
2) Recorder: enter (in the table on the last page) the height of each step and the number of stairs (from the teacher)
3) Timers: Go to the top of the stairs AND Recorder: stay at the bottom
4) Recorder: Call ready/set/go for Runner and Timers to start
5) Runner: Go as fast as possible to the top AND Timers: Stop your watches as soon as the Runner hits the top.
6) Recorder: Collect all three times.

Data Collection/Analysis:

Use the data collection and data analysis tables at the end of this handout to…

1) Runner: tell how much you weigh (in pounds) and convert to mass in kg
_____ lbs ÷ 2.2 = _____ kg.

2) Calculate the force the runner uses to lift themselves (F = mg).
3) Find the average time it took for the runner to get up the stairs, t.
4) Calculate how high the top of the stairs is relative to the bottom, H (H = nh, where n is the number of stairs, and h is the height of one stair).
5) Calculate the vertical velocity of the runner, v (v = H/t).
6) Calculate the work done by the runner, W (W = Fd = mgH)
7) Calculate power by dividing work by the average time
8) Calculate power by multiplying the runners force and the runners vertical velocity

Analysis:

1) The man commonly associated with the concept of power (for his work marketing steam engines) was James Watt. You've just calculated the power of one your classmates in watts (W) named after the same man. But Watt's unit for power was the "horsepower" (hp). 1 hp = 746 W. What was your runner's power in hp?

_____W ÷ 746 = _____hp

DURING CLASS DISCUSSION:

2) Which runner….
   a. Was the strongest (used the most force)?_____
   b. Was the fastest? _____
   c. Was the most powerful? _____

3) Was your runner the most powerful? Explain why he/she was or was not.

Application:

4) 1 food Calorie is equal to 4184 J.
   a) Knowing this, about how many times would your runner have to go up the stairs in order to burn off a 500-calorie meal?

   b) How long would it take them to burn off the meal?

Data Collection Tables:

Mass, m (kg)	Number of stairs, n	Height of one stair, h (m)

Timer #	Time
1	
2	
3	
Average	

Data Analysis:

Average Time, t (s)	Force of runner, F (N)	Height of Stairs, H = nh (m)	Vertical Velocity, v = H/t (m/s)	Work W = Fd = mgH (J)	Power P = Fv (W)	Power P = W/t (W)