Work and Power With Stairs Lab Activity

This lab is designed to help you understand the difference between work and power. To do this you'll calculate the work required to move your body up a flight of stairs. After calculating the work required to make it up the stairs, you'll make two trips, one slow and one fast, so you can calculate and see the difference in power.

SAFETY NOTES:

This lab will require you to run or walk quickly up a flight of stairs. **Move only as fast as you feel is safe**. Check the path and make sure it is clear. Don't hurt yourself or others. If you have any health concerns about this activity, have another person walk up the stairs for you. If you are unable to walk up a flight of stairs and are unable to find a person to walk up the stairs for you, just send Ms. Clanton an email, and she will send you some data which you can use to fill in the table, perform calculations, and answer the questions at the end of the document.

MATERIALS:

- Meter stick
- Stopwatch
- Flight of stairs
- Computer
- Internet Connection

GOALS:

- Learn to calculate work and power
- Understand what a difference in power can mean

PROCEDURE:

1. The equation for work is magnitude of force multiplied by magnitude of displacement. Because the stairs will be lifting your weight, and weight is a force, we must get your weight in Newtons. To do this, multiply your weight in pounds by 4.448 and enter the information in the data table. This is the force part of magnitude of force multiplied by magnitude of displacement. If you don't want to use your real weight or don't remember your weight, you can make something up.

2. Next we need to get the magnitude of displacement part of magnitude of force multiplied by magnitude of displacement. Go to the stairwell and measure the height straight up to the next landing. **Note: Measure VERTICALLY up, NOT diagonally along the stairs.** The easiest way to do this is to find the mortar line in the bricks that is even with the next landing and measure from the floor to that line. See the image below. Enter the magnitude of displacement in the data table.

3. Compute the work to be done by the stairs on you by multiplying the magnitude of force by the magnitude of displacement (your weight in Newtons X the vertical height of the stairs). Enter this value into the data table.
4. Using the stopwatch, find the time it takes you to walk up the flight of stairs. Enter this time in seconds in the data table
5. Repeat step 4 but "run or walk quickly up the stairs" as fast as it is safe to do so. Enter this time in the data table.
6. Compute the power required to walk and run up the stairs by dividing work by time and enter these values in the data table.
7. Answer the eight "Conclude and Apply" questions following the data table.

Work and Power Data Table	
Your weight in pounds: =_____	Magnitude of force: Your weight in Newtons: (pounds x 4.448) =_____
Magnitude of displacement: Vertical stair height in meters: =_____	
Work in Joules: (weight in Newtons X vertical stair height in meters) =_____	
Time walking in seconds: =_____	Time running in seconds: =_____
Power in watts: (work divided by time) =_____	Power in watts: (work divided by time) =_____

<u>CONCLUDE and APPLY</u>:

1. Is the work you did walking and running up the stairs the same?

2. Why?

3. Which required more power, walking or running up the stairs?

4. Why?

5. How much work did it take to get up the stairs?

6. What was your GPE at the top of the stairs? (Multiply your weight in pounds by .454 to find your mass in kilograms then use GPE = mass x the acceleration due to gravity x stair height)?

7. How do the answers in number 5 and 6 compare?

8. Why?