Physics 30

How Powerful Are You?

Purpose: To calculate the work and power of a student going up a flight of stairs.

Background: The weight (N) of a person can be calculated by multiplying the gravitational field intensity (9.8 N/kg) by the mass of the person in kilograms. Work is the product of the applied force times the displacement in the direction of the force. The SI unit for work is the joule (J). Power is the rate at which work is done. The SI unit for power is the watt (W); a common but non-SI unit for power is the horsepower (hp) where 1 hp = 746 W.

Materials: measuring tape
stopwatch
bathroom scale (kg)
stairs

Procedure:
1. Measure the vertical height of the stairs in meters.
2. Determine your mass and then calculate your weight.
3. Quickly walk up the flight of stairs. Do not run or skip stairs. Use a stopwatch to record the elapsed time.
4. Calculate your power in watts and horsepower.
5. Record all your information and that of five other students in a data table.

Student	Mass (kg)	Weight (N)	Height (m)	Time (s)	Work (J)	Power (W)	Power (hp)

Questions:

1. If another student weighing the same as you took twice the amount of time to walk up a flight of stairs, it could be said that you used twice the power but did the same amount of work. Explain this statement.

2. If the vertical displacement of the stairs was doubled, how would this affect the work and the power needed to climb the stairs?

3. What are the physical characteristics of the most powerful person in your group?

4. What is the power in horsepower of a 60–watt bulb? What is the power in watts of a 180 horsepower automobile engine?

5. A 70 g bag of potato chips contains 1.6 MJ of energy. Working at your maximum power, how long would it take to burn this energy?

Conclusion: Your conclusion must respond to the purpose.