Name: _____

Background Information:

Work equals force times the distance through which the force acts. Force is expressed in newtons (N) and distance is expressed in meters (m). Work is expressed in newton-meters, or the simplification, joules (J).

The rate which work is done is called power. Power equals work divided by time. If work is in joules (J) and time is in seconds (s), power is expressed in joules/second, or the simplification watt (W). James Watt was a British scientist who invented the steam engine. To find out how the power of his engine compared to that of a horse, Watt measured how fast an average horse could do work. He found the answer and expressed the amount of the work performed per second as a horsepower. One horsepower is the equivalent of 746 W.

PT1.Stair-Climbing Power

Objective:

1) To find out how much power you use when climbing the stars.
2) To practice calculating work and power.

Materials:

scale metric ruler stairs stopwatch

Procedure:

1) Measure your weight using the scale. Weight should be expressed in newtons. Convert pounds to newtons by multiplying pounds by 4.45. Convert kilograms to newtons with Newton's 2nd Law (F=ma). Multiply kilograms by the acceleration due to gravity.
2) Measure the height of one stair (in meters).
3) Count the number of steps you will be climbing—and multiply this by the height of a step to find the total height, in meters.
4) Climb the stairs as quickly and as safely as possible while your partner times you. Record the time as accurately as possible. **CAUTION: Be very careful. Make sure you hold onto the hand rail.**
5) Repeat step #4 twice, completing two more runs. **CAUTION: Be careful, if you are feeling overly exerted, do not continue.**
6) Switch roles with your partner and repeat steps #4 & #5.

Weight (N)	
Height of one step (m)	
Number of steps	
Total height of stairs (m)	
Time of climb 1 (s)	
Time of climb 2 (s)	
Time of climb 3 (s)	

Observations:

1) Were the three climbing times roughly the same, or did they vary considerably?

2) Did you feel as if you exerted the same effort on each climb? Explain.

Analysis:

Calculate your work and you power for each of the three climbs:

	Work (J)	Power (W)
Climb 1		
Climb 2		
Climb 3		

1) Was the amount of work you did for each trial the same? Why?

2) Was the amount of power you expended the same for each trial? Why or why not?

3) If you had climbed more slowly, how would the work have been affected? How would the power output have been affected? Explain you answer.

4) Compare your power output with the output of a horse by calculating your horsepower. To figure out your horsepower divide your **wattage** power by **746 watts/ hp.** This final step will give you your ***Horsepower.***

hp 1: _____ hp 2: _____ hp 3: _____

So how do you rate? Can you light up a light bulb? Mow a lawn? Beat a car on a race track? :)

Do the research and find out the horsepower for the following common items. Be sure to include your source for your information.

Object	Wattage	Horsepower	Information Source
Lawnmower			
Light bulb			
Microwave Oven			
Bayliner boat			
Toyota Prius			

. (Do you think you could keep up that power level for hours, like horses do?)

Conclusions:

1) How does your power output in climbing the stairs compare to the power output of a 100-watt light bulb? If your power could have been harnessed and the energy converted to electricity, how many 100-watt bulbs could you have kept burning during your climb?

2) How do you calculate the amount of work done? the amount of power exerted?

3) What is the difference between work and power?

4) Two people climbed to the roof of a building. The old person walked up a gentle ramp. The young person climbed up a steep spiral staircase. Which person did more work? Explain.

Note: This lab was adapted from Addison-Wesley