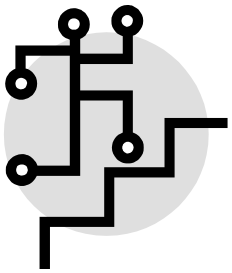
Name_____



Work & Power

Questions:

1. Do you do more work climbing stairs quickly or climbing stairs slowly?
2. Does it take more power to climb stairs quickly or climb stairs slowly?

Background Information: You are doing **work** when you use a force to cause motion in the direction of the force.

- Work can be calculated mathematically.
- The formula for work is: **Work = Force X Distance**.
- Time is not considered when calculating work.
- Force (or mass) is measured in newtons. Distance is measured in meters. Unit of measure for work = newton X meter or a newton-meter.
- A newton-meter is called a **joule**.

Work is the transfer of energy.

Another way of describing work is to say that work is done on an object when you transfer energy to that object.

If you put energy into an object, then you do work on that object.

Energy is the ability to do work.

Power is the rate at which work is done. It is the amount of work per unit of time.

- The formula for power is **Power = Work / Time**.
- Power = (Force X Distance) / Time.

Predictions:

1. _____

   _____

2. _____

   _____

Materials:

Calculator	Meter stick	Staircase
Bathroom scales		

Procedure:

1. Calculate the ***DISTANCE*** you will move:
    a. Count the number of steps. Record:_____
    b. Use the meter stick to measure the height of one step. Record: _____
    c. Calculate the total height of the staircase: **Height of staircase** = **height of one step** X **the number of steps.** Record: _____
    d. Convert the height of staircase from **centimeters (cm) to meters (m)**. To do this, **divide** the **height of the staircase** by **100**. It takes 100 centimeters to equal one meter. Label your answer in meters (**m**). Record: _____

2. Calculate the ***FORCE*** you will use to climb the stairs:
    a. Use the scales to find your mass in kg. (The scale will measure mass in kg). Record: _____
    b. **Mass** needs to be converted into **Newtons**. To do this use the following formula: **Force (Newtons) = mass X 9.8m/s^2** (9.8m/s^2 is the force of gravity)

$$\underset{\text{Force (newtons)}}{\_\_\_\_\_} = \underset{\text{Mass (kg)}}{\_\_\_\_\_} \text{ X } 9.8\text{m/s}^2$$

3. Climb the stairs ***slowly***. Have your partner use the stopwatch to time how long it takes you to climb the stairs. Record: _____
4. Climb the stairs ***quickly***. Have your partner use the stopwatch to time how long it takes you to climb the stairs. Record: _____
5. Calculate the amount of work you did as you walked up **slowly** up the stairs. Work = Force X Distance

    Work _____ = Force (from # 2) X Distance (from # 1)

6. Calculate the amount of work you did as you walked up **quickly** up the stairs. Work = Force X Distance

    Work _____ = Force (from # 2) X Distance (from # 1)

7. Calculate the ***POWER*** needed to climb the stairs slowly.
    a. Power = Work ÷ Time

    Power _____ = Work (from # 5) ÷ Time (from # 3)

8. Calculate the ***POWER*** needed to climb the stairs quickly.
    a. Power = Work ÷ Time

Power _____ = Work (from # 6) ÷ Time (from # 4)

Data:

	Height of stairs (m)	Force to climb stairs (n)	Time to climb stairs (sec)	Work done climbing stairs (j)	Power to climb stairs (j/sec)
Slowly					
Quickly					

Data Analysis:

Make a bar graph to compare the amount of **work** done when climbing stairs slowly and quickly.

Make a bar graph to compare the amount of **power** used when climbing stairs slowly and quickly.

What do the graphs tell you about work and power?

_____

_____

_____

Questions:

1. When did you do the most work, when you climbed the stairs slowly or quickly?

2. What must change to change the amount of work done?

3. When did you use the most power, when you climbed the stairs quickly or slowly?

4. What must change to change the amount of power used?

Conclusion:
Write a short paragraph explain what you learned in this investigation. Answer your original questions and use actual data to support what you say.