

# Initial Project Idea

## Science Fair 2020/2021

**Names of all participants (up to 3 people\* -- see note below):**

*Please make sure every participant submits this 1st proposal.*

**James Lee**

**Question you are trying to answer:**

**How Does Load Resistance Impact the Power Output of a DC Motor?**

**Independent Variable:** *This is the variable you are testing*

**The load resistance of the circuit.**

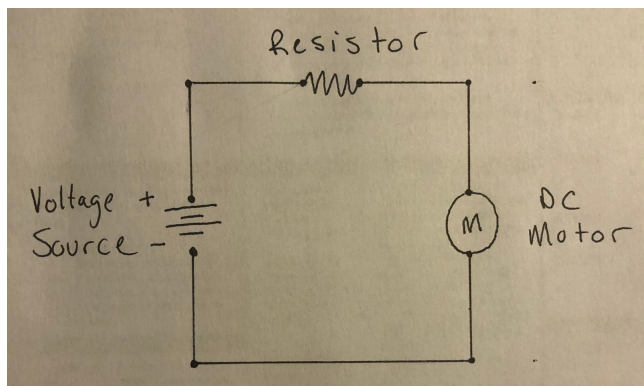
**Dependent Variable(s):** *This is the variable(s) you are measuring in response to your test.*

**The time it will take for a winch to lift a weighted string over a certain distance.**

**Experiment idea:** *Write briefly below about your proposed science fair project idea. Your experiment idea should include how you will conduct tests to find the answer to your question, as well as some comments about how you will record data, what data you will collect, and how you will control the experiment.*

**Before I talk about my experiment, let me introduce some of the concepts I've learned in school that led me to coming up with this:**

- According to Ohm's Law, the power in a circuit will decrease as current in the circuit increases, so long as the voltage stays the same.
  - Furthermore, it is also known that resistance and current are inversely related (as one increases, the other decreases).
    - So, for this reason, the more resistors that are added to a simple circuit, the less current will be flowing through it, and therefore the more power will be flowing through it.
- In physics, power  $P$  is described as the rate at which work  $W$  is performed over time  $t$ .
  - This value is expressed in Joules per second.  $1 \text{ J/s}$  is equal to  $1 \text{ W}$ . This is important to know because watts are also the electrical unit of power. Knowing this fact will allow me to be able to build an electrical system that will allow me to test Ohm's Law in real life.
- Work  $W$  is described as the force applied on an object  $F$  times the distance  $d$  the object travels parallel to the force.



Using a breadboard and jumper wires, I will create the electrical circuit shown above on the left. The majority of the pieces required for this experiment I already own or are relatively cheap to purchase.

The thing with breadboards is that it is really easy to connect and disconnect electrical components, so I will be able to replace resistors quickly and easily as I require without any soldering.

1. In my experiment, I will have a fixed resistor of a certain resistance in series with the winch system that is powered by a single DC motor. This winch system is connected to a weight of a specific mass by a string.
2. Using Ohm's Law as well as the resistance value of the resistor I am using, I will be able to calculate the theoretical value of power that the motor will exert.
3. I will turn on the circuit and measure with a stopwatch how long it will take the winch to lift the weighted mass. Using the equation  $W=Fd$ , I will calculate the Work that was performed by the winch. Then, using the equation  $P=W/t$ , I will calculate the experimental value of power that the motor had exerted.
4. I will perform step 3 (or more) times to reduce error.
5. Then, I will replace the resistor I used to one of a greater resistance, and repeat steps 2-4.

Because the motor I am using is not very efficient, the theoretical value will most likely be a lot higher than the experimental value. However, the reason why I am doing this is to be able to show that with an increase of load resistance will come an increase in power output. This will hopefully be supported by both my theoretical and experimental values.

Materials needed:

Vex 393 Motor  
Gearbox Bracket (To hold motor in place)  
Shaft  
String (to hold mass)  
Weight  
Several fixed resistors of varying resistances  
Bread Board (to make electrical connections)  
Jumper Wires (to make electrical connections)  
Voltage Source  
Timer

**Safety Concerns:** *What safety concerns do you have about your project, and how will you make sure to remain safe even with these concerns?*

There is a risk (albeit very negligible) of electrocuting yourself when the circuit is receiving power from the voltage source. For this reason, I will make sure to turn off the voltage source whenever replacing resistors. Also, I will make sure to not touch the circuit when it is activated.

**\*Important:** CCTEC is not allowing any pair or trio projects which require in-person meet-ups.

Independent projects are highly encouraged. You may only do a pair/trio project if your experiment doesn't necessitate students working together in person.