**WAMC Lab Template**

Math Concept(s): Direct Variation

Source / Text: Big Ideas Math , High School common Core 2015, Algebra 1

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**Attach the following documents:**

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

**Short Description (Be sure to include where in your instruction this lab takes place):**

This lesson take place just before learning graphing/writing linear equations. This lesson highlights the function y=kx often referred to as the "parent function"

**Lab Plan**

Lab Title: Direct Variation in electrical relationships

Prerequisite skills: basic computer skills, graphing points on X-Y plane.

Lab objective: This lab provides students an opportunity to graph points and understand direct variation. Later labs can extend this lesson to other linear relationships.

**Standards:** *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*

Mathematics K–12 Learning Standards:

CCSS.MATH.CONTENT.HSF.LE.A.1.B

Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

Standards for Mathematical Practice:

Practice 1: Make sense of problems and persevere in solving them.
Practice 2: Reason abstractly and quantitatively.
Practice 4: Model with mathematics.
Practice 5: Use appropriate tools strategically.
Practice 6: Attend to precision.
Practice 7: Look for and make use of structure.
Practice 8: Look for and express regularity in repeated reasoning.

Technology

ISTE 1.4 Innovative Designer - Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

**LEARNING AND INNOVATION**
Creativity and Innovation
☐ Think Creatively
☐ Work Creatively with Others
☐ Implement Innovations
Critical Thinking and Problem Solving
☒ Reason Effectively
☐ Use Systems Thinking
☐ Make Judgments and Decisions
☐ Solve Problems
Communication and Collaboration
☒ Communicate Clearly
☒ Collaborate with Others

**INFORMATION, MEDIA & TECHNOLOGY SKILLS**
Information Literacy
☒ Access and Evaluate Information
☒ Use and manage Information
Media Literacy
☐ Analyze Media
☐ Create Media Products
Information, Communications and Technology (ICT Literacy)
☒ Apply Technology Effectively

**LIFE & CAREER SKILLS**
Flexibility and Adaptability
☐ Adapt to Change
☐ Be Flexible
Initiative and Self-Direction
☐ Manage Goals and Time
☐ Work Independently
☐ Be Self-Directed Learners
Social and Cross-Cultural
☒ Interact Effectively with Others
☐ Work Effectively in Diverse Teams

**Productivity and Accountability**
☐ Manage Projects
☐ Produce Results
Leadership and Responsibility
☐ Guide and Lead Others
☐ Be Responsible to Others

## Teacher Preparation: (What materials and set-up are required for this lab?)

Materials

- Chromebooks / Computers (2 students per device preferred)
- Student Data Sheets

Set-Up Required:

- Login all computers / Chromebooks intended for use

## Lab Organization Strategies:

Leadership (Connect to 21st Century Skills selected):

- Students Access and Evaluate Information to determine the relationship of current and voltage to be linear.

Cooperative Learning:

- Students work and reason together.
- Students take turns making changes to their circuit.
- Students think-pair-share along the way.

Expectations:

- Students will raise their hand with any questions
- Students will ask for help from teacher before escalating any arguments amongst each other.

Timeline:

- Teacher ensures student devices are working (5 min)
- Teacher directs students to circuit lab (2 min)
- Teacher gives general info on circuits (open circuit, short circuit, etc) (2 Min)
- Students explore simulator for about (10 min)

- Students push reset icon (1 min) 
- Teacher gives lab instructions (25 min)
- Closing (5 min)



**Post Lab Follow-Up/Conclusions:**

Discuss real world application of learning from lab

- Taking measurements and interpreting data can help us make predictions for changing parameters.
- Direct Variation exists in many places and once you recognize it, you can extrapolate data from it.
- Electrical circuit understanding can help prevent malfunction and potential hazards.
- Extensions (future? Lessons for indirect variation and y=mx+b when b does not = zero)

Career Applications

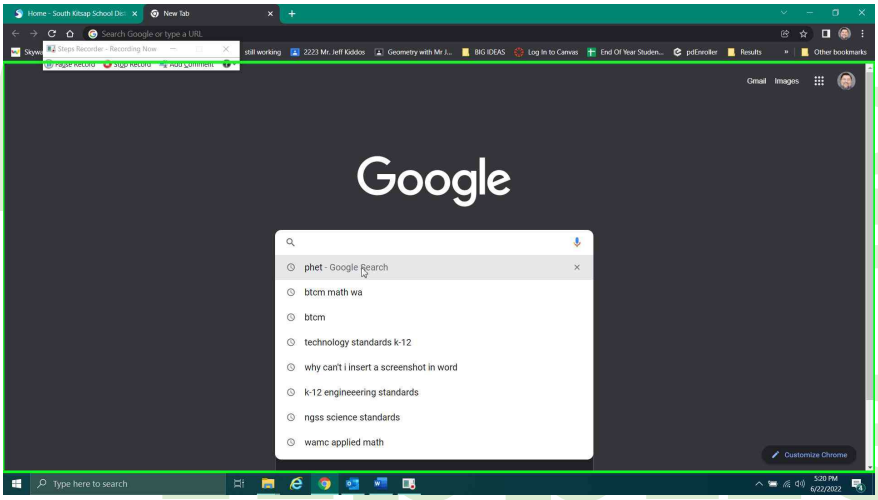
- Electrician
- Data analyst

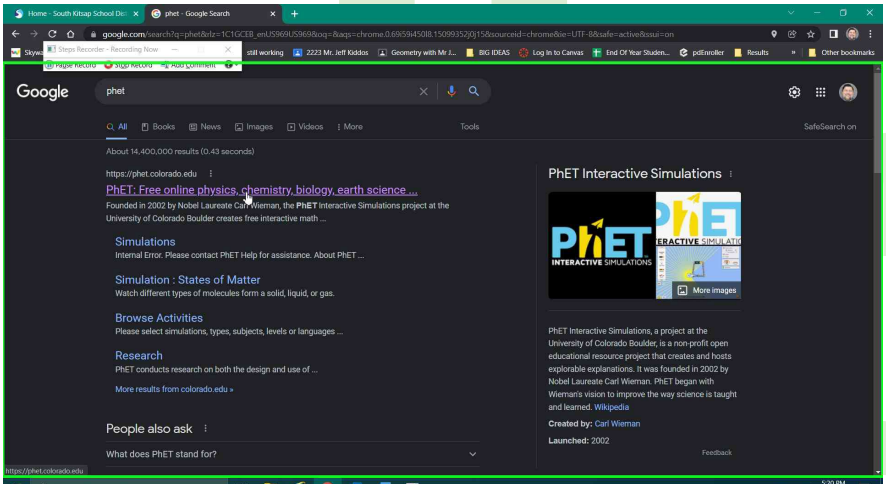
Optional or Extension Activities

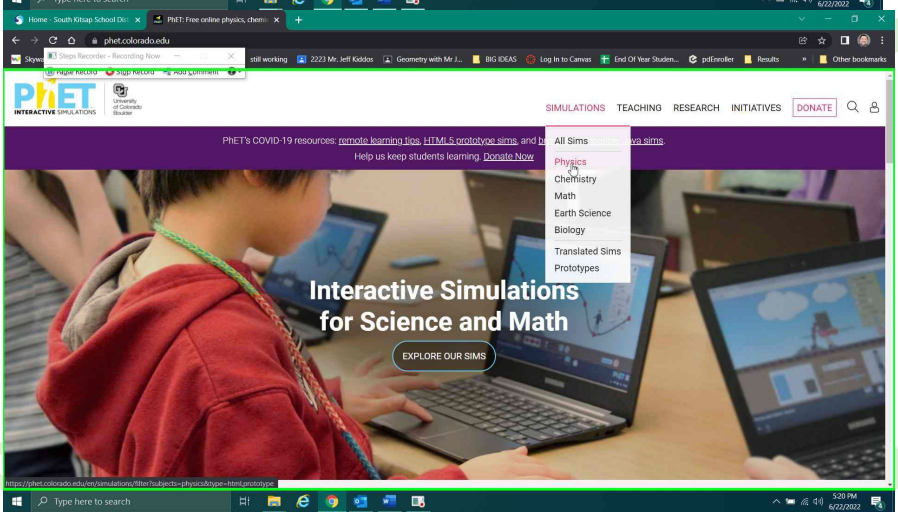
- Compare changes of resistance on current with a constant voltage to see Indirect Variation. (or save for next lesson)
- Have students write an equation for the relationship between current voltage and resistance (discuss ohm's law)
- Add a battery (or resistor) to have an activity without a y-intercept of (0,0) (or save for next lesson)
- OR ask students to conjecture about a circuit with a b not equal to zero. (or save for next lesson)

## Lab Instructions:

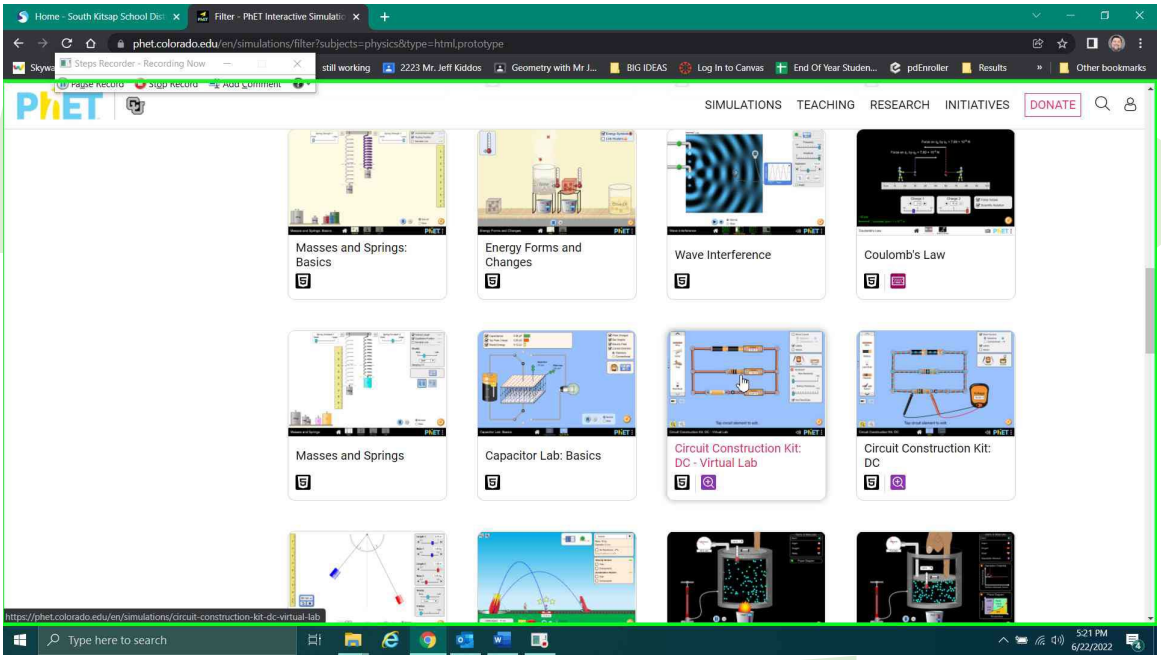
1. All devices should be internet ready
2. Go to PhET. Search under Simulations Click “Physics”

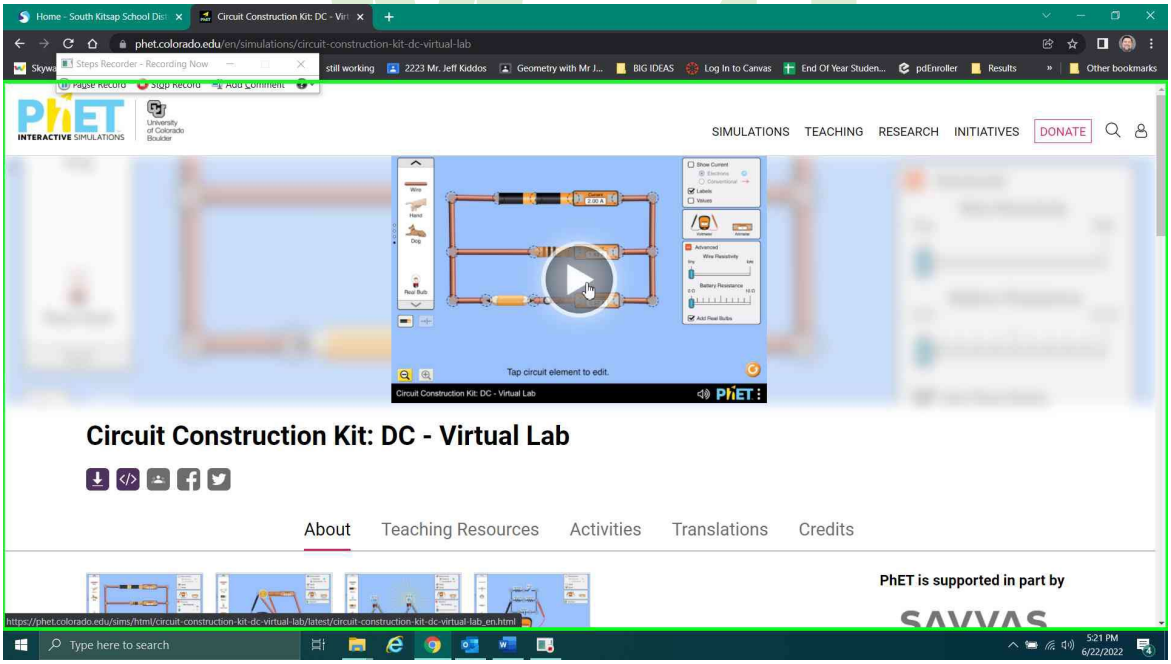


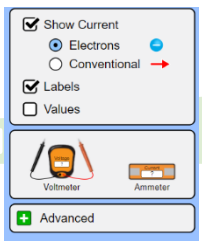



3. Scroll down to find "Circuit Construction Kit: DC - Virtual Lab simulation"
4. Left click on "Circuit Construction Kit: DC - Virtual Lab simulation"
5. Click the Play Triangle on the simulation.

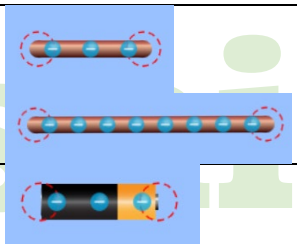
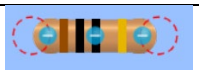
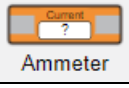
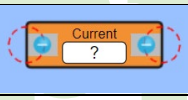



6. Have the options selected like this:



7. There are four components students will be using in this lab

| Image in menu | Once dragged into work area | Description |
|---|---|---|
|  Wire |  | Low resistance material that allows flow of electrons when connected in a closed circuit. (Elongated by dragging an edge) |
|  Battery | | Energy source that converts chemical energy into electrical energy when connected in a closed circuit. |
|  Resistor |  | Component with resistance to current. |
|   |   | Device that measures current (in Amps) when connected in series of a circuit. |

8. Instruct students:
   a. Components are selected by clicking-and-dragging them into the work area.
   b. Components and wires are connected by matching up the red dotted circles.
   c. The negative and positive sides of our battery must have a complete path for current to flow. This completes the "circuit".

9. Students are now given 10 min to explore the lab.

10. Circulate the room and encourage students to discuss with their partners things they notice about the lab.

*A circuit with no to low resistance is a short circuit and results in a high current situation.*

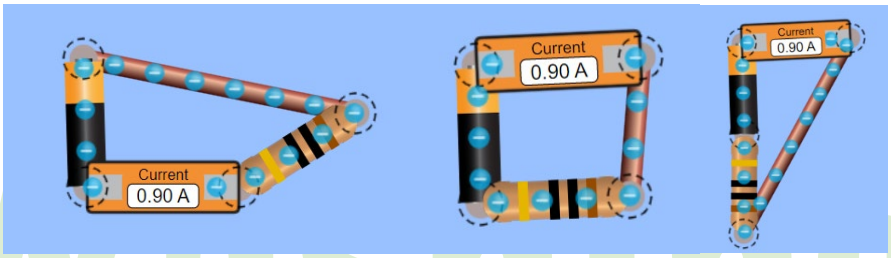
*The current produces enough heat to cause a fire in the components of the circuit.*

**Although once or twice is expected for curious students, repeated attempts at intentional short circuits should be highly discouraged as this is a realistic simulator of what would be an unsafe condition.**

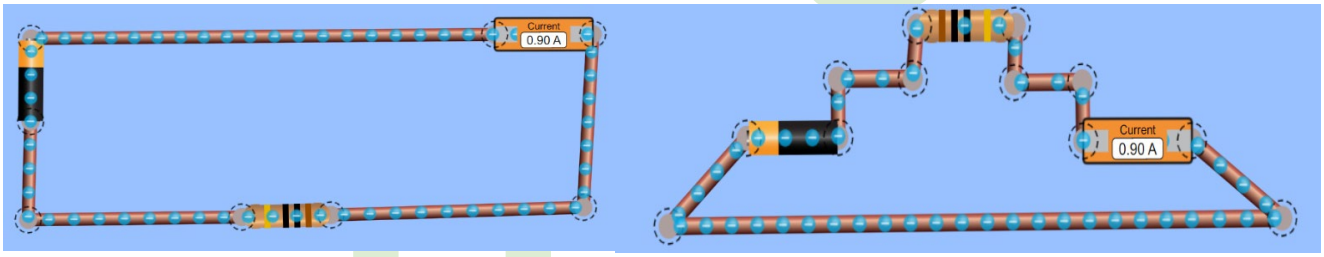
11. After 10 min encourage students to create a circuit using all 4 components.

*Students may use more than 1 wire, but not more than one of each of the other components*

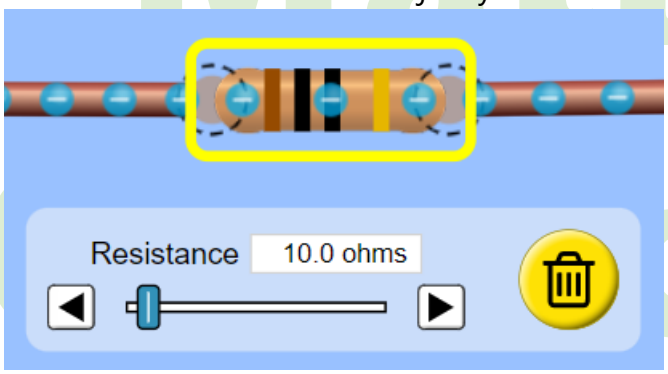
*Examples may include:*



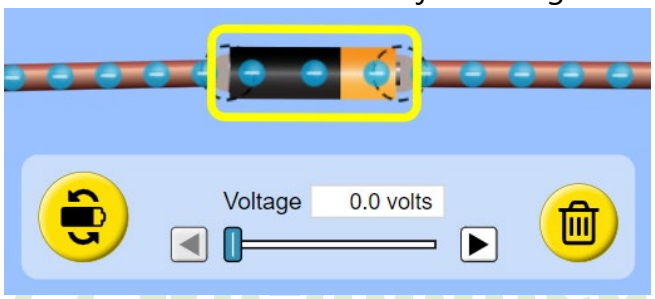

*Or use more than one wire like:*




12. Teacher circulates the room. Verify all students have a working circuit.
13. Instruct students:
    a. Click on the resistor in your circuit.
    b. Use the arrows or slider to adjust your resistance to 10 ohms




    c. Click on the battery (dc power source)
    d. Use the arrows or slider to adjust voltage to 0 (Zero)



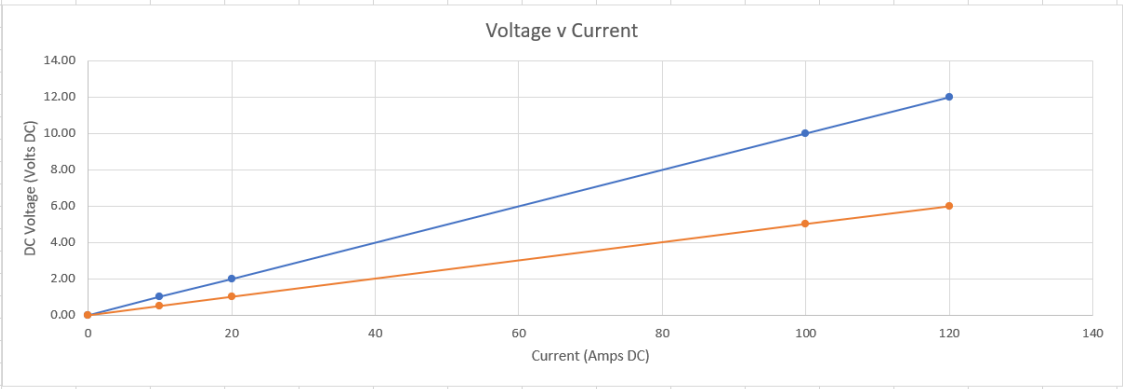

    e. Read and record Voltage and Current (from the ammeter) in your table and on your graph.
    f. Repeat steps d-e for values of 10, 20, and 30 volts

g. Students now predict ammeter current readings for 100 Volts and 120 Volts.
h. Students share their predictions with their partners.
i. Students repeat steps d-e for 100 Volts and 120 Volts to test their predictions.
j. Students discuss the results of their predictions.

14. Students record and share predictions of the effect of changing resistance.
15. Students repeat all of step 13 with a resistance of 20 Ohms.
16. Verify student data.

| Resistance= 10 ohms | |
|---|---|
| Voltage | Current |
| 0 | 0.00 |
| 10 | 1.00 |
| 20 | 2.00 |
| 100 | 10.00 |
| 120 | 12.00 |

| Resistance= 20 ohms | |
|---|---|
| Voltage | Current |
| 0 | 0.00 |
| 10 | 0.50 |
| 20 | 1.00 |
| 100 | 5.00 |
| 120 | 6.00 |



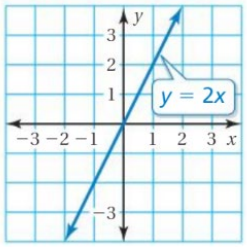

17. Have students record a DLIQ for the lab.
18. Use data from lab to teach about direct variation y=kx. Introduce slope.

**Key Idea**

**Direct Variation**

**Words** Two quantities $x$ and $y$ show **direct variation** when $y = kx$, where $k$ is a number and $k \neq 0$. The number $k$ is called the **constant of proportionality**.

**Graph** The graph of $y = kx$ is a line with a slope of $k$ that passes through the origin. So, two quantities that show direct variation are in a proportional relationship.




Leading questions for next lab/lesson:

What kind of relationship / data would we need to see a negative slope? What changes would you make to the circuit to produce that data/line?

How would negative voltages have affected our lines? Would that cause the slopes to be negative?

What kind of relationship / data would make the lines cross the y axis in a location other than (0,0) What changes would you make to the circuit to produce that data/line?

DC Circuit Direct Variation Lab Name_____

Three things I noticed during lab exploration:

1.

2.

3.

Sketch of my circuit



Tables / Graphs of Voltage v Current

| Voltage (DCV) | Current (DCA) |
|---|---|
| | |
| | |
| | |
| | |
| | |

Prediction for 100 V and 120 V:

DC Circuit Direct Variation Lab Name_____

Tables / Graphs of Voltage v Current

| Voltage (DCV) | Current (DCA) |
|---|---|
| | |
| | |
| | |
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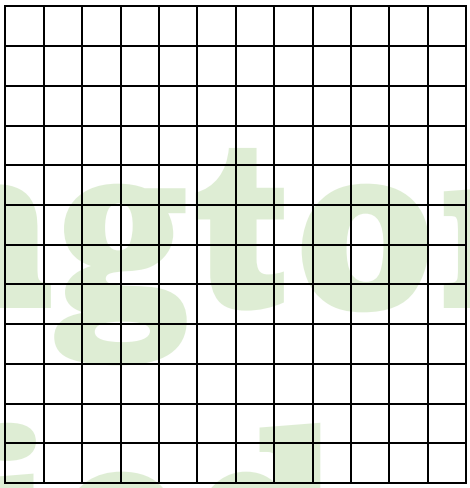

Prediction for 100 V and 120 V:

Tables / Graphs of Voltage v Current

| Voltage (DCV) | Current (DCA) |
|---|---|
| | |
| | |
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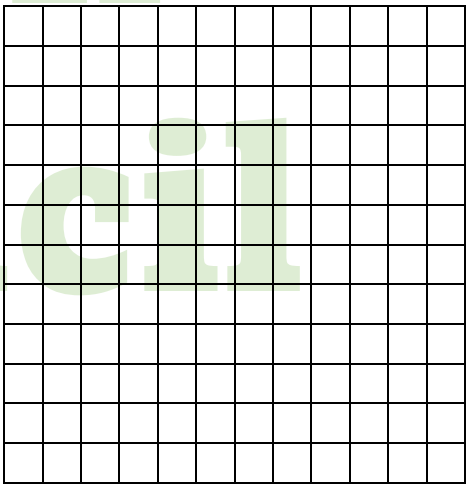

Prediction for 100 V and 120 V:

DC Circuit Direct Variation Lab Name_____

Tables / Graphs of Voltage v Current

| Voltage (DCV) | Current (DCA) |
|---|---|
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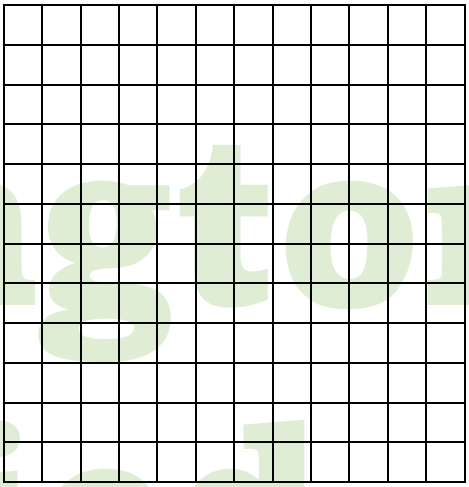

Prediction for 100 V and 120 V:

Define Direct Variation:

Define Constant of Proportionality:

Points to ponder……..

What kind of relationship / data would we need to see a negative slope?

What changes would you make to the circuit to produce that data/line?

How would negative voltages have affected our lines? Would that cause the slopes to be negative?

What kind of relationship / data would make the lines cross the y axis in a location other than (0,0)
What changes would you make to the circuit to produce that data/line?