Activity: Understanding Electric Potential

Model 1: Electric Field Hockey

Go to: https://phet.colorado.edu/sims/cheerpj/electric-hockey/latest/electric-hockey.html?simulation=electric-hockey

Goal: Understand how the charges you place interact with the positively charged hockey puck.

Example Image:	My Example:
	

1. Turn on the "trace" and "field" by selecting the boxes in the bottom part of the simulation, as you see in the yellow setting bar in the example above.
2. Explore the simulation by dragging positive and negative charges to the field from the top right corner. Press 'start' to observe the interactions between the particles and the positively charged puck and reset to move the puck back to its starting position. Use this exploration to answer the following questions.
    a. What do the red and blue arrows represent?

    b. How does the puck interact with positive charges?

    c. How does the puck interact with negative charges?

    d. The mass is set at 25. Increase the mass to at least 50. How does the increase in mass (green slide bar on bottom of simulation) affect the interactions?

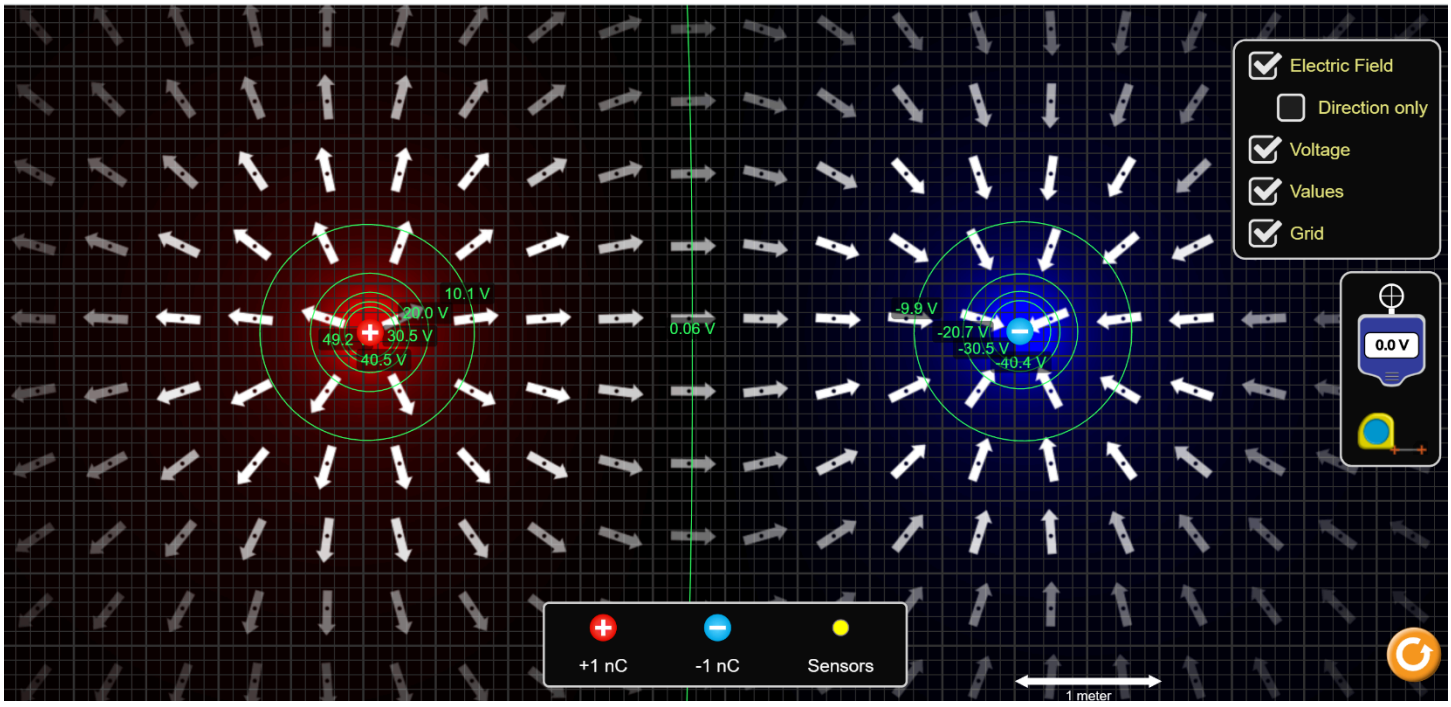
3. Once you understand the interactions- try Difficulty 1, 2, or 3! Insert a screenshot from any completed level into the "My example" box above.

Model 2: Charges and Fields

READ THIS! Two charges interact via the electrostatic force, a fundamental force that exists between all charged objects. Objects can become charged when they gain or lose electrons, which are small negative subatomic particles. When an object loses electrons, it becomes positively charges. When an object gains electrons, it becomes negatively charged. The electrostatic force is very similar to the gravitational force- but while gravity only attracts, this force can attract or repel objects. The area in which a charge would feel that force is called the electric field, similar to the gravitational field around Earth, the Sun, and other large masses.

Goal: See how electric fields are created and how it affects the electric potential, or voltage, in the surrounding area.

1. Go to https://phet.colorado.edu/sims/html/charges-and-fields/latest/charges-and-fields_en.html
2. Check the boxes to show the electric field, voltage, and values in the top right corner.
3. Recreate the image shown in the example below by adding a single positive AND a single negative charge to the field. Use the blue "equipotential" tool () to add at least 7 lines of voltage, separated by 10 V- it's okay if your numbers are not exact. Click the pencil to add the line. These are lines of "equal potential," or equal electrical potential energy if a charge was placed there.
4. Create the electric fields specified below by adding charges on top of each other to create multiple charges.

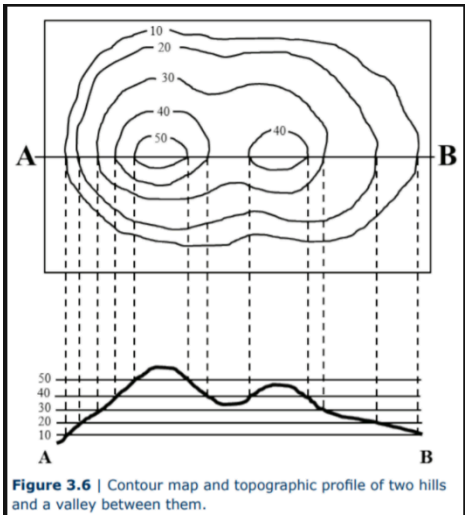
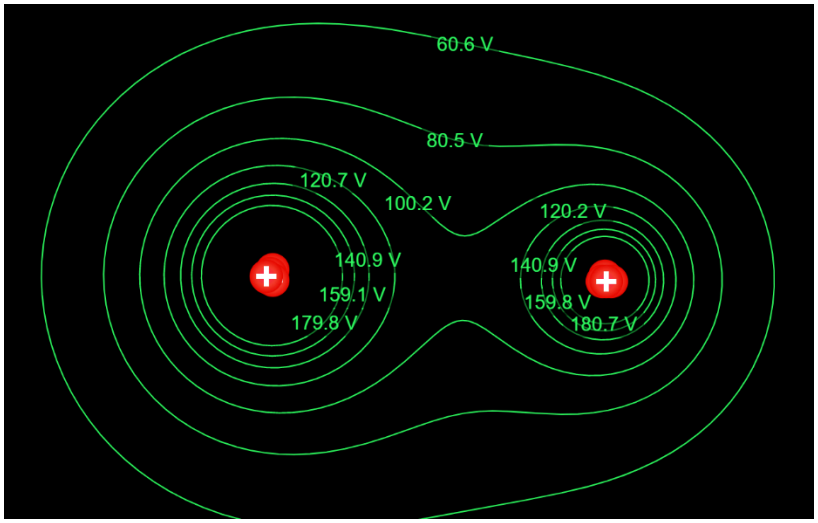
Two single, opposite charges. +1 and -1 
Two single, same charges. +1 and +1
One single and one double same charges. +1 and +2
Two double, different charges. -2 and -2

Answer the following questions:

1. The white arrows show the electric field, the brighter they are the stronger the electric field. What way to electric field lines point? Where are they the strongest?

2. Describe the map of the voltage, or equipotential lines. Where is the voltage positive? Negative? Where is the voltage the highest?

3. Maps of voltage can be compared to topographical maps, which are maps of elevation. What is similar about these? What is different?

Topographical Map Around two hills:	Voltage map around two charges:
 **Figure 3.6** | Contour map and topographic profile of two hills and a valley between them.	

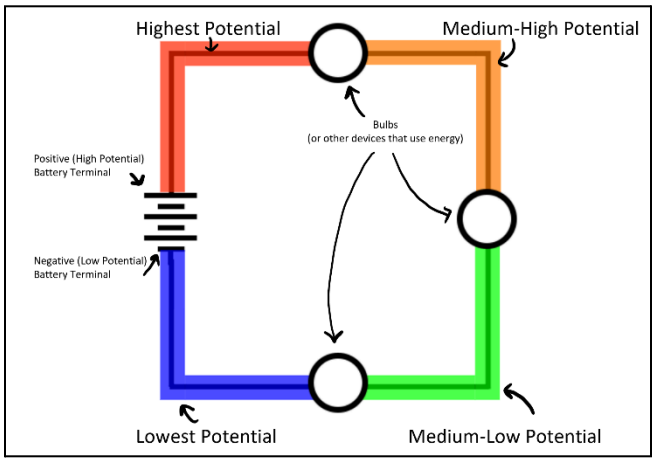
Model 3: Circuits and Electrical Potential

READ THIS! Power sources, such as batteries, have a high potential, positive, end and a low potential, or negative end. This creates a difference in electrical potential energy, so when they are connected a circuit- charges will flow due to the difference in electrical potential, much the way a ball will roll down a hill. The electric force though can either attract or repel, so while balls will never roll uphill due to gravity, the direction a charge falls depends on its sign. Positive charges will flow from high potential to low potential. Negative charges will do the opposite, flowing from low potential to high potential. In a circuit, we draw current the direction of positive charge flow- even though we now know electricity is the flow of negatively charged electrons in the opposite direction. Unfortunately, we discovered circuits before we discovered electrons- so the notation of electricity flowing from positive to negative stuck. On the journey between the high and low potential, any device that is in the circuit will use that electrical potential to do work- such as light a bulb, run a motor, charge your phone, etc.

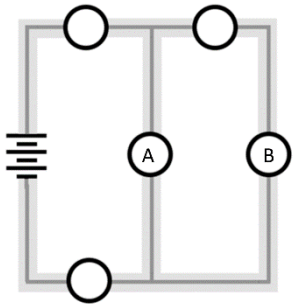
Goal: Map Electrical Potential in a Circuit

1. Go to https://www.physicsclassroom.com/Concept-Builders/Circuits/Know-Your-Potential/Concept-Builder

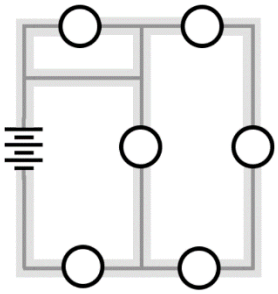
2. Click to launch the interactive, then on "Color Your Wires." In this simulation, you will use colors to map the potential in a circuit. The highest potential will be red, then orange, yellow, green, and the lowest potential is blue. See the example of the first activity, then try the rest of the four activities!



3. In the circuit shown below, do you think bulb A or bulb B would produce more light energy? Why?
**tip- this is the second circuit from the simulation, coloring your wires may help!*



4. In the circuit shown below, do you predict any of the bulbs would not give off light energy? If so, draw an X though it. Why?
**tip- this is the third circuit from the simulation, coloring your wires may help!*



Summary of Learning:

	Key Idea(s)- What did you learn? Provide 1-2 statements of your learning- these could be definitions, relationships, etc.	**Connections to Other Models-** How does what you saw here connect to the others?
Model 1: Electric Field Hockey		
Model 2: Charges and Fields		
Model 3: Know Your Potential		