Electric Fields Name:_____

Procedure: Open Charges and Field simulation http://phet.colorado.edu/en/simulation/charges-and-fields and click *play arrow*. When the Java information box opens choose run. Once the simulation opens, check the box next to *Show E-field*.

Part 1

Draw the field lines for the isolated charges below. Make sure you are sketching *continuous* field lines. Place a positive Charge in the middle of the screen.

1. Positive Charge:

Investigate and Analyze:

Move the charge vertically over top of a column of arrows. Move the charge horizontally over top of a row of arrows. Now move the charge between arrows (horizontally and/or vertically). Finally move the charge diagonally. As you move the charge around the screen what do you notice about the arrows surrounding the charge?

Take out an E-Field Sensor and place it near on the left and near on the right. Sketch the charge and the arrow for each location. Move the sensor far away on the left and far away on the right. Sketch the charge and the arrow for each location.

1. b. Positive Charge: E-Field Sensor Close left and close right

1. c. Positive Charge: E-Field Sensor Far left and far right

What happens to the direction of the arrow as it is moved from left to right?

What happens to the size of the arrow as it is moved from close to far?

2. Negative Charge:

Investigate and Analyze:

Move the charge vertically over top of a column of arrows. Move the charge horizontally over top of a row of arrows. Now move the charge between arrows (horizontally and/or vertically). Finally move the charge diagonally. As you move the charge around the screen what do you notice about the arrows surrounding the charge?

Take out an E-Field Sensor and place it near on the left and near on the right. Sketch the charge and the arrow for each location. Move the sensor far away on the left and far away on the right. Sketch the charge, E-Field sensor and its arrow for each location.

2. b. Positive Charge: E-Field Sensor Close left and close right

2. c. Positive Charge: E-Field Sensor Far left and far right

What happens to the direction of the arrow of the E-Field Sensor as it is moved from left to right?

What happens to the size of the arrow of the E-Field Sensor as it is moved from close to far?

Draw the field for each of the following Configurations:

4. Two Positive Charges: Separated horizontally by 5 field arrows

3. Two Positive Charges: Separated horizontally by 3 field arrows

Investigate and Analyze:

Turn on Show lo-res V. Move one charge on top of the other. What did you notice happened to the size of the Red Charge graphic? Try adding another positive charge on top.

Turn off Show lo-res V. Move one charge on top of the other. What did you notice about the direction of the field lines?

Move one charge back out to a separation of 5 and back into a separation of 3 (repeat as necessary).

What do you notice happening to the field lines direction and visibility?

What do you think is causing this effect?

What other separation would you expect a similar effect? Try it.

Repeat the set up for two Negative Charges. Compare and contrast the double positive to the double negative set up.

Similarities: Differences:

Draw field for two opposite charges:

5. Two opposite Charges: Separated horizontally by 2 field arrows

With the positive charge in the center of the screen move the negative charge out to a separation of 5 and back into a separation of 1 (repeat as necessary).

What do you notice happening to the field line direction and visibility?

What do you think is causing this effect?

Try moving the negative charge across to the opposite side. Keep moving the negative charge across and away from the positive charge. What did you notice happened to the field lines direction and visibility?

Try something else:

What did you try?

What did you find out?

Part 2 Application

Procedure: Open Electric Field Hockey simulation **https://phet.colorado.edu/en/simulation/electric-hockey** and click *play arrow*. When the Java information box opens choose run. Once the simulation opens, place a positive charge on the screen near the positive puck. Notice arrows start to originate from the puck once you introduce the charge.

What do you think these arrows represent?

What do you notice about the direction of the arrows as you move the charge around the puck?

What do you notice about the size of the arrows as you move the charge closer to and away from the puck?

Try to score a goal by moving the positive puck into the goal on the right hand side of the screen by placing the positive charge on the screen. Press start, watch what happens, if you succeed, great, if not press reset and try again.
How many tries did it take to make a goal?

What is the key to ensuring the puck enters the goal?

Now take out the positive charge and replace it with a negative charge.

What do you notice about the direction of the arrows as you move the charge around the puck?

What do you notice about the size of the arrows as you move the charge closer to and away from the puck?

Try to score a goal by moving the positive puck into the goal on the right hand side of the screen by placing the positive charge on the screen. Press start, watch what happens, if you succeed, great, if not press reset and try again.
Try to score again using a negative charge.

What is the key to ensuring the puck enters the goal?

Fill in the following law of static charges:

1.) Opposite charges _____ one another.

2.) Like charges _____ one another.

3.) All charged object attract neutral objects.

Challenge.
Uncheck the Puck is Positive and score a goal with one positive charge and with one negative charge.
Score a goal using two positive charges at two different locations.
Score a goal using two negative charges at two different locations.
Score a goal using two opposite charges at two different locations.
How many like charges can you use and still score a goal in under 5 trials?
How many opposite charges can you use and still score a goal in under 5 trials?
Score a goal on difficulty 1, difficulty 2, and difficulty 3