SHS Honors Physics
Electric Field Lab

Name: ______________________________
Date: ________________Period _________

Purpose:
In this lab you will investigate how a charge creates a field around itself, how test charges behave when placed in that field, and how the field various for different point charge distributions. Then you will apply these concepts to an Electric Field Hockey game.

Procedure:

1. Go the website http://phet.colorado.edu/en/simulation/charges-and-fields or http://phet.colorado.edu and type charges and fields in the search window. Click on the Icon arrow.

2. At the bottom of the screen you will see a box with a +1 nC , -1 nC, and “sensors”. Place a 1 nC positive charge and the yellow dot E-field sensor (show field strength) in the test area (black area on the screen). In the upper right hand, click the box for “Electric Field” to observe the white field lines (little arrows) and observe the sensor’s red arrow as you drag it around in the field.
    a. What do you observe?

    b. Replace the positive charge with a negative charge (remove charges by dragging them back into their box). How does this change the electric field (little white arrows)?

    c. By convention, field arrows point ___________________ from a positive charge and _________________ a negative charge. As the sensor gets closer to a point charge, the field strength created by that field ___________________.

3. Make sure the box is still check marked for “Electric Field” in the upper right of the screen. Place a positive charge in the left area of the screen and a negative charge in the right area of the screen, then add a E-field “sensor” between the two charges.
    a. Describe the electric field (white arrows) around this two-charge configuration. Draw this in the area below. Which way does the E-field “sensor” point? ________________________________

    b. What happens to the strength of the electric field (E-field sensor shows with an arrow) if you move the charges closer together?

c. What happens to the strength of the electric field (E-field sensor shows with an arrow) if you move the charges farther apart?

d. Put another negative charge directly on top of the one that is already in the test area. How does this change the electric field strength in the test area?

e. The basic law of electrostatics states that opposite charges will _____________. How might this be supported by the electric field in the test area?

4. Repeat step #3, but this time place two positive charges in the test area, then add a E-field "sensor" between the two charges.
   a. Describe the electric field (white arrows) around this two-charge configuration. Draw this in the area below. Which way does the E-field "sensor" point? ________________________________

   b. What happens to the strength of the electric field (E-field sensor shows with an arrow) if you move the charges closer together?

   c. What happens to the strength of the electric field (E-field sensor shows with an arrow) if you move the charges farther apart?

   d. Put another positive charge directly on top of the one that is already in the test area. How does this change the electric field strength in the test area?

e. The basic law of electrostatics states that like charges will _____________. How might this be supported by the electric field in the test area?

5. Set up a configuration in the test area with at least 3 charges of any sign combination, along with an E-field sensor and Electric Field box still checked.
   a. Draw the situation below along with Electric fields (white arrows) shown.

   b. Use E-field sensor and place it in various places. Can you find a place where the strength is zero? ________(yes, no) Add another sensor and see if you can locate a second location and even a third or fourth with additional sensors. When complete, draw this situation below with the locations of the charges and sensors.

6. Open the Electric Field Hockey simulation at http://phet.colorado.edu/en/simulation/electric-hockey and click Run Now and play. If you your computer won't open this site, skip and go to the next page.

   a. Setup your charges and go for the goal (turning on the Field and Trace may make things a little easier).

   b. Reset the simulation to try again with your charges in place.

   c. Challenge other students to duels.

   d. Try to use less than 12 charges total (how few can you use?)

Conclusion Questions and Calculations:

1. Closer to a point charge, the electrostatic field created is *stronger / weaker*.
2. Placed exactly between two **oppositely** charged point charges, a test charge (the sensor) will show *zero / minimum / maximum* force (N) or field strength (N/C).
3. Placed exactly on a point charge, the sensor will show *zero / minimum / maximum* field strength.
4. The point charges used in the simulation are ± 1.0×10^{-9} C (**n**ano**C**oulomb). If two such positive charges are placed 2.0 m away from each other, the force between them would be... (use formula)

   <u>*SHOW WORK HERE:*</u>

5. What is the magnitude of the electric field produced 2.0m away from **one** of the charges?

   <u>*WORK HERE:*</u>

6. A test charge of 4.5 C in a field of strength 2.2 N/C would feel what force?

   <u>*WORK:*</u>

7. A balloon is electrostatically charged with 3.4 µC (microcoulombs) of charge. A second balloon 23 cm away is charged with -5.1 µC of charge. The force of *attraction / repulsion* between the two charges will be:
   <u>*WORK:*</u>

8. If one of the balloons has a mass of 0.084 kg, with what acceleration does it move toward or away from the other balloon?
   WORK: