AP Physics 2 – Understanding of Electric Fields
Charges and Fields PhET Simulation Lab

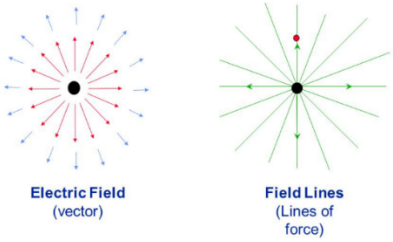
Today, you will use the Charges and Fields PhET lab to map the electric field around one or more point charges.

Beginning Observations

1. Open the Charges and Fields PhET simulation (linked in OneNote). Play with each of the tools within the simulation to see what they do.
2. What do the yellow "E-field sensors" show? (Include units)

3. Select "Electric Field" to turn on a vector field visualization.
   a. Electric Field vectors/lines point _____ positive charges and _____ negative charges.
   b. How does the color of the arrow relate to the strength of the field?

4. How can you make a charge of +2q? -3q?



Part 1 – Qualitative Understanding of Electric Fields around Point Charges

5. Draw the field lines for the scenarios below. Make sure you are sketching *continuous* field lines, though a vector field is shown in the simulation.

Two unequal, unlike point charges in a line	Two equal point charges in a line

Place a test e-field sensor anywhere on the screen for both scenarios and draw what you see.

6. When you have two like charges in a line – where is the electric field the greatest? Is there ever a point where the field will be zero?

7. When you have two unlike charges in a line – where is the electric field the greatest? Is there ever a point where the field will be zero?

8. Arrange the charges described below in any arrangement and sketch the electric field lines you see.

3 point charges, equal, like charges	4 point charges, 2 positive, 2 negative, all unequal	5 point charges all unequal, 3 positive, 2 negative

Part 2 – Quantitative Understanding of Electric Fields

The unit used for the electric field in this simulation is shown as V/m which means volts for each meter. You will use the equivalent unit of N/C, Newton's per Coulomb for electric field. Since newton is the unit of force and coulomb is the unit of charge, then the equation relating electric field to force and charge must be $E=F/q$, where E is the electric field, F is the force and q is the charge.

Set-Up: Turn on electric field, values, and grid

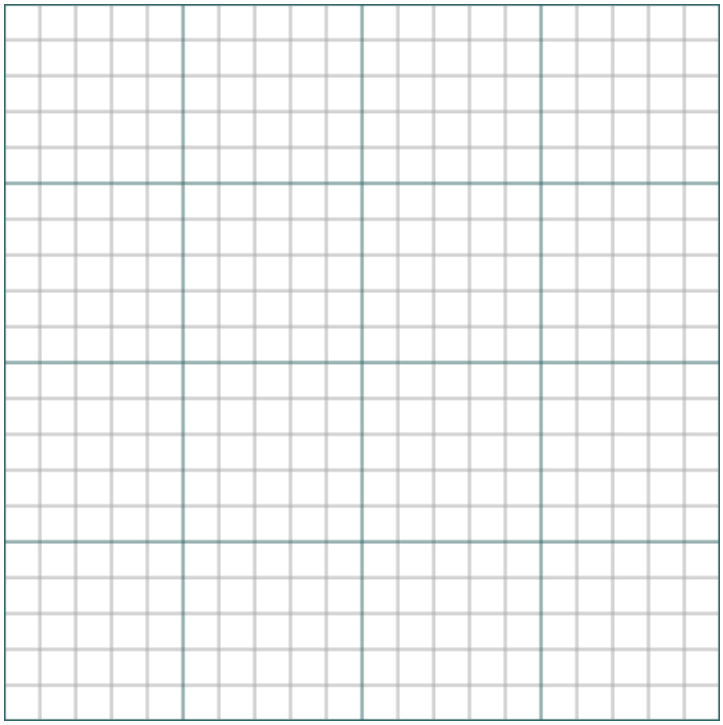
Procedure:

1. Place a single positive charge on an intersection of two major grid lines. Now drag a yellow sensor and move it around in the region surrounding the charged object, observing the indicator (vector arrow) as you move it closer and farther and when you have it above, below and to either side of the positive source charge.
2. Put the positively charged object back in the bin and take out a negatively charged object. Repeat your actions and compare what happens now with the e-field sensor (vector arrow), noting similarities and differences between the sensor indication with the positively charged object and the negatively charged object.
3. Place the sensor along one of the grid lines and leave it there.
4. Combine positively and/or negatively charged objects on top of each other, make quantitative measurements of the effects of the total charge on the magnitude of the electric field by checking the "show numbers" box and recording your results in the data table 1 below. **Create a graph of the magnitude of the electric field at a <u>fixed distance</u> from the source as a function of the net source charge**.
5. Create a charge of 3 nC, with the show numbers box checked, observe and record what happens to the magnitude of the field as you move the sensor to a location twice as far away, three times as far away, four times as far away, and five times as far away. Collect data to determine how the **magnitude of the electric field depends on the distance from the source charge and record in Data Table 2.**

Data Table 1: Magnitude of Electric Field vs. Net Source Charge

Distance between sensor and source charge**: _____ m**

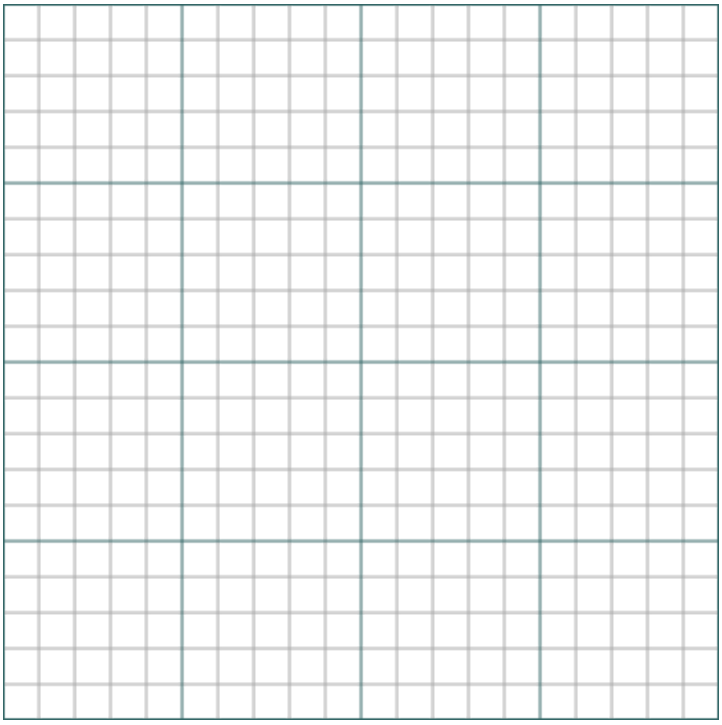
Net Charge (nC)	Electric Field (V/m)



Data Table 2: Magnitude of Electric Field vs. Distance from Source Charge

Magnitude of Source Charge: _____ nC

Distance (m)	Electric Field (V/m)



Analysis:

1. How does the magnitude of the electric field change as the magnitude of the source charge increases?

2. How does the distance away from the source charge effect the electric field strength?