Screen shot of simulation showing a pendulum created by two charged particles.

Worksheet: Coulomb Pendulum Simulation

Key Topic/Concept: Coulomb's Law and Newton's 2nd Law

Materials:
- One guide sheet for each student
- Computer with simulation downloaded
- Science Notebook

The EJS Coulomb Force simulation can be downloaded from the comPADRE National Digital Library if it not available on the local computer:
< http://www.compadre.org/OSP/items/detail.cfm?ID=9683>

Safety Precautions: No special precautions needed for this lesson.

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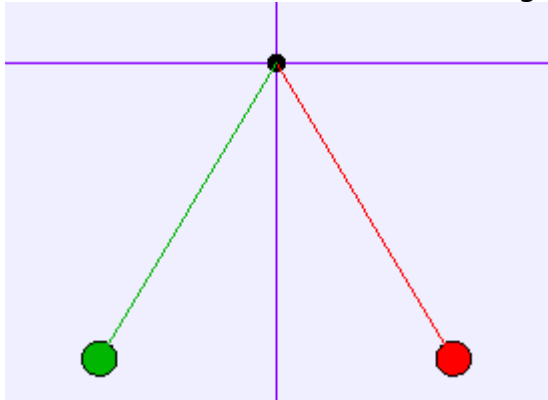## Physics Classroom Curriculum Alignment:
Static Electricity- Lesson 3: Newton's Laws and the Electrical Force

Introduction: Force Diagrams

Draw a force diagram for the pendulum below held at an angle. Show the x and y-components of the force.
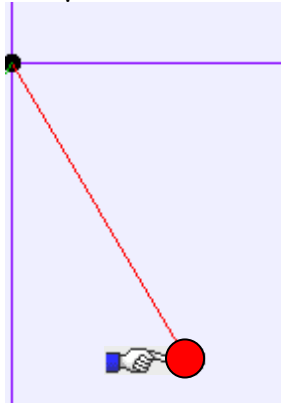
Draw a force diagram for the right-hand (red) charge which is held in place by the Coulomb force between it and the green charge.

The Coulomb force on the red charge is $F = kq_{red}q_{green}/d^2$. Show the distance d in the diagram.

Activity Guide: EJS Coulomb Pendulum Simulation

In this simulation, you can change the initial position of the charges, change the amount of charge on a particle and damp the motion.

1. Run the Applet file on-line OR run the simulation by double-clicking on the ejs_electric_sampler.jar and then navigating to the Coulomb Pendulum simulation and run the simulation by double-clicking on the green arrow. Push the play (▶) button to start the simulation.
2. Reset the simulation. With the same initial charge on each, push the ⸢v=0⸣ button until the charges balance. What is the angle?

   _____
   _____

3. The particles have the same mass. If you increase the amount of charge on only one of the charges, what difference do you expect in the angles where they will balance? Will it still be symmetric? Explain?

   _____
   _____
   _____

4. Now, use one of the sliders on the left to change the charge on either the red charge or the green charge. Push the ⸢v=0⸣ button until the charges balance. What are the angles?

   _____

   Are the charges symmetrically balanced? Explain.

   _____
   _____
   _____

5. The charge on each is given in µC (10^{-6} C) and the angle is given in degrees (from the vertical). The support cord is 1-m long. When the charges are balanced and at rest (use the [v=0] button as needed), record the angle and draw a force diagram for one of the charges. Use this to determine the mass of the charge (both charges have the same mass). Show your work: