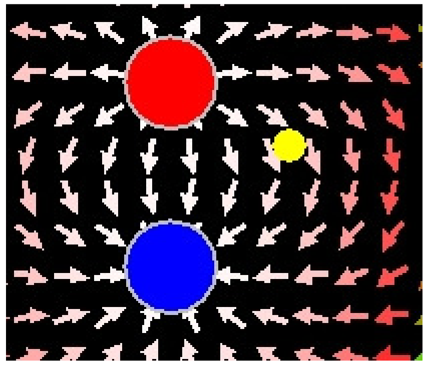


Screen shot of simulation showing the electric field of a dipole and a nearby test charge (yellow).

Lesson Plan: Dipole Trajectory Simulation

Key Topic/Concept: Electric Field and Newton's 2^{nd} Law

Materials:

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

The EJS Dipole Trajectory 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.

Written by: Anne J Cox
Edited by: Mario Belloni and Wolfgang Christian

Physics Classroom Curriculum Alignment:

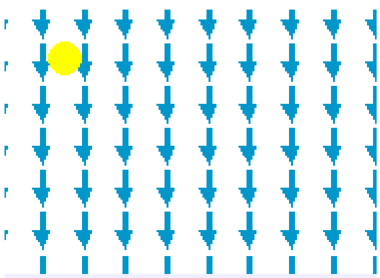
Static Electricity- Lesson 3: Newton's Laws and the Electrical Force
Static Electricity- Lesson 4: Action-at-a-Distance
Static Electricity- Lesson 4: Electric Field Intensity

Introduction: Field Review

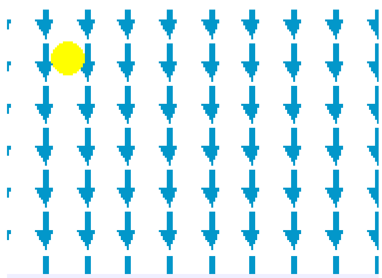
Review: What is an Electric Field?

What is a "test charge"?

Other forces that act at a distance can be described by a field. For example, the gravitational field near the earth's surface could be represented with field vectors as follows:



(a)



(b)

Sketch the trajectory of a particle a) released from rest in the field above and b) thrown horizontally. Even though the field vectors do not necessarily show the trajectory of the particle, what do they tell you about the trajectory of the particle?

Activity Guide: EJS Dipole Trajectory Simulation

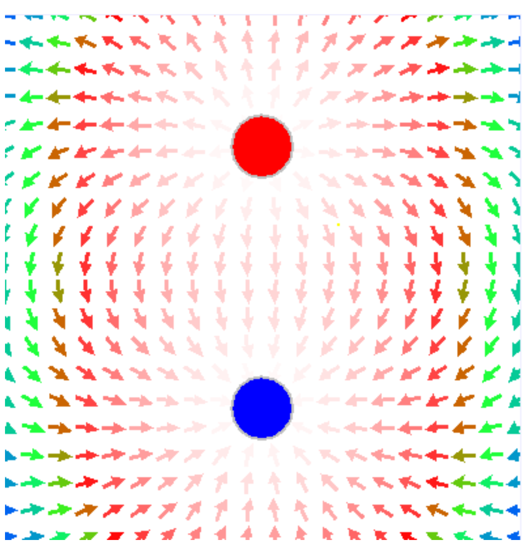
In this simulation, you can see the electric field around a dipole (red and blue charges). You can use the slider to change the separation between the charges. A test charge, with an adjustable initial position, is released from rest in the electric field when you push play. The arrow is its velocity vector.

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 Dipole Trajectory simulation and run the simulation by double-clicking on the green arrow. Push play ( ) to see the test charge move in the field.
2. Does the test charge follow the electric field vectors?

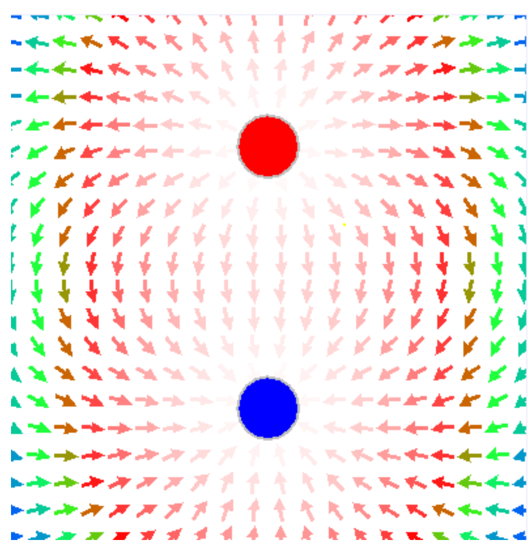
   ____
3. Many students find it surprising that the test charge does not follow the field or go in the direction of the arrows so we will explore this. Where can you place the charge initially so that it does follow the field arrows? Explain.

   ____

   ____
4. Reset ( ) the simulation and play it, pausing ( ) the simulation at some point during its path. Sketch the location of the test charge and its velocity:



t



t+Δt (a few time steps later)

5. Step () the simulation through a couple of time steps and sketch the location of the test charge, direction of the field vector and velocity vector at this new location in the diagram above. Describe or sketch the change in the velocity:

6. How does the direction of the change in the velocity (remember it is a vector: $\Delta\vec{v} = \vec{v}_1 - \vec{v}_2$) compare with the direction of the electric field vector at that point?

7. Using this information, how would you respond to a student who was surprised that the test charge did not necessarily follow the electric field vectors? (What incorrect assumptions might this student be making? What does this student need to know about the electric field?)