Three Dimensional Field Mapping

Purpose

To comprehend the relationship between electric field lines for a configuration of source charges and the resulting electric potential characteristics around such charges.

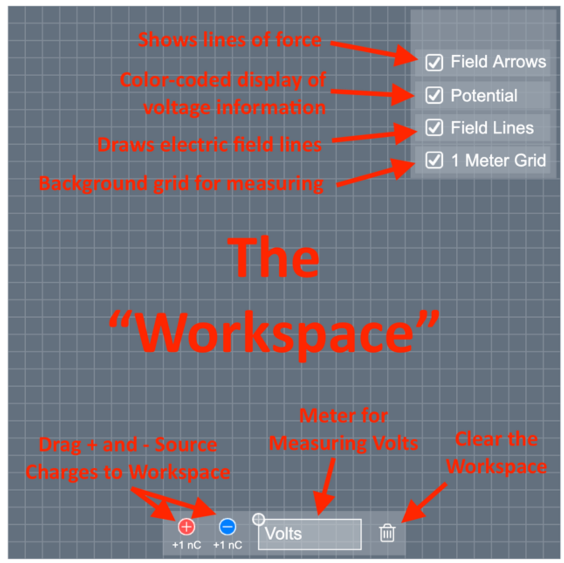
Getting Ready

Navigate to the **3D Field Mapping** Interactive at The Physics Classroom website:
https://www.physicsclassroom.com/Physics-Interactives/Static-Electricity/3D-Field-Mapping

Navigational Path:

www.physicsclassroom.com ==> Physics Interactives ==> Static Electricity ==> 3D Field Mapping

Getting Acquainted:



Begin by getting acquainted with the interface. It is described in the image at the right. Learn how to add + and – source charges to the grid. Learn how the **Trash Can** works. Also observe how a single charge can be removed by dragging it back onto the Control Panel at the bottom of the grid. Drag the "**Volt Meter**" onto the grid and observe how it measures the voltage at any location. Experiment with the four select boxes in the upper right of the grid to enable/disable the various displays. Finally, tap on the **Go to 3D View** button to view the situation in 3D. You will observe lines of force, color, and a 3-dimensional electric potential *topographic* map. Use the arrow keys (or your mouse) to rotate the map. Once you are comfortable with the interface, **Go to 2D View**, tap on the **Trash Can**, eable all four options (upper right corner), and begin **Activity 1**.

Activity 1: E and V in Two Dimensions

1. Drag a (red) + charge and a (blue) – charge onto the grid and place separate them by <u>about</u> 15 squares (meters). Observe the electric field lines. Complete:

   Electric field lines are directed from _____ (+, -) charges to _____ (+, -) charges.

2. Drag the volt meter about the grid. Look for a pattern in the electric potential (or *voltage*) values for locations near and far from the + and – charges. Complete:

   Electric potential (**V**) is a _____ (+, -) value near a + source charge and a _____ (+, -) value near a - source charge. Midway between opposite charges of a dipole, the electric potential is __________.

   V is most positive _______________ (furthest from, closest to) the + source and most negative _______________ (furthest from, closest to) the – source.

3. Suppose a test charge is moved from the + source to the – source. Describe in words how its **V** changes as it moves along this path.

4. The electric potential (**V**) is represented by shades of red and blue on the workspace. You will observe *nearly circular* regions surrounding the charges. Use the Volt Meter to measure the volts at a variety of locations along the perimeter of one of the larger red or blue near-circular regions. In words, describe what you observe.

5. The lines surrounding these regions are referred to as **equipotential lines**. This should make sense in light of your observations. Now focus on the locations where the electric field lines intersect the equipotential lines. What is the geometric relationship at these locations?

Activity 2: E and V in Three Dimensions

6. Tap on the **Go to 3D View** button. Observe the topographic map of electric potential and complete these statements:

   The movement of a positive test charge from a + source to a – source is a ___________________ (uphill, downhill) journey. This movement would require _____________ (no, lots of) work.

   The change in V per horizontal distance is _______________________________ (greatest nearest the source charge, smallest nearest the source charge, the same at all locations).