

Graphite potentiometer

Graphite conducts electricity because it is composed of electrically conductive sheets of graphene. Graphite is not a perfect conductor, it has some resistance since the individual sheets of graphene are not perfectly connected. We will make a potentiometer out of graphite “pencil lead” to control the amount of electricity arriving at an LED.

A potentiometer adjusts the voltage of electrical current. A potentiometer is a kind of resistor, or a material which limits or controls the flow of electrons. We will explore how to control the brightness of an LED based on the shape of drawn strips of graphite.

Materials

Sheet of paper

Graphite pencil (the softer the better, e.g. 2B or softer, although regular pencils can work. Soft graphite sticks used in art class are great).

9V battery

alligator clips

LED

Optional:

Multimeter, assorted resistors (for discussion)

Procedure

Using a soft graphite pencil draw solid shapes on paper, best are wide and narrow rectangles and small and large squares.

Attach the positive side (longer leg) side of the LED to the + terminal of the 9V battery using a wire and alligator clips. Attach a set of clips to the (-) terminal of the battery and to one edge of one of your graphite shapes.

(CAUTION: applying the clip directly to the – leg of the LED will supply current above the operating limits of the LED. You will fry the LED in this manner.)

Press the leg of the LED onto the graphite shape. You should be able to control the brightness of the LED based on the distance of the LED to the ground (-) clip. Once again, don’t directly connect the led to the battery without some graphite in between!

Discussion

What happens if you draw using different kinds of pencils or draw different shapes or thinner pads?

Test the brightness of the led at the opposite corners of different size squares: the brightness should be similar even though the distance the electricity travels is different. Why is this? (resistance is directly related to the distance between the electrodes and inversely related to cross sectional area of the conductive material)

Using a multimeter, measure the voltage drop across sections of the graphite strip. Measure voltage drops across various resistors. Why are resistors a key part of electronics projects?

Related standards:

- grade 7 #7, grade 8 #9: investigation and experimentation
- physics grade 9-12 #5 esp. a,b,c “Electric and magnetic phenomena”
- CA chemistry standards grade 9-12 #1 (esp. b, graphite as semi-metal and electron mobility), #2 (esp. a, chemical bonds discussed using conductive graphite activity)

Resources

“instructables” Pencil lead (graphite) LED potentiometer

<http://www.instructables.com/id/Make-a-Pencils-Lead-Potentiometer-Experimentatio/?ALLSTEPS>