**Lesson #2: Build Your Own Graphite Potentiometer (Sensor)**

**Student Handout**

**Purpose:**

**Materials:** pieces of paper, assorted sticks of soft graphite (min of 2B), alligator clips, 9V battery source, voltmeter, LED

**Procedures:** Modified from <http://www.instructables.com/id/Make-a-Pencils-Lead-Potentiometer-Experimentatio/>

1. Gather all materials.

2. Draw on your piece of paper a 7” long by 2” wide rectangle with your graphite stick and fill it in completely (dark as possible) with the graphite. Record pencil lead type you used on sheet. Alternatively, use a 3”x5” card and have them draw a 2” wide pathway with the graphite stick. Label the same way.

3. Set multi-meter to 20KΩ and check resistance. Record value in table below.

4. Use the multi-meter to check battery by first setting it to 20V on the dial. Touch red lead to positive (+) node of battery, and black lead to negative (-) node. It should read around 9V. Replace battery if lower than 8.5V or if battery gets hot.

5. Once battery checks out, attach red alligator clip to one end of the graphite rectangle, and black alligator clip to opposite end of step and test voltage reading with multi-meter. Record value in table below.

6. Test with an LED by 1st attaching one end of each alligator clip to the 9V battery, and the alligator attached to the negative (-) (shorter) side directly to the short end of the LED. Gently bend the longer end (+) of the LED so that it will make contact with your graphite rectangle. Leave the alligator attached to the positive (+) side detached as you will use it in the following steps.

**NOTE: DO NOT attach LED directly to 9V battery!!!** You will burn out the LED instantly.

7. Gently set the LED’s + lead to one end of the graphite rectangle and bring the unattached (+) alligator to the opposite end of the graphite rectangle. Record “dim” or “bright”, or what you see in table below.

8. Keep LED stationary, and move the unattached alligator closer to the LED. Record “dim” or “bright”, or what you see in table below.

**Results:**

|  |  |  |  |
| --- | --- | --- | --- |
| Position of Leads | Resistance (Ω ) | Voltage (V) | LED (Intensity) |
| Closest Together |  |  |  |
| Farthest Apart |  |  |  |

**Conclusion:**

1. What happens when you move the two leads closer together in the 1st test?

2. What happens when you move them farther apart?

3. What is really happening as the leads are moved farther apart?

4. What happens to the LED as you bring the unattached alligator clip towards the LED lead?

5. How does the graphite rectangle represent a potentiometer? Explain.

**Challenge:**

Given a smaller (3x3”) piece of paper, create a potentiometer circuit that will give you the same readings as the farthest setting of the 7”x2” rectangle you did earlier. Draw the design (but you can draw lighter or darker than before) you came up with below, write down which different pencil lead type you used, record Ω for multi-meter reads closest and farthest, and results for LED display.