KEY - LESSON 2: Introduction to Resistance

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Activity 1: Resistors in Series & Parallel

Build Project 7 – Light Emitting Diode

a. Turn on the switch and describe the brightness. Very Bright

b. Build Project 8. Reverse the direction of the LED (D1) in the circuit. What happens to the light? It does NOT light up.

Explain why? In a diode, the electrons only flow in one direction.

c. Replace the LED (D1) with a lamp (L1). Turn on the switch. Describe what happens. Explain the result. The lamp does not light because there is too much resistance and not enough current. Which uses more electric power (watts) a LED or incandescent light? Incandescent

d. Replace the lamp (L1) with the LED (D1). The resistor in this circuit is 100 Ω. Remove the R1 resistor and replace it with the 10K Ω resistor (R4). Describe what happens to the light when the switch is turned on. Compare it to the brightness from part A. It is dimmer. Why does this happen? There is more resistance.

Build Projects 98 & 99 – Simple Water Alarm & Simple Salt Water Alarm

a. Build the circuit but leave the jumper wires out of the cup. What happens when you turn on the switch? Nothing Why? The circuit is open or not complete.

b. Place the jumper wires in a cup of water. The circuit is now closed. (open or closed)

c. Based on this activity, is water an insulator or conductor? conductor

d. Add about 1 teaspoon of table salt to the cup of water and stir. Insert the ends of the jumper wires. Compare the sounds from the speaker without the salt and with the salt in the water. The sound gets louder because salt water is a better conductor than tap water.

Activity 2: Resistors in Series & Parallel

Build Project 110 – Adjustable Tone Generator

a. Turn on the slide switch. Describe the sound you hear. Low frequency (pitch) tone

b. Is the LED on or off? ON Is the LED bright or dim? DIM

c. Slide the switch on the variable (adjustable) resistor. Describe what happens to the tone? Higher frequency (pitch) tone Describe what happens to the LED brightness. It is brighter.

d. If a faucet controls the flow of water, a resistor controls the flow of electrons/current.

Build Project 172 – Red and Green Control

Describe what happens in each part:

a. With the slide switch **on** and the variable resistor set to the **left,** which LED is illuminated? RED
b. With the same set up as in part A, describe what happens when you also turn **on** the press switch (S2)? No change
c. With the slide switch (S1) **on** and the press switch (S2) **on**, describe what happens when you slide the variable resistor to the **right** side? The green LED is bright and the red LED turns off.
d. Turn **off** the slide switch (S1) and turn the press switch (S2) **on**. With the variable resistor slide on the **right**, describe what happens to the green LED. The green LED lights up.
e. When the variable resistor is on the **left** and the slide switch (S1) is **on**, explain why the red light brightens. Use the terms *current* and *resistance* in your answer. When the variable resistor switch is to the left, there is low resistance to the RED LED. This allows higher current so the light is bright.
f. Describe a place in your home where you may find a variable resistor in a circuit. A lamp with a dimmer switch or a fan with variable speeds.

Activity 3: Photoresistors

Build Project 272 – Photoresistor Control

a. With the switch on, describe the brightness of the LED. Not too bright
b. Describe the brightness of the LED when you limit the light entering the photoresistor with your finger. The light goes out.
c. Shine a flashlight directly on the photoresistor. What happens to the brightness of the LED? It gets brighter.
d. What is happening to the resistance and current as you cover the photoresistor? With less light to the photoresistor, the resistance is increased and the current is decreased.

Build Project 107 – Automatic Street Lamp

a. Press the press switch (S2) on and set the variable resistor so the lamp (L2) is barely lit. Slowly cover the photoresistor with your finger. Describe what happens to the lamp. The lamp gets brighter.
b. Explain what is happening to the current to the lamp when the photoresistor is covered. The current increases because the resistance is decreased.

Extension: Build Project 276 – LED Fan Rotation Indicator

a. Is this circuit wired in series, parallel or both? Both

b. Which way (clockwise or counter clockwise) does the fan turn when you turn on the slide switch (S1)? clockwise The positive side of the battery is connected to the positive side of the motor. The polarity of the motor determines the way it rotates.

c. Why does only one LED light turn on? The LED's are diodes. In this setup, they are in opposite directions. Only the green LED is connected with the polarity required when the slide switch (S1) is on.

d. Push the press switch (S2). The motor rotates counter clockwise (clockwise or counter clockwise) and the RED (red or green) LED lights up.

e. Now place the fan on the motor and turn on one of the switches but not both. One of the lamps is lit as the motor spins, but now the LED is dim. The motor needs a lot of current to spin the fan but only a small about of current without it (less resistance). In this circuit, a lamp is lit when the motor current is high, and a LED is lit when the motor current is low. Which has a higher resistance, the LED or lamp? lamp

Extension: Build Project 173 – Current Controllers

a. With the circuit complete, turn on the slide switch (S1). Describe the brightness of the LED. Medium brightness This circuit is in series. The 5.1K Ω (R3) controls the resistance. Trace the path of the electrons with your finger.

b. Turn off the slide switch (S1) and turn on the press switch (S2). Compare the brightness of the LED with just the press switch (S2) on. Dim, not as bright as with the slide switch on. Trace the path of the electrons in this circuit with your finger.

Placing resistors in series increases the total resistance, so the current is decreased to the LED.

$R_1 + R_2 = \text{Resistance}_{\text{series}}$ or in this circuit, 1KΩ + 10K Ω = 11K Ω

c. Turn on both switches. Compare the brightness with both switches on compared to only one switch. It is much brighter.