

## ELECTRIC CIRCUIT SCIENCE CHALLENGE

The science challenge questions are designed to relate science content to the FSEA projects. Some of the questions relate specifically to the project, others, though related, may go well beyond the project. Questions may vary in complexity but teachers and mentors are encouraged to introduce these concepts to students. The intent is to provide discussion material at the completion of the hands-on project. It is suggested that questions be handed out at the first session and then discussed by the students and facilitators at the final session. It would also be a good idea to give the students the questions with the answers after the discussion.

- 1. When assembling the circuit why is it important to be sure that all screws are tight and all wires make good contact?**

**Answer:** The buzzer requires a closed circuit in order to work. A closed circuit connects one side of the battery through the buzzer to the other side of the battery.

- 2. Why doesn't the buzzer sound when you don't touch the wire with the loop?**

**Answer:** Touching the wire with the loop closes the circuit. When the loop doesn't touch the wire the circuit is open and no current can flow.

- 3. What different forms of energy can you identify in this project?**

**Answer:** Stored chemical energy in the battery, electrons flowing down the wire in the form of an electric current, the mechanical energy of the vibrator in the buzzer the air molecules vibrating which makes the sound and finally your ear drum vibrating from the effect of the air molecules.

- 4. If you leave the loop touching the wire so that the buzzer continually buzzes. Why does it finally stop buzzing?**

**Answer:** The battery has a fixed amount of chemical energy stored. Each time current is drawn from the battery, some of the chemical is used. When all the chemical is used the battery is "dead" and will have no voltage to produce a current.

- 5. You will notice on the battery a (+) sign and a (-) sign. What do these signs mean on the battery?**

**Answer:** An electric current is a flow of electrons in a wire or other medium. The current flows from the + side of a battery to the negative

side. The electrons actually flow in the opposite direction from what we define as the current. On many devices such as on a car the + side of the battery must be connected to the right wire (usually red) and the minus side is usually connected to the black wire. You will notice the snap on the 9-volt battery can only be connected in one direction.

**6. If you were to touch the wire with the wooden handle instead of the loop, would the buzzer sound? Why?**

**Answer:** No, wood is an insulator, copper and many other metals are conductors. Only conductors have “free electrons” which will move down a wire when connected to a battery. Insulators are things like wood, glass, rubber etc.

**7. You have noticed different types of batteries. Many of the common flashlight batteries are about 1.5 volts. What does volts on a battery mean?**

**Answer:** The voltage of a battery is the electrical “force” with which the electrons are “pushed”. Wires, light bulbs and other devices have a certain amount of resistance to current flow. For example if you tried to connect a house light bulb with your 9-volt battery very little current would flow and there would be no light. House light bulbs are made for a very high voltage of 110 volts. Light bulbs in a car for example are made for 12 volts as cars use 12 volt batteries. The buzzer in the project is designed for 9 volts. It will not work with a 1.5 volt AA battery and would be destroyed if connected to a 110-volt house circuit.

**8. What is the relationship among current, voltage and resistance in an electrical circuit?**

**Answer:** As one would expect higher voltage would lead to more current and higher resistance would result in less current. The precise relationship for current in a circuit is given by Ohm’s law, which is stated as follows:

$$\text{Current} = \text{Voltage}/\text{resistance}$$

For example if the resistance of the buzzer is 450 Ohms, the current would be:

$$\text{Current} = 9/450 = 0.02 \text{ amperes}$$

If attached to a 1.5 volt battery:

$$\text{Current} = 1.5/450 = 0.003 \text{ amperes}$$

9. How much current would flow in the buzzer if it were connected to a 12-volt car battery?

**Answer:**  $12/450 = 0.027$  amperes/