SEMICONDUCTORS

In this activity students will investigate the properties of a semiconductor device known as a diode.
After completing this activity students will be able to:

• Recognize a diode as a one way conducting device.
• Describe alternating current and the use of a diode to convert it to direct current.
• Articulate the roles of electron and hole charge carriers in diodes and transistors.
• Describe the role of electric potential in the operation of a field effect transistor (FET).
Prior knowledge needed to complete this activity

- Understand the role of a capacitor in a circuit.
- Understand the role of a resistor in a circuit.
- Possess a general understanding of how charges move through a circuit.
- Understand the basic properties of the elements of Group 4 in the periodic table.
- Be able to set up a basic direct current circuit.
- Describe the transfer of energy between a capacitor, battery and resistor.
- Be able to read and draw a basic schematic diagram.
- Compare and contrast insulators and conductors.
Supplies needed for pairs of students

- 2 1-amp diode
- 2 bicolor LEDs (Radio Shack #276-012)
- 3 cells
- 2 round bulbs (Pasco bulb type #14)
- 2 long bulbs (Pasco bulb type #48)
- 1 capacitor
Supplies to share amongst 2 pairs of students

- 1 hand crank generator (Pasco Genecon©)
- 1 rubber rod
- 1 fur cloth
- 1 weight hanger
- 1 plastic comb
- 1 met-oxide-semiconductor field effect transistor (MOSFET) (Radio Shack #276-2072)
- 1 silk cloth
- 1 beaker
I. The role of diodes in a circuit

1. In the diagram shown, the circuit component on the far right side is called a diode. Construct this circuit exactly as shown. You will use this circuit to explore the conduction properties of a diode.
2. Record your observations in the space provided

3. Now turn the diode around such that the painted band is now the positive end. Record your observations in the space provided.
4. In terms of the orientation of the diode, when is the diode a conductor: When the band is oriented away from the positive terminal or towards the positive terminal?

5. Sketch a picture of the diode, showing the band. Use an arrow to show the direction in which the diode will allow conventional charge flow.
At this point in the lesson the teacher will:
- introduce and explain the diode symbol.
- explain how a diode works:
  a) A diode is a conductor in one direction
  b) The naming of a semiconductor based on the type of mobile charge present
  c) Explain how the diode is formed
  d) Explain the situations labeled forward bias and reverse bias.
  e) Dialogue: Where is the charge moving through a conductor coming from?
I(A). Converting AC to DC using a diode

In the diagram on the right the component featured on the far right is called an LED. Construct this circuit exactly as shown.

1. Rotate the handle clockwise 90 degrees once, then clockwise once. Record your observations.
2. Add the diode as shown in the diagram on the left. Observe the LED as the handle moves in both directions. Record your observations. **Alternate idea:** Substitute a bulb for an LED.
3. Place the capacitor into the circuit as shown on the left. Record your observations.

**This set-up creates a voltage doubler, so expect an interesting result!!**
Summation of activity I

In the previous activity, students explored the question, “How are diodes used in circuits?”

They used a diode to discover their behavior as a “one way valve in a circuit”.

Students simulated alternating current using the Genecon connected to an LED.

A rectifier circuit is built using a diode.
For review and discussion

- How does a diode control flow in a circuit?

- A diode only allows current to flow through in one direction. In a diode, does charge flow as conventional current, as electron flow, or some other current. Explain your reasoning.
Recall the circuit with the following components: A Genecon, a diode, an LED and connecting wires. When the crank is turned clockwise, the red/green bicolor LED glows red.

a. What happens if the diode is reversed and points to the left, and the generator is still turned clockwise?

b. What happens if the crank is reversed (turned counterclockwise) while the diode points left?