Lesson Plan: Conductivity Check

Presenters: Dr. Ken Scott & Ms. Paulette Dykes (ABD)
Trenholm State Community College
Patterson Campus

Session 1: Monday, 5 December 2016
Room: E101D
Time: 2:00 – 3:30pm

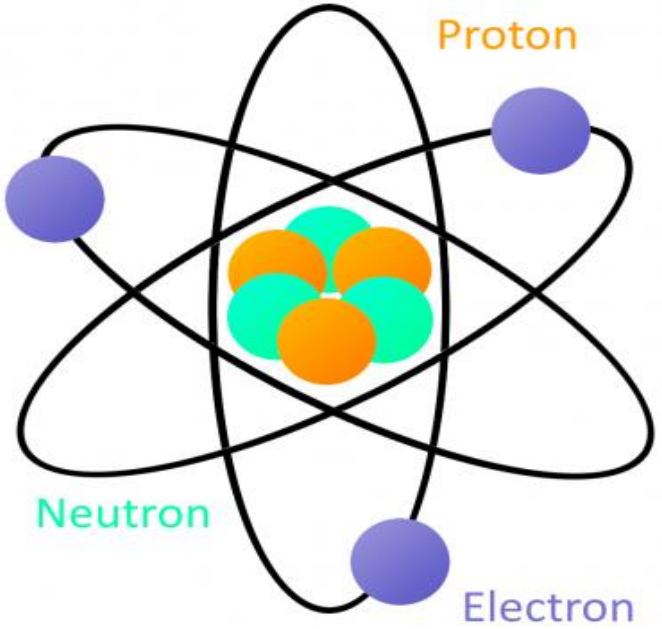
Session 2: Wednesday, 7 December 2016
Room: E101D
Time: 2:00 – 3:30pm

Participant ID: _____

Resources & Objectives:

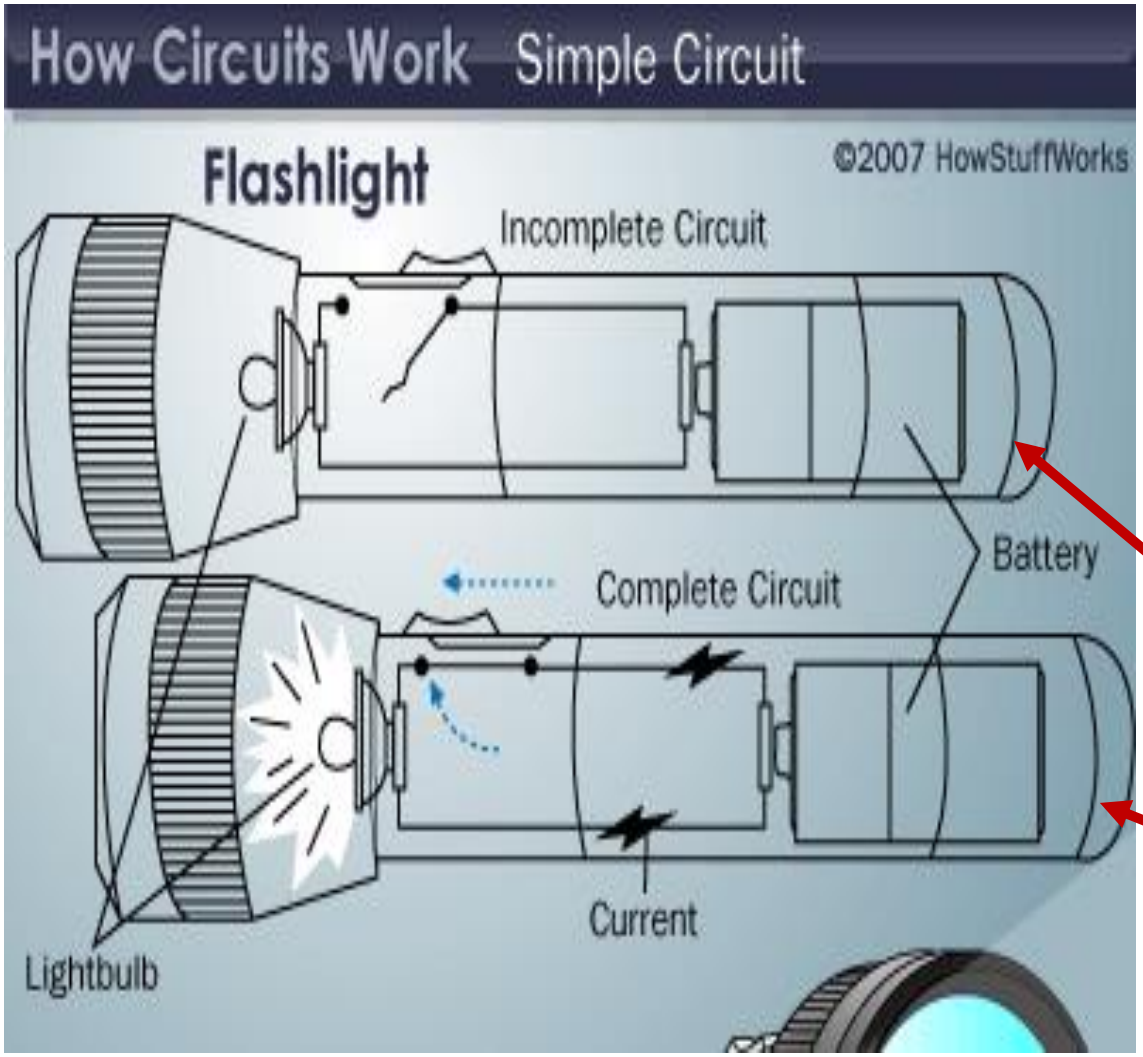
1) Student Consent Form
2) PreTest (10 Questions)
3) Electrical Conductivity Guide Sheet (Part of this handout)
4) Lesson Plan
5) PostTest (10 Questions)
6) Survey
7) **Objectives:**
   - Explain the difference between a conductor and an insulator
   - Attempt to close a circuit using any combination of pennies and erasers
   - Determine the conductive properties of the penny and the eraser

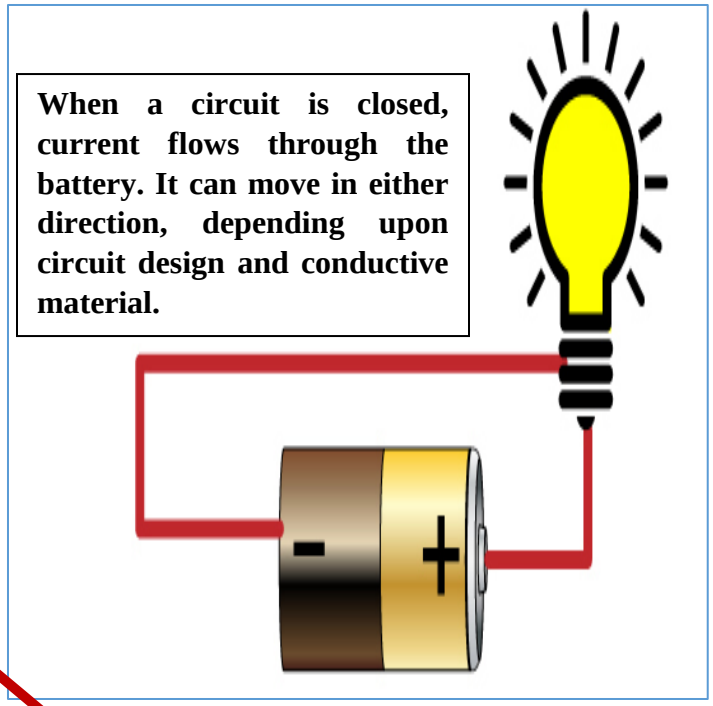
1. What is electricity? Electron flow is what we think of as electrical current. We are familiar with two types of electron flow, Direct Current, or DC, and Alternating Current, or AC. Direct Current is the kind of electrical flow we get from batteries and solar cells, when electrons travel in only one direction. On the other hand, AC is the kind of electrical flow we get from a typical electrical outlet in a home. AC is when the electrons flow in two directions, from the positive to the negative terminal and from the negative to the positive terminal, 'alternating' between the two directions. (Your lights will light up regardless of the direction of the electron flow.)



Electricity, as you probably already know, is the flow of electrons through a conductive path like a wire. This path is called a *circuit*.

2. Battery: To envision how a battery works, picture yourself putting alkaline batteries, like double AAs, into a flashlight. When you put those batteries into the flashlight and then turn it on, what you're really doing is completing a circuit. The stored chemical energy in the battery converts to electrical energy, which travels out of the battery and into the base of the flashlight's bulb, causing it to light up. Then, the electric current re-enters the battery, but at the opposite end from where it came out originally.





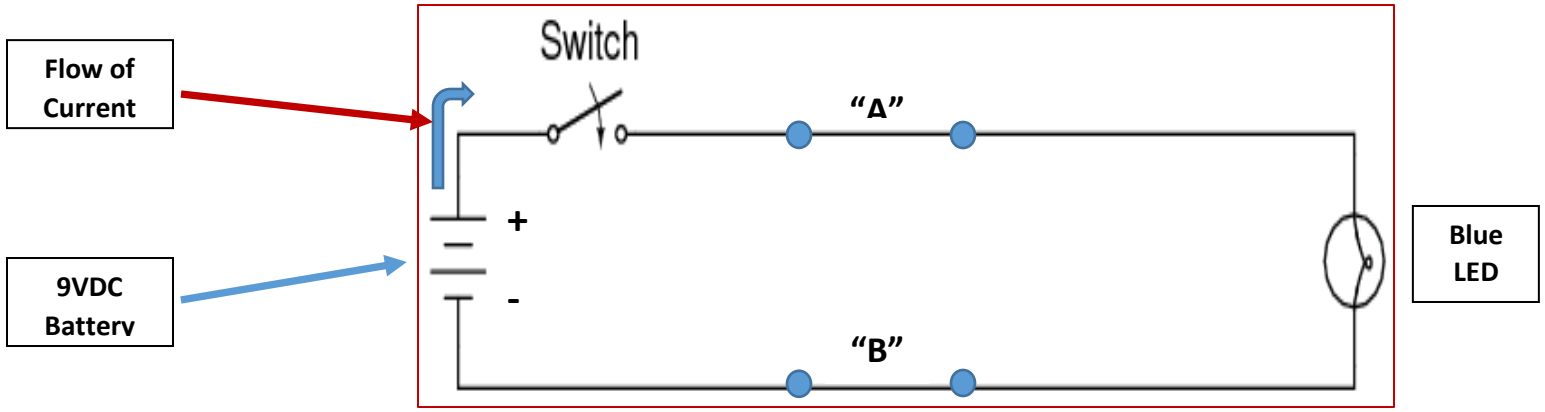
* Used with permission.

3. What is an insulator and a conductor in electrical systems and circuits?

Conductors: Do you remember the copper atom that we discussed? Do you remember how its valence shell had an electron that could easily be shared between other atoms? Copper is considered to be a **conductor** because it conducts the electron current or flow of electrons fairly easily. Most metals are considered to be good conductors of electrical current. Copper is just one of the more popular materials that is used for conductors. Other materials that are sometimes used as conductors are silver, gold, and aluminum. Copper is still the most popular material used for wires because it is a very good conductor of electrical current and it is fairly inexpensive when compared to gold and silver. Aluminum and most other metals do not conduct electricity quite as good as copper.

Insulators: **Insulators** are materials that have just the opposite effect on the flow of electrons. They do not let electrons flow very easily from one atom to another. Insulators are materials whose atoms have tightly bound electrons. These electrons are not free to roam around and be shared by neighboring atoms. Some common insulator materials are glass, plastic, rubber, air, and wood. Insulators are used to protect us from the dangerous effects of electricity flowing through conductors. Sometimes the voltage in an electrical circuit can be quite high and dangerous. If the voltage is high enough, electric current can be made to flow through even materials that are generally not considered to be good conductors. Our bodies will conduct electricity and you may have experienced this when you received an electrical shock. Generally, electricity flowing through the body is not pleasant and can cause injuries. The function of our heart can be disrupted by a strong electrical shock and the current can cause burns. Therefore, we need to shield our bodies from the conductors that carry electricity. The rubbery coating on wires is an insulating material that shields us from the conductor inside. Look at any lamp cord and you will see the insulator. If you see the conductor, it is probably time to replace the cord. Recall our earlier discussion about resistance. Conductors have a very low resistance to electrical current while insulators have a very high resistance to electrical current. These two factors become very important when we start to deal with actual electrical circuits.

4. LEDs, light bulbs, and other types of illuminators. Once electricity flows through these devices, they 'light up' from the flow of the electrons that pass through their 'filaments' or conductive elements. **What type of objects could be inserted into "A" or "B" below to close the circuit?**



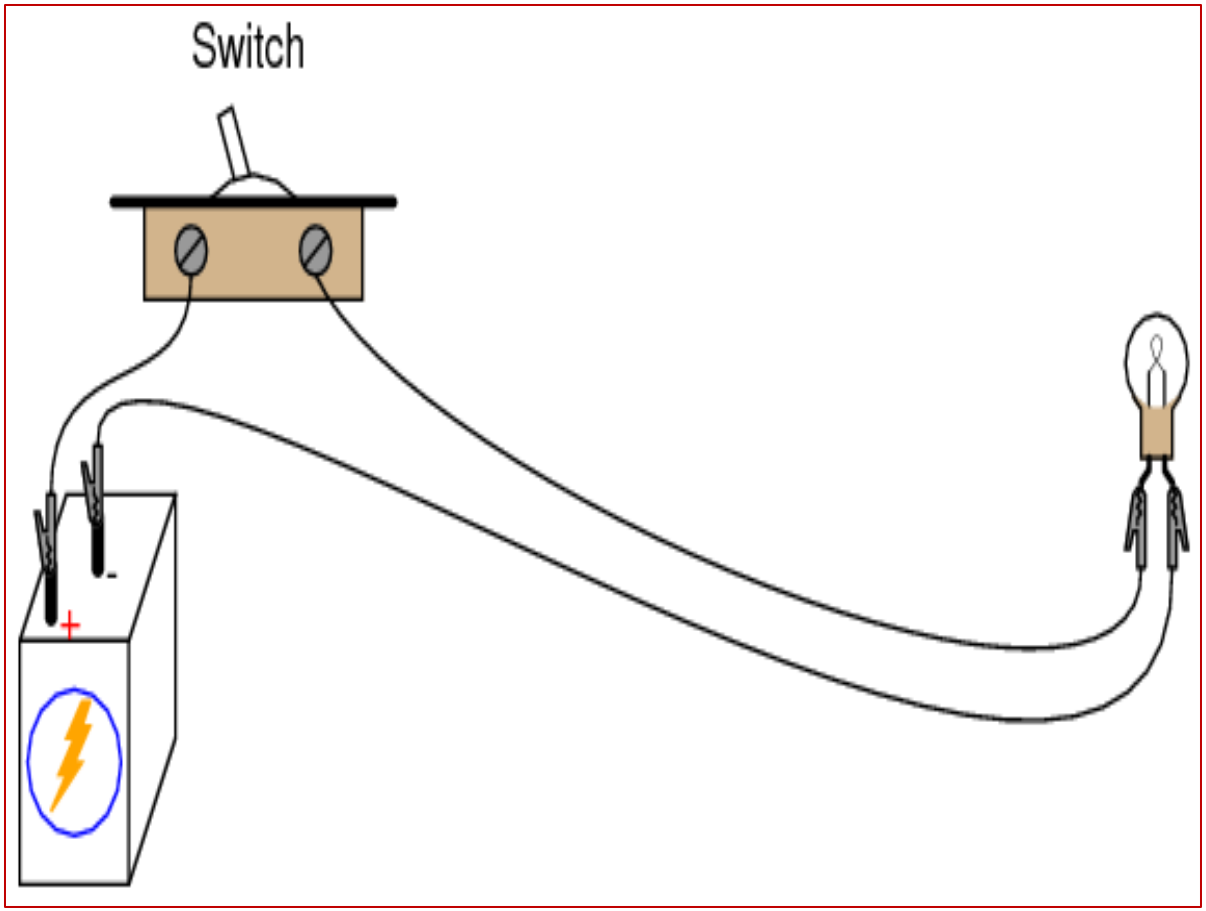
What happens if the switch is closed?

What happens if the switch is opened?

What does the Lamp (LED) do when the switch is closed and the battery has no charge?

What happens if a rat gets hungry and east one of the conductors?

How many poles does the battery have and what are they?



- 9-volt battery (DC)
- Low-voltage incandescent lamp (Radio Shack catalog # 272-1130 or equivalent)
- Long lengths of wire, 22-gauge or larger
- Household light switch (these are readily available at any hardware store)

Copper's outer electrons are detached easily, making it great at causing an electron chain reaction. Copper is also used because of its price. While its price is increasing, it's still far cheaper than other conductors.

PreTest (Select the option that best fits your understanding of the question presented.)

1. _____ When you join an eraser to a circuit that has a 9VDC battery and an LED so that the eraser is connected to the circuit, it will:
    a. Prevent electrons from flowing through the circuit so that the LED will not turn on;
    b. Slow the electrons down, but allow the LED to turn on;
    c. Allow electrons to flow but the LED will not turn on;
    d. An LED does not require electron flow to turn on.

2. _____ Which of the items below will cause an LED in a battery-powered circuit to 'turn off."
    a. The battery will exhaust its energy and ceases to enable electron flow;
    b. The wire within the path of the circuit is cut and the LED turns off;
    c. The switch within the path of the circuit is opened by an individual;
    d. None of these will impact the LED in any way;
    e. Answers a – c will cause the LED to turn off in a battery-powered circuit.

3. _____ Electricity is the flow of:
    a. Neutrons
    b. Protons
    c. Electrons
    d. Isotopes
    e. Isodopes

4. _____ Why is copper such a good conductor for electrical circuits?
    a. Because its neutrons are easily detached and causes electron flow.
    b. Because its protons are easily detached and causes neutron flow.
    c. Because its electrons are easily detached and causes moron flow.
    d. Because its electrons are easily detached and causes noise, which is converted into electricity.
    e. None of these responses is accurate, and therefore, are incorrect.

5. _____ Which item(s) below are considered insulators?
    a. Copper
    b. Glass
    c. Wood
    d. Rubber
    e. Air
    f. Distilled or pure water
    g. All items but option a are considered to be insulators

6. _____ What is a closed electrical circuit?
    a. One in which the switch is open.
    b. One in which the path includes an insulator.
    c. One that includes three AAA batteries in a series.
    d. One in which the LED has a micro-sized break in its wiring.
    e. One in which the polarities are reversed in the circuit.

7. _____ Why would a copper penny work in a battery circuit if the wire were broken and you inserted the penny where the wire was broken?
    a. because the penny is an insulator
    b. because the penny is a conductor
    c. because the penny is only worth 1cent and electrical circuits can't make change
    d. because the penny is a better insulator than an eraser
    e. because the eraser is a better conductor than the penny

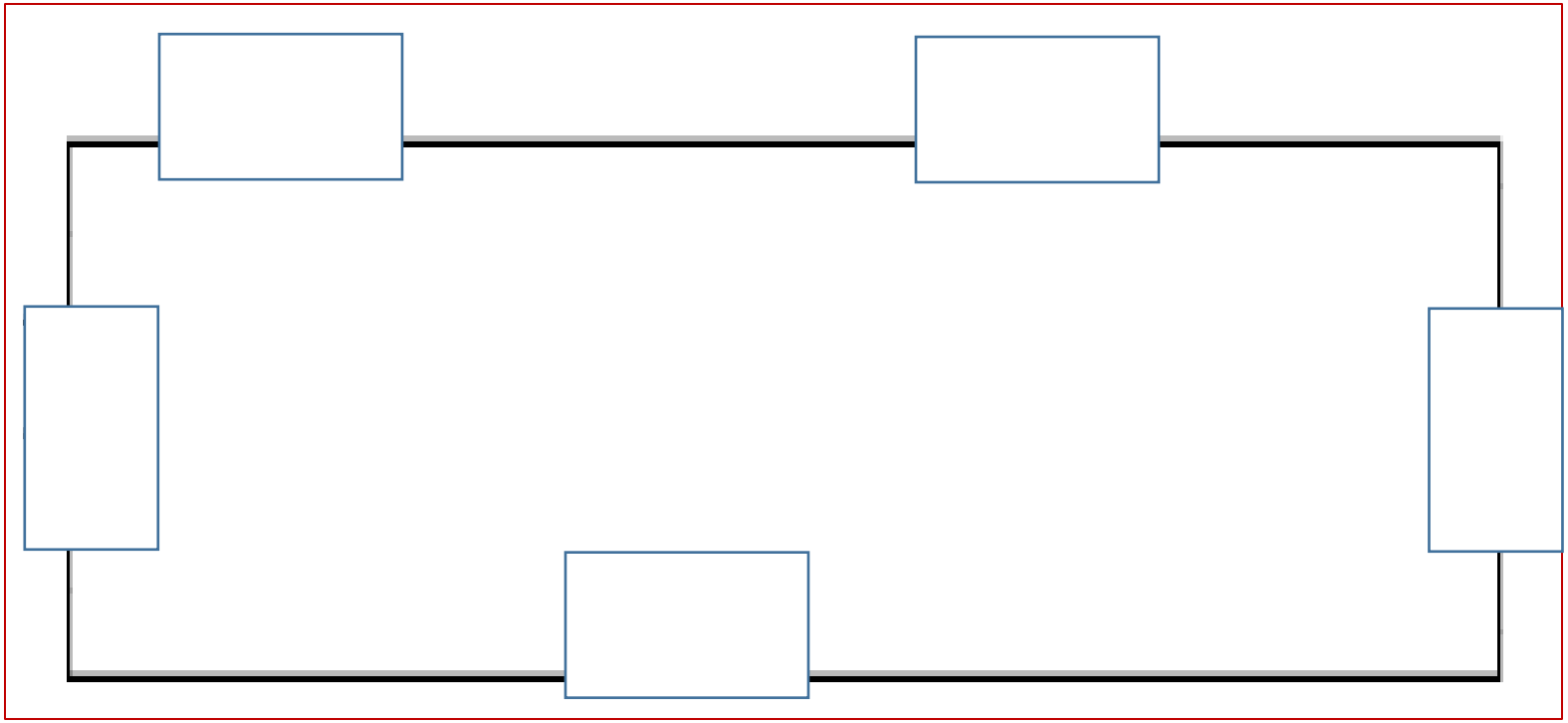
8. _____ In a circuit that has a battery and a switch, which item delivers electrons to the circuit?
    a. switch when closed
    b. wire
    c. LED
    d. battery
    e. switch when open

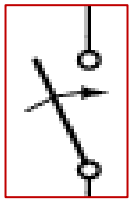
9. _____ In a circuit in which the LED is 'burned out', what is the status of the flow of electrons?
    a. they still flow, but the LED doesn't light up
    b. they still flow, and the LED passes them across the LED but it doesn't light up
    c. they do not flow, because the circuit is open at the battery
    d. they do not flow, because the circuit is open at the switch
    e. they do not flow, because the circuit is open at the LED

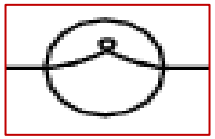
10. _____ When electrons flow through a copper wire, how does the insulator keep the current from getting into the finger of the person?
    a. conductors don't need insulators because the current remains in the wire
    b. insulators keep the current flow from leaving the wire and getting into the finger of the person
    c. when insulators are touched the electrons still leave the wire and conduct through the person
    d. electrons do not move through wires so not insulator is needed
    e. I hope this is the last question!

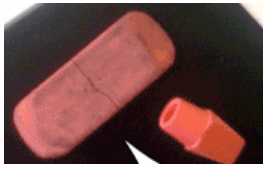
TASK EXERCISE:

The following circuit has some "missing sections." Insert the Letters (A – E) in the boxes in the circuit and the items inserted MUST be in the correct direction for the circuit as it is displayed. Not all items must be used, but the circuit must provide electrical energy to the LED to make it light up. You can use A, B, and C only once. D & E are not dependent on direction.









A B C D E

PostTest (Select the option that best fits your understanding of the question presented.)

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Notes:

1. Begin at 2:00PM;
2. Release Form signed PRIOR to any activity;
3. Pretest of 10 Q&A types of questions;
4. Lesson Plan Delivered (16 Participants in the Test Group; 15 Participants in the Control Group);
5. Completion and Timing of TASK EXERCISE;
6. PostTest of 10 Q&A types of questions;
7. Survey & Release of Student from the Research Session.