ENERGY USE AND DELIVERY – LESSON PLAN 3.1

Introduction to Electricity

This lesson is designed for 3rd – 5th grade students in a variety of school settings (public, private, STEM schools, and home schools) in the seven states served by local power companies and the Tennessee Valley Authority. Community groups (Scouts, 4-H, after school programs, and others) are encouraged to use it as well. This is one lesson from a three-part series designed to give students an age-appropriate, informed view of energy. As their understanding of energy grows, it will enable them to make informed decisions as good citizens or civic leaders.

This lesson plan is suitable for all types of educational settings. Each lesson can be adapted to meet a variety of class sizes, student skill levels, and time requirements.

Setting	Lesson Plan Selections Recommended for Use
Smaller class size, higher student ability, and /or longer class length	• The "Modeling" Section contains teaching content. • While in class, students can do "Guided Practice," complete the "Recommended Item(s)" and any additional guided practice items the teacher might select from "Other Resources." • NOTE: Some lesson plans do and some do not contain "Other Resources." • At home or on their own in class, students can do "Independent Practice," complete the "Recommended Item(s)" and any additional independent practice items the teacher selects from "Other Resources" (if provided in the plan).
Average class size, student ability, and class length	• The "Modeling" Section contains teaching content. • While in class, students complete "Recommended Item(s)" from "Guided Practice" section. • At home or on their own in class, students complete "Recommended Item(s)" from "Independent Practice" section.
Larger class size, lower student ability, and/or shorter class length	• The "Modeling" Section contains teaching content. • At home or on their own in class, students complete "Recommended Item(s)" from "Independent Practice" section.

Electrical Safety Reminder: Teachers should remind students that electricity is dangerous and that an adult should be present when any recommended activities or worksheets are being completed at home. Always obey instructions on warning labels and ensure one has dry hands when touching electronics or appliances.

Performance Objectives

By the end of this lesson, students will be able to:

- **Identify the characteristics of electricity.**
- **Label an atom.**
- **Explain static electricity.**
- **Describe characteristics of each subatomic particle.**

Public School System Teaching Standards Covered

State Science Standards

- AL 4.1.1 4th
- AL 4.1.2 4th
- AL 5.2.1 5th
- AL 5.4.1 5th
- GA S5P1 5th
- GA S5P3a,b,c 5th
- KY 3-PS-2-3 3rd
- NC 3.P.3.1 3rd
- NC 4.P.1.2 4th
- NC 5.P.2.3 5th
- TN GLE 0407.12.2 4th
- TN GLE 0407.12.3 4th
- VA 4.3 4th
- VA 5.4c 5th

Common Core Language Arts/Reading

- ELA.CCSS.W.3.1 KY, NC 3rd
- ELA.CCSS.W.4.1 TN, KY, NC, AL4th
- ELA.CCSS.W.5.1 NC, GA, AL 5th

I. Anticipatory Set (Attention Grabber)

Essential Question

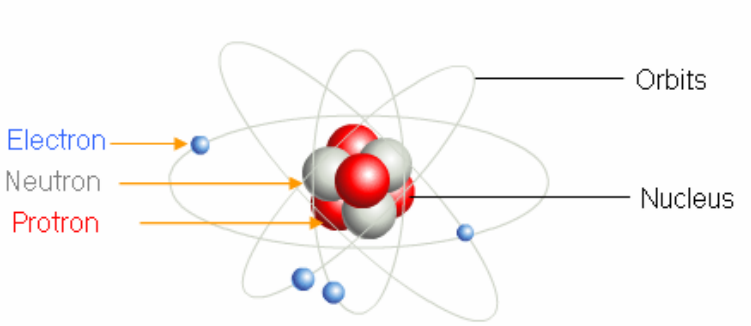
How does an electric current flow?

II. Modeling (Concepts to Teach)

Structure of the Atom

Very tiny particles, called atoms, make up all matter. Atoms are composed of subatomic particles, called protons, neutrons, and electrons. The protons and neutrons are located in the middle of the atom in what is referred to as the nucleus. Protons are positively charged and neutrons are neutrally charged. The electrons, however, are located around the outside of an atom. Electrons are negatively charged and are much smaller than protons and neutrons.

http://www.electronics-microcontroller.com/electronics-articles-basic-Structure-of-the-Atom.htm



http://www.physicsclassroom.com/class/estatics/Lesson-1/The-Structure-of-Matter

SUMMARY OF SUBATOMIC PARTICLES		
Proton	**Neutron**	**Electron**
In nucleus	In nucleus	Outside nucleus
Tightly Bound	Tightly Bound	Weakly Bound
Positive Charge	No Charge	Negative Charge
Massive	Massive	Not very massive

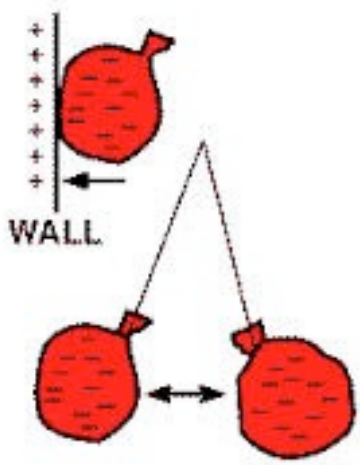
Opposite charges are attracted to each other. So, a negative charge is attracted to a positive charge and vice versa. This phenomenon is what holds an atom together. The nucleus has an overall positive charge and the electrons are negative. Therefore, the negatively charged electrons are attracted to the positively charged nucleus. The opposite is true for like charges (have the same charge – either positive or negative). Like charges repel each other. Negative-Negative repel and Positive-Positive repel. This is also true of magnets. The S and N ends are attracted to each other, but the S and S are repelled and the N and N are also repelled.

The charge of one proton is equal in strength to the charge of one electron. When the number of protons in an atom equals the number of electrons, the atom itself has no overall charge, it is neutral.

Static Electricity

Static electricity is the result of an imbalance of charge within or on the surface of an object. This imbalance of charge is due to the transfer of electrons and the charge is located in one location. It is static (not moving). It is easy to transfer electrons from one place to another since they are located on the outside of the atoms. For example, when a person moves rubber-soled shoes across a carpet, the shoes pick up and hold onto the electrons that are scraped off of the carpet. The shoes become negatively charged. Now, if that person touches something that is a good conductor, like a door handle, the electrons will flow out of the shoes giving that person a zap! In this example, the rubber-soled shoes are a good insulator. **Insulators** are materials that hold onto electrons very tightly. The door handle is made of metal and is a good conductor. **Conductors** are materials that are composed of atoms where the electrons are loosely held together. The electrons are able to flow more easily.

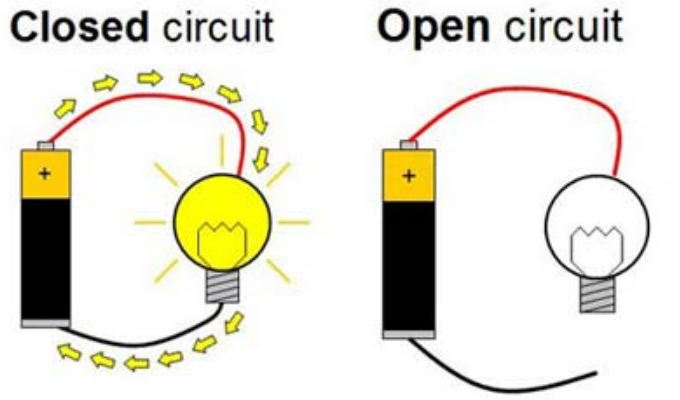
If someone rubs a balloon on a wool scarf something similar will happen. The electrons (-) from the scarf will be transferred to the balloon giving it an overall negative charge. The balloon will then be attracted to objects that are positively charged, like a wall (see diagram below) and be repelled by objects that are negatively charged, like another negatively charged balloon (see diagram below).



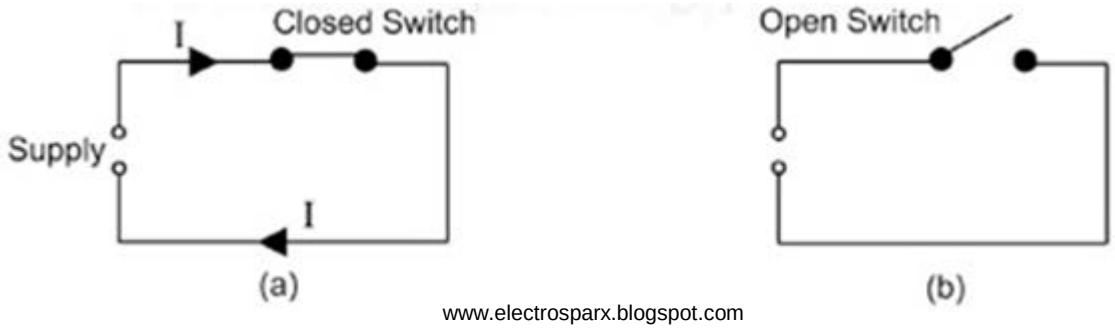
Current Electricity

Current Electricity is the flow of electrons in a pathway. The pathway is made up of a conductor, like a metal wire. The battery provides the voltage, or **electrical potential difference**, to drive the electrons from the negative electrode through the circuit and back to the positive electrode of the battery. Remember, opposite charges attract, which is why the negative electrons are attracted to the positive terminal of the battery. If the pathway is uninterrupted, then the circuit is closed and will provide energy to light up a light bulb. If there is a break in the circuit and the pathway from the negative end of the battery to the positive end of the battery is broken, the light bulb will not light up. This break would mean that it is an open circuit. (See diagram below).

http://www.kkfsgrade3.com/electric-circuits.html



This same concept is used when using an on/off switch for a circuit. The “on” position produces a closed circuit and the “off” position provides an open circuit. The on/off switch is often symbolized with an icon (see icon image below). Similarly, the (a) diagram is switched on and the (b) diagram is switched off.



www.electrosparx.blogspot.com

III. Checking for Understanding

Teachers can ask students these questions to determine understanding of concepts.

REMEMBER	What is an insulator? What is a conductor? Explain the nature of subatomic particles. (Class discussion)
UNDERSTAND	Explain how an atom is held together. Explain static electricity. (Class discussion)
APPLY	Illustrate the attraction between two magnets. (If teacher has two magnets, show the class.)
ANALYZE	Compare and contrast an open and closed circuit. Why must the circuit be closed in order to work? (Class discussion. Teacher can turn the lights off and on as an example.)
CREATE	Create a closed circuit. (If teachers have a circuit board, show the class. If not, draw a closed circuit up on the board. Refer to images in Section II, Modeling, Current Electricity, if needed.)

IV. Guided Practice Ideas

Recommended Items

Potato Battery Experiment; Make Your Own Electric Switch Experiment (see below)

Experiments

- Potato Battery Experiment: **http://www.thedailyspud.com/2011/06/12/potato-battery/**
- Make Your Own Electric Switch Experiment: **http://highhillhomeschool.blogspot.de/2012/04/make-your-own-electrical-switch.html**
- Make a Lemon Battery Video and Experiment: **http://www.pinterest.com/pin/161637074098989761/**

Videos

- Basic Electricity for Kids Video: **http://www.youtube.com/watch?v=yHFkaeDZJWs**
- Electricity – Bill Nye the Science Guy Video: **http://www.youtube.com/watch?v=gixkpsrxk4Y**

Games

- Interactive Games: **http://resources.woodlands-junior.kent.sch.uk/revision/science/electricity.htm**

Activity

- Structure of an Atom Activity: Use different sizes and colors of marshmallows, candies, or M&Ms to represent the differences in size of subatomic particles. Glue them together to show the nucleus (protons and neutrons combined together) versus a free electron orbiting around the nucleus and how each behaves and relates to each other. Refer to Structure of an Atom in Section II, Modeling, if needed.

V. Independent Practice Ideas

Other Resources

Personal Practice

- Writing Activity: Teachers write the following questions on the board and ask students to copy and answer them on a sheet of paper. What would you do without electricity? If you could only have one thing in your home that runs on electricity, what would it be and why?

Practice That May Involve Parents or Guardians

- At-home Activity: Teachers write the following question on the board and ask students to copy it on a sheet of paper. What kinds of entertainment run on electricity in your house? What kinds of entertainment do not require electricity? (Ex. TV, video games vs. board games, sports, piano).

VI. Assessment

These items provide a check for understanding so teachers can easily determine whether concepts need to be reinforced. These items can be graded, if desired.

- Writing Activity (if completed as Independent Practice, as shown above)
- At-home Activity (if completed as Independent Practice, as shown above)

VII. Materials Needed

The following materials are needed for the **Potato Battery Experiment** in “Recommended Items” in Guided Practice.

- Potato
- Insulated copper wire
- 1 galvanized nail
- Penny

VIII. Closing the Lesson

In addition to the Essential Question shown below, teachers can reference Performance Objectives at the top of the Lesson Plan.

Essential Question

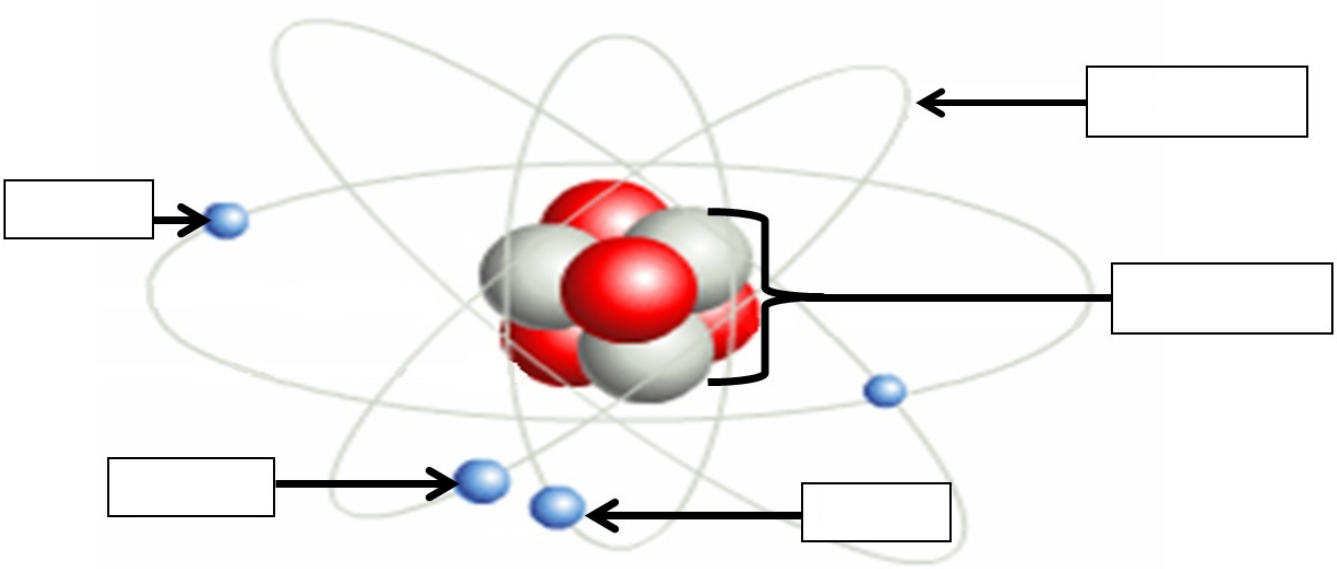
How does an electric current flow?

WORKSHEET FOR INTRODUCTION TO ELECTRICITY LESSON 3.1

NAME: _____

Components of the Atom

Objective: Students will be able to label the different components of an atom.



Label the components of the atom.

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