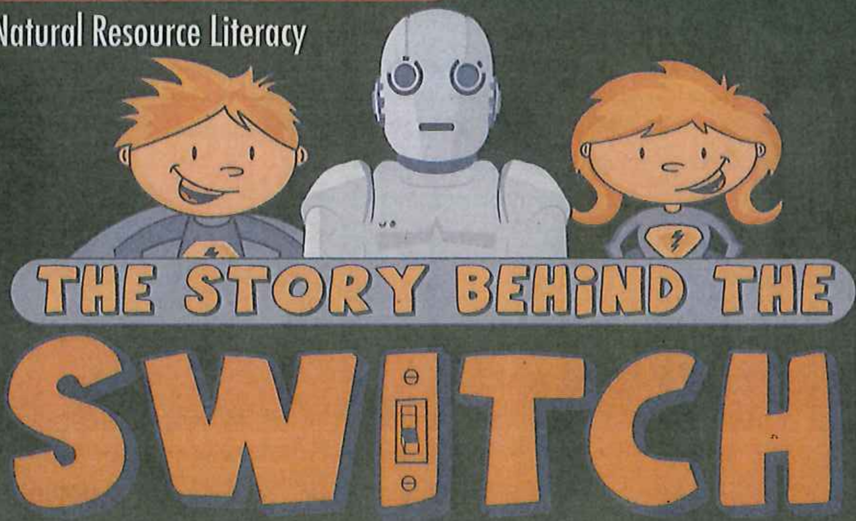
# New Mexico Ag in the Classroom

**AG in the Classroom**

Helping the Next Generation Understand Their Connection to Agriculture

Food, Fiber and Natural Resource Literacy




Isn't it amazing that when you flip a light switch you instantly have light? Behind that switch, electricity is there, ready for you to use.

Think about all the people who are also using electricity. Electrons flow to everyone's home, all the schools and all the businesses, every hour of every day.

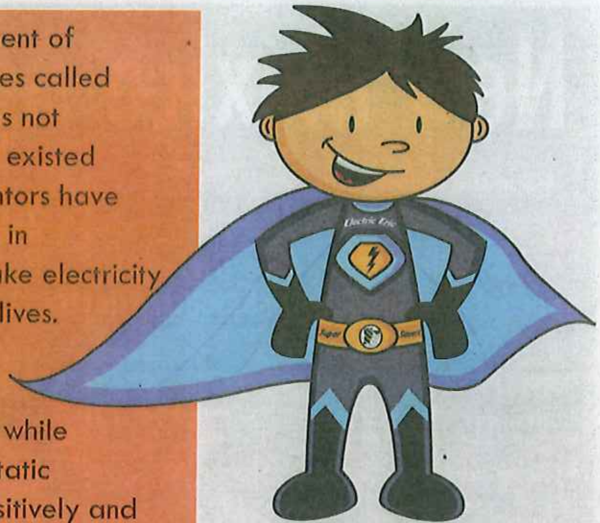
Electricity is so reliable we rarely think about it. But look around you, how many things in your classroom and your home use electricity?

Electricity makes your life safer. It provides you light so you can see in the dark. It rings the fire alarm in case of fire. It allows most phones to work if you need to call for help.

Electricity helps keep you healthy – it provides the energy so the refrigerator will keep foods cold or frozen. It helps furnaces keep you warm in the winter and air conditioners keep you cool in the summer.

Electricity also makes doing things easier. A dishwasher, microwave oven, clothes washer and dryer are examples of electrical appliances that make our lives easier.

Electricity is the movement of charged atomic particles called electrons. Electricity was not invented; it has always existed in nature. Several inventors have played important roles in developing ways to make electricity useful in our everyday lives.



Electricity can be classified as either **static** or **current**. Static electricity happens when electrons accumulate on a surface, while current electricity is a flow of electrons through something. Static electricity exists whenever there are unequal amounts of positively and negatively charged particles present.

# Electricity in Nature

Here are four Leyden jars in a circuit.

Electricity has always existed in nature. Humans found ways to harness and use electricity to their advantage. In the 1700s they found ways to generate and store large amounts of static electricity using friction and devices called Leyden jars. These jars released electricity in one short burst. Therefore, they did not provide enough electricity to run machines.

In the early 1800s Alessandro Volta discovered how to produce a continuously flowing current of electricity. He used a chemical reaction to create the electricity. From this discovery he developed a battery.

In 1831, Michael Faraday discovered how to generate a continuous current by moving a coil of wire past a magnetic field. This process, known as **electromagnetic induction,** is used in most generators producing electricity in power plants.

Burning fossil fuels, using nuclear and **renewable** natural resources creates a **primary** energy resource. Converting that power into a form we can use in school, at home and other places makes a **secondary energy resource**.

**What causes lightning?**

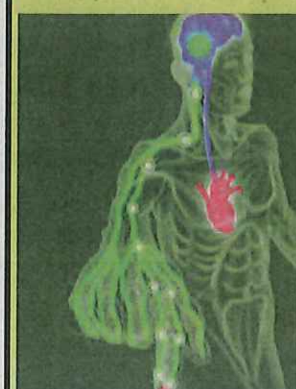
Lightning is a form of static electricity. Have you ever felt a static electricity shock or seen sparks when you take off your sweater? When lightning is produced, the same thing happens, but on a much bigger scale. It starts when droplets of water are caught in an updraft and are carried higher in the clouds. As these droplets move through the air, they become charged. Eventually, the whole cloud fills up with electrical charges. Lighter, positively charged particles form at the top of the cloud. Heavier, negatively charged particles sink to the bottom of the cloud.

When the positive and negative charges grow large enough, a giant spark - lightning - occurs between the two charges within the cloud. This is like the static electricity sparks you see, but much bigger. When lightning occurs, the air **ionizes** and we see a lightning bolt. The lightning bolt heats the air as it travels causing the air to expand rapidly. When the air rushes back to fill the vacuum, we hear thunder.

Does your hair really stand up when lightning is near? Yes, it can! Thunderstorms can create an imbalance in positively or negatively charged particles. If an imbalance exists where you are standing, your body will become charged. Because "like" charges repel, your hair strands will repel each other and stand up.

**Lightning is dangerous. Move inside a building when you see it.**

**Electricity in Our Bodies**



Our bodies are electric. Electrical signals travel along nerves, carrying information to and from our brain. Electricity makes your muscles move and keeps your heart beating, your eyes seeing, your ears hearing and your fingers feeling. Without those electrical impulses, we wouldn't be alive. Many of the touch screens in phones and tablets are **capacitive** touch. This means they use electricity from the human body to complete the connection. It is how you select an icon or play many of the games.

# Transforming Energy

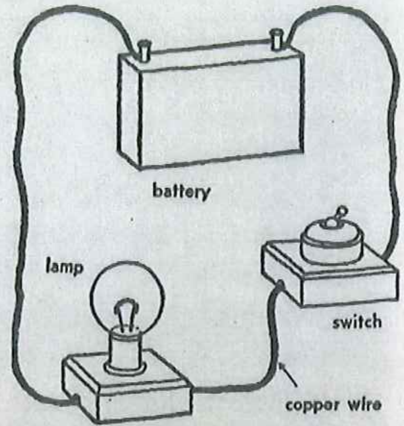
The electricity found in your home is called current electricity. It is generated by transforming another type of energy. For example, we burn coal or natural gas (primary energy sources) in a power plant to create electricity (secondary energy source.) The energy in the moving water (primary energy source) at a hydro-power plant is changed to electricity (secondary energy source.) The power of wind moving large blades (primary energy source) on a windmill is changed into electrical energy (secondary energy source.) All of these systems use **generators** to create electricity. The **mechanical energy** of the generator is converted to **electrical energy.**

Electricity is transferred from one area to another area by **conductors.** Conductors allow electrons to flow freely through them. Copper and other metals are good conductors because electrons can move easily through them. Materials that do not allow electrons to flow through them easily are called **insulators.** Examples of materials that are insulators are plastic, rubber, wood and glass.

The force or pressure that moves the flow of electrons is **voltage** and it is measured in **volts.** When you add more electrons, you have more force. (Remember meeting Alessandro Volta on page 2?)

Flowing electrons are called a **current.** A current is measured in **amperes or amps.**

The path that an electric current follows is called a **circuit.** Electric circuits can be simple or complex. Devices can be added to a circuit to control the flow of current. A




**switch** is the simplest example. When the switch is off, it creates a gap in the circuit and the current will not flow. When it is on, it completes the circuit and the current will flow.

Electric currents may be **direct** (DC) or **alternating** (AC). Direct current flows in one direction. AC current reverses its direction many times a second. An example of direct current is a battery. An example of alternating current is household electric power.

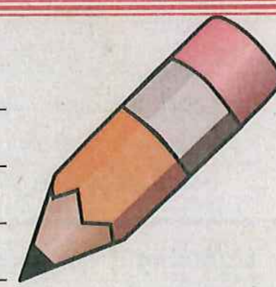
On the lines below write two sentences that explain the difference between DC and AC currents.

________________________________________

________________________________________

________________________________________

________________________________________



# Language of Electricity

We have introduced you to a lot of new words in this reader. From the list of words below, choose the best word(s) that would complete the meaning of the sentences and write it in the blank.

**List of Words**

electromagnetic induction
nonrenewable
renewable
secondary energy
ionizes
generators
mechanical energy
electrical energy
conductors
insulators
voltage
volts
current
amperes or amps
circuit
switch
direct
alternating
watts
kilowatt

**Fill in the Blank Sentences**

1. ________________ are substances that electrons can freely flow through like copper and other metals.
2. A process for generating a continuous current by moving a coil of wire across a magnetic field is called ________________________.
3. We see lightning when the air __________.
4. Materials that electrons can not easily flow through like plastic, rubber or wood are called ___________.
5. The force or pressure that moves the flow of electrons is __________ and is measured in volts.
6. Flowing electrons are called a ____________________ and are measured in amperes or amps.
7. The path an electric current follows is called a ________________.
8. ______________ current is the type of current found in a battery.
9. 1,000 watts is called a ______________________.
10. Volts x amps = ______________________.

## Watt's What?

We measure electricity in watts, volts, amperes (or amps) and ohms.

**Volts** indicate the strength or pressure of an electric current.

**Amps** indicate how many electrons flow past a specific point in a circuit over a given length of time.

**Watts** indicate the total electrical energy being used. Volts multiplied by amps equals watts.

Here is another way to look at it: The number of electrons moving through a circuit (amps) and the pressure of those electrons (volts) tell you how much power the electricity has (watts).

**Here is the formula:**
**volts x amps = watts**

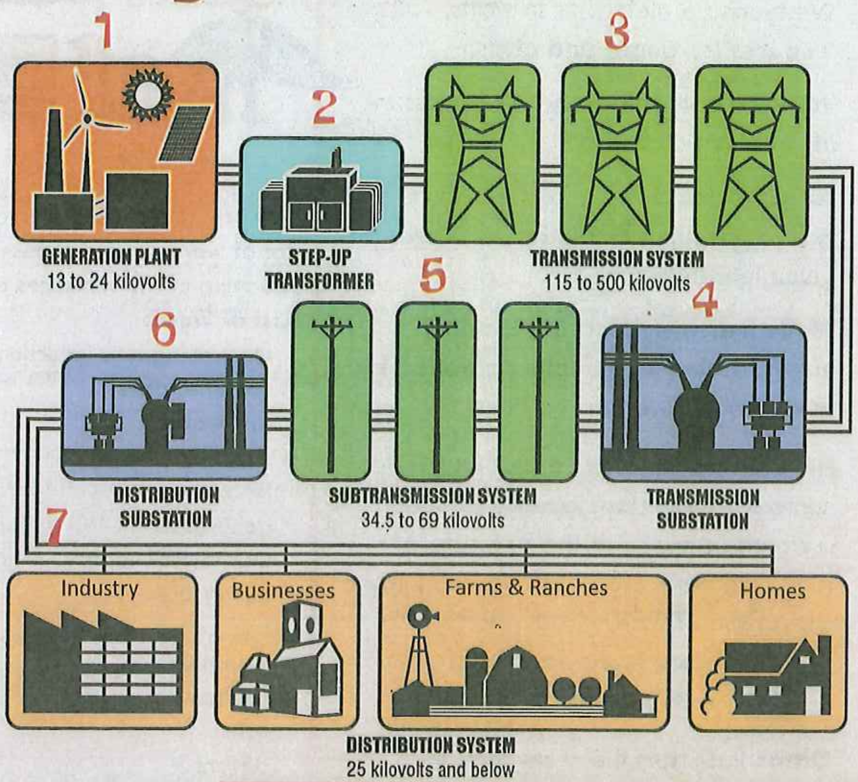
**Ohms** indicates the resistance to electron flow in the circuit.

Most household circuits in the United States carry 110 volts and 15 amps.

A kilowatt is equal to 1,000 watts. If you look on you home's electricity bill, you'll see it is measured in kilowatt-hours. A kilowatt-hour is one kilowatt of electricity used for one hour. An average house in the United States might use 500 kilowatt-hours in a month.

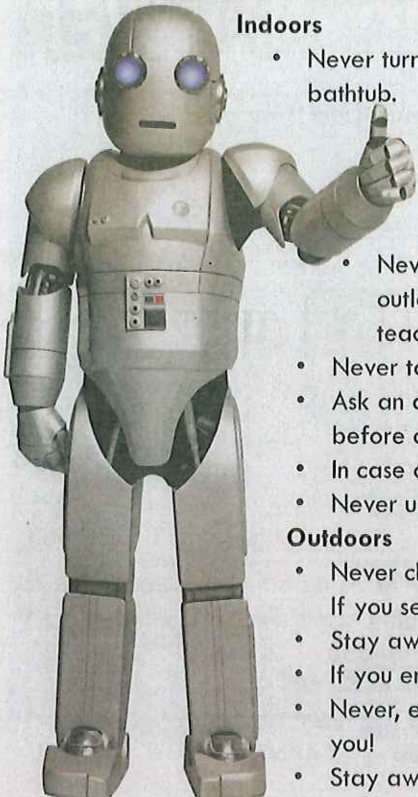
# How Electricity Reaches You

1. Electricity starts at the generation plant where it is generated from a source of energy. It may be the burning of coal or natural gas, or nuclear reactions, or flowing water, or blowing wind or shining sun.
2. From the generation plant electricity goes to the step-up transformer. It increases the voltage of the electricity so it can be sent over large transmission lines.
3. Large transmission lines carry the electricity across the country to substations. These lines carry between 115 to 500 kilovolts.
4. These substations lower the voltage so it can travel down subtransmission lines.
5. The subtransmission lines carry the electricity to distribution substations where the voltage is stepped down and sent out on distribution lines ranging from 34.5 to 69 kilovolts.
6. The distribution lines carry electricity to the pole transformer near your home where it is again lowered to 110 to 220 volts so it can now be used as household current.
7. Then you turn on the light switch and, voila, you have light!




**The cooperative difference** – electric co-ops work for people not for profits. Chances are good that if you live in a small town or rural area you are probably receiving your electricity from a rural electric cooperative. Unlike investor-owned utilities that serve the more densely populated areas of our state, cooperatives are not-for-profit businesses that exist solely to serve their members. Each person who receives service from this not-for-profit, member-owned electric utility is both a member and an owner, which means that decisions are made based on the needs of the community. Co-ops and their employees support a thriving community as neighbors help neighbors.

# Be Safe Around Electricity



**Indoors**

- Never turn on a light switch or electrical appliance while you are wet or while you are in the bathtub.
- Be careful not to leave electrical cords where people might step on them. Wear and tear on the cord can cause it to become unsafe.
- Check electrical cords for exposed wiring before plugging anything in. If you see a worn-looking cord, point it out to an adult.
- Never put any object other than a plug designed for that purpose into an electrical outlet. If you have questions about whether a plug is safe to use, ask your parent or a teacher.
- Never touch electrical outlets with your fingers or with objects.
- Ask an adult to help you change light bulbs. Always turn lamps and other light fixtures off before changing a bulb.
- In case of a fire at home get out of the house, then call the fire department and an adult.
- Never use water to try to put out an electrical fire—you could be electrocuted.

**Outdoors**

- Never climb utility poles, transmission towers, or fences around electrical plants or substations. If you see other people doing these things, tell an adult you trusf right away.
- Stay away from areas or buildings marked with signs that read "Danger: High Voltage."
- If you enjoy climbing trees, avoid trees that are near electrical power lines.
- Never, ever touch an outdoor electrical pole or wire that has fallen to the ground. It could kill you!
- Stay away from and never touch transformers (usually large metal boxes attached to utility poles or on the ground) or substations. They contain high-voltage equipment that can hurt or kill you.
- Come inside during a thunderstorm (or even occasional flashes of lightning with no rain). Many people around the world are struck by lightning each year. Nearly all are badly injured and some are killed.
- Call 911 if you see a person who has been or is being electrocuted. Do not touch the person because they could be carrying the flow of electricity.
- Never swim or go near water during storms. As soon as you hear thunder or see lightning, get out of the water.

## Meet Power

Power helps members of rural electric cooperatives use energy wisely. Learn more at www.powerworksforyou.coop

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## CHALLENGE

1. Which of the following energy resources is not renewable:
   - ❒ Wind
   - ❒ Water
   - ❒ Natural gas
   - ❒ Sunshine

2. Electricity is the movement of charged atomic particles called:
   - ❒ Electrons
   - ❒ Protons
   - ❒ Atoms
   - ❒ Electricity

3. Our bodies use electricity to:
   - ❒ Pump our heart
   - ❒ Send messages via the nervous system
   - ❒ Allow us to see and hear
   - ❒ All of the above

4. Materials that allow electrons to flow freely through them are called:
   - ❒ Insulators
   - ❒ Plastic
   - ❒ Wood
   - ❒ Conductors

5. The force or pressure that moves the flow of electrons is:
   - ❒ Watts
   - ❒ Amps
   - ❒ Voltage
   - ❒ Conductor

6. True or false? Generators use mechanical energy to create electrical energy.
   - ❒ True
   - ❒ False

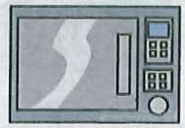
7. Flowing electrons are called:
   - ❒ Watts
   - ❒ Amps
   - ❒ Current
   - ❒ Conductor

8. True or false? You would find direct current in a battery.
   - ❒ True
   - ❒ False

9. True or false? The current in your home is alternating current.
   - ❒ True
   - ❒ False

10. The first step in getting electricity to your home starts at the:
    - ❒ Transmission Lines
    - ❒ Generation Plant
    - ❒ Transmission Substation
    - ❒ Distribution System

Agriculture in the Classroom



# Knowledge is POWER

### How much do they cost to run?

This chart shows how many hours an appliance can run continuously for $1.00.

| | |
|---|---|
| Alarm Clock | 1,250 hours |
| Computer (asleep) | 208 hours |
| Computer (awake) | 46 hours |
| Stereo | 31hours |
| Fridge with freezer | 22 hours |
| Toaster | 16 hours |
| Microwave | 8 hours |
| Brewing Coffee Maker | 8 hours |
| Oven | 1 hour |

1. About how much does it cost per month for your computer to run if it stays awake the entire time?
   ❒ $15 ❒ $20 ❒ $33 ❒ $55

2. Which item uses the least amount of electricity to run? ❒ stereo ❒ microwave

3. Which item uses the most amount of electricity to run? ❒ oven ❒ toaster

4. If you work on your computer 2 hours per day, how many days could you work on your computer for $1.00?__________