

Grade Level/Course: 4 th - 5 th grade Science
Lesson/Unit Plan Name: Circuits, Conductors, and Switches
Rationale/Lesson Abstract: Students will construct circuits to discover that the circuit must be complete; they will identify the parts of a light bulb and show how the circuit is completed in side the bulb; they will discover which parts of the circuit are conductors. They will construct a switch to open and close the circuit.
Timeframe: 3 lessons, 50 minutes each
<p>Common Core Standard(s):</p> <p>4-PS3.A Definitions of Energy Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2: make observations that energy can be transferred),(4-PS3-3: predict outcomes)</p> <p>4-PS3.B Conservation of Energy and Energy Transfer Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4)</p> <p>4-PS3-4 Apply scientific ideas to design, test and refine a device that converts energy from one form to another.</p> <p>4-ETS1.A Defining Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (<i>secondary to 4-PS3-4</i>)</p> <p>5-PS1-3 Structure and Properties of Matter Make observations and measurements to identify materials based on their properties (Examples of properties include ... electrical conductivity)</p>

Lesson 1: Simple Circuits

Instructional Resources/Materials:

Items for each group (groups of 2)

- 1 D cell battery
- 1 1.5 volt bulb
- 1 10-20cm insulated wire (strip insulation of 2 cm from both ends of the wire)
or wire with banana clips
- 1 Gallon plastic zip bag to contain the above items

Items for each student

- Science Notebook
- Circuits page (found at the end of this lesson)

Activity/Lesson:

Engage:

Hold up a battery, wire and light bulb.

This is all you need to make light! Flashlights, lamps, etc. are just fancy holders!

Think/pair/share how you might use them to light the bulb. List some of the responses.

Now you get to try it! You will work with you partner, and use these items, to light up the bulb!

Once students have successfully lit the bulb, ask if there is another way they can arrange their material, and get the bulb to light.

Explain:

In their Science Notebooks, draw a diagram of how they assembled the materials to light the bulb. Be sure to label the parts (wire, D cell, bulb).

Project some of their drawings.

T: What is different and what do they have in common?

S: There are different ways to make it light

S: It's connected in kind of a circle

S: The metal parts have to touch

S: The wire and battery have to touch two different parts of the bulb – the bottom and the side.

T: When it lights, you have made a complete, electrical circuit.

Write the definition of circuit in your Science Notebooks.

Circuit: Circuits are a closed path for electricity. Every electrical appliance in your home, whether it is battery operated or you plug it in, is a circuit. Like the word, circle, "circ" means to go around. All circuits have 3 main parts: a power source, a conducting path and a load (something that will use the electricity).

Extend:

Distribute the Circuits page

Students will use their materials to make the bulb light 3 different ways and draw each of those on the Circuits page.

They will then draw 3 ways that do not make the bulb light.

Glue this into their Science Notebooks.

Assessment:

Evaluate:

Students answer the following question in their Science Notebooks:

What must you do to light the bulb?

(expected responses: Metal must touch metal. There is a circuit – or circular path for the electricity to go around, leaving the battery and coming back to the battery.)

Lesson 2: Conductors and Insulators

Instructional Resources/Materials:

Items for each group (groups of 2)

- 1 D cell battery
- 1 Battery holder (optional, but it will make it easier to set up the circuit)
- 1 1.5 volt bulb
- 2 10-20cm insulated wires (strip insulation of 2 cm from both ends of the wire) or wire with banana clips
- 1 Gallon plastic zip bag to contain the above items

Items for each student

- Science Notebook
- Parts of a Light Bulb page (found at the end of the lesson)
- Colored Pencil

Activity/Lesson:

Engage:

Yesterday we found that the wire had to touch certain parts of the bulb and the battery to make the bulb light.

T: What had to touch to make the circuit work?

S: metal had to touch metal

T: metal is a conductor, we'll talk about conductors in a moment

S: it had to make a complete circle or circuit

Explain:

Write these definitions for Conductors & Insulators in their Science Journals.

Conductors are made of materials that electricity can flow through easily.

Some examples of conductors are:

Copper	Aluminum	Platinum
Gold	Silver	Water
People	Animals	Trees

Insulators are materials opposite of conductors, preventing or blocking the flow of electricity.

Some examples of insulators are:

Glass	Porcelain	Plastic
Rubber		

T: What about our designs, yesterday, made the bulbs light?

S: The wire and what it touched were all conductors.

T: What are the parts that do not make it work?

S: Touching the glass bulb, the plastic on the wire, and the side of the battery – these are all insulators.

Continue to explain that circuits work because of moving electrons. In a cell (battery) the electrons are repelled away from the negative terminal, through the conducting path and the appliance and back to the cell. After going through the path the electrons are attracted to the positive terminal of the power source and ready to go again. This is like magnets where the opposite poles are attracted.

The electrons need a complete path or circuit to flow through so the electrons can go from the negative to the positive terminals of the power source. This flow of electrons is known as an **electric current**.

If there is a break in the circuit, the electrons can't get through to the appliance and there will be no electrical charge.

Write in Journal:

The path of the electricity goes from the negative end of the battery back to the positive end.

Extend:

Today we will figure out what part of the bulb actually lights, what parts of our circuits are insulators and what parts are conductors, and what the path is that the electricity takes through it.

Pass out the materials.

Set up the battery in the holder (if you have battery holders and two wires, it will make this part easier, but several sets of hands can work). Connect a wire to each end of the holder.

Use the two wires to touch different parts of the bulb to determine which parts are conductors.

On the **Parts of a Light Bulb** page write:

CONDUCTOR or INSULATOR under each word describing a part of the bulb.

Use a colored pencil or marker to show the path the electricity takes through the bulb. After drawing the path, add arrows to show the direction the electricity is going from the negative end of the battery and back to the positive end where it will start over again.

Students should discover that the **filament** is the only part of the bulb that makes light.

Add the definition of filament to their Science Journals.

Filament: The thin metal wire in a light bulb that gets hot and emits light.

Assessment:

Write a summary of the lesson in their Science Journals. They are to describe the path of the electricity through the circuit and explain exactly what part of the bulb lights. Explain why it is good to have insulators in the design.

Expected responses:

The path is from the negative end of the battery, through the wire and then into the light bulb either at the tip or on the threads, it goes up the filament holder to the filament, down the other holder to the threads or tip (whichever was not said first) and back to the positive end of the battery. The only part that actually lights is the filament.

The insulators are good to keep the electricity from escaping to other places. If the outside of the wire did not have insulation and you held it, the electricity would go into your body and there wouldn't be enough left to light the filament.

Lesson 3: Make a Switch

Instructional Resources/Materials:

Items for each group (groups of 2)

- 1 index card (3" x 5")
- 1 large paper clip
- 2 brass brads
- 1 D cell battery
- 1 Battery holder (optional, but it will make it easier to set up the circuit)
- 1 1.5 volt bulb
- 3 10-20cm insulated wires (strip insulation of 2 cm from both ends of the wire)
or wire with banana clips
- 1 Gallon plastic zip bag to contain the above items

Items for each student

Science Notebook

Engage:

T: How do we normally turn on appliances?

S: Flip a switch, turn a knob, etc.

Explain:

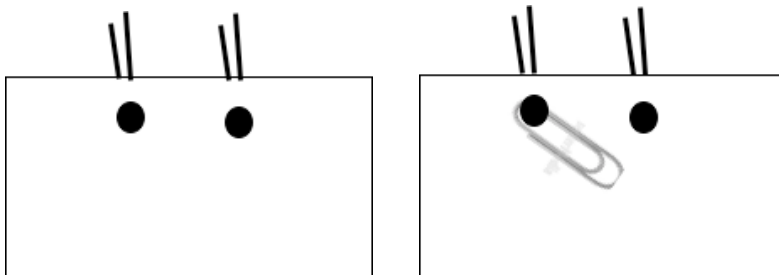
Switches are easier to use than having to physically connect the wires each time we want to use an appliance or turn on a light.

A switch opens and closes an electrical circuit. When it is open, no electricity flows; when it is closed it makes a complete circuit.

Extend:

Pass out the index cards, brads and paperclips

Poke the brads through the cards about an inch from the top of the card and about 1 ½ inches apart.

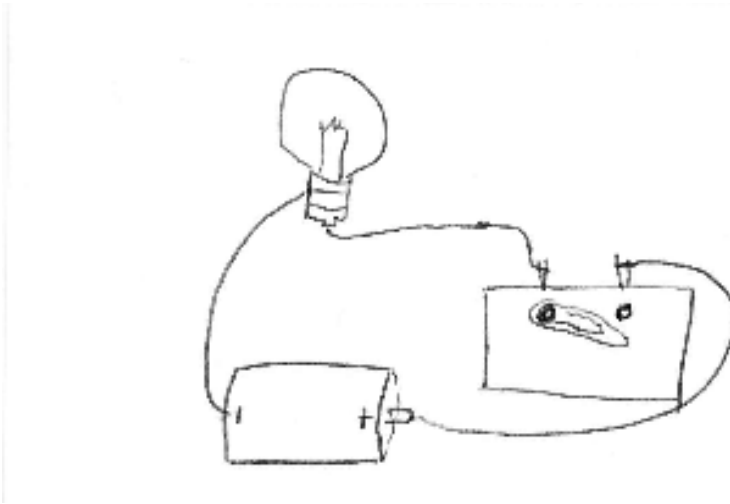


Take one brad out and put it through the paper clip, then put the brad back in the card.

Pass out the rest of the materials. Connect the switch in the circuit (this will take 3 wires). When the paper clip touches both brads the bulb will light (this is a closed circuit), when you move the paper clip away, it turns off (this is an open circuit).

Assessment:

Draw a picture of the new circuit in their Science Journal. Describe how the switch works.

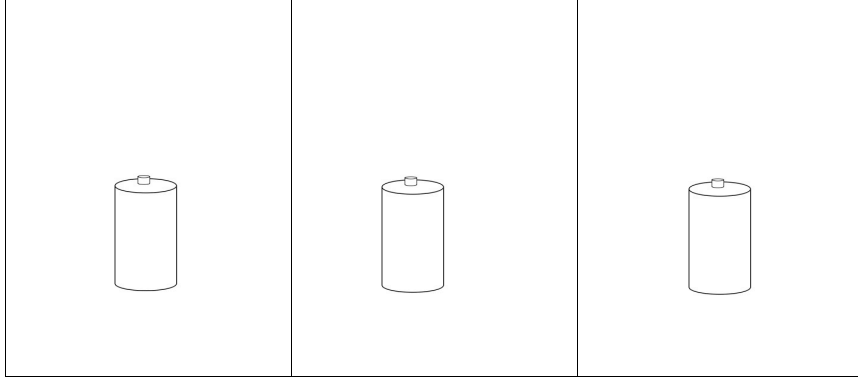


Touch the paper clip to both brads and the bulb lights, because that closes the circuit and the electricity can then go all the way around.

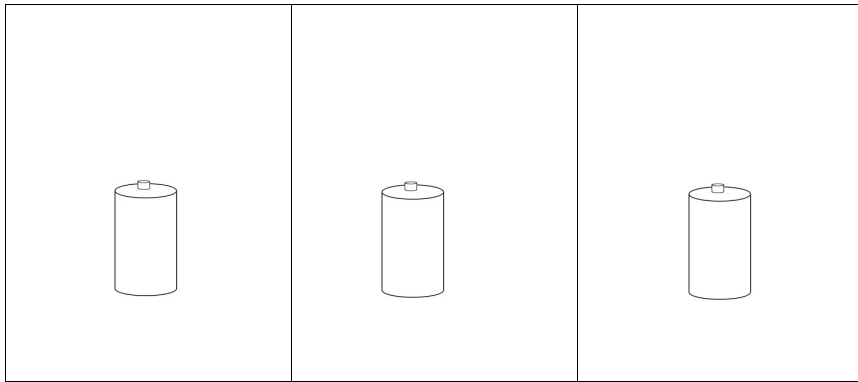
Name _____

Circuit Drawings

Draw 3 ways you made your light bulb light.



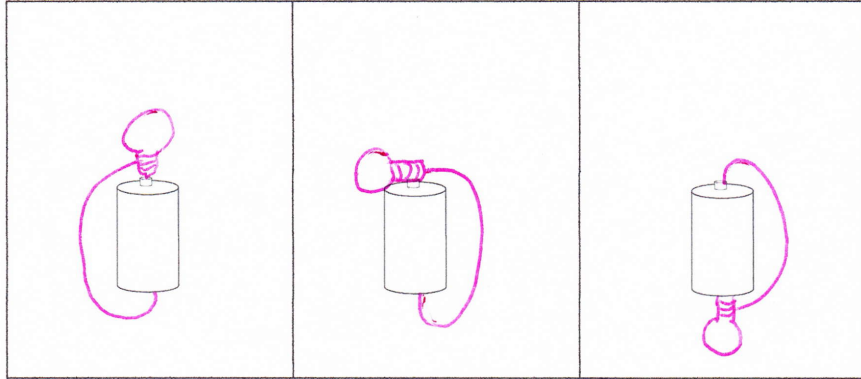
Draw 3 ways that the bulb will NOT light



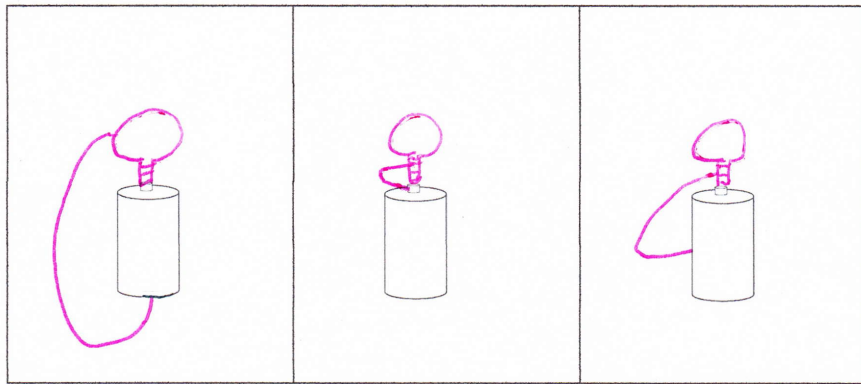
Name Key

Circuit Drawings

Draw 3 ways you made your light bulb light.



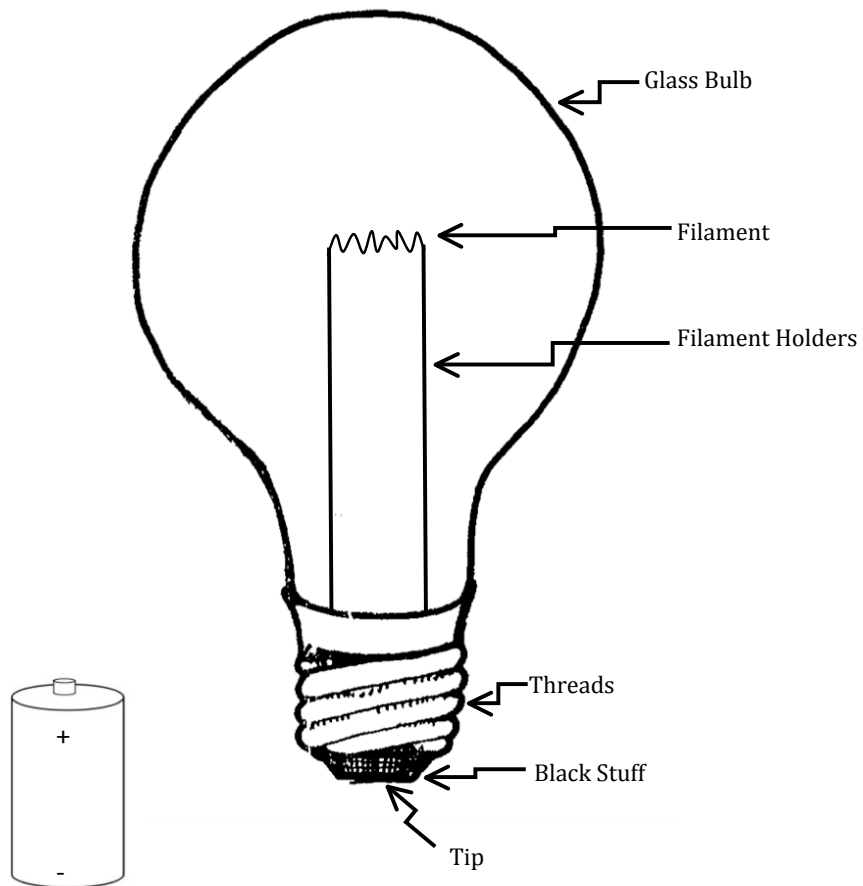
Draw 3 ways that the bulb will NOT light



Name _____

Parts of a Light Bulb

1. Identify which parts are conductors and which parts are insulators.
2. Show the path the electricity takes through the bulb with a colored pencil.
3. Where is the light? _____



Name Key

Parts of a Light Bulb

1. Identify which parts are conductors and which parts are insulators.
2. Show the path the electricity takes through the bulb with a colored pencil.
3. Where is the light? on the filament

