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# ELECTRICITY PHYSICAL SCIENCE LAB

**Targets standards in these areas:**

- Understand electricity as a form of energy
- Convert electrical energy
- Design and build circuits
- Identify objects that conduct electricity

Perfect for science centers, our hands-on lab is a fun, engaging way for students to explore electricity! Children just display one of the seven experiment cards in the wooden stand and follow the step-by-step instructions to complete the activity. Plus, the back of each card features background information on the concept covered by the experiment—so students learn important facts as they work.

## What's Included

- 4 bulb holders
- 6 lightbulbs
- 2 knife switches
- 4 "D" battery holders
- 2 red alligator clips
- 2 blue alligator clips
- 2 plastic combs
- 2 sandpaper squares
- 2 fans
- 2 buzzers
- Red bell wire
- 7 experiment cards
- Wooden stand

**Note:** To build the circuits, you will need "D" batteries, which are not included. Do not mix old and new batteries. Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.

Also, some experiments require additional materials that are commonly found in the classroom. The names of these items are printed in italics in the "You will need" section of the experiment cards.

## Before You Begin

Reproduce the experiment cards for students to complete in pencil. Then gather the required materials (listed at the top of the cards), and place one "D" battery inside each of the battery holders.

To prepare the bell wire, cut it to the lengths specified on the experiment cards. Then use wire strippers to remove a half-inch of insulation from each end of the wires. Because the bell wire is extremely thin, be very careful not to cut the wire itself when stripping away its insulation. (In many cases, you can use the alligator clips instead of bell wire. If you use the alligator clips with the knife switches, you will need to slide the protective plastic back from the ends of the clips to allow them to open wide enough to attach to the switches' contacts.)

**CAUTION** - Contains glass that can break into sharp edges or points. Handle with care. Adult supervision required.

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# Using the Materials

Discuss electricity with your students. You may want to briefly explain the scientific method and how scientists use experimental evidence to answer questions about the natural world. Point out that each experiment in the lab is meant to answer a specific question about electricity. Here are suggested discussion questions to ask your students:

- What is electricity?
- What do you already know about electricity?
- Where does electricity come from?
- What do we use electricity for?

Now discuss the following terms, which students will read on the backs of the experiment cards:

| | |
|---|---|
| **electrical circuit:** | a path that electricity flows through |
| **energy source:** | something that produces electrical energy |
| **load:** | something that uses electrical energy to do work |
| **circuit:** | a path that electricity flows through |
| **complete (closed) circuit:** | a circuit with an unbroken path; electricity flows through the path in a loop |
| **incomplete (open) circuit:** | a circuit with a broken path; electricity cannot flow through the path |
| **switches:** | things that can be moved to close circuits (turn them on) or open circuits (turn them off) |
| **electrical charges:** | amounts of electricity; electrical charges can be positive or negative |
| **static electricity:** | the buildup of electrical charges |
| **series circuit:** | a circuit in which electricity flows along only one path; items in a series circuit are connected in a row |
| **conductors:** | materials that conduct, or move, lots of electricity |
| **conductivity:** | how well a material conducts electricity |
| **insulators:** | materials that do not conduct, or move, much electricity |
| **wires:** | thin strips of metal that connect items in a circuit |

Finally, select an experiment for students to conduct, and place the card in the wooden stand. Then set out the required materials (including a photocopy of the experiment card for each student). Remind students to read the information on the back of the card before beginning the experiment on front.

# Extension Activity

Encourage students to create science journals to keep a record of what they've learned from the electricity experiments. Have children write down the important terms from the backs of the cards, and prompt them to illustrate each term. After students complete each experiment, prompt them to write a paragraph about what they learned and what observations they made. Have students hand in their journals for your review.

# Meeting Individual Needs

### ELL

Before students conduct an experiment, review the important terms on the back of the card. You can also use any pictures on the back of the card to help explain the terms. Encourage children to write the terms in a notebook and draw a picture for each one. Then introduce each of the experiment's required components. Allow students to refer to their notes as they complete the experiment. You can also allow students to conduct the experiment with a partner.

### Reteach/Extra Support

With a small group or one-on-one, read the passage on the back of an experiment card, checking for understanding as you go. Then review the important terms and their definitions. Ask students to provide an oral summary of the passage and explain the important terms. Now review the directions on front to make sure children understand the task. Invite children to complete the experiment and direct them to keep in mind the concepts from the back of the card.

### Challenge

Encourage students to do independent research to learn more about the seven topics covered in this lab. Invite children to get nonfiction books from the school library or search the Internet for information on the terms and concepts on the experiment cards. Then ask students to share their findings with the whole class or a small group of classmates.

## Informal Assessment Ideas

- After students complete an experiment, collect their papers and review their work. Keep the papers in students' files.
- Create a quiz to check students' understanding of the important terms on the cards. For easy reference, the terms and definitions are listed on page 2 of this guide.

## Summary of Experiment Outcomes

### Making a Simple Circuit

Students will learn how an energy source powers a load when the two are connected with wires.

### Testing for Conductors

Students will learn that some materials conduct electricity and others do not.

### Complete and Incomplete Circuits

Students will learn that a circuit must be complete (closed) to conduct electricity.

### Static Electricity

Students will learn that static electricity can happen when two objects are rubbed together.

### Making a Series Circuit

Students will learn that an energy source can power more than one item when the items are connected in a series circuit.

### Making a Simple Switched Circuit

Students will learn that a switch opens and closes a circuit.

### Electricity at Home

Students will learn that a battery's energy lessens after powering a load.

# MAKING A SIMPLE CIRCUIT

Name _____

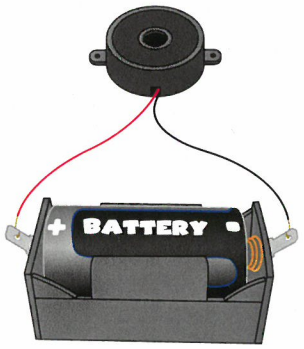
**You will need:**

Buzzer

Battery Holder with *"D" Battery* Inside

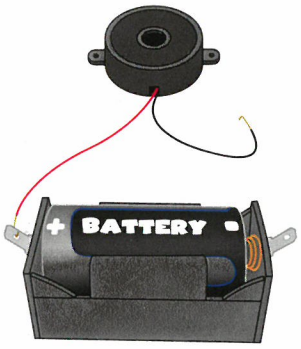
**1** Read the back of this card.

**2** Connect the end of the buzzer's red wire to the battery holder's positive ( + ) end. Slide the wire through the metal tab on the battery holder and bend the wire to secure it. Make sure the exposed wire is touching the metal tab. In the same way, connect the end of the buzzer's black wire to the battery holder's negative ( – ) end.




| What happens? | Why does this happen? |
|---|---|
| | |

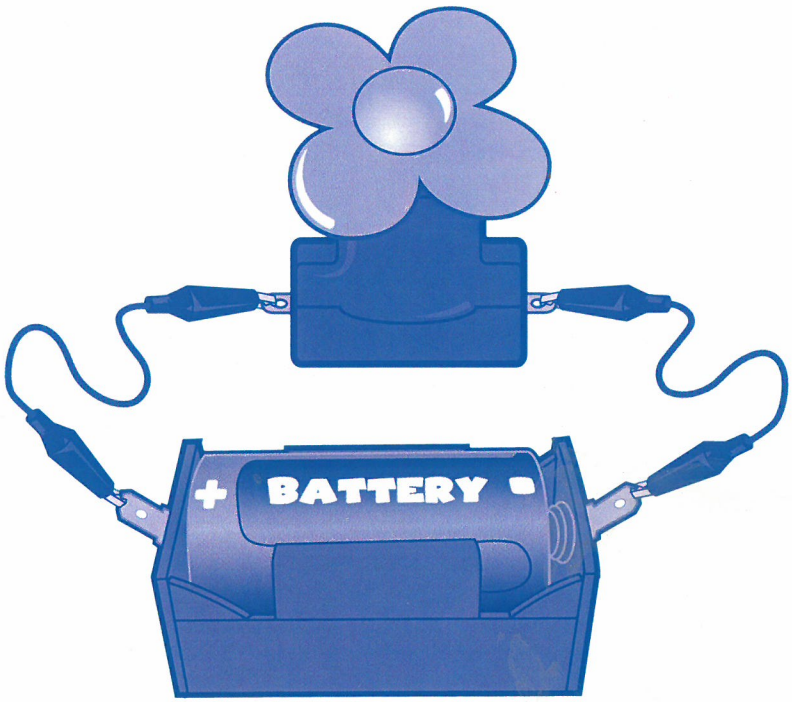
**3** Remove one of the wires from the battery holder.




| What happens? | Why does this happen? |
|---|---|
| | |

# WHAT IS AN ELECTRICAL CIRCUIT?

An **electrical circuit** is a path that electricity flows through. A circuit has an energy source and a load. The **energy source** produces electrical energy, and the **load** uses that energy to do work. An example of a circuit is a battery connected to a fan. In this circuit, the battery is the energy source, and the fan is the load. The fan does work by moving air to keep us cool. Two wires connect the battery to the fan. Electricity flows through one wire from the battery to the fan—and then back to the battery through the other wire! Electricity can only flow through a closed, or complete, circuit. If one wire breaks, the circuit is open and therefore incomplete. If the fan turns off, you know that the circuit has stopped working.




| Important Terms | |
|---|---|
| **electrical circuit** | A path that electricity flows through |
| **energy source** | Something that produces electrical energy |
| **load** | Something that uses electrical energy to do work |

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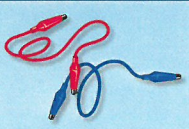
# TESTING FOR CONDUCTORS

Name _____

**You will need:**

Lightbulb in Bulb Holder

Battery Holder with *"D" Battery* Inside


2 Alligator Clips

Plastic Comb

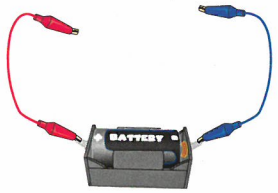
*Pencil*

*Penny*

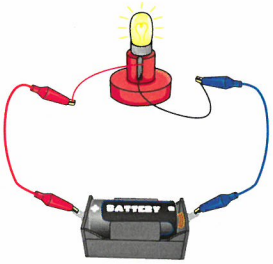
*Eraser*

**1** Read the back of this card.

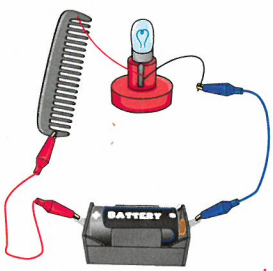
**2** Attach one end of the red alligator clip to the metal tab on the battery holder's positive ( + ) end. Attach one end of the blue alligator clip to the metal tab on the battery holder's negative ( – ) end.



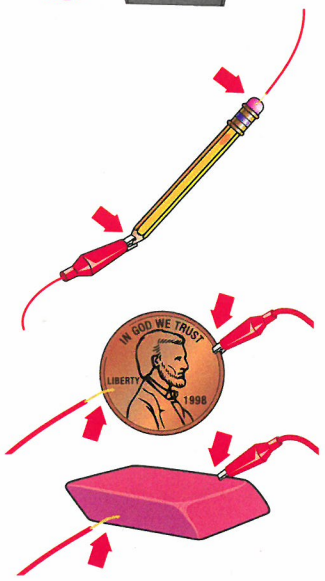

**3** Attach the other end of the red alligator clip to the exposed end of the bulb holder's red wire. Attach the other end of the blue alligator clip to the exposed end of the bulb holder's black wire. You should see the bulb light up.




**4** Remove the red alligator clip from the bulb holder's red wire. To test what materials conduct electricity, touch each item with the red alligator clip and the exposed end of the bulb holder's red wire. Fill out the chart as you go.

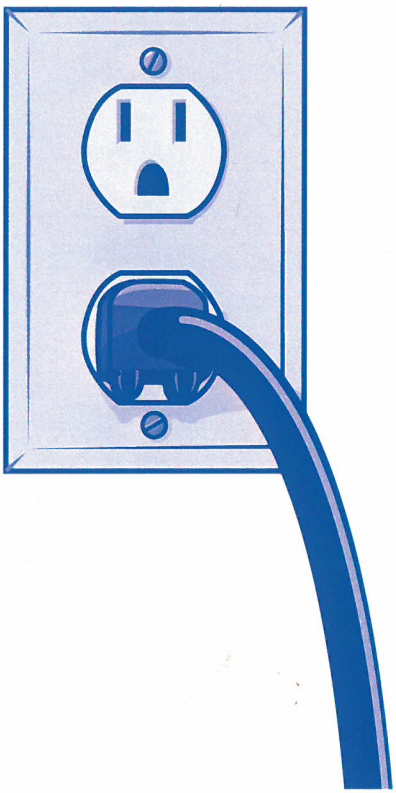



| Item Tested for Conductivity | Is It a Conductor? |
|---|---|
| Plastic comb | |
| Pencil<br>(Touch the exposed end of the wire to the eraser. Touch the alligator clip to the sharpened end.) | |
| Penny | |
| Eraser | |

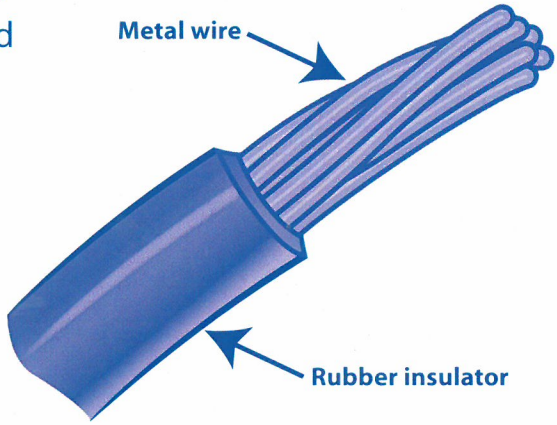


# WHAT ARE CONDUCTORS AND INSULATORS?

Electricity can move through certain materials easily. These materials are called **conductors** because they conduct, or move, lots of electricity. **Conductivity** is how well a material conducts electricity. Copper and most metals are conductors. They have high conductivity. Other materials do not conduct much electricity. These materials are called **insulators** because they insulate, or separate, the materials around them from electricity. Rubber and plastic are insulators. They have low conductivity.



Conductors and insulators are all around us! For example, appliances and many other electrically powered items in your home use conductors to get electrical energy from power outlets. Each of these items has a power cord. The cord might be rubber or plastic on the outside, but it has a metal wire with high conductivity on the inside! This wire is what lamps, stereos, and TVs use to get electricity. Because their charges can give us an electric shock, the wires inside power cords are covered with an insulator like rubber or plastic. Electricity does not move easily through these materials. That is why you can safely hold a power cord while electricity is moving through it!




| Important Terms | |
|---|---|
| conductors | Materials that conduct, or move, lots of electricity |
| conductivity | How well a material conducts electricity |
| insulators | Materials that do not conduct, |
| series circuit | path; items in a series circuit are connected in a row |

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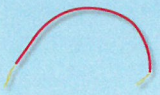
# MAKING A SIMPLE SWITCHED CIRCUIT

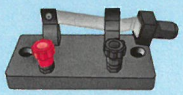
Name _____

**You will need:**

Lightbulb in Bulb Holder



7" Bell Wire with Stripped Ends

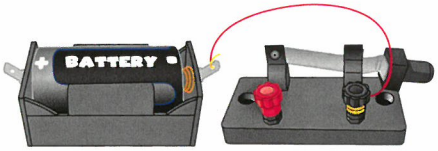


Knife Switch

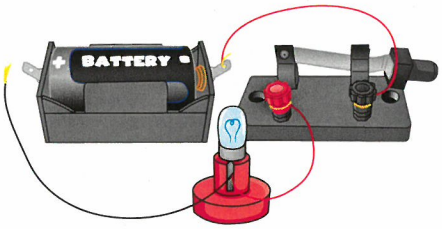
Battery Holder with *"D" Battery* Inside

**1** Read the back of this card.

**2** Loosen the black screw on the switch. Wrap the exposed end of the bell wire around the black screw and tighten the screw to hold the wire securely in place. Wrap the other end of the bell wire around the metal tab on the battery holder's negative ( – ) end.



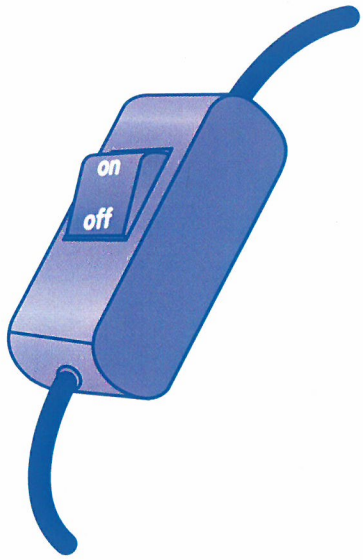

**3** Loosen the red screw on the switch. Wrap the exposed end of the bulb holder's red wire around the screw. Tighten the screw. Be sure the handle of the knife switch is down.



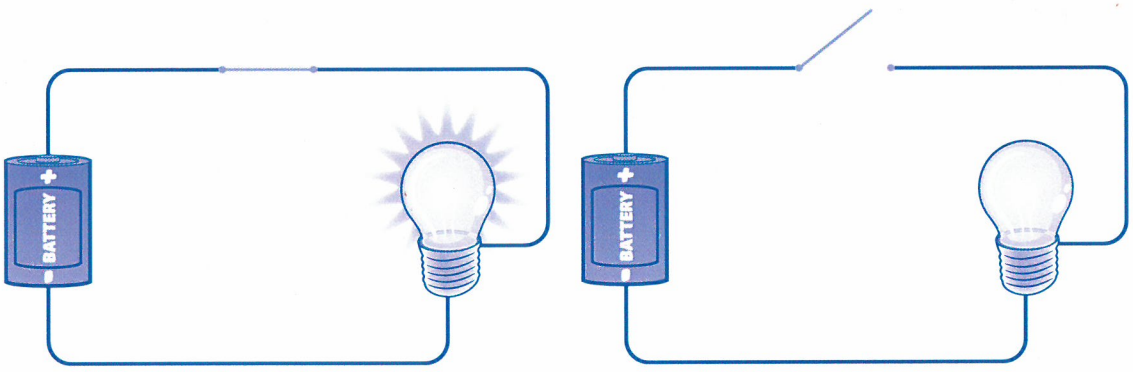

| Try this! | What happens? | Why does this happen? |
|---|---|---|
| Attach the exposed end of the bulb holder's black wire to the metal tab on the positive ( + ) end of the battery holder. | | |
| Open the knife switch by raising its handle. | | |
| Close the knife switch by putting the handle down. | | |
| Detach the bulb holder's black wire from the battery holder. | | |

# WHAT DOES A CIRCUIT'S SWITCH DO?

To move through a circuit, electricity needs a path that is **complete**, or **closed**. When a circuit has a broken wire or a dead battery, electricity cannot flow through it. The circuit is **incomplete**, or **open**, and no longer works. To get the circuit working again, you need to fix its wire or replace its battery.




But not all circuits are broken when they are open. A lot of circuits have **switches**. Switches close and open circuits, or turn them on and off. We use switches every day to close and open electrical circuits. For example, when you press a blender's "on" button, you are using a switch to close the blender's circuit and let electricity flow through it! And when you press the blender's "off" button, you are using a switch to open the circuit and stop the flow of electricity.




| Important Terms | |
|---|---|
| complete (closed) circuit | A circuit with an unbroken path; electricity flows through the path in a loop |
| incomplete (open) circuit | A circuit with a broken path; electricity cannot flow through the path |
| switches | Things that can be moved to close circuits (turn them on) or open circuits (turn them off) |

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# ELECTRICITY AT HOME

Name _____

**You will need:**

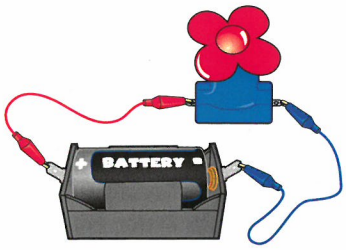
2 Battery Holders with *"D" Batteries* Inside

Fan

2 Alligator Clips

**1** Read the back of this card.

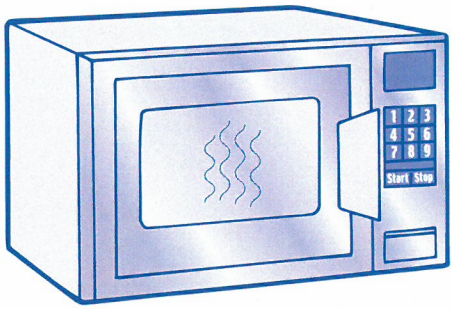
**2** Connect one battery holder and the fan with alligator clips to make a working circuit like the one in the picture.



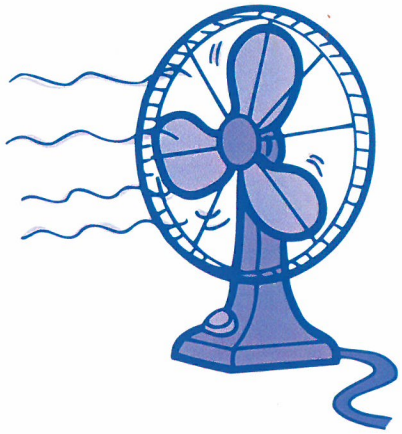

| Action | Question | Answer & Explanation |
|---|---|---|
| Let the fan run for about two minutes. | What do you think would happen to the battery's power if you left it running overnight? | |
| Disconnect the blue clip from the negative ( – ) end of the battery holder. (Keep the other blue clip connected to the fan.) | What happened to the battery's power? | |
| Add another battery to the circuit by touching the second battery holder's positive ( + ) end to the open end of the first battery holder. Connect the blue clip to the negative ( – ) end of the second battery holder. | What happened to the fan? | |

# HOW DO WE USE ELECTRICITY AT HOME?

Most houses and apartment buildings have **wires** inside their walls. Each of these wires is part of a **circuit** that brings energy to ceiling lights, doorbells, and other electrically powered objects that are permanent parts of the home. Other items need to be plugged in to get electrical energy. Look around your home to find some of these things. Whenever you use a computer, listen to the radio, or watch television, you are using electricity! And what about the appliances in your kitchen? Refrigerators, microwaves, and some ovens run on electricity, too!




Some plug-in items, such as refrigerators, need to be on all the time. But others can be turned off when you're not using them. For example, when you go to sleep at night or leave your home, you should turn off the lights and the TV. If your home has electric heating, you can save a lot of energy when it's cold by using extra blankets and layers of clothing instead of turning up the heat!



| Important Terms | |
|---|---|
| **wires** | Thin strips of metal that connect items in a circuit |
| **circuit** | A path that electricity flows through |

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