



Build It: Game Boards

<p>THE BASICS</p>	<p>THE TOOLBOX</p>	<p>EDUCATION STANDARDS</p>	<p>Physical Science Content Standard: Reinforces principles of electricity and how it travels in a simple circuit.</p>
<p> Grade Level: 3-12</p>	<ul style="list-style-type: none"> • Electric or hand drill with 1/4" drill bit • Paper hole punch • Wire cutter and wire strippers 	<p>SAFETY CONCERNS</p>	<p>Handle wire carefully—the ends are sharp. Only adults should use the drill, and should always wear goggles to protect their eyes.</p>
<p> Estimated Time: 1-3 hours</p>	<ul style="list-style-type: none"> • Specific materials for each game board are listed below 	<p>FOR KIDS WITH DISABILITIES</p>	<p>Students with hearing impairments may use only lightbulbs, and students with visual impairments may use only buzzers.</p>



Educational Objective:

To reinforce students' understanding about simple electrical circuits and apply it to building a game they can play with their friends.

Materials Preparation:

To make game board #1, for each one or two students you will need the following materials:

- Manila file folder
- Crayons, markers, pens, and/or pencils to decorate game board
- Sheet of aluminum foil 12" square cut into strips
- Two 12" pieces of insulated wire
- Masking tape
- Flashlight bulb with holder or 3-volt buzzer
- 2 D-cell batteries
- 2 D-cell battery holders (optional)
- 2 small alligator clips (optional)
- 10 brass paper fasteners
- assorted reference books, including a dictionary, thesaurus, pocket encyclopedia, and/or atlas

To make game board #2, for each 2 or 3 students you will need the following materials:

- One 14" square piece of ¼" thick pressboard or plywood
- Sandpaper (medium grit)
- Paint, markers, contact paper, etc. to decorate board
- Scissors
- Pen/pencil
- Five 12" pieces of insulated wire with ends stripped ½"
- Two 24" pieces of insulated wire with ends stripped ½"
- 10 brass paper fasteners
- glue or glue stick
- flashlight bulb and holder or 3-volt buzzer
- Two D-cell batteries
- Two D-cell battery holders (optional)
- Two small alligator clips (optional)
- assorted reference books, including a dictionary, thesaurus, pocket encyclopedia, and/or atlas
- safety glasses

What to Do:

- Game board #1 will take about 1 hour to complete and game board #2 will take about 3 hours to complete.
- Build a model of the game board you plan to have the students make. This will also help you to decide how much materials preparation you want to do before you do the activity depending on the age of the students, the size of the group, or the amount of time you have to complete the activity.
- For the younger students (or if time is a constraint), you may want to drill or punch holes in the game boards, and cut and strip wires or foil. Remember, when possible, don't do for the students that they can do for themselves. Keep these activities "hands-on."

Questions to Ask Students As They Do This Activity:

For game board #1:

- How do you know where to put each strip of foil (wire) on the back of the game board?
- Why do you put tape over each strip of foil? (The tape acts like the insulation on a piece of wire.)
- Why does the bulb light (buzzer sound) when you connect the right answers?
- Why doesn't it light (buzz) when you connect the wrong answers? (In the first case, you have made a complete circuit so the electricity from the batteries can flow through the bulb; in the second, the circuit is not complete.)

For game board #2 (Also see questions for game board #1):

- What would happen if you used wire without insulation on the back of your game board? Try it!

- Can you show where the electricity starts (the negative end of the battery), the path it follows, and where it ends (the positive end of the battery)?

Why It Happens:

Be sure to read the "Why It Happens" section of the activity, *Lights, Sound, Action!* In each of these games, the students are forming incomplete (or open) circuits. These circuits are incomplete because they do not provide a complete, uninterrupted pathway for the electrons to flow from the negative end of the battery to the positive end. Without this complete pathway, electrons cannot flow through the lightbulb or buzzer and, therefore, no light or sound is produced.

In the game boards, the students form a complete (or closed) circuit by attaching the lightbulb/buzzer and batteries to the two ends of a single piece of wire or foil. The tape over the foil (or insulation on the wire) prevents the electrons from jumping from one wire/foil piece to another on the back of the game board. Therefore, the circuit is complete only when the question is connected to the correct answer.

WEB SITES

- **How Stuff Works: Electronics**
<http://www.howstuffworks.com/category-electronics.htm> (Grades 5-12)
- **Energy & Science Projects**
<http://www.energy.ca.gov/education/projects/projects-html/projects.html>
(Grades 1-12)

SOFTWARE

- **Super Solvers Gizmos and Gadgets!** The Learning Company, 1995. (Grades 3-6)
- **STV: Electricity and Simple Machines**
National Geographic Society, 1995.
(Grades 4-7)

READING ROOM

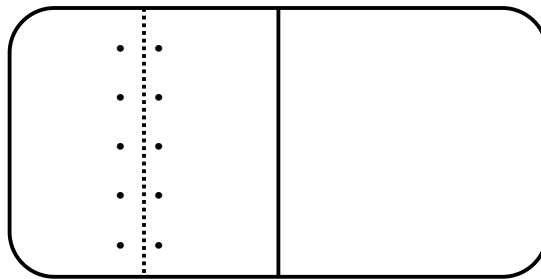
- Bridgman, Roger F. **Electronics.** Dorling Kindersley, Inc., 1993. (Grades 2-6)
- Oxlade, Chris. **Electronic Communication.** Watts, 1997. (Grades 2-6)
- Bonnet, Bob, and Dan Keen. **Science Fair Projects with Electricity and Electronics.** Sterling, 1996. (Grades 7 and up.)

Career Connections

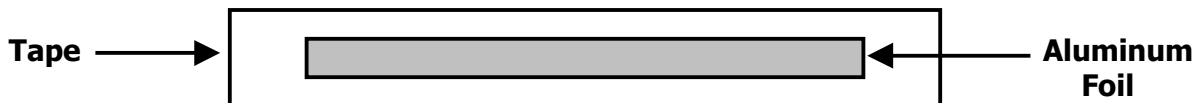
Software developers and system engineers require knowledge about electrical circuits in order to design their games and test them properly.

BUILD IT: GAME BOARD #1 ACTIVITY SHEET

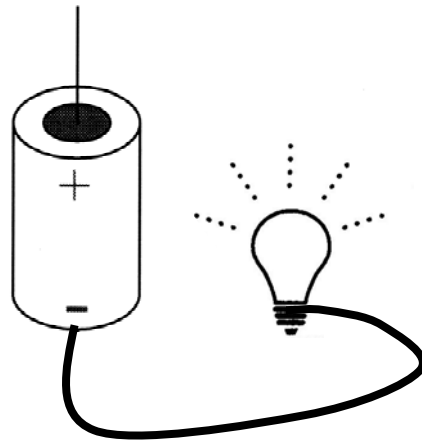
1. Open your manila folder so it is flat. On the left side of the folder, punch 10 holes with a paper hole punch as shown. Fold the left side in half lengthwise. Slip the folded side into the hole punch as far as it will go, so you can punch through both layers at once.



2. Slip one brass paper fastener through each hole and open up the prongs of each on the back side of the folder.
3. Using some of the reference books brought by your leader (or from information you already know) make up five questions and answers. These will be the questions you will ask on your quiz.
4. Write the questions on the left side of your folder, one beside each paper fastener. Then, write the answers by the paper fasteners on the right side, but be sure to mix up your answers so they aren't right next to the questions they match. Look at the sample folder your teacher or leader has made.
5. Using $\frac{1}{2}$ " wide strips of aluminum foil (or pieces of insulated wire with $\frac{1}{2}$ " of insulation stripped from each end), connect your first question with the correct answer on the inside of your folder. Cover the piece of foil with tape before applying the next piece. Repeat this procedure for each of your questions.



6. Close your folder. From the outside, you should not be able to tell which paper fasteners are connected to each other.
7. Now, let's test your game board. Connect a flashlight bulb or a buzzer in an open circuit as shown on the next page:

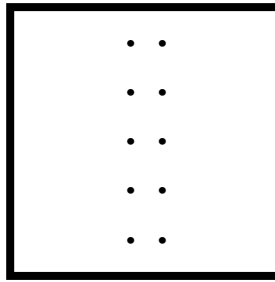


8. Now, you are ready to test your game board. Touch the two ends of the tester to a matching question-and-answer pair. Does your light come on (or your buzzer buzz)? If not, check to make sure that:
 - You have the right question and answer connected by foil or wire in the back; and
 - Your connections in the circuit are tight.
9. Try all of your question-and-answer pairs to make sure that only the correctly matched questions and answers cause the light to come on (or the buzzer to sound).
10. Finally, you can tape your game board closed and decorate it using markers, crayons, or pencils.
11. Now, let someone else take your quiz while you try his/hers. How many questions did your friend get correct? How many did you get correct on his or her game board?
12. Could you make a game board for younger students? Maybe they could match pictures of farm animals to the names of the animals, or colors with the names of the colors. They could also match two things that are the same, such as two cats, two flowers, and two houses. What other ways can you think of to use your game board?

BUILD IT: GAME BOARD #2 ACTIVITY SHEET

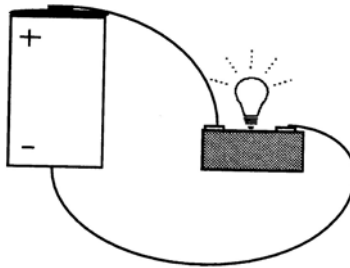
What to Do:

1. Cut a 14-inch square piece of pressboard or plywood. Sand the edges with medium-grit sandpaper if they are rough.
2. Using the pattern shown below, drill 10 holes using an electric or hand drill with a $\frac{1}{4}$ inch bit. **Younger students: Ask an adult to help with this part of the activity!** Be sure to watch your leader demonstrate how to use the drill, and wear protective eye gear when using the drill.



3. Slip a brass paper fastener through each hole and open up the prongs of each one on the back side of the board.
4. Using some of the reference books brought by your leader (or from information you already know), make up five questions and answers. These will be the questions you will ask on your quiz.
5. Cut five 3" x 5" index cards in half. Write your questions on five of the cards and glue them onto the left side of your board, one beside each paper fastener. Look at the model done by your leader. Then, write the answers to the questions on the other card pieces and glue them by the paper fasteners on the right side. Be sure to mix your answers so they aren't right next to the questions they match.
6. Using pieces of insulated wire with $\frac{1}{2}$ " of insulation stripped from each end, connect the prongs of the paper fasteners for the correct questions and answers on the back of the board. You can secure the wire to the paper fastener prongs with tape.
7. Turn over your board. From the front, you should not be able to tell which paper fasteners are connected to each other.

8. Now, let's test your game board. Connect a flashlight bulb and holder or a buzzer in an open circuit as shown below:



9. Now, you are ready to test your game board. Touch the two ends of wires from the tester to a matching question and answer pair. Does your light come on (or your buzzer buzz)? If not, check to make sure that:
- You have the right question and answer connected by wire in the back; and
 - Your connections in the circuit are tight.
10. Try out all of your question-and-answer pairs to make sure that only the correctly matched questions and answers cause the light to come on (or the buzzer to sound).
11. Finally, you can decorate your game board using paint, markers, crayons, or pencils.
12. Now, let someone else take your quiz while you try his/hers. How many questions did your friend get correct? How many did you get correct on your friend's game board?
13. Could you make a game board for younger students? Maybe they could match pictures of farm animals to the names of the animals, or colors with the names of the colors. They could also match two things that are the same, such as two cats, two flowers, and two houses. What other ways can you think of to use your game board?