PATfinders

Topic
Electric circuits

Key Question
How can you make a complete electric circuit that will light a bulb?

Learning Goals
Students will:
1. learn about complete and incomplete circuits by trying to light a bulb using various systems of bulbs, wires, and cells (batteries); and
2. write instructions that others can follow.

Guiding Documents
Project 2061 Benchmarks
- *Make safe electrical connections with various plugs, sockets, and terminals.*
- *Make sketches to aid in explaining procedures or ideas.*
- *Write instructions that others can follow in carrying out a procedure.*

NRC Standards
- *Plan and conduct a simple investigation.*
- *Electrical circuits require a complete loop through which an electrical current can pass.*

Science
Physical science
electricity
circuits
light

Integrated Processes
Observing
Predicting
Collecting and organizing data
Drawing conclusions
Communicating

Materials
For each group:
D cell
flashlight bulb
two 10-15 cm wires (see *Management 5)*
scissors
red and yellow crayons or markers
glue

For each student:
student pages

Background Information
A complete circuit is a series of wires and/or electrical devices that form a closed path through which electricity can flow. To work, a circuit needs a source of electrical energy. The source of electricity used in this investigation is the chemical energy in the cell, better known to most people (incorrectly) as a battery.

A cell is a single unit containing electrodes and an electrolyte for producing electricity. A battery is made up of two or more cells joined together. If an incandescent bulb is placed in a complete circuit so that the electricity passes through it, it will light. Incandescent bulbs have two thick wires supporting a thin, tightly coiled, conducting filament that glows when electricity flows through it. (Edison's original bulb used sewing thread for the filament!) To make the bulb a part of the circuit, one of the circuit wires must be touching the bottom tip of the bulb's base, and the other must touch the metal side of the bulb's base. Any system that causes the bulb to light is a complete circuit.

Management
1. *Sparky's Light Kit* may be used before this activity to provide some experience with circuits.
2. This activity works best if students work in groups of two or three.
3. Beforehand, make sure that all the cells and bulbs are functioning.
4. Although D cells work best for this activity, C or AA cells can also be used.
5. Insulation should be stripped off about two centimeters at the ends of the wires so that a good connection can be made. Narrow strips of aluminum foil that have been backed with masking tape can be substituted for the wire.

Procedure
Part One
1. Show students a cell, two wires, and a bulb. Discuss the *Key Question:* How can you make a complete electric circuit that will light a bulb?
2. Give each group a cell, wires, and a bulb; challenge them to get their bulb to light. Allow time for exploration so that students may test various circuits. Help any groups that have trouble.
3. Have each successful group show and explain what they did.

4. Hand out the yellow and red crayons and the activity sheet. Have students predict which of the pictured systems will light by drawing a red star on them.
5. Have students build each system pictured and observe whether or not it lights the bulb. Diagrams A, E, G, and H depict complete circuits. Tell students to color a yellow star on the diagram of each arrangement that worked.
6. When groups have finished testing all the systems, discuss the results.

Part Two

1. Distribute scissors, glue, and the third activity sheet. Explain that students should cut out each of the systems on the second sheet and glue them on this sheet, diagrams of complete circuits in the *Lights R Us* store and incomplete circuits in *Sparky's Fix It Shop*.
2. Have each group think how Sparky can make the incomplete circuits work. Groups can test these predictions and draw in the necessary changes.

Part Three

1. Hand out the last activity sheet, *Repair Manual*. Have groups cut out the pictures of the circuits that won't light and glue them in the *Repair Manual*. Let the groups discuss why the systems' pictures won't work and then how they could be fixed. Tell students to record this information on the sheet. Encourage the students to follow their written instructions to see if they are clear and correct.
2. As a class, share methods of fixing each of the non-working systems. Let students check the instructions by manipulating their systems as groups read their solutions.

Connecting Learning

1. What are the similarities of the systems that work?
2. What are the similarities of the systems that don't work?
3. Is electricity flowing through the systems that make the bulb light? How do you know?
4. Is electricity flowing through the systems that don't make the bulb light? How do you know?
5. What do you think are necessary elements of all complete circuits?
6. Which was easier illustrating the repairs or writing the repair manual? Explain why you think one was more difficult.
7. What are you wondering now?

Extensions

1. Make as many different complete circuits as possible using the materials provided.
2. Test other materials that can be substituted for the wire.
3. Make a switch that turns the bulb on and off.
4. Use a battery (two or more cells linked together) as a part of the circuit and note the difference in the brightness of the bulb. Warn students that bulbs burn out more quickly when more cells are added.

Curriculum Correlation

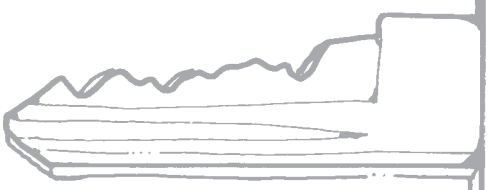
Language Arts

Write a story about working in *Sparky's Fix It Shop*.

Social Studies

Discuss how the electric light has changed our daily life. Read about how the light bulb was invented. Read a biography of Thomas Edison. What else did he invent? Since he is thought to have had a learning disability, discuss his achievements in the light of his limitations.

PATfinders



Key Question

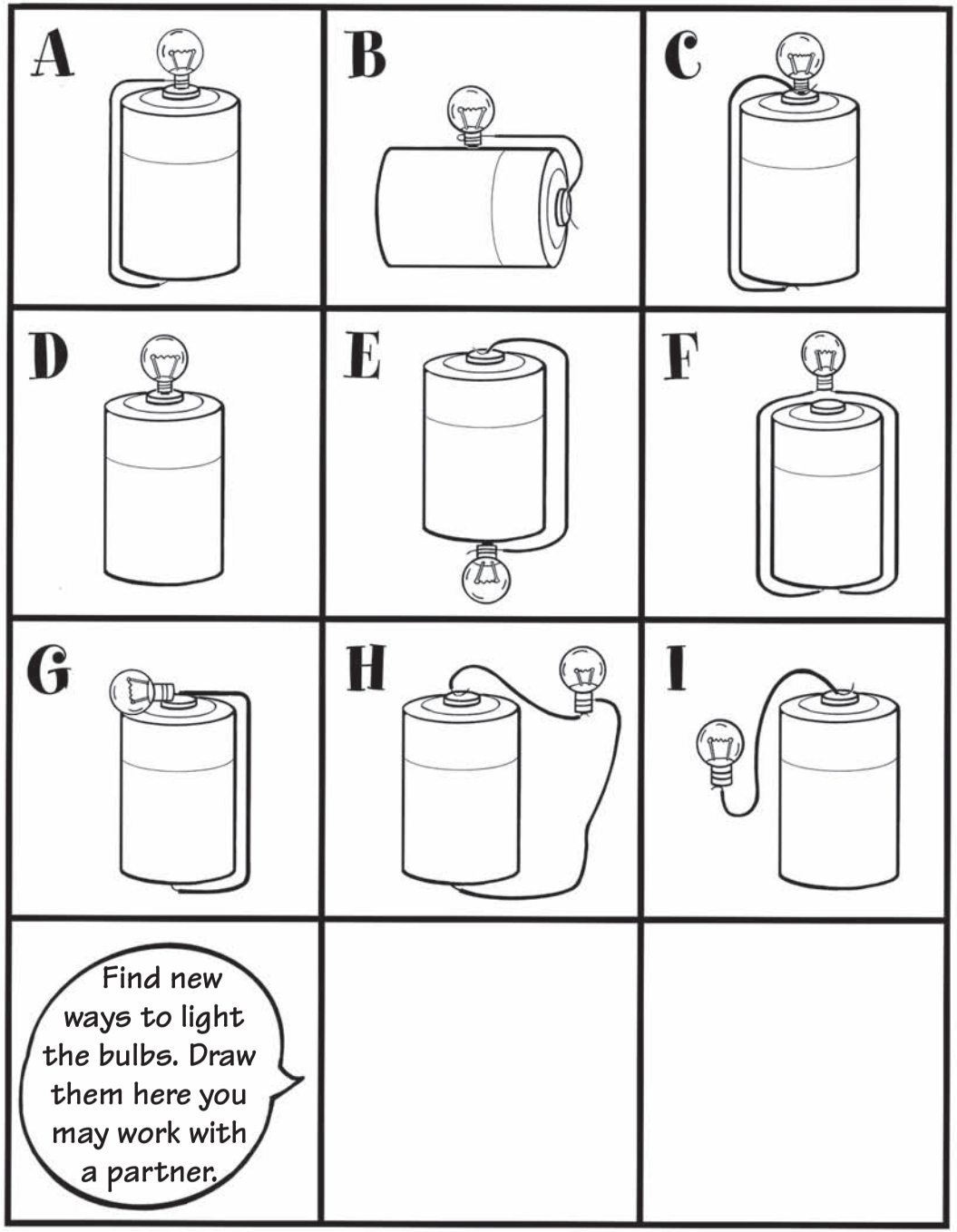
How can you make a complete electric circuit that will light a bulb?

Learning Goals

Students will:

1. learn about complete and incomplete circuits by trying to light a bulb using various systems of bulbs, wires, and cells (batteries); and

2. write instructions that others can follow.

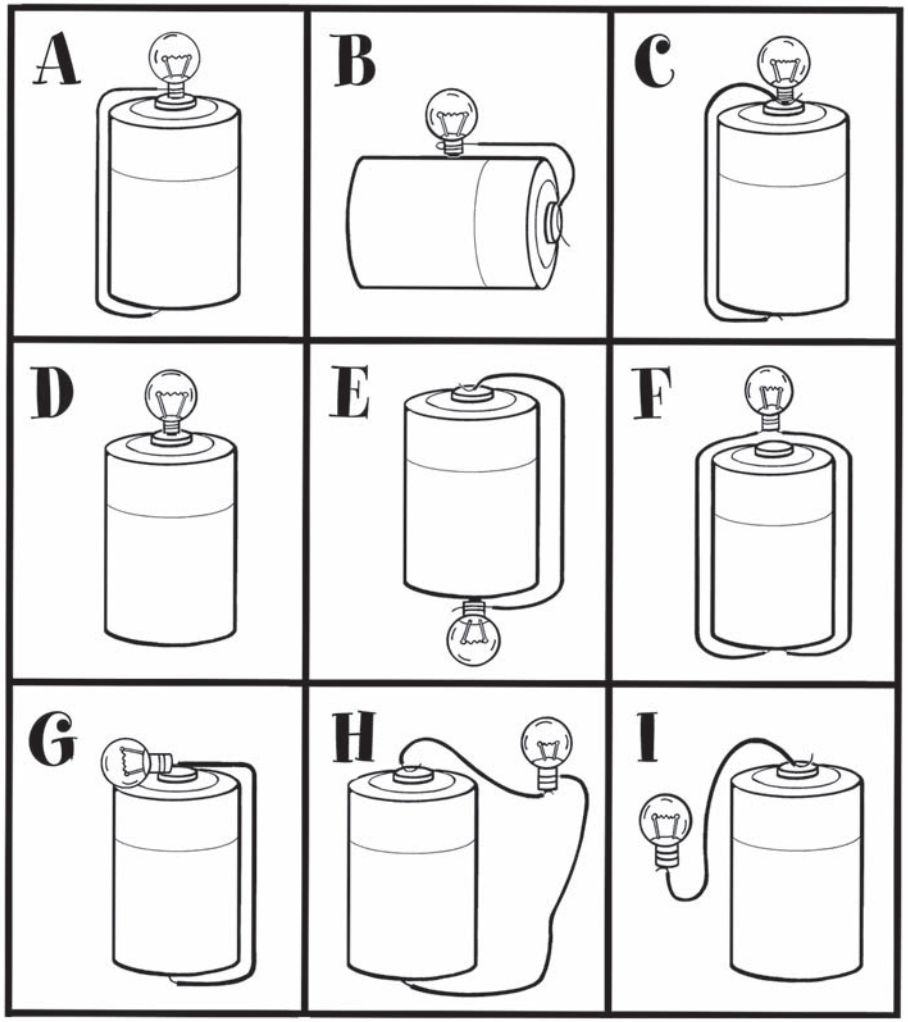


PATH finders

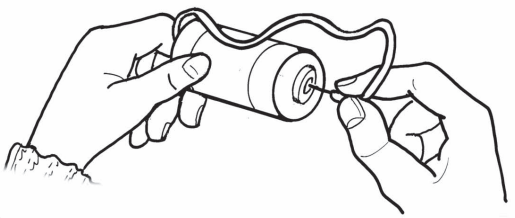
1. Predict which bulbs will light by making a red star beside them.
2. Make a yellow star on all those that really did light.

Lights R' US and SPARKY'S FIX IT SHOP

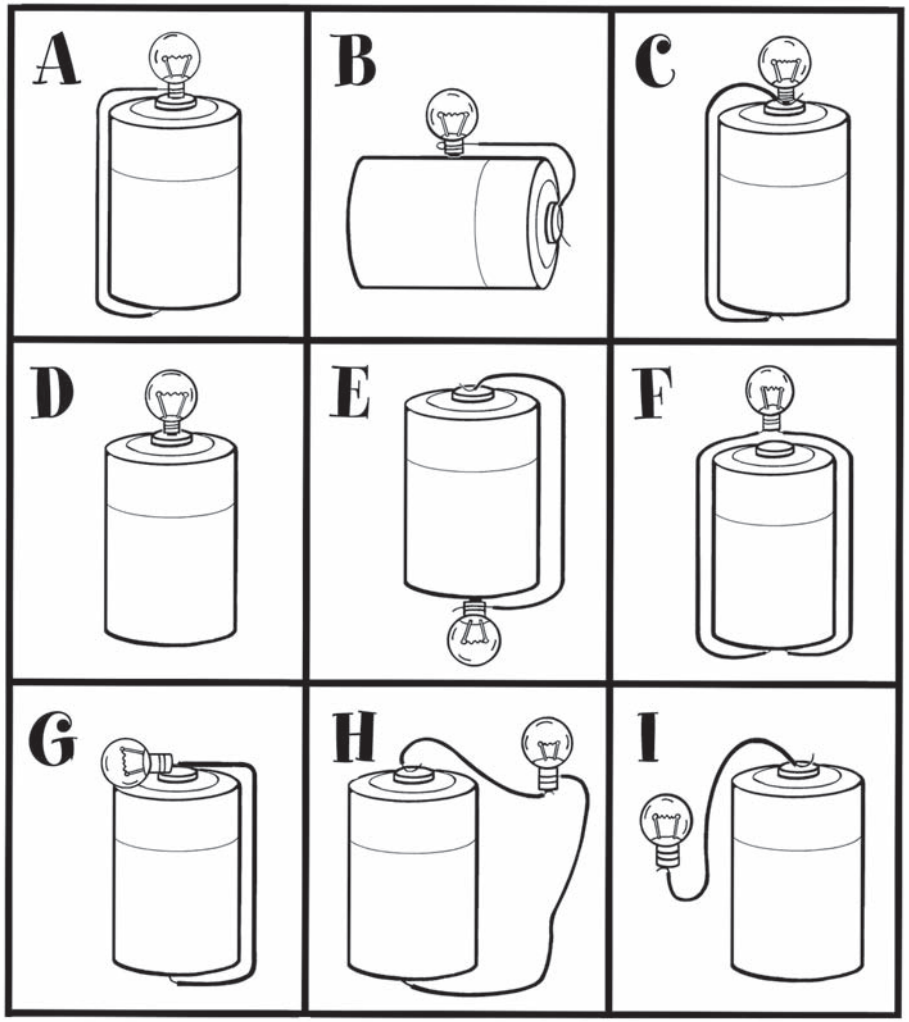
Cutouts

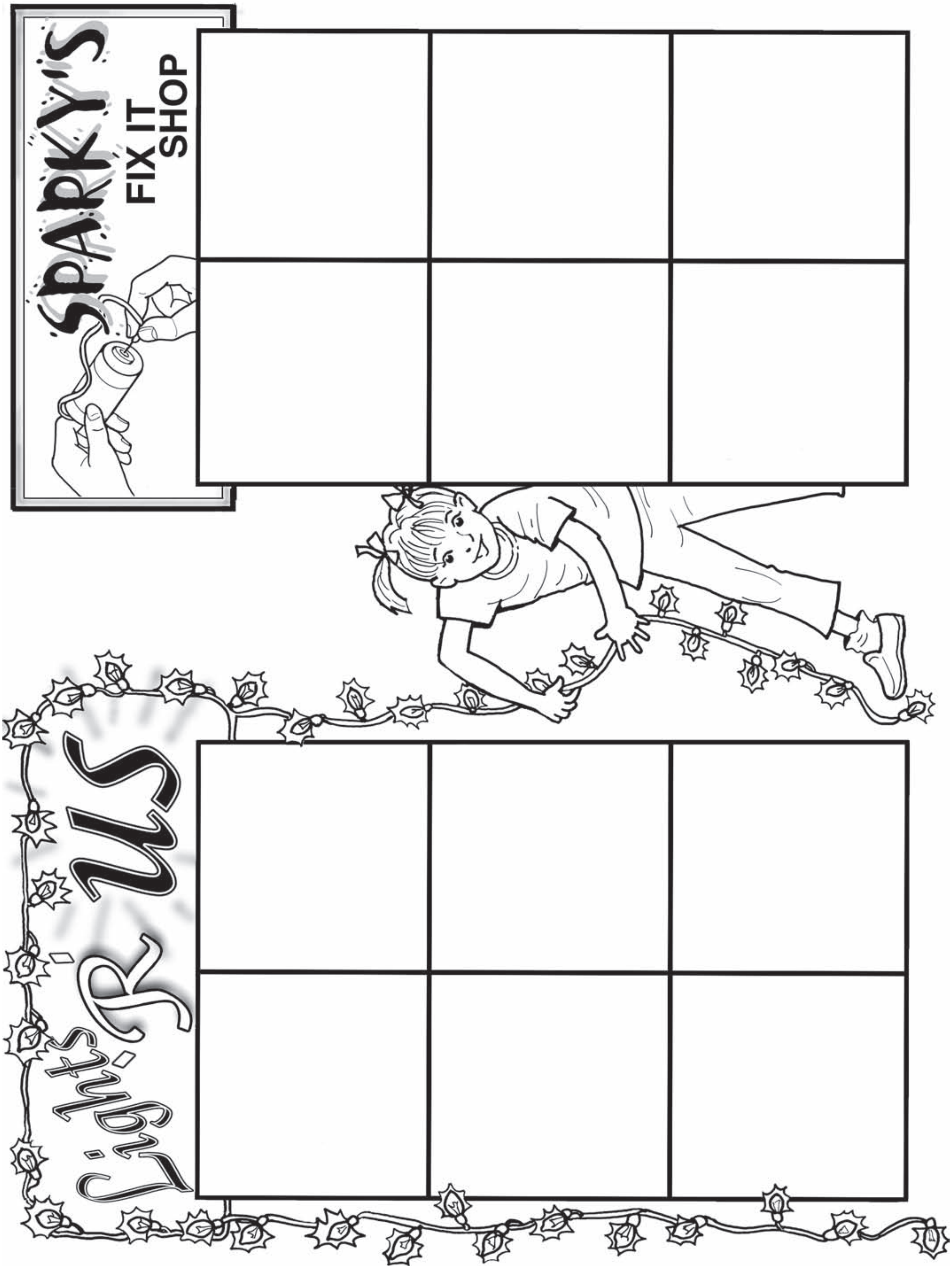


REPAIR MANUAL

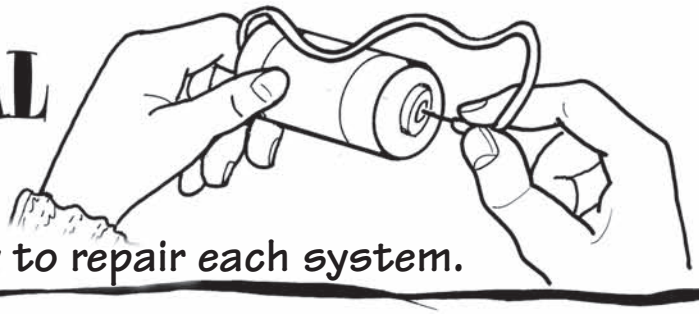


Cutouts




SPARKY'S
FIX IT
SHOP
Lights 'R' Us

REPAIR MANUAL



Describe how to repair each system.

Glue picture here	
Glue picture here	
Glue picture here	
Glue picture here	
Glue picture here	

PATfinders

Connecting Learning

1. What are the similarities of the systems that work?

2. What are the similarities of the systems that don't work?

3. Is electricity flowing through the systems that make the bulb light? How do you know?

4. Is electricity flowing through the systems that don't make the bulb light? How do you know?

5. What do you think are necessary elements of all complete circuits?

6. Which was easier, illustrating the repairs or writing the repair manual? Explain why you think one was more difficult.

7. What are you wondering now?

