Electric Circuits

Topic
Series and parallel circuits

Key Question
How does the flow of electricity in a series circuit differ from the flow in a parallel circuit?

Learning Goals
Students will:
- build series and parallel circuits, and
- compare the two types of circuits.

Guiding Documents
Project 2061 Benchmarks
- *Make safe electrical connections with various plugs, sockets, and terminals.*
- *Make sketches to aid in explaining procedures or ideas.*

NRC Standards
- *Employ simple equipment and tools to gather data and extend the senses.*
- *Use data to construct a reasonable explanation.*
- *Electricity in circuits can produce light, heat, sound, and magnetic effects. Electrical circuits require a complete loop through which an electrical current can pass.*

Science
Physical science
electricity
circuits

Integrated Processes
Observing
Predicting
Drawing conclusions

Materials
For each group:
two D cells
three small bulbs and holders
10 pieces of wire, 20-30 cm
wire stripper, if needed (see *Management 3)*
rubber band, heavy duty

For each student:
student pages

Background Information
There are two basic types of electric circuits, *series* and *parallel*. In a series circuit, there is only one path for the current, and a break in the circuit stops the current. In a parallel circuit, there are multiple pathways or branches. If there is a break in any branch, the current will still go through the other branches. Only if all the branches have breaks will the current stop.

An added factor in any electric circuit is the resistance involved. Electrical resistance is anything that hinders the flow of electricity. The amount of resistance in a conductor depends on the conductivity of the material, its length, thickness, and temperature. Electrical devices such as motors, transistors, and lights add resistance to a circuit. An electric bulb, for example, has much more resistance than the wires in a circuit since its filament is long, thin, and made of a material with high resistance. In circuits, the amount of current varies with the resistance. Circuits with less resistance allow more electricity to flow, while circuits with more resistance restrict the amount of current.

If three bulbs are connected in series, the current goes through each bulb in turn, and the resistance of each bulb is added to the total resistance of the circuit. Less current goes through the circuit and the bulbs glow less brightly than a single bulb would. If a bulb is removed, the path is broken and the current stops.

If the three bulbs are connected in parallel, the current has multiple paths, and the resistance in the circuit is reduced. Since there is less resistance, more electricity flows and each bulb glows as brightly as a single bulb. If a bulb is removed, the others stay lit since the current goes through the other branches of the circuit.

Management
1. Students should work in groups of three or four.
2. Bulbs (item number 1962), bulb holders (item number 1958), wire (item number 1968), and wire strippers (item number 1970) are available from AIMS.
3. The ends of the wires will need to be stripped prior to building the circuits.

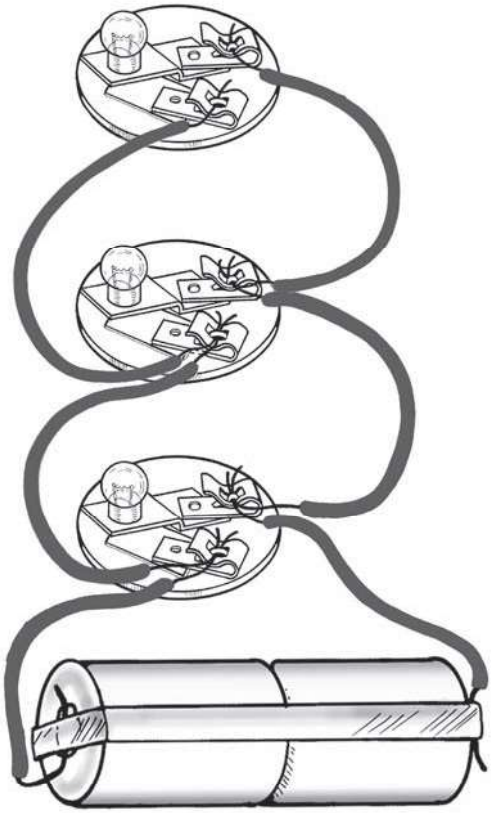
Procedure

Part One

1. Distribute the materials to each group.
2. Have each group build the series circuit pictured and predict what will happen when one of the bulbs is removed. Have students remove a bulb and record the results.
3. Have students build the parallel circuit pictured and predict what will happen when a bulb is removed. Have them test their predictions and record results.
4. Have some groups replace the bulb in the parallel circuit while others rebuild the series circuit.
5. Direct students to compare the brightness of the bulbs in the two circuits. Have them record their observations on the activity sheet.
6. Discuss the results and record conclusions.

Part Two

1. Discuss the schematic diagram and have students build the circuit pictured.
2. Have students build circuits of their own and then make schematic diagrams.
3. Invite students to exchange diagrams and build the circuits pictured.



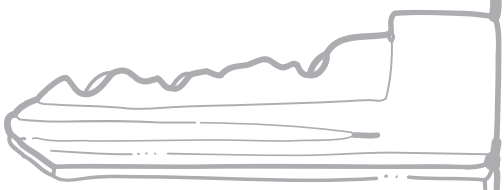
Connecting Learning

1. Why did the other bulbs in the series circuit go out when one bulb was removed? [In a series circuit, there is only one path for the current, and removing the bulb breaks that path and stops the current.]
2. Why did the other bulbs in the parallel circuit stay lit when one bulb was removed? [In a parallel circuit, there are multiple pathways for the current, and breaking one path doesn't keep current from going through the other paths.]
3. Why are the bulbs in the parallel circuit brighter than the bulbs in the series circuit? [There are more paths for the current and less resistance in the parallel circuit.]
4. What problems might you have when lights (such as Christmas tree lights) are wired in series? [When one bulb burns out, it breaks the circuit and all the lights go off. It is often difficult to find the defective bulb, and each bulb in the series must be tested individually.]
5. What kind of circuit is most common in our homes? [parallel] Why?
6. What are you wondering now?

Extensions

1. Try more than three bulbs in the circuits.
2. Add switches or buzzers to your circuits.
3. Try different numbers of cells in the circuits.
4. Use two identical (new) cells and put one in each circuit. Leave the circuits on until both cells are dead. Compare the difference in how long they lasted.

Electric Circuits



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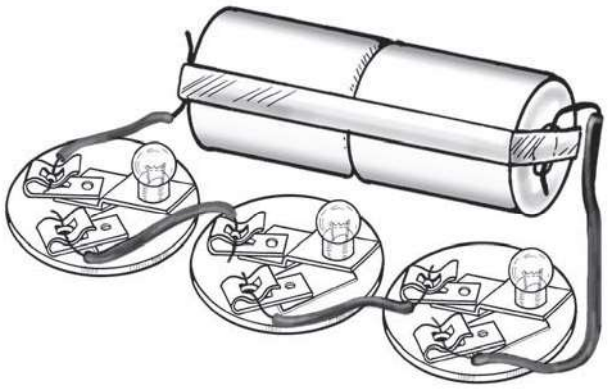


Electric Circuits

Part One

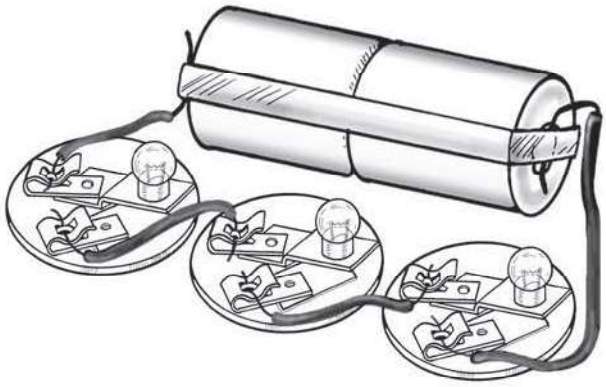
How does the flow of electricity in a series circuit differ from the flow of electricity in a parallel circuit?

1. Build a series circuit like this.

2. What happens when you remove a bulb?

Prediction

Results



Series

3. Build a parallel circuit like this.

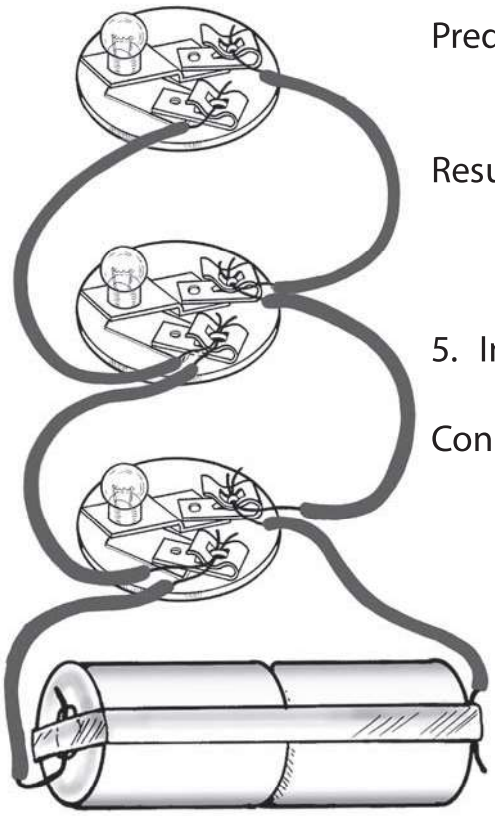
4. What happens when you remove a bulb?

Prediction

Results

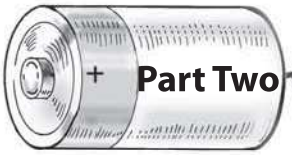
5. In which kind of circuit did the bulbs glow more brightly?

Conclusions

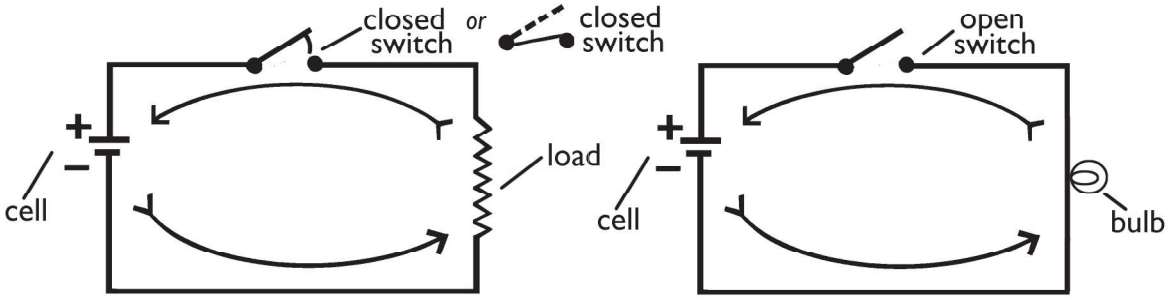


Parallel

Electric Circuits



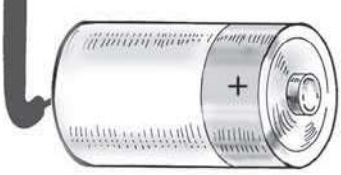
Here is a schematic diagram of an electric circuit. Electricians use diagrams like this when they put electric circuits into houses and other buildings.

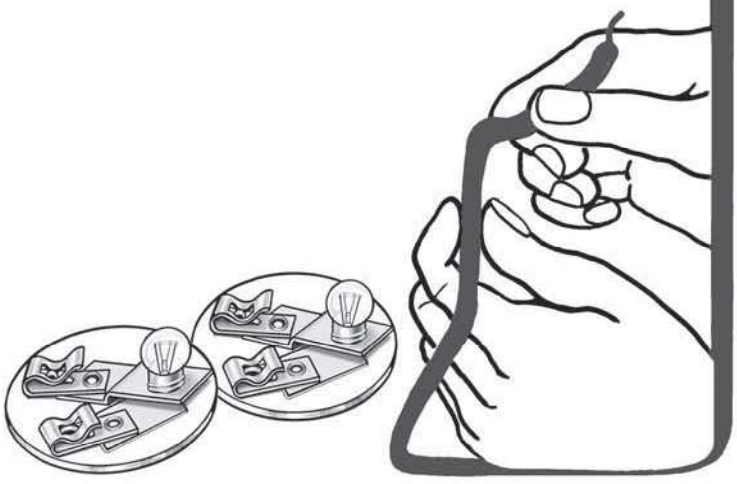


1. Build a circuit using this diagram as a plan. Use a dry cell (battery) for your power supply and a bulb for your load.

   Notice that there is a switch. When the switch is open, the circuit is broken. If you do not have a switch for your circuit, what else can you do to break the circuit and turn off your light?

2. Now make another circuit. After you have built it, make a diagram of it like the one above. See if a friend can follow your diagram and build your circuit.





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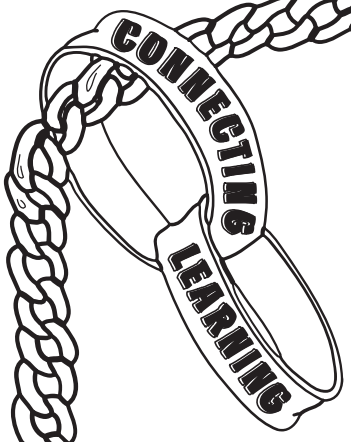

Connecting Learning

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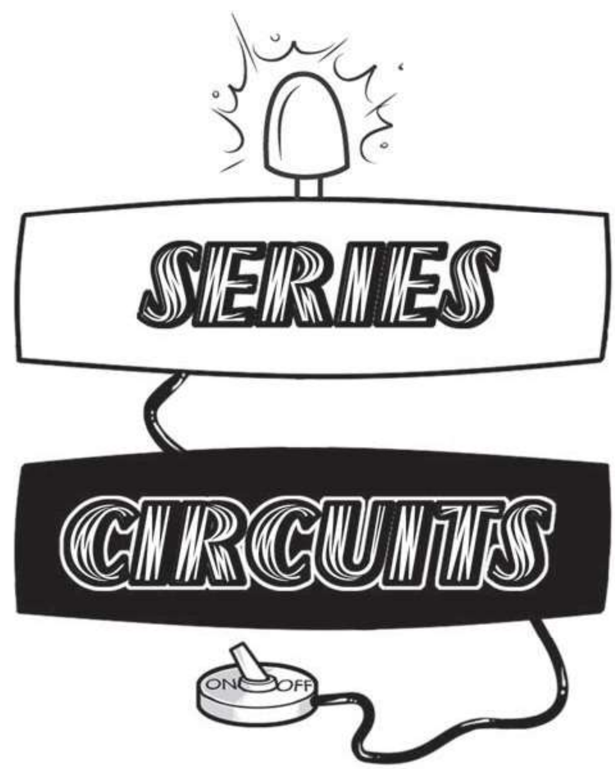
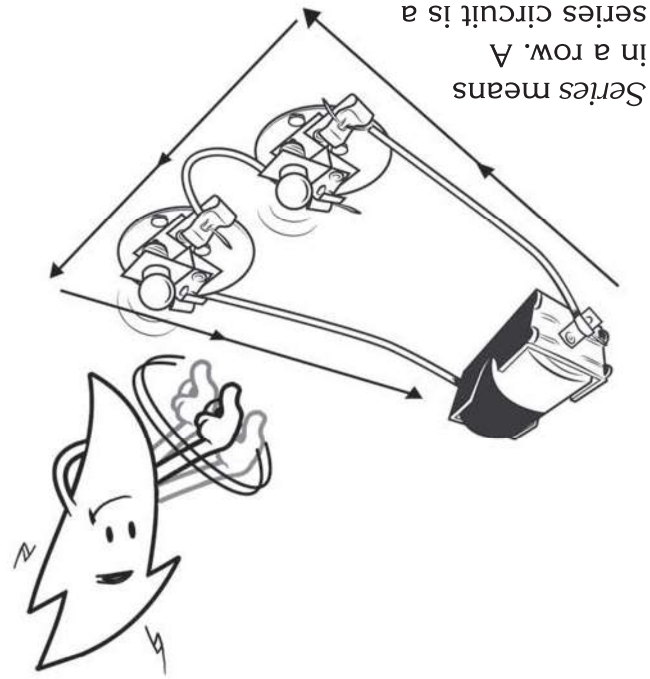
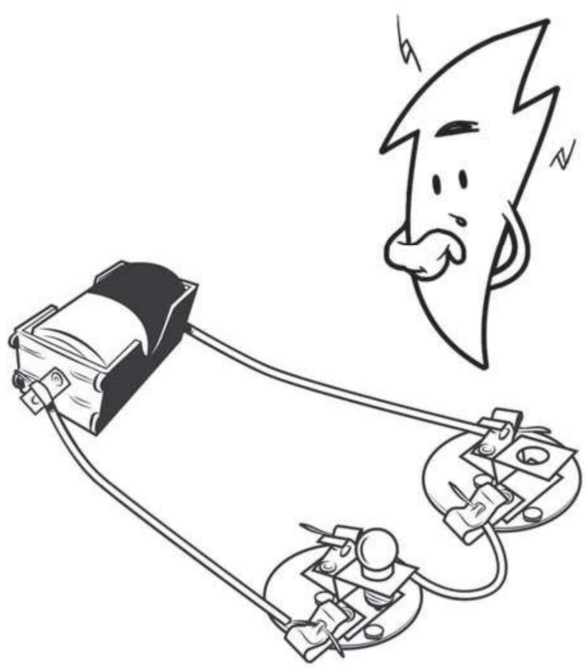


Series means in a row. A series circuit is a circuit with only one path for electricity to flow through. The components are all in a row, one after the other. This picture shows a series circuit.



Some miniature tree lights are wired in series. There is only one path for the electrical current. If there is a break in a series circuit at any point, the whole circuit stops working.



That means that if any one of the light bulbs burns out or is removed, no bulbs will light.

