



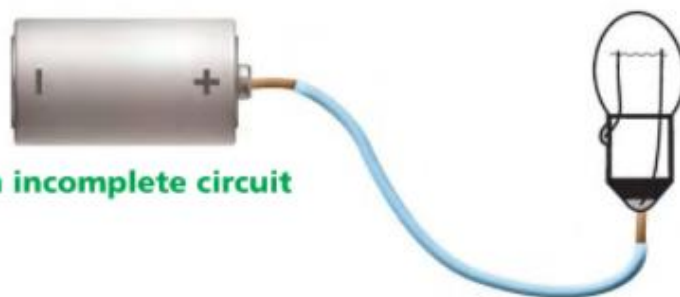
# Series and Parallel Circuits

**E**lectric current comes from an energy source. The source might be a D-cell battery, a **solar cell**, or a wall socket. When a **component**, like a lightbulb, is connected to a source of electricity, the lightbulb will make light. When a different component, like a motor, is connected to an electricity source, the motor shaft will turn. How do you connect a lightbulb or a motor to an electricity source?

You can use a D-cell to light a lightbulb. Metal wires carry the electricity. If you try to get the lightbulb to light using one wire like this, the lightbulb will not shine.



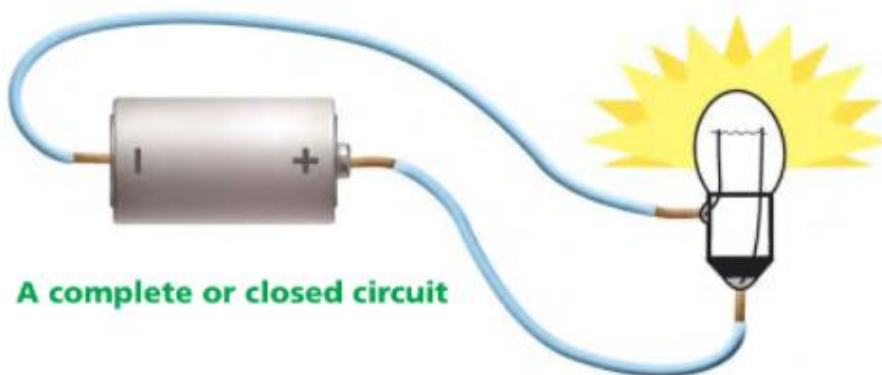
An incomplete circuit



The trick is to use two wires. One wire connects the base of the lightbulb to one end of the D-cell. The second wire connects the metal casing of the lightbulb to the other end of the D-cell. This setup results in a bright, shining lightbulb. It is called a **complete circuit**, or a **closed circuit**. The places on a D-cell and lightbulb where wires touch the component are called contact points.



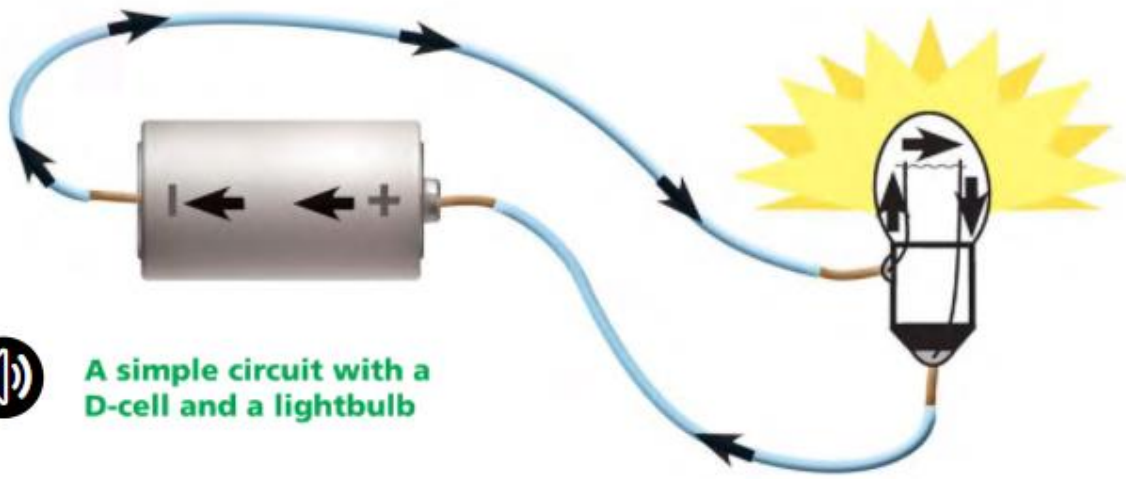
A complete or closed circuit





If you disconnect one of the wires from the lightbulb or from the D-cell, the lightbulb will stop shining. This is because the pathway through which the electric current flows to the lightbulb is broken. A circuit with a break is called an **incomplete circuit**, or an **open circuit**.

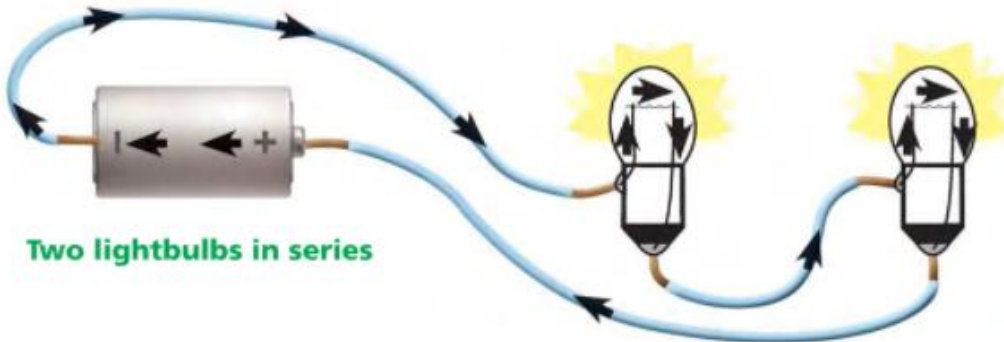
It is important where the wires connect to the D-cell and the lightbulb. One wire must connect to the positive (+) end of the cell. The other wire must connect to the negative (-) end of the cell. The other end of one of the wires must connect to the metal casing of the lightbulb. The other end of the second wire must connect to the base of the lightbulb. These connections make a closed circuit. The electric current will flow, and the lightbulb will shine.



**A simple circuit with a D-cell and a lightbulb**

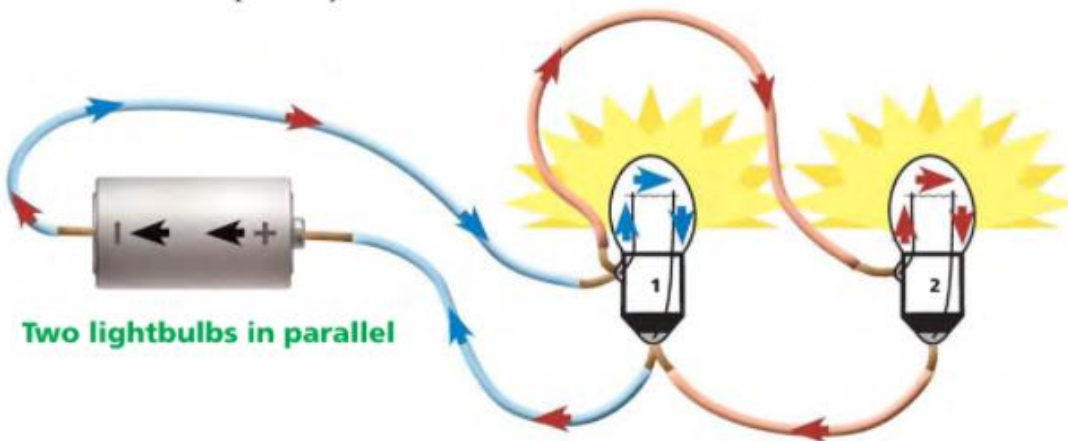


You might want to connect two lightbulbs to a D-cell. How can you do this? There are two ways. You can open the one-lightbulb circuit and put a second lightbulb into the circuit. Now the electric current flows through two lightbulbs in one circuit. This is a **series circuit**. There are two lightbulbs and one D-cell connected in series. In a series circuit, current has only one pathway to flow from the source (D-cell) to the components (lightbulbs).



Two lightbulbs in series

There is another way to add a second lightbulb to the one-lightbulb circuit. You can use two wires to connect the second lightbulb to the first lightbulb. This is called a **parallel circuit**. There are two lightbulbs in parallel connected to a D-cell. In this parallel circuit, each component (lightbulb) has its own pathway to the energy source (D-cell). Lightbulb 1 is in the blue-arrow pathway; lightbulb 2 is in the red-arrow pathway.



Two lightbulbs in parallel



## Which Circuit Should You Use?

Suppose you want to light two lightbulbs. Is there any reason to put them in parallel rather than in series? Yes. The reason becomes clear when you compare the two kinds of circuits. Two lightbulbs in series both shine with a dim light. Both lightbulbs in parallel shine brightly. If you want bright lights, put the lightbulbs in parallel.

Why is there a difference? Two lightbulbs in series have to share the energy of the D-cell. There is only one pathway for the electric current. The current flows from the negative end of the cell through the first lightbulb. It then goes through the second lightbulb and back to the positive end of the cell.

Two lightbulbs in parallel do not have to share energy of the D-cell. Each lightbulb has its own pathway to the source of electricity. Even though some wires are shared for part of the pathway, more than one pathway lets each lightbulb get its own electricity. That's why lightbulbs in parallel shine more brightly.

So, is it better to connect your lightbulbs in series or in parallel? It seems like parallel would be better because you get two bright lights. But there is a cost. The energy of the D-cell will drain much faster when it is supplying electricity to two lightbulbs in parallel. When lightbulbs are connected in series, the D-cell lasts longer, but the lights are dimmer.



**Two or more lights connected in parallel shine brightly.**

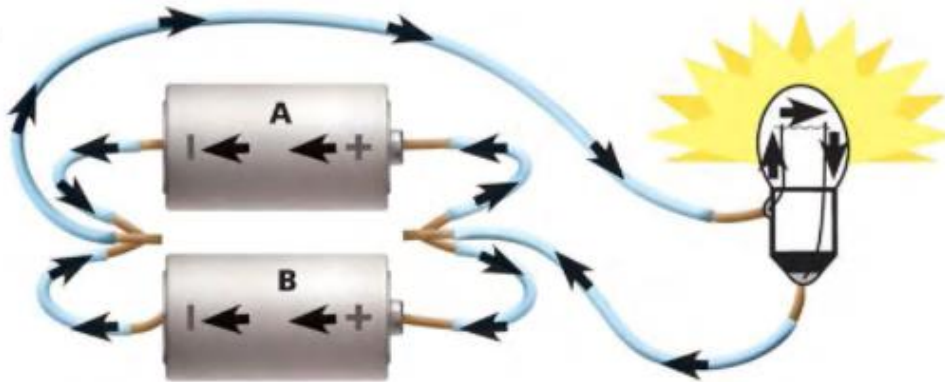


## Adding More D-Cells to a Circuit

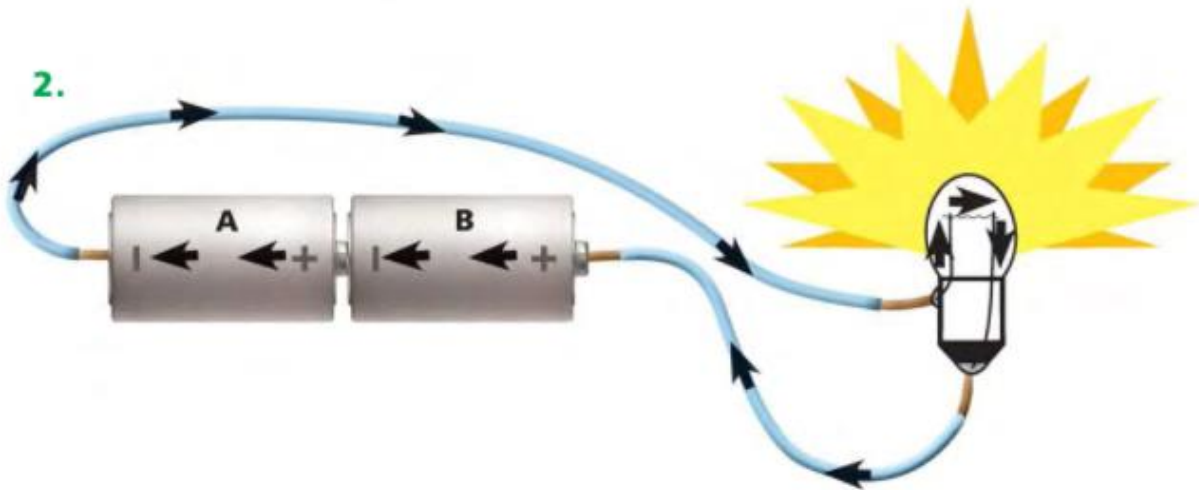
If you want to put two or more D-cells in a circuit, they can be connected in series or in parallel. Which of these circuits shows two cells in series? Which shows two cells in parallel?



1.



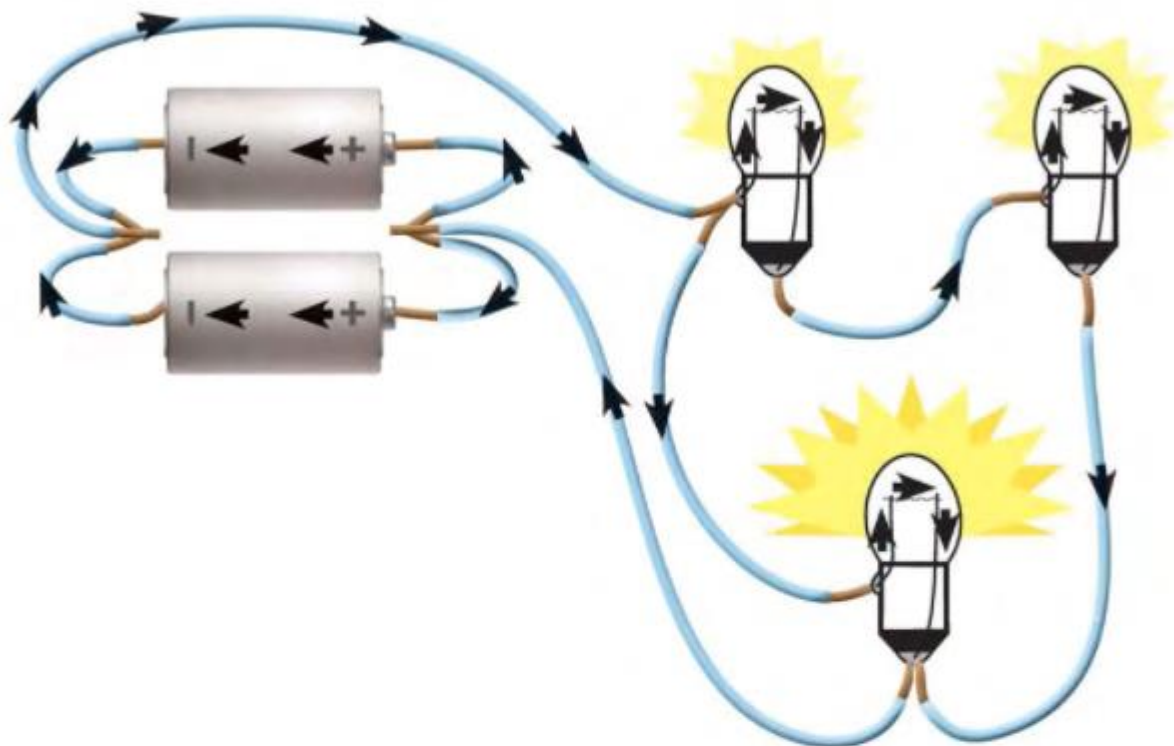
2.



In circuit 1, cells A and B are in parallel. Each cell delivers electricity to the lightbulb in its own pathway. In circuit 2, electricity is delivered to the lightbulb by two cells working together in the same pathway. As a result, the lightbulb in circuit 2 will be twice as bright as the lightbulb in circuit 1.



Here is an interesting circuit made with lightbulbs and D-cells. How would you describe this circuit?



This circuit is one lightbulb in parallel with two lightbulbs in series, powered by two D-cells in parallel. If you said that, you got it right.



## Thinking about Circuits

1. What is the advantage of wiring two lightbulbs in parallel?
2. Why are two lightbulbs in series with a D-cell dim?
3. Do you think the lights in your home are wired in series or in parallel? Why do you think so?

