

Electricity and Circuits

Reading and Discussion

When ancient men saw lightning strike, they probably thought the gods were angry. Without understanding the scientific explanation behind electricity, it's easy to mistake lightning and static electricity for some magical power. As the human species developed, people began to question this powerful force of nature. They wanted to understand what caused the power they were seeing, and even wondered if they could someday use it for themselves.

Thanks to the hard work of inventors and scientists like **Ben Franklin** and **Thomas Edison**, we now understand exactly how electricity is created. Most communities of the world not only use electricity, they *depend* on it for survival.

What is electricity?

Electricity is the movement of an electrical charge. Let's break that down a bit:

You have probably already learned that everything in the universe is made up of atoms. Even you are made up of too many atoms to count. Atoms are so tiny that a million of them could fit on the period at the end of this sentence. But atoms are not the smallest building blocks in nature. They are made up of even smaller particles called protons, neutrons, and electrons. Protons and neutrons live in the nucleus, or brain, of the atom. Electrons move around on shells that surround the atom. They move much like planets in orbit around the sun. They stay on the shells of the atom, because they are held in place by a powerful electrical force.

Electrons and protons have opposite charges. Electrons have a negative charge, and protons have a positive charge. Like magnets with opposite charges, electrons close to the center of the atom are strongly attracted to the protons, so they do not move very far. Electrons on the outer shells are not pulled as strongly toward the protons. Sometimes they can be forced out of their path on the shell. Atoms are always seeking balance. To achieve a balanced charge, the electrons that aren't very attracted to the protons in their own atom may jump to another atom. When electrons move from one atom to another, electricity is created.

Whenever we see lightning, a spark from an electrical outlet, or even feel a static shock when we touch a doorknob, we are experiencing electricity that began when electrons relocated to new atoms! Moving electrons may seem like a small change, but that change creates one of the most powerful forms of energy in nature.

How do we use electricity?

Today we use electricity to power nearly everything. But how do we harness the energy for our own use? Scientists have figured out that if we put an object in the path of the moving electrons, we can use the electricity to power that object. This object where the work is being done is called the **load**. For example, when we turn on a light bulb, we are

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placing the light bulb in the path of the moving electrons. As they travel through the bulb, or load, they provide power and the light turns on.

There is an important rule scientists have learned to make electricity work. Electrons can only travel in a closed loop. This loop is called a **circuit**. As long as the path the electrons will follow is complete and returns to its original starting point, the electricity will flow. If there is a break in the circuit, or an opening in the loop, the electricity will not travel.

Let's revisit the light bulb example. A light switch is a perfect demonstration of a circuit. When we turn on a light switch, we are closing a circuit. The electrons can flow and electricity travels through the bulb. When we turn the switch off, we are opening the circuit. Electricity cannot flow across the broken loop, so the bulb goes out.

In order to provide power to things like televisions, radios, irons, and telephones, there must be a closed circuit. In order to close a circuit, the loop must be completed with something that can conduct electricity. Any material that electricity can travel through is called a **conductor**. All metals are conductors, and so is water. Wood is not a conductor, but people are! When lightning strikes a man, his body becomes part of the circuit, so electricity flows through him. In order to be safe, electricians always put a non conductor, like wood or rubber, between them and the source of the electricity.

Another law of electricity is this: electricity without a path will always seek the ground. If electrons are moving along a closed loop of wire, the electricity will remain in the circuit. If electricity does not have a circuit to follow, it will find the most direct path to the ground. When lightning jumps from a cloud to the Earth, it is seeking out the ground. That is why it is unsafe to stand in a lightning storm, especially with a tall metal object like an umbrella or a golf club. The lightning will seek the shortest path, which could be you! That is also the reason you should never touch downed power lines. The electricity will travel through you to get to the ground.

Electricity today

Electricity is a big part of our daily lives. We use it to power our homes and cars, cook our food, and even entertain us. It's easy to take for granted, because it's always there. However, electricity is a secondary form of energy, and must be generated by another source. Power plants are working around the clock to generate electricity by moving electrons. They use many forms of energy to do this, including coal fire, fuel, steam, water, and nuclear power. Today scientists are working very hard to find safe and renewable ways to create electricity. For example, solar and wind energy are now used all over the world to create electricity. Someday, scientists and environmentalists hope to power all communities with electricity created from an energy source that is completely safe, free, and renewable.

Activities

Activity A: Test Your Knowledge! Circle the letter of the correct answer.

1. What is a circuit?
 - a. Closed loop upon which electricity can travel;
 - b. A form of energy;
 - c. An objects that conducts electricity;
 - d. A path from a an object to the ground.

2. What is a load?
 - a. The movement of electrons from one atom to another;
 - b. The object in a circuit where the work is done;
 - c. The amount of electricity needed to do work;
 - d. The weight of circuit.

3. What atomic particle must travel between atoms to create electricity?
 - a. Proton;
 - b. Electron;
 - c. Neutron;
 - d. Nucleus.

4. What is a conductor?
 - a. The loop upon which electricity travels;
 - b. An object that attracts protons;
 - c. An object through which electricity can travel;
 - d. An object that opens a circuit.

5. What does electricity always seek?
 - a. The ground;
 - b. Air;
 - c. Metal;
 - d. Nonconductors.

Activity B: If the statement below is true, write a T in the blank. If it is false, write an F.

- ___ 1. Atoms are always seeking a balanced charge.
- ___ 2. Neutrons travel from atom to atom to create electricity.
- ___ 3. Conductors cannot be used to close a circuit.
- ___ 4. Water can conduct electricity.
- ___ 5. A break in a circuit will stop the flow of electricity.
- ___ 6. Electrons on the outer shells of atoms cause electricity.
- ___ 7. Electricity can travel on an open loop with the help of nonconductors.
- ___ 8. The work electricity can do is called the load.
- ___ 9. Electricity must be generated by another source of energy.
- ___ 10. Electricity travels only on a closed circuit.

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Answer Key

Activity A

1. A
2. B
3. B
4. C
5. A

Activity B

1. T
2. F
3. F
4. T
5. T
6. T
7. F
8. T
9. T
10. T