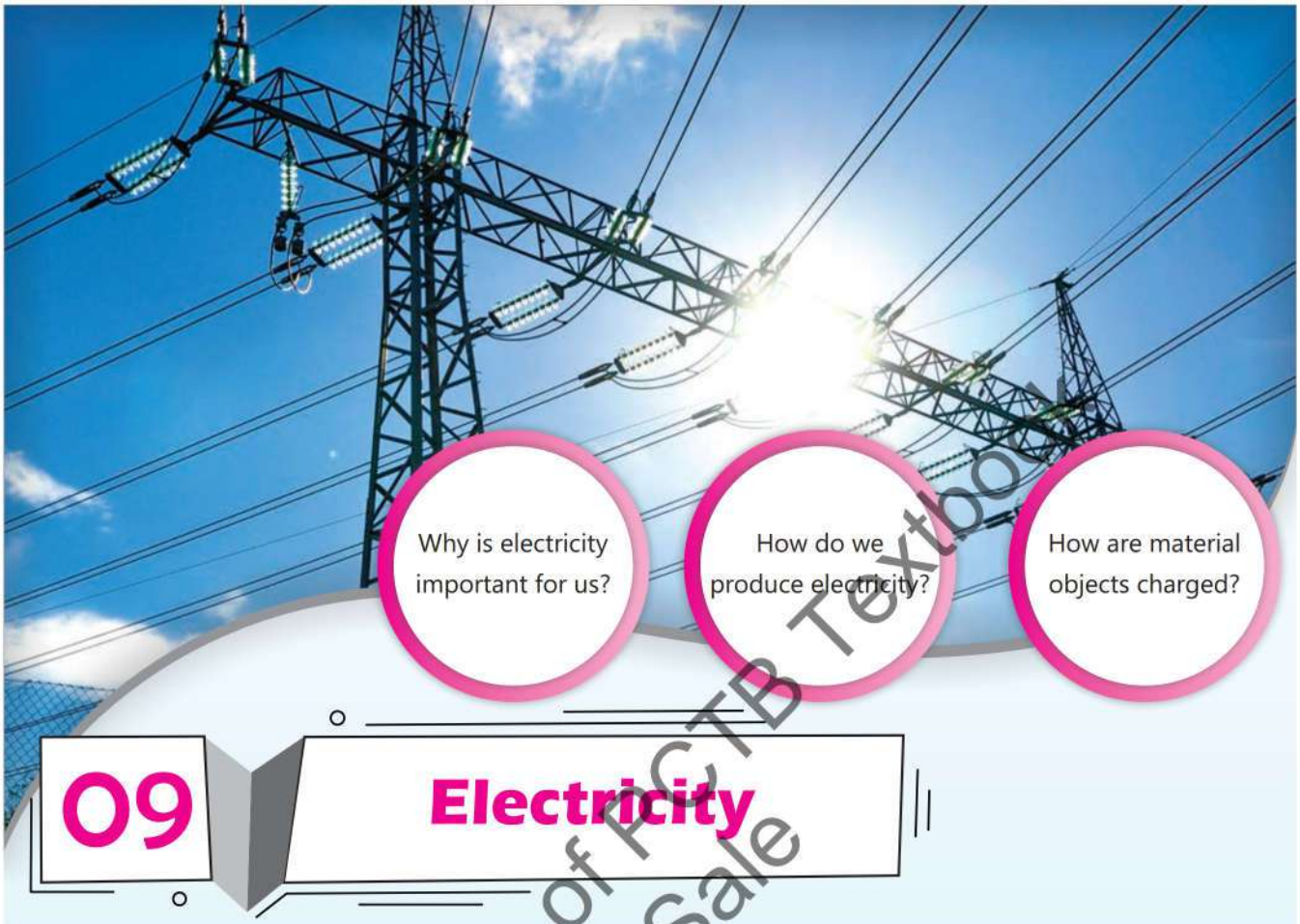


Why is electricity important for us?

How do we produce electricity?

How are material objects charged?

09 Electricity

Students Learning Outcomes

After studying this chapter, students will be able to:

- Explain the phenomena of static electricity in everyday life.
- Recognize electric current as a flow of charges.
- Describe a simple circuit as a path for flow of charges.
- Differentiate between open and closed circuits.
- Draw and interpret simple circuit diagrams (using symbols).
- Describe the characteristics of series and parallel circuits.
- Draw and construct a series and parallel circuits.
- Identify the use of series and parallel electric circuits in daily life.
- Investigate the factors that affect the brightness of bulbs or speed of motors, number of batteries, number of bulbs, type of wire, length of wire, thickness of wire.
- Assemble and operate a trip wire security alarm system using simple items. (STEAM)

VOCABULARY

Electric current	Electric circuit	Electric switch	Battery	Static electricity	Charge
Flow of electric charge	The path along which electric charge flows	A device used to open or close the electric circuit	A source of electric charges	Electricity due to charges at rest	A basic property of matter

Recall what you have learnt in previous classes

Electricity is a form of energy. It is produced by the charge. Charge is the basic property of matter. It is of two types, i.e., positive charge and negative charge. Positively charged protons and negatively charged electrons are present in every atom of the matter **(Figure 9.1)**.

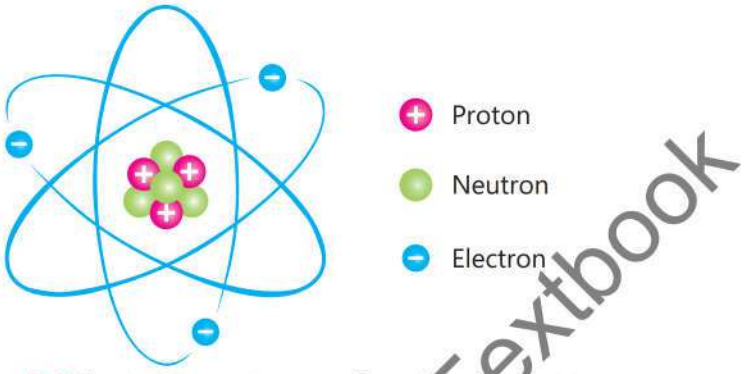


Figure 9.1 Electrons, neutrons and protons in an atom

Properties of charge

1. Like charges repel each other.
2. Opposite charges attract each other **(Figure 9.2)**.

Figure 9.2 Properties of charges

Inquiry 6.1

Teacher Guide

Facilitate students investigate and conduct a discussion to conclude about the inquiry as under:

- Despite the presence of positively charged protons and negatively charged electrons in an atom, it is known as a neutral particle. Why?

Investigation and discussion

- As for as, the total number of negatively charged electrons remains equal to the total number of positively charged protons in an atom, the sum of negative charge cancels the effect of sum of the positive charge. In this way, the atom remains neutral.
- Some material objects, when rubbed with some other objects, lose or gain electrons. The object which loses electrons acquires positive charge on it, as the number of positively charged protons increases as compared to the number of electrons present there. On the other hand, the object which gains electrons, acquires negative charge on it, as the number of negatively charged electrons increases as compared to the number of protons present there.
- When a positively charged object comes close to the negatively charged object, both objects attract each other.
- When similarly charged objects come closer, they repel each other.

Conclusion:

9.1 STATIC ELECTRICITY

Figure 9.3 **Lightning**

The charge produced on an object remains there at rest. When the charge at rest is gathered on an object, it is known as **static electricity**. The word static means something at rest. Charge is often created when things are rubbed together.

Lightning **(Figure 9.3)** is an example of static electricity. When clouds rub against the air, a huge charge is gathered on them. When oppositely charged clouds approach or meet, a big spark is produced, which is called **lightning**.

Activity 9.1

- Place a few paper bits on the table.
- Pull a plastic comb through your dry hair twice or thrice in the same direction.
- Bring the comb near the paper bits. Do the bits stick to it? Why does the comb attract these paper bits?
- The reason for this phenomenon is that the comb has acquired charge.

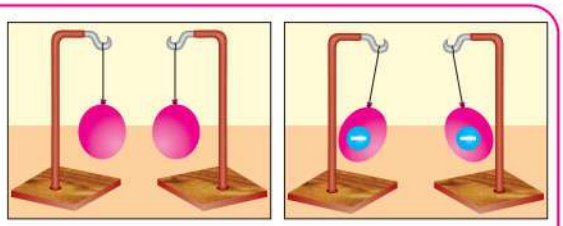
Recall

Activity 9.2

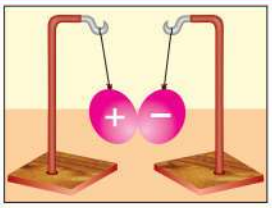
- Suspend an inflated balloon with the stand using a thread.
- Bring a piece of woolen cloth near to it. Does the cloth attract the balloon towards it?
- Rub the balloon vigorously with the woolen cloth and then remove it.
- Bring the cloth nearer the balloon slowly, once again.
- Does the cloth attract the balloon this time? You will observe that the cloth attracts balloon this time.
- The reason is that there was no charge on both of them before rubbing. After rubbing they have acquired opposite charges due to which they attract each other. The balloon has acquired negative charge and the cloth positive charge.

Activity 9.3

- Suspend two inflated balloons with the stands using thread.
- Place them at a small distance from each other as shown in the Figure.
- Bring the balloons closer by moving the stands. Do the balloons attract or repel each other?
- Rub each balloon with a woolen cloth. Bring them close, again. Do they attract or repel each other?
- Now rub one balloon with woolen cloth and the other with a plastic comb or ruler.
- Bring the balloons closer. Do they attract or repel each other? What inference do you draw from your observations?
- When balloons were rubbed with woolen cloth, both of them acquired negative charge. Due to which they repelled each other.



- When one balloon was rubbed with woolen cloth and the other with plastic object they acquired opposite charges. Hence, they attracted each other.



Point to ponder

What makes the balloon negatively charged when rubbed with woolen cloth?

9.2 CURRENT ELECTRICITY

When the positive terminal of battery is connected to its negative terminal through a metallic (copper) wire, charge begins to flow through the wire. The electricity produced by the flow of charge is called **current electricity (Figure 9.4).**

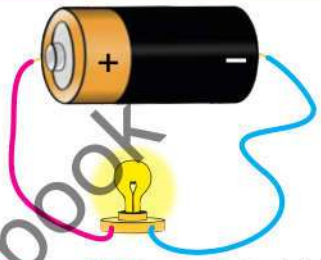


Figure 9.4 Current electricity

Electric Circuit

Electric circuit is a path of flow of current.

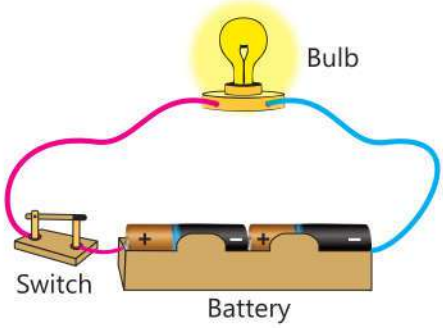
In our homes, we turn ON the switch to light a bulb or to run a fan. The same switch is also used to turn them OFF. Various electric circuits are made for this purpose.

Simple Electric Circuit

Let us make a simple electric circuit.

Activity 9.4

- Insert a torch bulb in a holder.
- Connect the bulb to a cell or battery through a switch with the help of metal wires as shown in the Figure.
- Turn the switch ON and observe the bulb. Does it start glowing?
- Now, turn the switch OFF and observe the bulb. Why did it stop glowing? When the switch is turned ON then why does the bulb start glowing?



- Bulb starts glowing because an electric current flows through it.
- Electric current passes through the cell or battery, bulb, switch and wires as shown in Figure. They together provide a path for current to flow through.

As you see in the Figure (Activity 9.4), the battery, bulb and switch are connected through wires in an electric circuit.

Bulb, battery or cell and switch are called the components of electric circuit.

Battery is a source of electric current. The switch is used to control the flow of current and glowing bulb indicates that current is passing through it.

Open and Closed Circuits

You have learnt that on turning the switch ON, the circuit becomes complete or **closed** due to which the current starts flowing through it. On turning the switch OFF, the circuit becomes

incomplete or OPEN, so the current stops flowing through the circuit. It is called **open circuit (Figure 9.5)**.

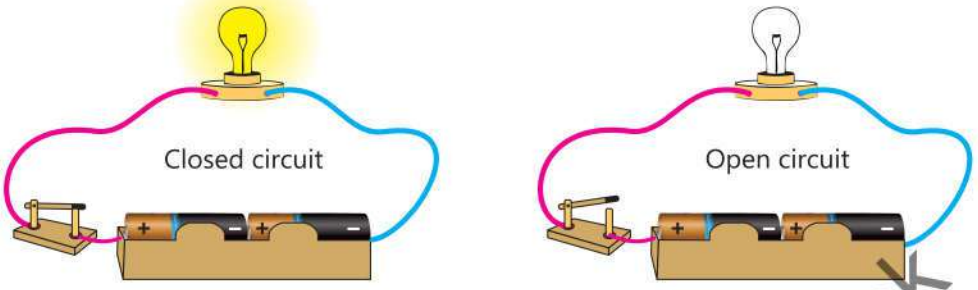


Figure 9.5 Open and closed circuit

Components of Electric Circuit

Electric cell or **battery**, **key (switch)**, **conductors (wires)**, **bulb** and other devices which are used for making an electric circuit are called components of an electrical circuit **(Figure 9.6)**.

Electric components	Electric cell	Electric bulb	Switch in "ON" position	Switch in "OFF" position	Battery	Wire
Symbols						

Figure 9.6 Components of electric circuit

A cell or battery is a device that stores chemical energy and converts it into electrical energy. A switch is a device which is used to open and close an electric circuit. Wire is a conductor which allows the current to pass through the circuit. A bulb is an electrical convertor which converts electrical energy to light energy.

Circuit diagram

The diagram shown below describes an electric circuit. It is thus, called circuit diagram **(Figure 9.7)**

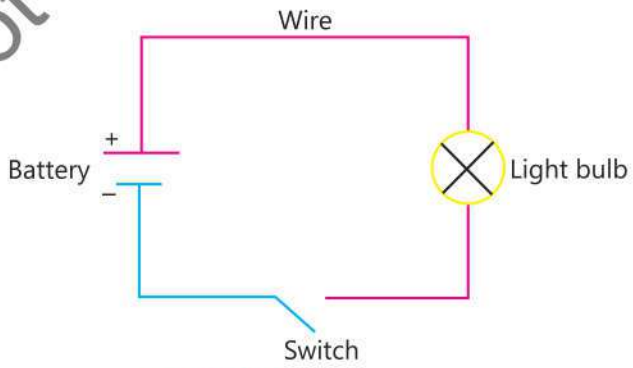


Figure 9.7 Circuit diagram

9.2.2 Types of Electric Circuit

Based upon the ways the electric devices are connected in the circuit, electric circuits are of two types, i.e., series circuit and parallel circuit.

Series circuit

In a series circuit, electric devices are connected one after the other across a source (cell or battery)

in a single lope **(Figure 9.8)**. There is only one path for the electric current to flow. The current in a series circuit is the same throughout the circuit. We cannot turn ON and OFF every device independently.

Figure 9.8
Series circuit

In a series circuit, current is same in all the components connected in the circuit. Electric current in increases equally in all the components with the number of batteries connected in the circuit.

Disadvantage of series circuits

Why series circuits are not recommended for domestic or industrial wirings? The reason is that if a fault happens at any part of the circuit, it stops the flow of current in the whole circuit **Figure 9.9)**.

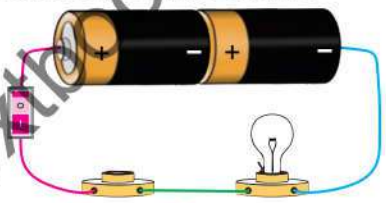


Figure 9.9 Series circuit

Parallel circuit

In a parallel circuit, two or more electric devices are connected independently across a source (cell or battery) giving multiple paths to the current to flow **(Figure 9.10)**.

Figure 9.10 Parallel circuit

Advantage of a parallel circuit over the series circuit

The advantage of a parallel circuit over a series circuit is that a break or fault at some branch or device will not stop the current flow to the other branches or devices. Only the faulty branch or device will have a break in current flow.

Applications of parallel circuits

Parallel circuits are used in electric wiring in our homes, automobiles, e.g., for wiring car headlights. Parallel circuits are also used in computer hardware.

Factors that affect the brightness of bulbs or speed of motors

Following are the factors that affect the brightness of bulbs or speed of motors:

Number of batteries

If the number of batteries connected in a series circuit is increased, the bulbs light up brighter or the speed of motor increases.

Number of bulbs

If the number of bulbs connected in a series circuit is increased without increasing the number of batteries, it makes the bulbs dimmer.

Length of wire

Short wires conduct electric current more easily than long wires. The increase in length of the wire decreases the bulb's brightness. In case, electric motor is connected in the circuit, the increase in length of the wire decreases the speed of the motor.

Thickness of wire

Thick wires carry more current as compared to thin wires. The bulb glows brighter if the thin wire is replaced with thick wire.

Do you know?

Lights of a ship are connected in a parallel circuit. If one light goes out, the rest keep on working.

Tripwire Security Alarm

Activity 9.5 Assemble and operate a tripwire security alarm

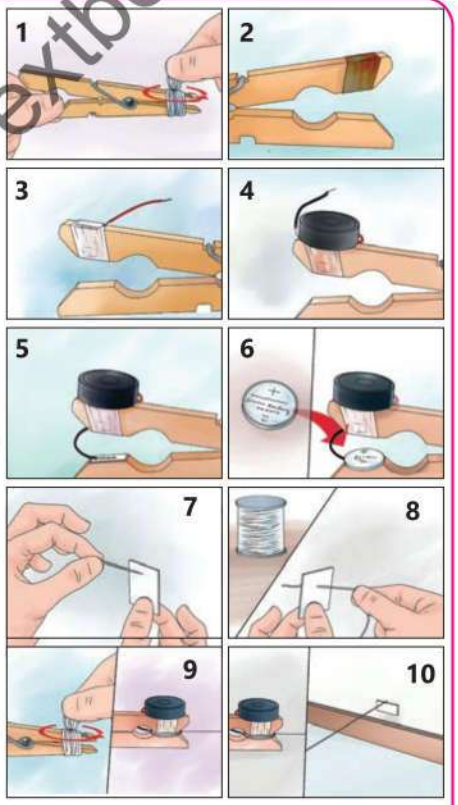
Material Required

Clothes clipper, electronic buzzer, lithium battery, two sided adhesive pads, a twist tie, fishing line, copper tape, etc.

Procedure

1. Squeeze the ends of a clothes clipper using the thread.
2. Wrap the copper tape around one open end of the clothes clipper.
3. Stick a black wire to top of the copper tape.
4. Attach a buzzer on the copper tape.
5. Place a sticky pad on inside end of the clothes clipper and stick the black wire on its top.
6. Place lithium cell on the top of this black wire keeping its negative side towards the black wire.
7. Take a 3 cm thin cardboard, make a hole in it using a needle.
8. Tie a strong thread around the hole of the cardboard and place it inside clothes clipper's mouth.
9. Release the twist tie at the back of the clothes clipper and attach the thread to the wall.
10. Run the thread across the doorway and make sure that it is tight but not tight to pull out the cardboard.

When some one crosses the thread, it pulls out the cardboard. The clothes clipper will close, completing the circuit and the buzzer will sound.



KEY POINTS

- Electricity is a form of energy. It is produced by the charge.
- When the charge at rest is gathered on an object, electricity is known as static electricity.
- The electricity produced by the flow of charge is called current electricity.
- Charge is the basic property of matter. It is of two types, i.e., positive charge and negative charge.
- Electric circuit is the path through which electric current flows.
- Cell or battery, electric wire, electric switch and the bulb, etc., are known as components of

an electric circuit.

- Electric circuits are of two types, series circuit and parallel circuit.
- In a series circuit, electrical components are connected one after another in a single loop. The same current flows through each component connected in a series circuit.
- In a parallel circuit, electrical components are connected in parallel branches. The current flowing through each branch is less than the current flows out from the source (battery).
- In a series circuit, if some fault happens at any part, it stops the flow of current in the whole circuit.
- In a parallel circuit, a break or fault at some branch or device will not stop the flow of current through other branches or devices.
- Increasing the number of batteries in a series circuit, increases the brightness of the bulbs.

QUESTIONS

9.1 Encircle the correct option.

1. A positively charged particle:

a. electron b. proton c. neutron d. atom

2. A device that stores chemical energy and converts it into electric energy when connected in a circuit:

a. electric switch b. bulb c. cell d. metallic wire

3. A circuit that provides multiple paths to the current to flow:

a. series b. parallel c. open d. short

4. The type of circuit used in domestic wiring:

a. series b. parallel c. open d. short

5. A device used to open or close an electric circuit:

a. battery b. bulb c. switch d. wire

6. Increasing the number of batteries in a series circuit:

a. increases the brightness of the bulbs

b. decreases the brightness of the bulbs

c. converts the series circuit to parallel circuit

d. stops the flow of current through the circuit

7. The current has only one path to flow through:

a. series circuit b. parallel circuit c. open circuit d. close circuit

9.2 Give short answers.

1. What is static electricity?
2. Is series circuit preferably used in home wiring?
3. What is current electricity?
4. What types of charges repel each other?
5. Name a few components of an electric circuit.

9.3 Write answers in detail.

1. Describe the factors that affect the brightness of the bulbs in series circuits.
2. Describe the characteristics of parallel circuit.
3. What is charge? How does it produce electricity?
4. Explain the phenomenon of lightning.

9.4 Constructed Response Questions

1. The electricity due to charges at rest is called static electricity.
   (a) Is it being mostly used in domestic wirings?
   (b) How can it be produced?
   (c) How can we make it useful in daily life?
2. Electric circuit is the path along which electric current flows.
   (a) Sketch an open and closed circuit and differentiate between the two.
   (b) What are series and parallel circuits?
   (c) Describe the advantages of a parallel circuit.
3. What type of circuit contains two or more branches for the current to flow? Explain.
4. Draw and interpret simple circuit diagrams using symbols.

9.5 Investigate how electricity is produced and supplied to your town and home?

9.6 Project

Teacher Guide

Facilitate students build a working model of simple alarm system by using simple easily available items.