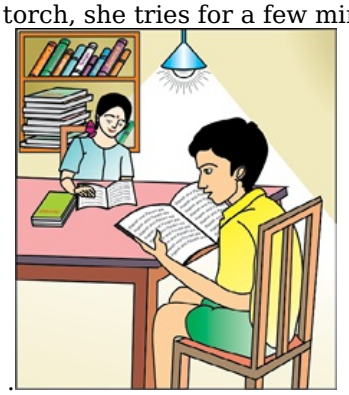
7 ELECTRICITY

CURRENT AND IT'S EFFECT

Rajesh and Pavani are studying at night (fig. 1)and the power goes off. (fig.2) Rajesh searches the table desk for the torch and the batteries.

Pavani tries to insert the batteries in the torch, she tries for a few minutes and the torch lights up



You must be familiar with such a situation.

Think:

1. Do you know how to insert batteries in a torch?
2. Can you make out whether the switch of the torch is working properly?
3. Can you determine whether the bulb in the torch is fused?

In class 6 you have learnt about the torch and how it works. Now let us make our own cell or battery.

MAKE YOUR OWN CELL

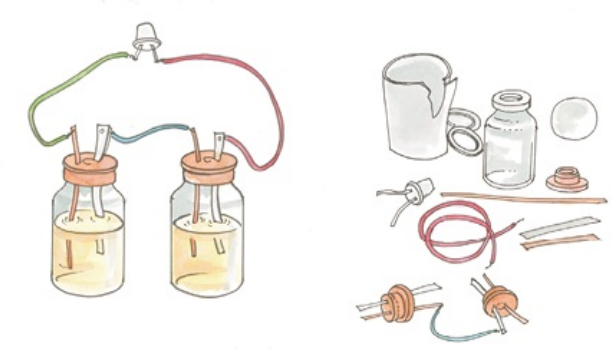


Fig. 3

You will need a few things to make a cell. First get two injection bottles. Then cut two 3cm long bits of thick copper wire. Use sandpaper to scrape about 1cm of the coating off both ends of the wires. Break open a discharged dry cell and remove its outer metal covering (made of Zinc). Cut two 2mm wide and 3cm long strips from this zinc plate. Insert the copper wires and zinc strips separately into the rubber caps of the injection bottles as shown in Fig 3. Ensure that the copper wires and zinc strips do not touch each other.

Now take a wire and connect the zinc plate of one bottle with the copper wire of the other bottle. Fill both bottles with sulphuric acid (ask your teacher to help you). Carefully close the bottles with the caps in which the copper wires and zinc strips are inserted.

Your cell is ready. How will you test it? Take an LED (Light Emitting Diode). Attach two wires to its two terminals. Touch the wire from one terminal to the copper wire of the first bottle and the wire from the other terminal to the zinc plate of the second bottle.
Did the LED light up? In case you have any problem, consult your teacher.

Do all the cells contain liquid in them? Let us

find out what the batteries in our torches contain.

Do this:

Take the help of your teacher to cut open a dry cell. What can you see inside it? Observe the chemical components in the dry cell. Inside a dry cell there are certain chemicals which react with one another to produce electric energy.

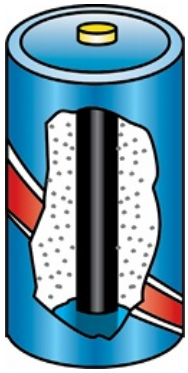


Fig. 4
Dry Cell

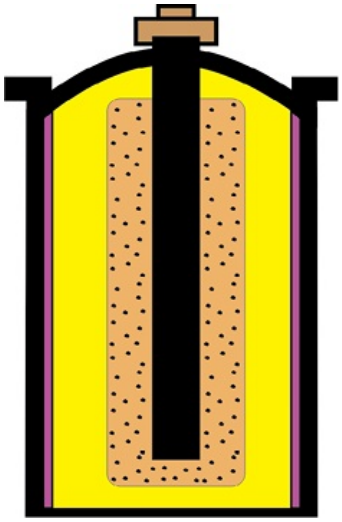


Fig.5-Parts of Cell

A dry cell consists of a container made up of zinc metal. The container also serves as the negative terminal in the centre. A carbon (graphite) rod with a metal cap serves as a positive terminal.

The carbon rod is surrounded by a mixture of carbon particles and a chemical called ammonium chloride. The cell is sealed from the top.

The dry cell can supply electric current in a circuit for a certain time. After that, its chemicals get exhausted and it cannot be used any more.

Dry cell converts chemical energy into electrical energy

Symbols of electric Components

Do you know about symbols? How do you indicate to your teacher that you wish to go out to drink water? You know the signs for addition, subtraction, multiplication and division. You might have used the symbols for ‘greater than’,’ less than’ , ‘equal to’ etc.

Symbols play an important role in our life. They convey precise meaning with few descriptions. Some common electric components can be represented by standard symbols as shown in the following page.

Do this: Drawing a circuit diagram

In the previous class you have learnt about some simple circuits. Let us learn a little more about them by performing a few experiments.

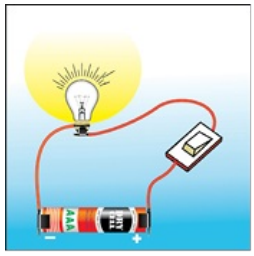
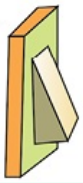
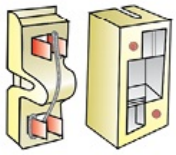


Fig. 6-Simple switch to close the circuit

Look at figure 6. A bulb, battery and switch are connected as shown. Can we make this drawing simpler using symbols? The picture of circuit using symbols is called a circuit diagram.

Figure 7 shows a circuit diagram of the circuit shown in figure 6.

Sl. No.	Electric Component	Symbol	Description / use
1.	Cell 		The longer line denotes the positive terminal and the thicker smaller line denotes the negative terminal
2.	Electric Bulb 		Electric bulb is in OFF position
3.	Switch in ON position 		Switch is a device used to close or open an electric circuit
4.	Switch in OFF position 		Switch is also called as key Switch is open.
5.	Electric Bulb ON 		Electric bulb is in ON position.
6.	Battery 		Two or more cells joined together form a battery
7.	Fuse 		Fuse Safety device used in electric circuit

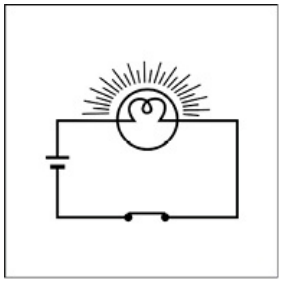


Fig. 7 - Circuit daigram

Circuit Diagram

There should be a source, which is one or more electric cells(battery). The switch can be placed anywhere in the circuit. If the switch is in the ON position, the circuit is complete from the positive terminal of the battery to its negative terminal. The circuit is then said to be closed and the current flows throughout the circuit constantly. The wires should not have any discontinuity (gaps). When the switch is in the OFF position, the circuit is incomplete. It is said to be open. No current flows through any part of the circuit.

Observe the sequence in which the cell, bulb and switch are connected in the circuit.

The sequence of components is as follows:

Positive terminal of the cell ⟶ Wire ⟶ Switch ⟶ Wire ⟶ Bulb ⟶ Wire ⟶ Negative terminal of the cell

Is it compulsory to follow the above sequence? Can you change the sequence and still make the circuit work. Try this experiment and write other possible sequences.

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Series and Parallel circuits:

In a series circuit, electricity has only one path to flow through. All the electrical components are connected in this path. If any one of them is removed or is not functioning properly, the circuit will be incomplete.

A parallel circuit has more than one path for the flow of electricity. Each bulb in the circuit is connected in a separate path through which electricity can flow.

Connecting Electrical cells in series:

Do this:

Take a dry cell and torch bulb. Connect the bulb to a cell using copper wires shown in figure-8. Observe the intensity of light.

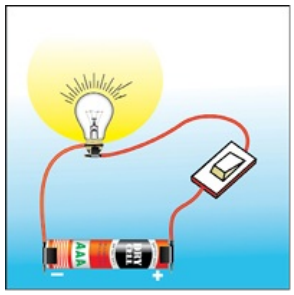

Fig. 8 - Dry cell to make a bulb glow

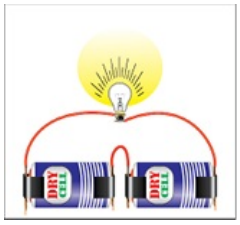

Fig.9 Connecting Dry Cell in series.

Now take one more dry cell and connect two cells as shown in figure-9. In this method the positive terminal of the first
cell and the negative terminal of the second cell are connected to the bulb.

Is there a difference in the intensities of the bulb in the above case? When does the bulb glow brighter?

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You may use three or four cells in the same manner. The bulb glows brighter and brighter. Thus by connecting cells in series, we get a battery. The battery cells in the torch are in series.

Think:

Can we connect as many cells as we want for making a bulb glow brighter and brighter? Is there any restriction on the how many cells can be/should be used for a given bulb?

Connecting Electric cells in Parallel:

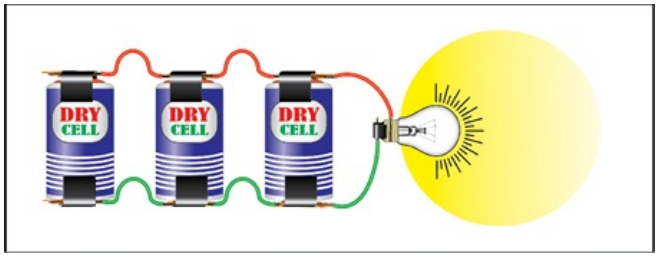

Fig. 10 - Connecting cells in parallel

Do this:

Take three dry cells and connect them as shown in figure-10. That is, all the positive terminals of the three cells are connected together and all the three negative terminals are connected together. These three positives and three negatives are connected to a bulb.

Is there any difference in the intensity of bulb glow compared to that in the case of only one cell?

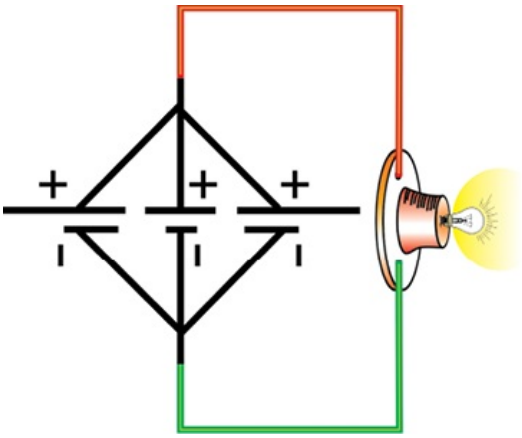

Fig. 11 - Parallel circuit daigram

Connecting Electric Bulbs in Series:

Fig. 12 - Bulbs connected in series

Connect three torch bulbs in series as shown in figure-12.

Connect this to a dry cell. Observe the brightness of each of the three bulbs. Now connect one more dry cell in series with the first cell. Observe the brightness of each of the bulb. Then connect one more dry cell in series with the first two cells. Again observe the bulbs.

Disconnect one of the three bulbs from circuit. What do you observe? In series connection of bulbs, if one bulb gets fused, all the other bulbs in the series will stop glowing. It means that if one bulb is disconnected the other bulbs do not glow. This can be observed in serial bulbs used in decorative items at the time of marriages and other festivals.

Connecting bulbs in parallel:

Fig. 13 - bulbs connected in parallel

Do this:

Connect three bulbs in parallel as shown in figure 13. That is, one end of each of the three bulbs are connected to one wire. The other ends of the three bulbs are connected to another wire. These two wires are connected to a cell. All the three bulbs glow dimly. Now disconnect one of the bulbs. What would happen? Can you predict? It means that if one bulb is disconnected the other bulbs continue to glow. This can be

observed in our household electric circuit. All components in our houses are connected in parallel.

Think!

1. Why does the bulb glow brighter and brighter when electric cells are connected in series?
2. Do the electric bulbs used in your house glow with a dry cell? Why?
3. Are the cells used in torch light and wrist watch the same?
4. What is the reason for connecting electric bulbs in parallel in a household electric circuit?

Heating effects of Electric Current

Fig.14 Electric bulb

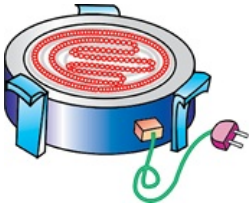

Fig. 15 Electric Heater

The bulb becomes hot when you put it on for some time. Why do you think this happens? It is the filament of the bulb that heats up due to current flowing through it.

You might have seen an electric iron, electric cooker and electric heater. All these contain a coil of wire made up of Nichrome. This coil is called filament of the appliance.

You might have noticed that when these appliances are switched on, their filaments become red hot and give out heat.

The amount of heat produced in a wire depends on its material, length and thickness. Thus, for different requirements, the wires of different materials, lengths and thicknesses are used.

The wires used for making electric circuits do not normally become hot. On the other hand, the elements of some electric appliances become so hot that they are easily visible. The filament of an electric bulb gets heated to such a high temperature that it starts glowing and giving out light.

When an electric current passes through a wire, the wire gets heated. Can you think of some electric appliances that get heated up just like a bulb when electric current passes through them?
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Do this:

Think of the main use of electrical appliances and write their names in the correct column. One example is given for you.

Used for Light	Used for Heat	Used for a Movement
E.g. Table Lamp		

An Electric kettle, a lift in a building, a street lamp, a tube light, an exhaust fan, a rice cooker, a cassette player, an electric mixer, an electric oven, a water pump.

Tube Lights and Compact Fluorescent Lamps (CFLs)

Wastage of electricity can be reduced by using fluorescent tube lights (figure-16 a) in place of bulbs.

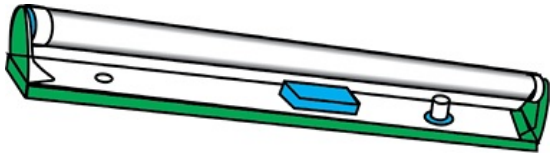


Fig. 16 a – Tube light

Fig. 16 b – Tube light

Compact Fluorescent Lamps (CFLs) (shown in figure 16 b) also reduce wastage and can be fixed in ordinary bulb holders. The ISI mark of a lamp ensures that the appliance is safe.

Electric Fuses

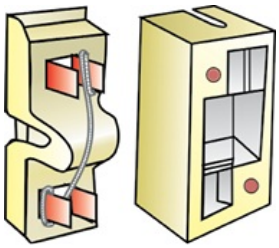


Fig. 17 – Elecrtic Fuse

When excessive electric current flows through a circuit the wires or the appliances may get heated and can catch fire. To avoid fire, a safety device known as a fuse is connected in series in the circuit.

A fuse is a small piece of wire as shown in figure 17. It is made of a special alloy that gets heated quickly and melts. If the current in the circuit is too high, the fuse wire gets hot and melts. This leaves a gap in the circuit. Automatically the circuit is broken and flow of electricity is stopped. This protects appliances from getting burnt due to the passage of too large a current through them.

Miniature Circuit Breaker (MCB):

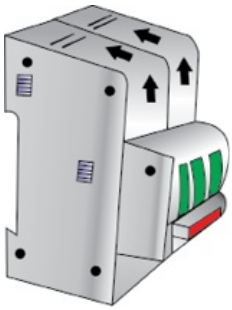


Fig. 18 - Miniature Circuit Breaker

These days Miniature Circuit Breaker (MCB) is increasingly being used in place of fuses. These are switches which automatically turn off when current in a circuit exceeds the safe limit. It has a switch which goes OFF automatically if there is overheating. This breaks the circuit. If we turn them ON, the circuit is once again complete

The advantage miniature circuit breakers have over fuses is that they can be reset (manually or automatically) to restore normal operation, whereas fuses need to be replaced after every single operation. The MCB can be reset by hand and the circuit becomes complete once again . Look for ISI mark on MCBs also.

What can be a disadvantage of MCB?

Electricity in our home:

Fig. 19 - Electric & Digital Meter

Most of the electricity that we use at home and at school is alternating current. The mains electricity that is supplied to our houses comes from power stations and sub-stations distribute electricity. Electricity is not free of cost. We have to pay for it according to how much we consume.

You may have noticed that a person belonging to the electricity department, the meter reader, visits houses every month and takes the meter readings. If you look at the meter in your house you will notice a wheel that goes around and the numbers in the window keep changing. Modern meters have digital displays.

What does the term 'one unit' mean? How is the usage of electricity measured? If you look at the bulbs used in your home, you will notice that they are marked in watts 25W, 40 W, 60W, 100W. The wattage measures how 'powerful' the bulb is. The brighter the bulb, the higher its wattage and the more the electricity used by it.

1 Kilowatt (KW) is 1000 Watts (W). When any appliance of 1 Kilowatt is used for one hour, it uses up one kilowatt - hour (KWH) or 'one unit' of electricity. If it runs for two hours it will use up two units of electricity.

You can learn how to calculate the amount you have to pay in the electricity bill through the following exercise table.

Exercise:

1) The meter reading in Ayub's house in January is 400 units, February 580 units. Calculate how much his parents would have to pay towards electricity bill of February? The unit cost is Rs. 3.05.

Reading in January 1st	400 Units
Reading in February 1st	580 Units
Number of units Electricity Used	180 Units
Cost per unit	Rs. 3.05/-
Total Amount to be paid	180 x 3.05 = 549/-

Note: Unit cost differs in different areas and also on the slabs. Electricity provided for domestic purpose is cheaper compared to that for commercial or industrial purposes.

2) Suppose in a house there are four bulbs of 100 W each, six of 60 W each and six of 40 W each. All of them are used for two hours a day. How many units of electricity will be used up in 30 days? How much will they have to pay at Rs. 2.80 /- per unit.

Total power used

= (4 x 100W) + (6 x 60 W) + (6 x 40 W)

= 1000 W = 1 KW.

Total power used every day

= 2 hrs x 1Kw = 2 KWH

In 30 days, power used

= 2 x 30KWH = 60 KWH

The cost of the power is

=Rs. 2.80 x 60 = Rs. 168/-

Think!

Are there households in Andhra Pradesh who do not have electricity ? Which areas of A.P. are they found in large numbers? What may be the reasons for those people having to live without electricity?

Think! Our country faces shortage of electricity. So wasting electricity means you are depriving someone else of electricity. Your bill also goes up. So use electricity carefully and only when it is needed. Think of the ways of saving electricity.

Do you Know!

Michael Faraday (1791-1867) Michael Faraday observed that by moving a magnet in and out of a coil. we can make electric current flow through the coil. Using this he built the first electric generator or dynamo in 1831. He also invented the transformer.

New words:

Cell, Battery, Fuse, Series Circuit, Parallel Circuit, Bulbs in Series, Bulbs in Parallel, Tube light, Compact Fluorescent Lamps, Miniature Circuit Breaker, Watt, Circuit Diagram, Heating effect of Current, Switch,

What we have learnt:

- Electric cell is a source of electric energy.
- The two terminals of an electric cell are called positive (+ve) and negative (-ve).
- Dry cell converts chemical energy into a electrical energy.
- Two or more cells joined together form a battery.
- The battery cells in the torchlight are kept in series.
- An electric bulb has a filament that is connected to its terminals.
- An electric bulb glows when electric current passes through it.
- In a closed electric circuit, the electric current passes from one terminal of the electric cell to the other terminal.
- Switch is a single device that is used either break the electric circuit or to complete it.
- If one bulb is disconnected in a series connection, all the other bulbs also get disconnected.
- Wastage of electricity can be reduced by using fluorescent tube lights in place of bulbs.
- Safety device used in electric circuit is fuse.
- 1 Kilowatt (KW) equal to 1000 watts.

Improve your learning:

I. Answer the following Questions

1) Draw the symbols of the following electric components

a) Cell b) Battery c) Switch d) Electric bulb

2) Draw an electric circuit diagram consisting of a cell, a bulb and an electric switch.

3) In a series connection of bulbs, if one bulb fails, why do all other bulbs go OFF?

4) Write the difference between series connection and parallel connection.

5) What is the advantage of Miniature Circuit Breaker?

6. Fill in the blanks

a. Longer line in the symbol for a cell represents its _____ terminal.

b. Smaller line in the symbol for a cell represents its _____ terminal.

c. The combination of two or more cells is called a _____

d. Safety device used in electric circuit is _____

e. The device used to close or open an electric circuit is _____

7. Mark **'T'** of the statement is true and **'F'** if it is false. Give reasons for choice of answer.

a. In series circuit the electricity has only one path (T/F).

b. In parallel circuit the electricity has more than one path (T/F).

c. To make a battery of two cells, the negative terminal of one cell is connected to the negative terminal of the other cell (T/F).

d. When the electric current through the fuse exceeds a certain limit, the fuse wire melts and breaks (T/F).

e. The switch is used to close or open an electric circuit (T/F).

8. Choose correct answer.

i. Arun buys four bulbs of 15W, 40W, 60W and 100W respectively, Which one should be use in his room as a night bulb.

a) 15 W b) 40W ( )

c) 60W d) 100W

ii. Device used to close or open an electric circuit is ( )

a) Electric bulb b) Battery c) Switch d) Fuse

iii. Which one of the following is used as a for light source. ( )

a) Cassette player b) Electric mixer

c) Rice Cocker d) Table lamp

iv. Safety device used in electric circuit is

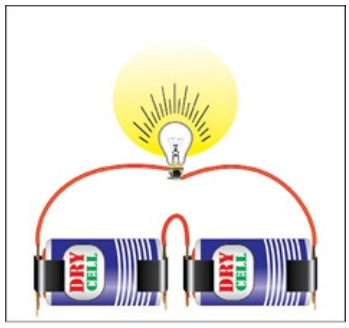
a) Electric bulb b) Battery ( ) c) Switch d) Fuse

9. Visit your classmates houses. Find out the meter readings of three months. Record your observations. Ask your parents about how electricity bill is paid?

10. Draw the symbols for the electrical components in the table.

S.No.	Electric Components	Symbol
1	Cell	
2	Electric Bulb	
3	Electric Switch	
4	Battery	

11. Draw the circuit daigram for the following series connection.



12. Match the following

1. Cell ( ) a) Used to open or close a circuit
2. Switch ( ) b) Safety device used in electric circuit.
3. Circuit ( ) c) A complete path for the flow of an electric current
4. Miniature Circuit Breaker ( ) d) Reset by hand, circuit becomes complete once again.
5. Fuse ( ) e) A device which converts chemical energy into electrical energy