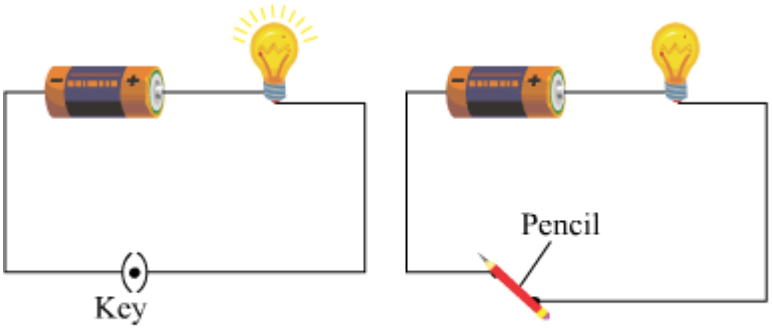
Chemical Effects of Electric Current

Conductivity Of Liquids

The materials that allow current to pass through them are called **good conductors** of electricity. The materials that do not allow current to pass through them are called **bad conductors** of electricity.

How do we test whether a particular appliance or material allows an electric current to pass through it?



Key is a good conductor Wood is a bad conductor

Tester is a simple device, which is used to test the flow of current through any device or material. You have already learnt how to construct a simple tester. The given circuit diagram shows a glowing bulb, which indicates that metallic key is a good conductor of electricity. Metals such as aluminium, copper, iron, etc. are good conductors of electricity.

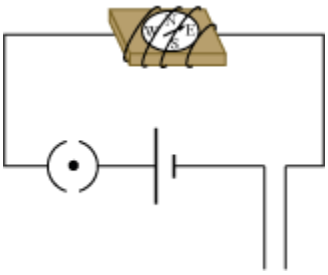
On the other hand, pencil is a bad conductor of electricity because it is made of wood. Materials such as rubber, wood, plastic, etc. are bad conductors of electricity.

Do liquids also conduct electricity?

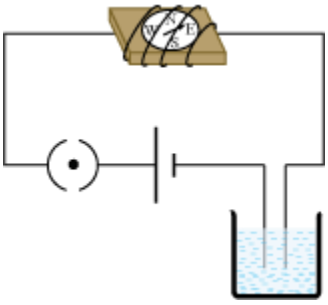
So, you see that not all liquids conduct electricity. The following table shows the results of the previous activity with some other liquids:

Liquid	**Does the bulb glow?**	**Nature of conductor**
Pure water	No	Bad
Salt water	Yes	Good
Lemon juice	Yes	Good
Vegetable oil	No	Bad

Kerosene/petrol	No	Bad
Milk	Yes	Good
Honey	No	Bad
Sugar solution	No	Bad



A magnetic compass needle experiences a force and deflects when a current carrying a wire is placed near it.



You can test whether liquids allow current to pass through them or not by observing the deflection of a magnetic compass needle.

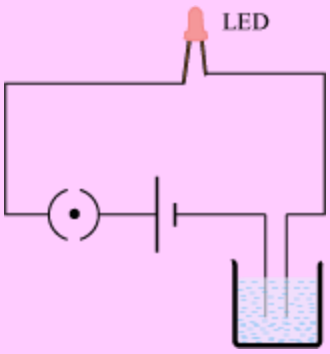
Take a magnetic compass and place it in a match-box. Construct an open electric circuit, which consists of a cell and a switch only. Make sure that the wire in the circuit is of sufficient length, so that it can be wrapped around the match box. Turn the switch on. Join the open ends momentarily. **Does the compass needle deflect?** You will observe that the compass needle deflects. The circuit becomes closed when the free ends are joined. Hence, a current starts flowing through the wire. As a result, the compass needle shows deflection.

Place the two ends of the circuit inside a beaker containing vinegar. Observe the compass needle carefully. It shows deflection. This shows that vinegar allows the current to pass through it. Hence, vinegar is a good conductor of electricity. Perform the same activity with liquids such as pure water, salt water, lemon juice, milk, honey, etc. and prepare a list of good and bad conductors in liquids.

Light Emitting Diode (LED)

LED is a bulb that consumes little energy. It consists of two leads. One lead is slightly shorter than the other. You can construct a tester using LED, as shown in the figure.

Make sure that the longer lead is connected to the positive terminal of the cell and the shorter lead is connected to the negative terminal of the cell. Test the conducting nature of some liquids, which are easily available at home.

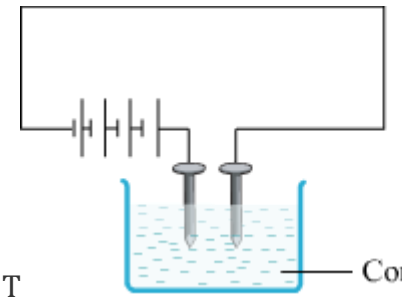


Air is a bad conductor of electricity. Thus, we do not get a shock standing at a distance from a wire carrying current. Minerals naturally present in water make it a good conductor of electricity since salt solutions can conduct electricity. Hence, it is advisable not to touch an electrical appliance with wet hands.

Solution of acids, bases, and salts are good conductors of electricity. For example, lemon juice and vinegar (both acids) are good conductors of electricity.

Chemical Effect of Current

A chemical reaction takes place when an electric current passes through a conducting solution. You can easily observe the chemical effects in the form of bubbles or gases in the solution.



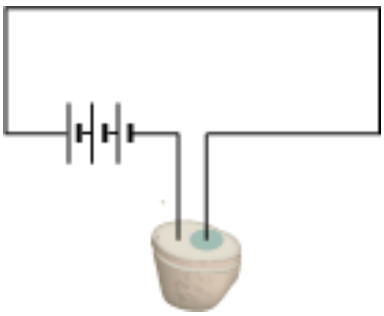
Take two iron nails (2.5 cm each). Wrap the free ends of an open circuit around the caps of both nails. Make sure that the circuit consists of a battery. Now, take a glass beaker and suspend both nails in it. Pour a conducting liquid such as salt solution or vinegar in it. Ensure that the caps of nails are not immersed in the solution.

The two nails are called electrodes. Let the current pass through the solution for about 5 minutes. Observe the surroundings of both the electrodes.

Do you find any change in the solution?
You can observe the formation of bubbles and gases near the electrodes. This implies that a chemical change has taken place in the solution. A chemical reaction depends on the nature of the electrode material and solution used.

You can easily observe the deposits of metal by performing the following activity:

Construct a simple open electric circuit consisting of a battery. Then, cut one half of a potato and insert the open end of the circuit in it.



Since potato is a good conductor of electricity, it allows the current to pass through it. Hence, the current flows through the circuit. Leave the circuit for about 25 minutes. Observe the inserted place of the potato carefully. **Do you notice a greenish-blue spot on the potato around the positive electrode?**

A chemical reaction has taken place around the positive terminal of the free end.

This shows that a chemical reaction takes place when an electric current is passed through a conductor.

Do You Know:

Electrochemical cells

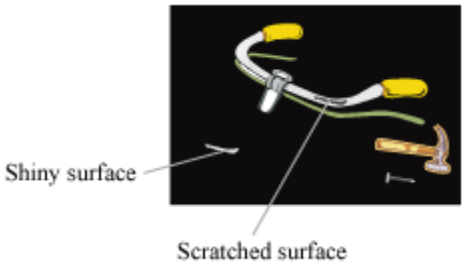
The chemical effects of electric current are used in the working of electrochemical cells. If two electrodes are immersed in mineral water and a current is allowed to pass through them, then bubbles of oxygen and hydrogen are produced on the positive and negative electrodes respectively. This effect was first shown by a British Chemist, William Nicholson, in 1800.

Electrochemical cells which generate current are called **voltaic cells** or **galvanic cells**. Common batteries also consist of one or more such cells.

Electroplating

FOR THE NEXT TOPIC

Electroplating



Try to scratch the shiny coating of the handle of a bicycle. You will find that the surface beneath is dull. **Do you know how the handle bar of a bicycle is made so shiny?**

Electroplating is the process of depositing a layer of metal over another metal or any other object using electricity. Electroplating is used to make ornaments by depositing a layer of gold on silver jewelleries.

Chromium is a shiny metal, which prevents objects from corrosion, scratches, etc. However, since chromium metal is very expensive, objects cannot be made from it. Therefore, a layer of chromium is used to deposit on objects through the process of electroplating. Hence,

chromium plating is done on parts of vehicles, burners, bathroom taps, bicycle handle bars, bicycle rims, etc.

Now, there are some key points that you should remember in the previous experiment.

- **Since free zinc gets attracted towards the negative terminal of the battery, negative free end is attached to the copper plate**.

- The amount of zinc in the zinc sulphate solution is reduced due to the loss of free zinc from the solution. The lost amount of zinc is replenished from the zinc plate, which is connected with the positive terminal of the battery. Hence, in this way, the quantity of zinc in the solution remains constant. As zinc from the zinc plate goes into the solution, **the thickness of the zinc plate reduces with time**.

Therefore, in the process of electroplating, one metal (zinc) gets plated to the other metal (copper).

Tin cans

Tin cans are used to store food, oil, etc. instead of iron cans. This is because food gets spoilt if it comes in contact with iron. By depositing expensive tin over less expensive iron by the technique of electroplating, less expensive tin cans can be produced.

Electroplating protects iron from rusting

Rusting of iron reduces its strength. Thus, there should be an alternative that can be used in bridges, automobiles, frames of structures, etc., which can provide the desired strength.

A coating of zinc on iron protects it from rusting. This can be achieved by electroplating of zinc on iron. Zinc plated iron is known as **galvanised iron**.

Faraday's Laws of Electrolysis

When electric current is passed through an electrolytic solution, the positive ions move towards the negative electrode, while the negative ions move towards the positive electrode. This process is known as electrolysis.

Michael Faraday, a British Chemist and Physicist devised two laws, for quantitative estimation of substances deposited on the electrode during this process. These laws are popularly known as Faraday's Laws of electrolysis. These are as follows:

- First law − The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolytic solution or melt.
- Second law − The amounts of different substances liberated by the same quantity of electricity passing through the electrolytic solution are proportional to their chemical equivalent weights.

  Chemical equivalent weight $= \frac{\text{Atomic mass of metal}}{\text{Number of electrons required to reduce the cation}}$

- If Q = Quantity of electricity passed

  I = Current (which is constant)

  t = Time

  Then, Q (coulomb) = I (ampere) × t (second)

- 1F (Faraday) = 96487 C mol^{-1} ≈ 96500 C mol^{-1}