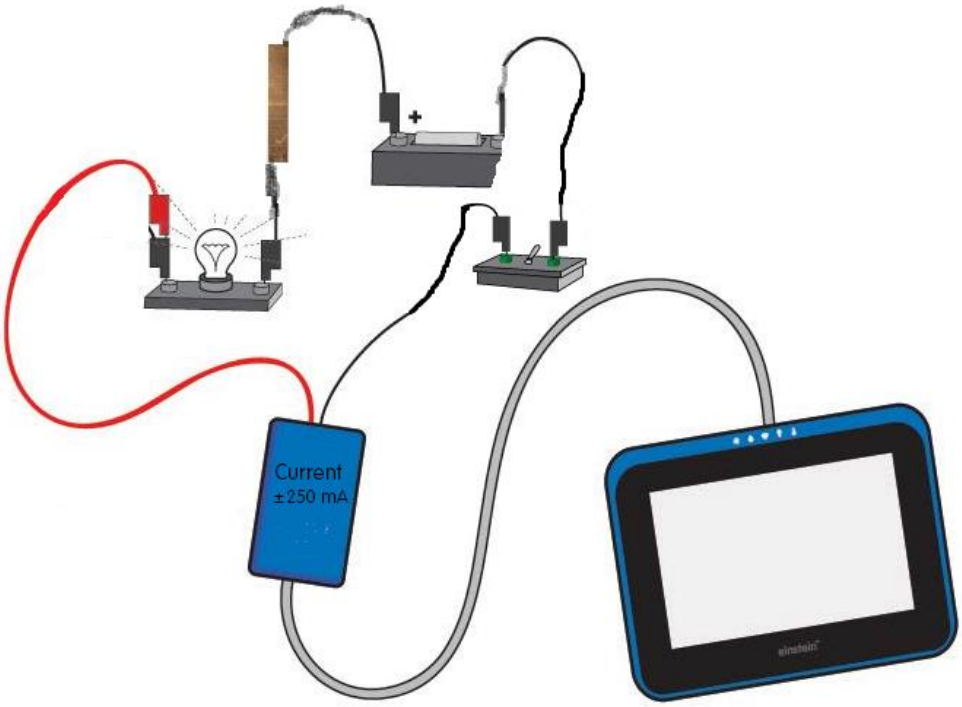
# Metals as Conductors of Electricity




## Challenge

Have a look at the following video which shows an invention developed in the High-Low Tech Lab at MIT.

What is the special property of the ink the researchers have invented?

## What will we investigate?

We will investigate which materials allow electricity to flow through them. Materials which allow the flow of electricity are called **conductors**. Materials which do not allow the flow of electricity are called **insulators**. We will insert all the materials which we want to test into an electric circuit and we will measure the electric current which each materials allows to flow. We will compare how well the different materials conduct electricity and classify materials as either **conductors** or **insulators**.

## Equipment and Materials

- einstein™Tablet+ or einstein™Labmate+™ paired with a tablet
- Current sensor (±250 mA)
- Metal strips (try to find at least 3 and to include copper, aluminum and stainless steel)
- Strips of other materials for investigation (wood, plastic, glass)
- Battery with battery holder (1.5 V)
- Light bulb (1.5 V) with light bulb housing
- ON/OFF switch
- Connecting wires

**Note**: All the metal strips used in this investigation must be equivalent in size and shape.

## Before You Begin

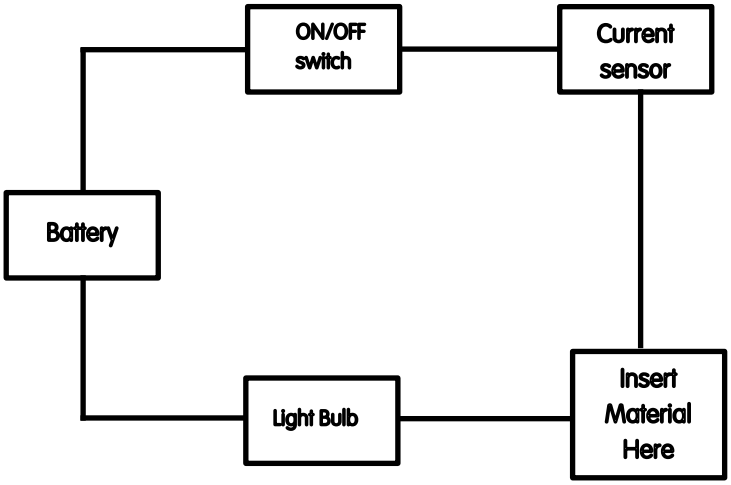
Conductivity is a property of a material.
An **insulator** will not complete an electric circuit. A **conductor** will complete an electric circuit.

Predict which of the materials that you have chosen will complete the circuit you will build.

## Experimental Setup

### Group Work

1. Build a circuit which includes:
    a. The battery in its battery holder
    b. The light bulb in its light bulb housing
    c. The ON/OFF switch
    d. The Current sensor
    e. One of the materials you have chosen
2. Use the connecting wires to connect the components in a circuit as shown in the diagram below.
3. Connect the Current sensor to your einstein™-enabled device.
4. Short circuit the Current sensor by touching the two (black and red) leads together.
5. Turn on the einstein™Tablet+ or einstein™Labmate+™ (paired with a tablet).
6. Tap the MiLAB ( ) icon to open the application.




## Sensor Setup

1. While there is no electric current in the circuit, set this value to zero. Tap the **Settings** cog ( ) beside the Current sensor. Switch **Set As Zero** to **ON**.
2. Tap the **Setup** cog ( ) and use the table below to set up the measurement parameters:

| | |
|---|---|
| **Sensor:** | Current (±250 mA) |
| **Rate:** | 1 / sec |
| **Duration:** | 20 Sec |

## Experimental Procedure

1. Create a data table like the sample table below for recording your measurements.
2. Before beginning the investigation, make sure all the components of the circuit are working:
    a. Connect together the two wires which will lead to and from the material to be tested.
    b. Select the **Meters** view ( ) from the lower toolbar and select the digital display.
    c. Put the switch in the ON position.
    d. Tap **Run** ( ) to measure the current flowing in the circuit you have built.
        i. Is the light bulb glowing?
        ii. How much current are you measuring?
    e. Return the switch to the OFF position.
3. Now include one of the test materials in the circuit as in the diagram above.
4. Put the switch in the ON position.
5. Tap **Play** ( ) to measure the current flowing in the circuit you have built.
    a. Is the light bulb glowing?

b. How much current are you measuring?

6. Return the switch to the OFF position.
7. Repeat steps 3 to 6 for each of the materials.

## Sample Data Table

| Material | Current Measurement (mA) | Did the light bulb glow? (yes/no) | Did you complete the electric circuit? (yes/no) |
|---|---|---|---|
| Copper | | | |
| Aluminum | | | |
| Stainless steel | | | |
| Plastic | | | |
| Glass | | | |
| Wood | | | |
| ? | | | |

**Note**: 1000 mA (milliamperes) = 1 A (ampere)

## Understanding the Measurements

1. Which materials completed the circuit so that the light bulb glowed?
2. How does the electric current you measured for those materials compare between one material and another?
3. Which materials did not complete the circuit?
4. What can you say about the current measurements you made for those materials?
5. Divide the materials that you tested into two groups: **conductors** which allow electric current to flow and **insulators** which do not allow electric current to flow.

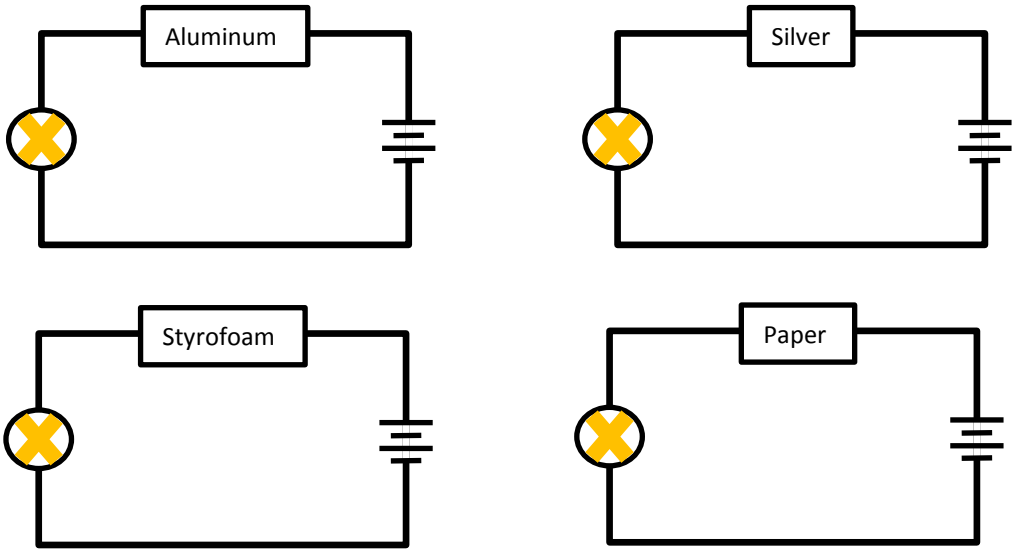
## Grouping Your Materials

| Conductors | Insulators |
|---|---|
| | |
| | |
| | |
| | |

6. What do the conductors have in common?
7. How do we use the properties of conductors in everyday life?
8. How do we use the properties of insulators in everyday life?

## Using What You Learned

1. Which of the circuits below is complete and will allow the light bulb to glow?
2. Try this Science Kids activity about Conductors and Circuits.




## Understanding the Science

**Electrical conductivity** is a measure of how well a material is able to conduct electricity. Materials which allow electricity to flow through them are called **conductors**. Materials which do not allow the flow of electricity are called **insulators**. Many metals are good conductors while non-metals such as plastic, glass and wood are good insulators. Conductors can be ranked as better or worse at conducting electricity. People take advantage of the properties of conductors by using them in electric cords and cables. For example, copper is often used for wiring. People also take advantage of insulators, for example, as an insulating coating on the outside of electric wires to keep people safe from the electricity.