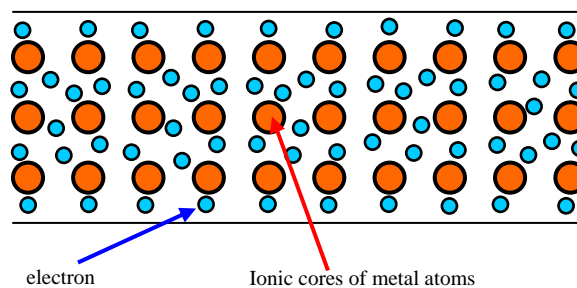


Episode 107: Preparation for electrical resistance topic

The central idea is that of electrical resistance - what it is, how it can be measured, how it arises and what affects it. We begin by relating resistance to current and voltage through the electrical characteristics of various components (at the same time providing more practice in setting up electrical circuits and using ammeters and voltmeters). This will naturally introduce some of the key factors affecting resistance - choice of material, temperature, light intensity....

Next we investigate the temperature dependence of the resistance of metals and semiconductors and (where relevant) discuss the phenomenon of superconductivity and its applications. An investigation of the dependence of resistance on type of material and dimensions leads to resistivity. The electrical behaviour of different types of material can then be linked back to their microscopic structure.



(Diagram: resourcefulphysics.org)

Episode 108: Resistance

Episode 109: Electrical characteristics

Episode 110: Resistance and temperature

Episode 111: Semiconductor devices

Episode 112: Resistivity

Advance warning

Most multimeters can function as ohm meters, for measuring resistance directly. They apply a small voltage to the component being tested and then measure the current it draws. Ohm meters must only be connected directly across the components they are measuring, which must be removed from any other circuits.

You will have to teach your students how to use micrometer screw gauges to measure diameters of thin wires. This can also form the basis of a useful lesson in handling errors in measurements.

Check with your technician or other support staff that you have enough suitable diodes and thermistors, and check also the supplies of bare constantan and nichrome wire. You may also wish to check the availability of conducting paper or conducting putty for the experiments on resistivity, but you can use more conventional wire if they are not available.

Find a table of values of the electrical resistivity of materials (conductors and insulators). This property covers a greater range of values than any other material property.

Main aims

Students will:

1. Measure the I -V characteristics of metals, carbon resistors, semiconductor diodes and filament lamps.
2. Define resistance.
3. Use an ohm meter.
4. State and use Ohm's law.
5. Describe and explain the effect of temperature on the resistance of a metal and of a thermistor.
6. Describe and explain the effect of light on an LDR.
7. Investigate the dependence of resistance on length and cross-sectional area using resistive putty and resistive paper.
8. Make measurements of resistivity.
9. Perform calculations involving resistivity.

Prior knowledge

Students should have previously encountered the equation $R = V / I$, which defines resistance. They should also be familiar with the idea that metals contain free electrons, which is why they conduct well (both electricity and heat).

Where this leads

Students will have extended their understanding of the microscopic nature of electrical current in solid materials. This will help later in understanding the internal resistance of cells and power supplies, as well as other currents such as electron beams.