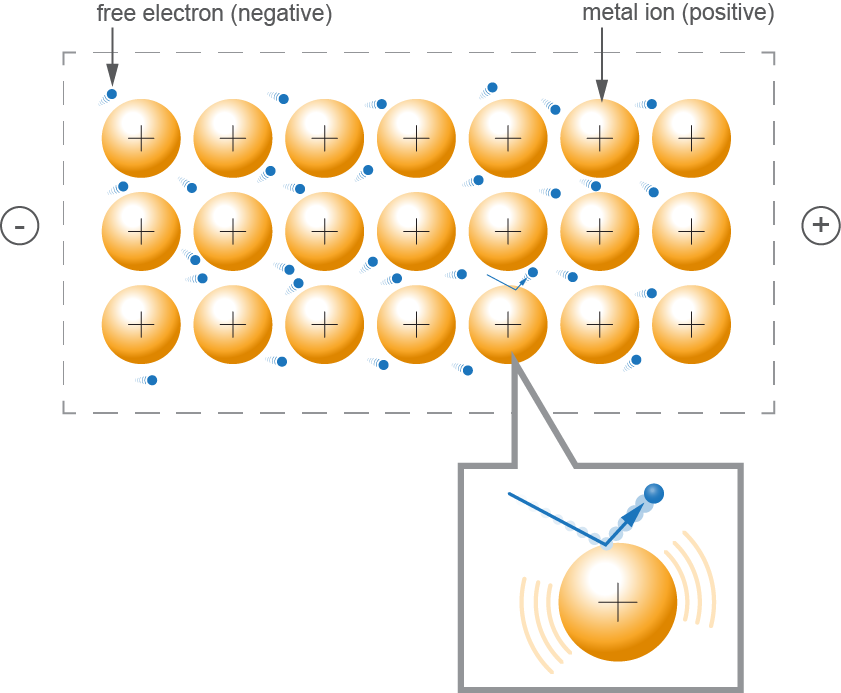
|  |  |
| --- | --- |
|  | Australian Curriculum Year 9 Science sample assessment ׀ Assessment resource  Electric kettles |

© The State of Queensland (Queensland Curriculum and Assessment Authority) and its licensors 2014. All web links correct at time of publication.

## Explaining resistance in terms of the particle model

* A metallic structure consists of metal ions (metal atoms with an electric charge) and a sea of free moving electrons. Normally the motion of these electrons is random due to their thermal energy. However, if a voltage is put across a section of a conductor, the negatively charged electrons are attracted to the positive (+) battery terminal and there is a net drift of the electrons in this direction. As the electrons move, collisions between the electrons and the metal ions occur. This is the cause of resistance.

**

* Resistance is defined as the opposition to the flow of charge; the opposition comes as a result of these electron–metal ion collisions. Energy transfer takes place during these collisions. The electrical energy of the electrons is transferred to the metal ions as vibrational kinetic energy. This is the reason that current can have a heating effect (remember that a higher average kinetic energy of the particles is recorded as a higher temperature).
* Most materials (excluding superconductors) have some electrical resistance and so some of the electrical energy of the electrons will be converted into heat energy as a current passes through it. If the current is kept low then the heat energy produced by the flow of current can dissipate into the surrounding environment and the substance can remain at room temperature. If the energy transferred from the current does result in a temperature rise then, for metals, the resistance increases. More vibration of the metal ions means that collisions between metal ions and electrons are more likely and the resistance to current flow increases. For example, when electric current passes through the filament of a light bulb, the filament heats up and causes the resistance to increase.
* The reason a voltage needs to be maintained across a component to keep current flowing is because of resistance and the fact that electrical energy is being continually converted into vibrational kinetic energy which manifests itself as heat. A battery or other electrical power source supplies the necessary voltage. If a substance had zero resistance (e.g. a superconductor) then once a current was set up there would not need to be a voltage across it to maintain the current, because electrical energy would not be continually transferred into heat in the substance.

Based on:

* BBC, *GCSE Bitesize,* Accessed 20 August 2013, [www.bbc.co.uk/schools/gcsebitesize/science/add\_aqa/electricity/resistancerev1.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/electricity/resistancerev1.shtml).
* Eastewell, P 1996, *Physics Spectrum*, McGraw-Hill Book Company, Sydney.
* *Hyperphysics*. Accessed 20 August 2013 [hyperphysics.phy-astr.gsu.edu/hbase/hframe.html](http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html).
* Nelkonn, M & Parker P 1987, *Advanced Level Physics (Sixth Edition)*, Heinemann Educational, London.
* *The Physics Classroom*, [www.physicsclassroom.com/class/circuits/u9l3b.cfm](http://www.physicsclassroom.com/class/circuits/u9l3b.cfm).
* Walding, R, Rapkins, G, & Rossiter, G 2004, *New Century Senior Physics*, Oxford University Press, Melbourne.