Activity 8. Conduct, insulate, resist: The Dance

Learning intentions
Students will have a deeper understanding about what makes a conductor and insulator, the nature of resistance and its implications for how we produce and use energy.

Materials
None

Teacher notes	Teaching notes: running the activity
While one of the objectives of this exercise is to provide a simple visual model of how the mobility of electrons affects their conductivity, the main purpose is to demonstrate that the more difficult it is for an electron to move through a material – the more it interacts with other atoms and the more energy that is required to release them from their atomic nucleus - the more energy is lost as heat, which is wasted energy. This is the concept of resistance. Feel free to select some funky music to do this to. Ask students how many electrons would make it through the insulator in a given time compared to the conductor. Conductors allow electrons to flow more easily than insulator. The more electrons per unit of time that move through a space, the greater the current (or amount of electrical energy). For the electrons to move in the first instance, they need a force or form of energy such as the chemical energy from a battery. Consider adding a student battery to represent an extra battery – the same as joining two batteries end to end. This student battery will (gently) push each student electron. The push or force must remain constant for both the insulator and conductor scenarios. That is, a 1.5 battery cannot increase or decrease its force (voltage) with a change in circuit material. It is simply that a 1.5 volt force will push more electrons through a conductor (higher current, low resistance) in given time than through an insulator (lower current, higher resistance). Ask students what sort of material they would use in their circuits. Conductors or insulators? We use good conductors such as metals (eg copper) in circuits to conduct electricity and we use insulators such as plastic to	**Method** There are two dances for students to perform: The Insulator and The Conductor. *The insulator*: Get students to arrange themselves in 3 lines of 5-8 students per line (although the longer the line the better, if you have the students to spare). Each student in the grid represents an atom. They will place their right arm on the shoulder of the person in front of them and their left arm on shoulder of the person to their left. This represents the atomic lattice or structure of a material that an electron must pass through to generate electricity. Three students who represent the electrons associated with the atoms form a straight line – one behind the other – in front of the students representing the atomic lattice. (This is not a true representation as there would normally be more than one electron per atom for any material that is a conductor or insulator.) The student electrons must try to pass from one end of the grid to the other. The students playing the atoms are moving a bit because that is what atoms do, but students must maintain the grid to make it as hard as possible for the electron to pass through. These student atoms represent an insulator and atoms in insulators have their electrons bound tightly to the atom, so it is harder for the electron to move through an insulator. Ask the students playing the electron how hard it was to get through the insulator. Do they feel puffed and hence a bit warmer? Any warmth they feel represents energy lost as heat. The property of the material the acts to prevent the movement of electrons is known as resistance.

coat those wires and prevent us getting electrocuted.	*The Conductors*: Now get the atoms to only have their right arms on the shoulders of the person in front. Get the electron to now travel down the line of atoms, which are moving and bumping into the electron, but not offering much resistance. Ask the electrons how puffed or warm they feel now compared to the dance through the insulator? In theory they will have lost a lot less energy as heat because of the minimal resistance.