Electricity: Misconceptions	
What pupils think……	Notes…..
Wires are made out of plastic	Younger pupils may think this as the outer insulation is made from plastic. It would be a good idea to use wire strippers in order to expose the wire fibres to discuss what the wires are made from.
Pupils call cells batteries	Even though the generic term for a cell is a battery it is helpful to explain scientifically that it is referred to as a cell. A battery is 2 or more cells used together. It is helpful as students move into KS3 and KS4 to be able to know the difference.
Battery stores electricity; electricity from both ends of the battery ; electricity used up; battery runs out of charges; battery runs out of electric currents; shorter connecting wire needs less electricity	Complete circuit; no gaps; battery stores energy; electric current is a flow; charge travels; add a battery for brighter bulb; extra battery gives more energy; battery runs out of energy
The electric current gets used up in the bulb.	Energy is shifted by the action of the bulb. As the charged particles first pass through the bulb, they encounter resistance in the filament, and energy is shifted to the thermal store of the filament as it warms up and starts to glow. The charged particles continue around the circuit. Energy, and not the charged particles, is shifted by the bulb and dissipated.
Different coloured wires affect how the circuit works	The colours of wires are important to electricians and each colour serves a different purpose but the wires used in school all have the same function so the colours of the insulation do not matter. You may wish to use a plug to illustrate why electricians need to have colour coded wires. The ones in school are usually black or red so this can help; since they are not related to the wiring of a plug. However, if pupils are using a power pack, they often think that because the DC output connectors are black and red, that the wires should match those on the power pack or the circuit won’t work
Current, voltage and electricity are all the same thing	**Current**- The movement or flow of electrical charges. This is measured in amps (A). The greater the charge that flows, the bigger the current. Just as in a flowing water system, the current is analogous to the flow of water **Voltage**- The voltage provides the force that pushes the current around the circuit. A voltmeter measures voltage in volts (V). The higher the voltage, the more current is passing through the component and if this is too high, a bulb could blow. Just as in a flowing water system, the voltage is analogous to water pressure. **Charge (electron)-** An electric current flows when electric charges move through a wire. Just as in a flowing water system, the charge is analogous to the amount of water in the system
Current gets less as it passes through the components	The current is not used up by the components in a circuit. This means that the current is the same everywhere in a series circuit, even if it has lots of lamps or other components.
Electricity is something that can be seen	In the instance of electricity, the most common way it affects objects is by charging electrons, and because these are so small, so plentiful and move so quickly once charged, they are all but invisible to the naked human eye
Batteries store charge	Because we talk about 'charging' a battery, it's a common misconception that batteries store electric charge or electrons. This is tied up with another incorrect idea that an electric current is the flow of electrons through initially empty wires. For every electron that leaves a battery at one terminal another one enters at the other, so batteries never run out of charge. What they run out of is the ability to make the charges everywhere in the circuit move. This is essentially because the chemicals that make the battery work have all reacted. It's useful to think of batteries running out of energy. Cells and batteries store chemical energy.
The current takes the easiest route (KS3/GCSE)	This argument is often used to explain short circuits, and parallel circuits where the resistances are different. It's a variation of the constant current misconception. The key idea is that there isn't 'the current' which chooses a route. If you change a circuit, then the current changes. The same current doesn't just 'split' differently.
Charges slow down as they go through a thin piece of wire (KS3/GCSE)	It's a common misconception that charges slow down as they go through the filament of a bulb because the filament is thinner than the wires in the rest of the circuit. When road traffic goes through a bottleneck it slows down. But with charges the opposite happens. This is because the current has to stay constant. In other words, the number of charges passing a point each second has to stay constant. If fewer charges can go side-by-

	side, then they have to go quicker. Quicker charges interact with the metal lattice more frequently and so this is where energy tends to get converted. It's important to realise with this argument that there isn't a 'the current'. If you add a constriction to a circuit then the current everywhere is smaller.
The constant current misconception (KS3/GCSE)	This is one of the most enduring and widespread misconceptions and comes in many forms. The misconception tends to be implicitly rather than explicitly stated but the essential misunderstanding is that batteries want to produce a particular current. In other words, there is this current that wants to flow and circuits try and resist or split this current. In other words, people see batteries as constant current providers. In fact they are constant voltage providers (if you ignore internal resistance) and the current depends entirely on what you connect them to. The problem normally rears its head when a circuit changes, for example an extra bulb is added in parallel, and the assumption is that the current drawn from the battery stays the same and simply splits differently. In fact as soon as you change a circuit the current drawn from the battery changes.
High resistance bulbs are brighter than low resistance ones (KS3/GCSE)	Energy is converted in the filament of a bulb because it has a high resistance compared with the rest of the circuit. A wrong conclusion would be that the higher the resistance of the filament, the brighter it should be. This comes from a feeling that the current has to 'try harder' to get through the bulb and so more energy must be transferred. This is another symptom of the constant current misconception. The result of having a high resistance in a circuit is not that 'the current' has to struggle to get through but simply that the current would be less than it would otherwise be. If the resistance is very high, then the current is nearly zero and hardly any energy is transferred at all.
Thick wires have a lower resistance because the charges have more space (KS3/GCSE)	If you believe that charges move through empty wires then it makes sense that the charges must move quicker when the wire is wider because there's more space. This isn't what happens. The wire is already full of charges no matter how thick it is. The lattice of positive ions completely fills the wire because that's what the wire is made from. Having a thicker wire doesn't create more gaps. In a given metal the speed of the charges depends only on the voltage. You can model a thick wire as lots of thin wires side by side. The current is bigger because each wire contributes charges passing a point each second. Bigger current for the same voltage means lower resistance. An analogy is a three-lane road with the cars travelling at 30 mph has more cars passing a tree each second than a single-carriageway road with the cars travelling at the same speed. Another way of looking at it is that for a *given* current the charges move slower if the wire is thicker. This means they transfer less energy to the lattice. In other words, you need a smaller voltage for a given current. Hence lower resistance.