Activity 7. Life without resistance

Learning Intentions
Students get to think critically about the concept of resistance and the value of research that aims to develop materials that can conduct electricity without resistance.

Materials
- Pencils, crayons, etc
- Paper

Teacher Notes	Teaching Notes: Running the activity
Resistance is a property of the material that impedes the flow of electrons. Therefore, the greater the resistance of a material, the more energy is required to get electrons to flow through that material and fewer electrons will be moving. There will be a reduced flow of charge. Where there is resistance – and there is always some – energy in the electron is lost as heat rather than being used to perform the task we want such as powering the TV or computer. This is why your laptop and phone get hot when in use. Digital technologies [anything with a computer chip] consume about 10% of global electricity and this proportion is increasing each year as we demand smarter, more powerful computing systems to be integrated into our daily lives. Today, a lot of that computer processing happens in huge factory-sized data centres. Some of the bigger data centres are more than 20 times bigger than the MCG (Australian football stadium) and each use about the same amount of electricity as a whole city of Melbourne suburb. Think Google, Facebook and Amazon, Microsoft. Scientists and engineers have developed ways to make these data centres extremely energy efficient compared to how your laptop or desktop computer stores and processes data. Despite these efficiencies, our increasing digital demands mean we continue to build more data centres and so our digital energy consumption continues to increase. Resistance is behind what we call “compensatory emissions.” These emissions are the result of the extra	**Method** Students form small groups to brainstorm the following questions: What would it mean if we could conduct electricity without resistance? How would this affect how you use energy? What would this mean for society? Consider the following ways to communicate your brainstorming: • Construct a mind map, to connect all your ideas with the central theme, ‘Electricity without resistance’. • Draw images to represent your ideas. Explain these in a story to the rest of your class.

electricity – often generated from fossil fuels – required to compensate for energy lost throughout out grid because of resistance. It has been calculated that worldwide, compensatory emissions amount to nearly a billion metric tons of carbon dioxide equivalents a year, in the same range as the annual emissions from heavy trucks or the entire chemical industry. Given these facts, there is considerable scope to improve the efficiency of our digital technologies and the way we generate and transmit electricity around the world if we can develop materials that conduct electricity without resistance. This is why FLEET is working on developing atomically thin materials – materials just one atom thick – that can conduct electricity without resistance. These materials will be used in digital technologies to make them use a lot less energy. Note: Ensure students understand that having zero resistance does not equate to suddenly having extra lethal levels of electricity coursing through our circuits.	