

Reading 2

► You are going to read a popularized article on superconductors. Before you do so, can you say what superconductors are? What are their properties and uses? Discuss in groups.

► Look at the pictures on the right. The first one is related to science, and the second to science fiction. The first one shows a magnet levitating above a superconductor and the second a hoverboard, a magic skateboard from the film 'Back to the Future', directed by Robert Zemeckis.



a) What do the two pictures have in common?

b) Can you guess the meaning of the words *levitate* and *hover*?

► Try to answer the following questions. Then go through the text and check your answers.

- What is the basic difference between insulators and superconductors?
- Can superconductors produce their own magnetic fields?
- How do you think the above pictures are related to the properties of superconductors?

Explainer: what is a superconductor?

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Materials can be divided into two categories based on their ability to conduct electricity. Metals, such as copper and silver, allow electrons to move freely and carry with them electrical charge. Insulators, such as rubber or wood, hold on to their electrons tightly and will not allow an electrical current to flow.

In the early 20th century physicists developed new laboratory techniques to cool materials to temperatures near absolute zero ($-273\text{ }^{\circ}\text{C}$), and began investigating how the ability to conduct electricity changes in such extreme conditions. In some simple elements such as mercury and lead they noticed something remarkable – below a certain temperature these materials could conduct electricity with no resistance. In the decades since this discovery scientists have found identical behaviour in thousands of compounds, from ceramics to carbon nanotubes.

We now think of this state of matter as neither a metal nor an insulator, but an exotic third category, called a superconductor. A superconductor conducts electricity perfectly, meaning an electrical current in a superconducting wire would continue to flow round in circles for billions of years, never degrading or dissipating.

Electrons in the fast lane

On a microscopic level the electrons in a superconductor behave very differently from those in a normal metal. Superconducting electrons pair together, allowing them to travel with ease from one end of a material to another. The effect is a bit like a priority commuter lane on a busy motorway. Solo electrons get stuck in traffic, bumping into other electrons and obstacles as they make their journey. Paired electrons on the other hand are given a priority pass to travel in the fast lane through a material, able to avoid congestion.