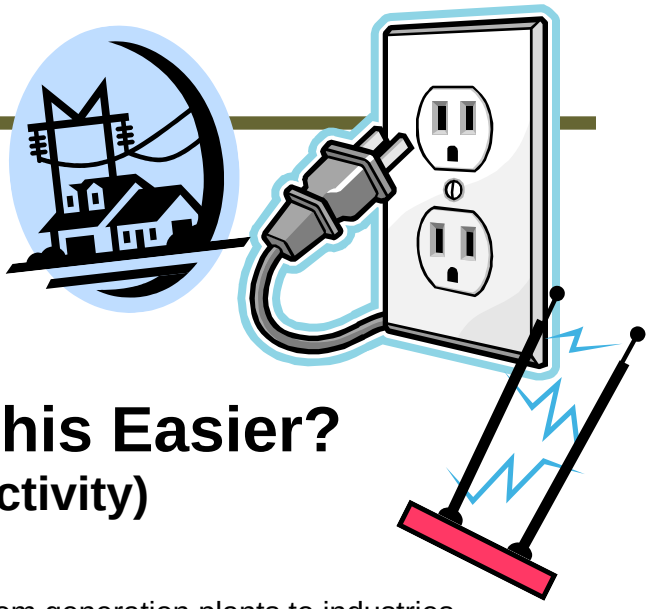
science FRONTIERS



Can You Make This Easier?
(Superconductivity)

Electricity is transmitted through cables and wires from generation plants to industries, offices, schools, and homes. It is also carried from storage sites, such as batteries, to devices that use the electricity. As the electricity flows, some is converted from electric energy into heat energy. This loss is expensive because consumers have to pay for all the electricity produced, even though some is lost along the way. For some uses, the heat generated must be removed and this adds additional cost to the total bill.

Superconductivity refers to the complete or nearly-complete lack of resistance to the flow of electricity. Although scientists have discovered some metals, alloys, and other materials that reduce the resistance, most superconductivity occurs when the conductors are very cold. One solution to reduce loss is to use larger wires and cables, but this may not be practical. Reducing the friction that causes loss is more efficient than secondary solutions to deal with the loss. Materials, such as some alloys and ceramics that are superconductors close to **ambient** *(surrounding environment)* temperatures, are generally expensive and not suited to all uses. For many uses, it is cheaper to cool metal cables and wires to make them superconductors. Liquid nitrogen is commonly used, because it is readily available and cools the conductor sufficiently.

The city of Pittsburgh, Pennsylvania, like most cities, has large cables under city streets to carry massive amounts of electricity throughout the city. As demand increased, the cables were not adequate to carry the load. The city faced the challenge of tearing up most of the streets to install larger cables without completely disrupting traffic. They decided to use superconductivity to increase capacity without increasing the space required for cables. Thick cables were removed and replaced by hollow pipes that contained ribbons of superconductors and the liquid nitrogen to cool the ribbons. This work was done with minimal disruption to traffic, since it was possible to work underground in the existing space.

Superconductivity is also used in magnetic levitation. Applications such as mag-lev trains use superconductivity for both the levitation and the conductivity. As we increase our demand for electricity and electromagnetic energy, the use of superconductors will become more important.

Questions to Think about or Research:

Can you find examples of levitation in the Bible?

What kind of an education would help you invent a new superconductor?

Research Ideas

Levitation, electrical resistance