



Wafer Power: Mighty Silicon

Understanding How Semiconductors Work in Microelectronics



Lexington, MA (MIT Lincoln Laboratory)—Engineers design tiny electronic circuits—on the micron scale. These microchips are “the brains” of devices such as cell phones, computers, cameras, and televisions. Engineers are finding ways to make smaller, faster, more powerful, and less expensive microelectronics. The tiny technology can be programmed to perform a great range of functions.

“Silicon is one of the fundamental elements. It’s a crystal and very strong and rigid. It’s most commonly found in the form of sand.” Jeremy Muldavin, electrical engineer

Framework

Middle School

Standards

- NSES - B.i.1 ➤ A substance has characteristic properties.
- NSES - B.i.2 ➤ Substances react chemically in characteristic ways.
- NSES - B.iii.4 ➤ Electrical circuits transfer electrical energy.
- STL - 19.F ➤ Manufacturing changes the form of a material.

Content Illustrated

- Animation of a transistor made from a semiconductor.



Content



Physical Science

- Silicon has a strong, rigid crystal structure and is found in nature as part of the compound silicon dioxide.
- Silicon is a good insulator. It does not conduct electricity.
- Adding impurities to silicon makes it a semiconductor so that it responds to electric fields and acts like an on-off switch for the flow of electricity.

Earth & Space Science

- Silicon is a highly abundant element. It naturally occurs in sand as silicon dioxide.

Technology

- Microelectronic chips are used in televisions, computers, cameras, and cell phones. Microelectronic components can control different functions in applications such as thin-film displays, radio communications, and keypads.
- A transistor amplifies or blocks the flow of electricity.
- Semiconductors are placed between two conductive plates, sending electrons from the emitter to the collector. The semiconductor acts like a transistor allowing the flow of electrons.
- Thousands of transistors can be created on an integrated circuit, or semiconductor. Semiconductors are made from very thin sheets, or wafers, of silicon. Circuitry is printed directly on the silicon wafer and programmed to perform thousands of functions.

Math

- Micron scale, 1 micron = 1 millionth of a meter.
- A piece of paper is about 100 microns thick.

Guiding Questions

To think about as you watch:

- How are semiconductors used in microelectronic devices?

Suggested Activities

- Find out which of the elements are semiconductors.

Keywords

boule, integrated circuit, collector, crystalline structure, electricity, emitter, impurities, microelectronics, micron, semiconductor, silicon, switch, transistor