



# Wafer Power: Building Circuits Manufacturing Electrical Circuits and Small Devices That Move



Lexington, MA (MIT Lincoln Laboratory)—  
Engineers are making tiny electrical circuits and devices that are about 1/1000 the size of a piece of dust. The devices have to be made in special clean rooms which protect them. Through many elaborate and complex steps, the circuits and devices are produced on silicon wafers. The technology made in this lab may lead to smaller, faster, and better everyday products.

*"We make extremely small switches and circuits that will end up in cell phones in cameras and in computers in 5 to 10 years."* **Jeremy Muldavin, electrical engineer**

## Framework

Middle School

## Standards

- NSES - B.i.2 ➤ Substances react chemically in characteristic ways.
- NSES - B.iii.1 ➤ Energy is transferred in many ways.
- NSES - B.iii.4 ➤ Electrical circuits transfer electrical energy.
- STL - 19.H ➤ The manufacturing process includes the design and development of products and systems.
- STL - 19.I ➤ Chemical technologies alter chemical substances.

## Content Illustrated

- Steps in making silicon wafers.



# Content



## Technology

- Semiconductor circuits are made in a “clean room” in which temperature, air flow, vibrations, and dust are controlled. Scientists and engineers must wear protective lab gear, called bunny suits, in the clean room.
- The process of making a circuit entails melting silicon dioxide (sand) and adding impurities to make it semiconductive. Then a rod with a silicon seed crystal is placed in the molten material. The rod is turned and cooled, resulting in a pure semiconducting silicon cylinder which is sliced into thin wafers.
- The wafers are oxidized (burned in oxygen) so that the surface is composed of silicon dioxide. Then layers of metal and light-sensitive material is deposited on the surface.
- By projecting light onto the light-sensitive resistant-coating, circuit patterns are projected and the surface is etched using chemicals.
- The switches, on the silicon layer of the wafer, are connected by tiny wires too small to see.
- MEMs, micro electro mechanical systems, are tiny moving parts on a semiconductor. This system is used by applying a voltage to cause the shutter-like piece to connect with the substrate.

## Engineering

- Channels are etched into the semiconductors to contain the energy used to operate MEMs. The channels are coated with metalized silicon to help the circuits. This design feature allows for smaller and faster semiconductors that may contain more circuits.

## Guiding Questions

*To think about as you watch:*

- Why must everything be so clean in a microelectronics manufacturing process?

## Suggested Activities

- Create a crystal using a string dipped and pulled from a sugar-based solution.

## Keywords

bunny suit  
chip  
circuits  
clean room  
Micro Electro  
Mechanical  
Systems (MEMS)  
oxidation  
semiconductor  
silicon wafer