

PHOTO #1—CIRCUIT BOARD

- This is a photo of a microchip (black square) being held with tweezers in front of a circuit board (green) containing other microchips (black squares and rectangles).
- Circuit boards, sometimes called motherboards, are found inside computers and other electronic devices. They connect all the electrical components and chips.
- This is the macroscale.

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PHOTO #2—PHOTO OF A MICROCHIP WITH THE COVER REMOVED

- This is a photo of the Intel 486 chip introduced in the early 1990s.
- It was the first chip to have **more than a million transistors**.
- The actual chip is only about **1/2-inch** by **1/4-inch**.
- This photo is magnified **40 times**.
- Even at this magnification it is difficult to see the tiny wires on the chip—the rectangle in the center. (The large gold wires around the outer edge connect the chip to pins on the back of the chip that attach it to the circuit board.)

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PHOTO #3—A SCANNING ELECTRON MICROGRAPH IMAGE OF WIRES ON A MICROCHIP

- This image shows the wires or connectors on a microchip magnified about **400 times**.
- If these wires get too close, electrons can jump from one wire to the next, which makes the circuit much less efficient.
- This is one of the main challenges of making smaller, more powerful microchips.

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MAKING STUFF

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PHOTO #4—A MICROCHIP ON A FINGERTIP FOR SCALE

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PHOTO #5—A NANOWIRE COMPARED TO A HUMAN HAIR

- This is an image of a **nanowire** taken at **500 times** magnification.
- The **nanowire** is 50 nanometers wide.
- The single strand of **hair** shown behind it is **1,000 times thicker**.

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