



## Computer Chips are 3D Structures!

**Computer chips** look flat, but if you looked through a very powerful microscope, you would see that they are actually 3-dimensional structures. There are many layers of **metal lines** (or 'wires') connecting the outside world to the tiny **transistors** built into the **silicon**.

That's right, the tiny transistors aren't just sitting on top of the silicon, they are actually built right into it! Silicon is a **semiconductor**, which means sometimes it acts like an insulator (**electrons** do not easily flow) and sometimes it acts as a conductor (electrons flow easily).

By '**implanting**' only certain areas of the silicon chip with extra electrons, we can build transistors right into the silicon. The transistors act like switches, and turn on or off ('1' or '0') in different combinations to do calculations. The electrons travel from the transistors through the different layers of metal lines and finally to the bond pads where they can connect to the outside world.

If you cut into a computer chip like a sandwich, and looked at it from the side, you would mostly see the many layers of metal lines stacked on top of each other. The transistors would be at the very bottom layer of the sandwich.