Electronics

Electronics began in 1904 with a **vacuum tube** that had two electrodes. A heated electrode sends a current. Vacuum tubes are glass tubes with a complicated wire system to control the on/off pulses. In 1906, Lee De Forest added a third electrode, which enabled the current to be controlled. The vacuum tube's triode (three wires) was made of a natural semiconductor material like silicon. The material can detect, change, and amplify (strengthen) electric current. People first used vacuum tubes in radios to amplify the signals. Although vacuum tubes are good at amplifying sound, they use much energy and are not very reliable. Vacuum tubes are no longer used.

A **transistor** is a very small electronic system made of electronic circuitry on a silicon chip. The single chip acts like a switch for on and off pulses of electricity. The basis of the transistor was a short piece of wire that made headphones work. The wire is called a cat's whisker. This led to the transistor, which ushered in the second generation of computers. In 1947, physicists John Bardeen, Walter Brattain, and William Shockley developed the transistor using a solid crystal. It did the same thing as the glass and wire vacuum tube, but it was inexpensive and small. It was the beginning of transistors.

Transistors can be made of different materials, but the most successful are made of silicon. They are tiny, and controlled electricity flows through them. Transistors are the foundation of all modern electronics. In 1948, the transistor enabled the invention of miniature portable radios.

In 1959, Jack Kilby discovered that one slice of silicon could hold thousands of transistors. Scientists called it an **integrated circuit**. It is also known by two other names: a silicon chip (because the transistors sit on a tiny piece, or chip, of silicon) and a microchip (because the silicon chip is very small). In the 1960s integrated circuits (ICs) replaced transistors. Integrated circuits were replaced by large-scale integrated circuits (LSIC), which were not larger in size but larger in power or in the number of transistors they could hold. Then very large-scale integrated circuits (VLSICs) replaced LSICs.

In 1971, Ted Hoff created the **microprocessor.** A microprocessor is a complete computer processor on a single chip. It has thousands of transistors and can complete more than 100,000 program instructions a minute. Microprocessors led to the development of the personal computer.

Exercise:

1. Why are vacuum tubes no longer used? _____

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2. What is an integrated circuit? _____

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3. What does "chip" refer to? _____

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4. What is a microprocessor? How did the invention of the microprocessor change computers?

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