How Computers Work: Information (Part I)

A light switch turns electricity on and off. A computer works with circuits of electricity that are either on or off. A computer is like billions of light switches all wired together in special circuits. In a computer, these switches are TRANSISTORS that turn current on and off.

A light switch has moving parts when it turns on and of. A transistor turns electricity on and off without any moving parts. Transistors are much smaller than a light switch and they have no moving parts.

Transistors turn on and off by varying their resistance depending on electrical charges that control them. Transistors are powerful, but extremely tiny. In an iPhone there are over 32 billion transistors!

Transistors are used in computers to store data, represent information, perform calculations, and make decisions. They do this by using a BINARY system to store and work in information. In other words, we can use ON and OFF to create a system of logic.

When humans do math, we use a decimal system that creates placeholders for ones, tens, hundreds, thousands, ten thousands, hundred thousands, millions, and so on. Binary systems differ because they use only 2 digits, 0 and 1.

In a computer's digital binary system, the 0 means OFF – there is no current. The 1 means ON – there is a current. Just like decimal systems, binary systems use placeholders.

In decimal systems, we saw that each "place" to the left of a decimal stands for ones, tens, hundreds, thousands, ten thousands, etc. In a binary system, each placeholder represents ones, twos, fours, eights, etc.

Any number can be represented in either a decimal or binary system. 13 is a decimal number (1 group of 10, 3 ones). We would write 13 in a binary system as: 1101 (1 eight, 1 four, 0 twos, and 1 one).

Each on/off switch in a computer represents a piece of information. We call each on/off switch in a computer a BIT. A single one or zero in a computer -- one switch or transistor – represents one bit of data.

Computers work with many bits of data. A typical laptop computer, in 2012, could store over 2 trillion bits. Today's computers can work with many more.

A bit is a tiny piece of information, not enough to be useful. It is just one on/off switch. To create useful information in binary system, we need to be able to work with groups of bits – groups of on/off switches.

When we create a group of 8 bits – 8 on/off switches, we have created a BYTE of information. A group of 8 bits represents a single byte. A byte can represent any whole number between 0—255. To represent other values, we create groups of bytes. Computers group bytes together to form more complex information structures.

Computers store information in groups of binary numbers, 1s and 0s, or on/off electrical systems. To store music, emails, websites, and photos, computers create a special code for different types of information.

Colors, in a computer, are represented and stored as mixtures of three colors – the primary colors in light – red, blue, and green (NOTE: This is different than the primary colors we paint with: red, blue, yellow). The color system used by computers is based on a binary system that combines bits (on/off) into groups of 8 (bytes). This system is called RBG – which stands for red, blue, green.

By combining different mixtures of red, blue, and green light, a computer's RBG system can create more than 16 million different colors. This is many more colors than most of us can actually see.

Computers use a binary system of bytes (groups of 8 bits) to create text. Each letter in any alphabet is assigned a number. Computers represent letters with binary numbers. A special code creates this system.

The most popular coding system in the world for text is called UNICODE. It can represent all letters, punctuation, and numbers used in all of the common languages world-wide.