The Journey Inside[SM]: Digital Information
Student Handout: Computers and Pictures

Computers and Pictures

One way to think about a computer is that it is made up of millions of electronic switches called transistors. Transistors are on or off. Electricity is either flowing through the transistor or it isn't. This means a circuit is closed or open. The two states (switch closed so that electricity can flow; switch open so that electricity cannot flow) can be represented by two symbols—1 and 0.

This binary code of 0s and 1s is how all information, including numbers, words, sounds, and pictures, is stored in a computer. Of course, there are no actual 0's and 1's inside the machine. These symbols merely represent a switch being off or on.
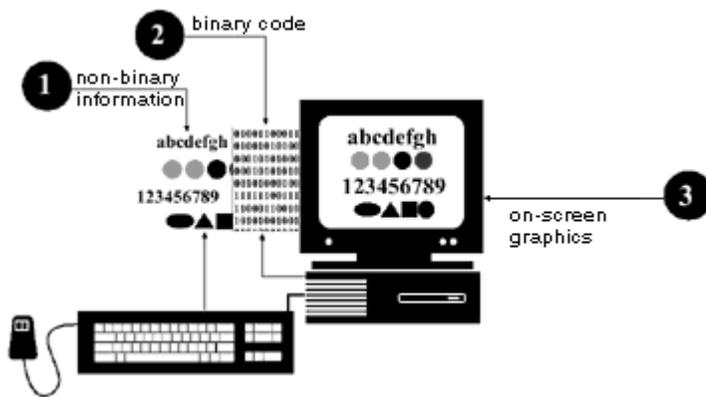
In your computer, special graphics chips are used to translate the binary coded information into what you see on your screen. Think of your screen as being made up of a large number of tiny dots arranged in rows and columns. Each dot is called a picture element or pixel, and each dot is given some combination of red/green/blue to display.

If your color monitor is set for only 256 colors, the graphics chip makes use of 256 different codes, each made using just 8 bits. Every one of the 256 colors is coded into a special 8-bit value.

For convenience in writing and talking about the colors of pixels, it is easier to use the numbers 0, 1, 2, 3, ..., 254, 255 rather than the binary codes. Color 3 is color 0000 0011₂. It is represented in the computer memory by eight transistors set at off-off-off-off-off-off-on-on.

Activities

1. The table below represents a small part of a black-and-white computer screen. It is 10 pixels high and 15 pixels wide. The screen contains a hidden picture displayed as the symbols 0 and 1. To see the picture, color each pixel marked 0 with black to represent a pixel that is black or off. Leave all pixels that show a 1 blank to represent a white pixel or on.

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	0	0	0	0	0	1	1	1
1	1	1	1	1	1	1	0	1	1	1	0	1	1	1
1	1	1	1	1	1	1	0	1	1	1	0	1	1	1
1	1	1	1	1	1	1	0	1	1	1	0	1	1	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	1	1	1	1	1	1	1	0	0	1
1	0	0	1	1	1	1	1	1	1	1	1	0	0	1

2. On the grid below, create your own picture by coloring some of the pixels black and leaving others white.

3. On this next grid, translate your picture into a binary code (0s and 1s).

4. Now cut out the grid with your binary code that you created on step 3 above. Give this grid to someone and see if by blackening all the squares marked with 0, they can recreate the picture you made in step 2.