

Project: ASCII Necklaces

Introduction (20 minutes):

Today we are going to learn some of the concepts behind how you talk to computers. Computer engineers, computer programmers, and electrical engineers need to understand how they can make a computer do different things so they need to know how to talk to them. Today we are going to learn about binary numbers and ASCII codes.

Then, we will use that information to make a necklace.



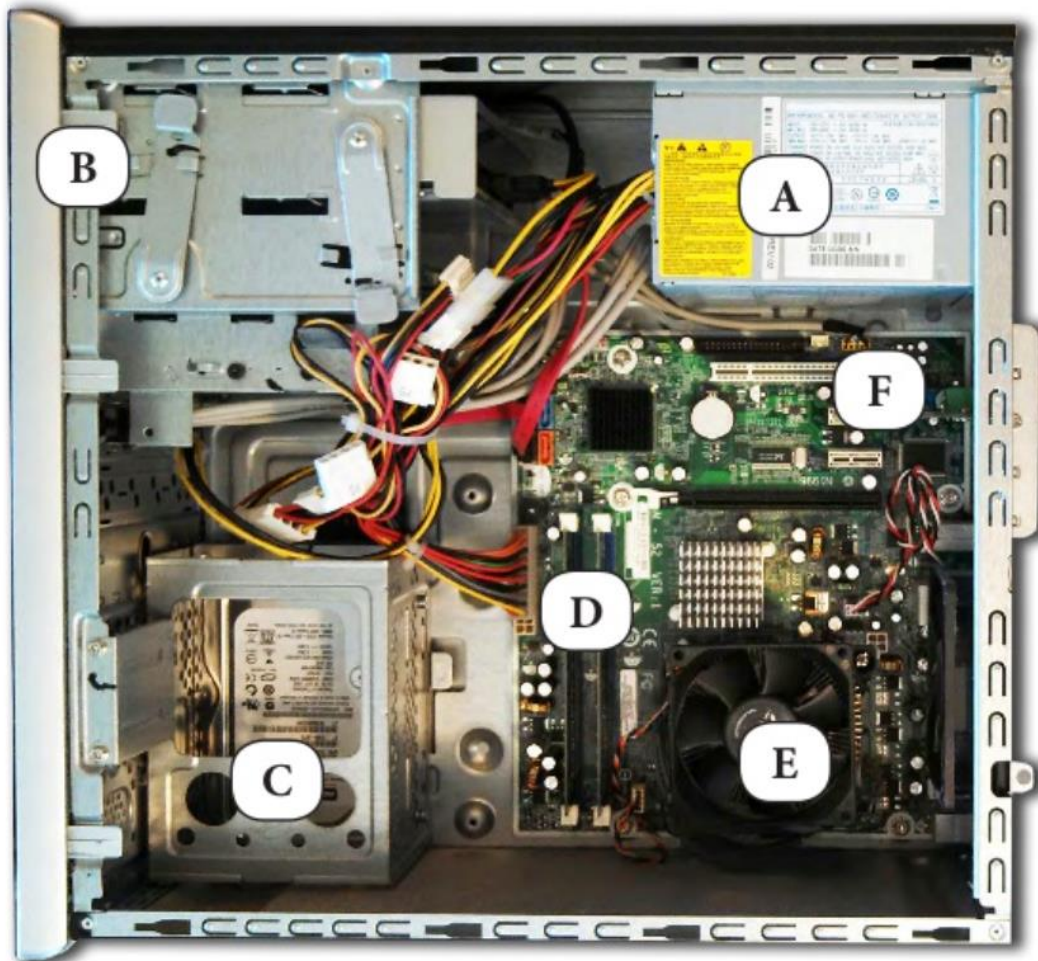
To introduce the project, ask the girls if they have seen inside a computer. If any of them have, ask what's inside.

Show them the picture of the inside of a computer on the next page. Discuss the parts and their functions as described on the following page.

Inside a Computer:

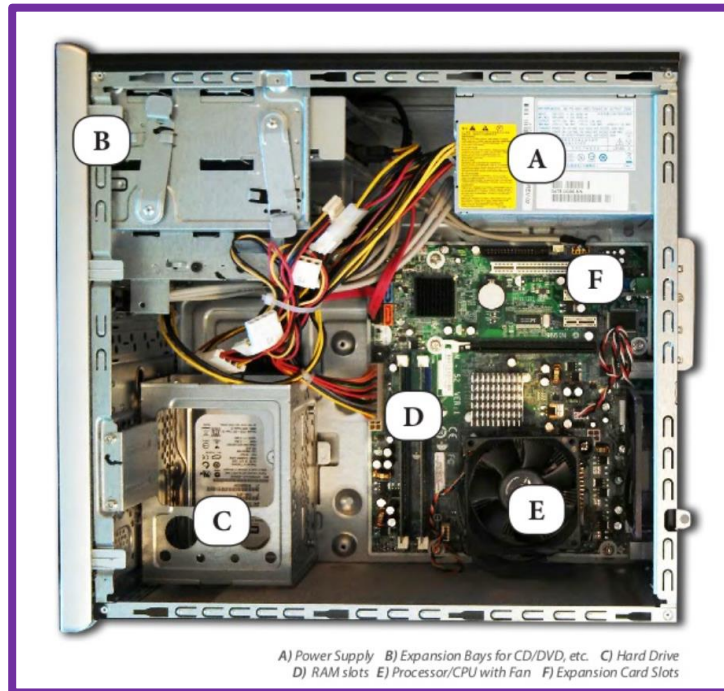
Computer Image Pack

Traveling Circuits
Image 1 - Inside a Computer



A) Power Supply B) Expansion Bays for CD/DVD, etc. C) Hard Drive
D) RAM slots E) Processor/CPU with Fan F) Expansion Card Slots

Inside a Computer:



Do you see that big silver box with all of the wires under the label **A**? That's the **Power Supply**. It converts the power that comes from the wall outlet into power that the computer can use. It then feeds that power to the rest of the computer parts.

Next, look at **D**. Label D is the **RAM**, which stands for “**Random Access Memory**”. This is a really fast storage space where the computer can keep information that it uses often.

When the RAM is full, or when you are done using information for a while, the data can be stored to the **Hard Disk Drive**, which we see under the **C** label.

Now, if you look at label **E**, you'll see what looks like a tiny fan. Under the fan is the **CPU (Central Processing Unit)**. Sometimes called the Processor, the CPU is full of wires — more than three million of them — each 1/100th the thickness of a human hair. The processor gets extremely hot, since those wires leak a little bit of electricity every time an instruction is performed, and the average processor in 2013 performed about 178 million instructions per second. Because of this heat, a fan is usually near the processor to keep it cool.

How a Computer Works:

Explain that wires carry information through the machine in the form of electricity. The two options that a computer uses with respect to this electrical information are "off" and "on."

When computers represent information using only two options, it's called "Binary."

Inside a computer, **EVERYTHING is numbers**—specifically, binary (base-2) numbers. As far as the computer is concerned, everything is just a bunch of binary numbers. Photos, your grandma's voice and face on Skype, all the movies you watch on Netflix—all these things are just binary numbers. The computer doesn't actually distinguish between these things in storing the data or performing computations on it in the CPU.

Software imposes our human interpretations on the data—it could interpret the exact same binary number as a high pitch sound in one case, as a shade of dark green in another, and in yet a third case as a letter of the alphabet. When people agree on what interpretation we want to impose on different collections of binary numbers, it gives them meaning in that context. We call these agreed-upon interpretations *encoding schemes* or just *encodings*. This activity explores an encoding scheme named **ASCII**, which is one common way of interpreting binary numbers as letters of the alphabet.

Pass out the ASCII Code for capital letters sheet to each girl at your table (**Handout 1: ASCII Code for Capital Letters**).

Explain that unlike base-10 numbers, which can have the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, binary (base-2) numbers can only have the digits 0 and 1 (we usually call the binary digits *bits*). On the handout, the white squares represent 1 and the black squares represent 0.

ASCII Code for Capital Letters:

Letter	Binary	Letter	Binary
A	01000011	N	01101101
B	01000010	O	01101100
C	01000011	P	01101100
D	01000100	Q	01101001
E	01000101	R	01101101
F	01000110	S	01101100
G	01000111	T	01101100
H	01001000	U	01101001
I	01001001	V	01101010
J	01001010	W	01101011
K	01001011	X	01101000
L	01001100	Y	01101001
M	01001101	Z	01101010

Using the ASCII Code, you can see that the word “CAT” would be spelled 01000011 (C) 01000001 (A) 01010100 (T). Tell them that ASCII is also able to encode lower-case letters, spaces, and some punctuation.

Do an exercise to help the students understand ASCII before starting the necklace.

1. Have two students work together. Have each of them choose a letter from the Binary Decoder key.
2. Have each student fill in the squares on the provided sheet to match the pattern of the squares next to the letter each of them selected (**Handout 2: Encoding/Decoding Exercise**).
3. Have each student use the decoder to determine which letter the other student filled in.
4. If the students get the concept, move on to making the necklace. If not, help the girls individually after letting the students that understand start making the necklace.

ASCII Necklace Instructions: (25 minutes)

Materials:

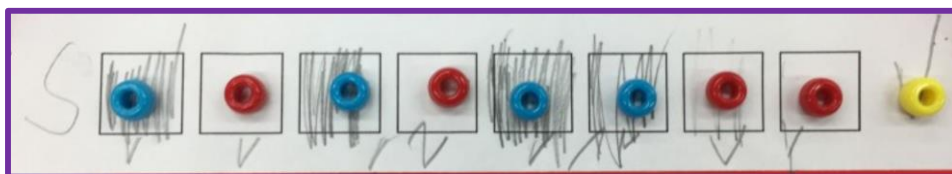
- Scissors
- Colored Pencils or Crayons
- Beads (3 colors including one for a spacer)
- String for the necklaces
- Clasps for the necklaces



Writing your Name or Initials:

The craft activity involves letting the students make a stylish necklace for themselves, where their names or initials are spelled out in binary using two different colored beads to represent the ASCII code.

First pass out the worksheets (**Handout 3**) and have the students color in squares to spell out their names. Have them pick any two color of beads. After the students have spelled out their names on paper, let them write out the letters with beads to make a necklace.



Explain that they can use different beads as a spacer to separate each letter in their name. In computer science, we call special separating markers like this *delimiters*. Many encodings use delimiters, especially if the size of each unit can vary. Of course, you don't actually need a delimiter to know when one character ends and another begins in ASCII (assuming you know the start of the whole message), because the size of each character doesn't vary—we can always rely on each character using exactly 8 bits.

(5 minutes) Wrap up:

Ask the girls what they learned and discuss answers.

Handout 1: ASCII Code for Capital Letters

Letter	Binary	Letter	Binary
A	01000001	N	01001110
B	01000010	O	01000111
C	01000011	P	01001011
D	01000100	Q	01001000
E	01000101	R	01001001
F	01000110	S	01001010
G	01000111	T	01001011
H	01001000	U	01001010
I	01001001	V	01001011
J	01001010	W	01001011
K	01001011	X	01001011
L	01001100	Y	01001011
M	01001101	Z	01001011

Handout 2 – Encoding/Decoding Exercise:

A	■□■ ■■□	N	■□■ ■□□■
B	■□■ ■■□■	O	■□■ □□□□
C	■□■ ■■□□	P	■□■ ■■■■
D	■□■ ■□■ ■	Q	■□■ ■■□□
E	■□■ ■□□□	R	■□■ ■■□■
F	■□■ ■□□■	S	■□■ ■■□□
G	■□■ ■□□□	T	■□■ ■□■ ■
H	■□■ □■■■	U	■□■ ■□■ □
I	■□■ □■■□	V	■□■ ■□□■
J	■□■ □■□■	W	■□■ ■□□□
K	■□■ □■□□	X	■□■ □■■■
L	■□■ □□■ ■	Y	■□■ □■□□
M	■□■ □□■ □	Z	■□■ □■□■

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Working in pairs, have each student select a letter and fill in the squares to match the pattern of the squares next to the letter each of them selected.

Have each student's partner use the decoder to determine which letter the other filled in.

Handout 3 – ASCII Necklace Worksheet:

Name Or Initials	ASCII Code
	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
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