Lesson 15: Binary Bracelets

40 minutes

Overview

This **exploratory** lesson introduces the concept of binary which is how computers today store all sorts of information.

Purpose

In this lesson students will learn how information is represented in a way such that a computer can interpret and store it. When learning binary, students will have the opportunity to write codes and share them with peers as secret messages. This can then be related back to how computers read a program, translate it to binary, use the information in some way, then reply back in a way humans can understand. For example, when we type a sentence into a document then press save, a computer translates the sentence into binary, stores the information, then posts a message indicating the document has been saved.

Standards

> Full Course Alignment

CSTA K-12 Computer Science Standards (2017)
> ▶ **AP** - Algorithms & Programming

Agenda

Warm Up (15 minutes)
> **Reflect**
> **Vocabulary**
> **Introduction**

Main Activity (20 minutes)
> **Binary Bracelets**
>
> **Optional Assessment (15 minutes)**

Wrap Up (5 minutes)
> **Reflection**

Extended Learning

Objectives

Students will be able to:

- Decode binary back to letters.
- Encode letters into binary.
- Relate the idea of storing letters on paper to the idea of storing information in a computer.

Preparation

- (Optional) Watch the ***Lesson in Action** video.
- Gather markers for the bracelets. Other decorations like beads and pipecleaners are optional.
- Print one ***worksheet** and one ***assessment** per student.
- (Optional) Write a short message on the board in binary.

Links

> **Heads Up!** Please make a copy of any documents you plan to share with students.

For the teachers

- **Binary Bracelets** - Lesson in Action Video
- **Binary Bracelets** - Assessment Answer Key ⬇ Make a Copy
- **CSF - Course C - Slides 2022-2023** - Slides (**Download**) ⬇ Make a Copy

For the students

- **Binary Bracelets** - Unplugged Video (**Download**)
- **Binary Bracelets** - Worksheet ⬇ Make a Copy

- **Binary Bracelets** - Assessment
  - ▾ Make a Copy
- **Bits Versus Bytes** - Student Video

Vocabulary

- **Binary** - A way of representing information using only two options.

Teaching Guide

Warm Up (15 minutes)

Reflect

▤ **Display**: Show "Reflect" slide

Reflect: *What is inside a computer?*

Vocabulary

▤ **Display**: Show "Vocabulary" slide

Say: *This lesson has one new and important word:*

- **Binary** - A way of representing information using only two options
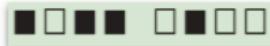
Introduction

Off and On

▤ **Display**: Show "Can you read this message" slide

Do This: If you've written a short message on the board in binary, call the students' attention to it and ask if anyone knows what it is or what it means.

Can you read this message?

Put the message aside and move on to prepping for the activity.

📧 **Display**: Show "What's in here?" slide

- You can start by asking the class if they have ever seen inside a computer.
  - What's in there?
  - This is a good place to actually show them the inside of a computer (or pictures of the inside of a computer).

📧 **Display**: Show "Off and On" slide

🎤 *Remarks*

- 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." Just like the lights in this room!
  - When computers represent information using only two options, it's called "Binary."
  - That theme of two options doesn't stop when the information gets to its destination.

🖥 **Display**: Show "Computer Storage" slide

🎤 *Remarks*

- Computers also store information using binary. Binary isn't always off and on:
  - Hard Disk Drives store information using magnetic positive and magnetic negative.
  - DVDs store information as either reflective or non-reflective.

🖥 **Display**: Show "Binary" slide

🎤 *Remarks*

How do you suppose we can convert real-life things that we want to store in a computer into binary?

🖥 **Display**: Show "Letters in Binary" slide

Say: Let's start with letters.

Do This:

- This is a good time to mention that each spot where you have a binary option is called a "binary digit" or "bit" for short.
- Ask if anyone knows what a grouping of eight bits is called (it's a byte.)
- Fun fact: A grouping of four bits is called a nibble.

🖥 **Display**: Show "Bits Versus Bytes" video

Do This: Watch the ***Bits Versus Bytes - Student Video** (~1 minute)

🖥 **Display**: Show "What Letter is This?" slide

Do This: Drag the blocks on the slide to make different letters.

- Go over a few examples of converting letters into binary, then back.
- Afterward, write an encoded letter and give the class a few seconds to figure out what it is.
- When the class can figure out that encoded letter on their own, you can move on to the activity.

Main Activity (20 minutes)

Binary Bracelets

(Unplugged Activity) **Binary Bracelets - Unplugged Activity**

Binary Bracelets - Worksheet

You do not need to cover the whole of binary, like counting and converting numbers back and forth from decimal. This lesson is intended to be a fun introduction to how computers store information, not a frustrating lesson in bases.

🖥 **Display**: Show "Binary Bracelets" slide

Directions:

- *Find the first letter of your first name on the activity sheet.*
- *Fill in the squares of a bracelet to match the pattern of the squares next to the letter that you selected.*

🖥 **Display**: Show next slide

- *Cut the bracelet out.*
- *Tape the bracelet around your wrist to wear it!*
- *Share your bracelet with your classmates to see if they can figure out your letter.*

Letter	Pattern		Letter	Pattern
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	■□■□ □■□■

🖥 **Display**: Show "Can you read this message now?" slide

After the activity, revisit the message that was on the board and see if your class can decypher it using what they've learned.

🔲 **Display**: Show "Answer" slide

Walk students through the steps needed to read the message.

Optional Assessment (15 minutes)

🔲 **Display**: Show "Assessment" slide

- Hand out the ***assessment** and allow students to complete it independently after the instructions have been well explained.
- This should feel familiar, thanks to the previous activities.

Wrap Up (5 minutes)

Reflection

Flash Chat: What did we learn?

🔲 **Display**: Show "Flash Chat" slide

- What else do you think is represented as binary inside of a computer?
- How else might you represent binary instead of boxes that are filled or not filled?
- What was your favorite part about that activity?

🔲 **Display**: Show "Reflect" slide

Reflect: *Use the activity worksheet to write out the rest of your name or your favorite word in binary.*

Extended Learning

Use these activities to enhance student learning. They can be used as outside of class activities or other enrichment.

Binary Images

- There are several great resources on the web for taking this activity to the next level.
- If your students are interested in how images (or even music) can be represented as binary, you can find more details in Thinkersmith's **Binary Baubles**.

If you are interested in licensing Code.org materials for commercial purposes **contact us**.