

(<http://csmatters.org/pd-new>) C - 01

0bC - 0b1

Bits, Binary, and Hex

Unit Concept Lessons

Revision Date: Aug 31, 2017

Duration: 90 50-minute sessions



Lesson Summary

Summary: Teachers will master Lesson 1-4: Bits, Binary, and Hex. They will understand binary and its relation to computers. They will understand converting decimal to binary. They will also understand different types of memory.

Outcomes:

Teachers will

- Understand binary and its relation to computers/computing
- Be introduced to the concept of abstraction
- Understand different types of memory
- Be introduced to logic gates
- Understand how to convert decimal to binary and vice versa

Overview: (Total: 60 min)

1. Getting Started Activity
2. Binary: Importance, Conversions
3. Flippy Do Worksheet
4. Decimal to Binary Activity

Learning Objectives

CSP Objectives

Big Idea - Professional development provides ongoing opportunities for teachers to examine a variety of classroom assessments, practice using them in their classrooms, and analyze the results to (1) understand and report on student mastery of Maryland content standards.

- ○ LO 1c - Professional development provides ongoing opportunities for teachers to examine a variety of classroom assessments, practice using them in their classrooms, and analyze the results to (1) understand and report on student mastery of Maryland content standards.

Big Idea - Professional development combines a variety of learning experiences, including, but not limited to, individual study, demonstrations, observation, practice, feedback, and reflection as well as opportunities for collaboration and problem solving among colleagues.

- ○ LO 9b - Professional development combines a variety of learning experiences, including, but not limited to, individual study, demonstrations, observation, practice, feedback, and reflection as well as opportunities for collaboration and problem solving among colleagues.

Big Idea - Professional development recognizes and draws on the knowledge, skills, and dispositions of successful teachers by including them as leaders, facilitators, and resources in professional learning opportunities.

- ○ LO 9e - Professional development recognizes and draws on the knowledge, skills, and dispositions of successful teachers by including them as leaders, facilitators, and resources in professional learning opportunities.

Key Concepts

1. Concept of different number systems - how they are the same and different
2. How place valued number systems work - exponents on the base indicates the value given to that place
3. How to do conversions binary to/from decimal
4. How to compare values of different bases

Teacher Resources

CL01_Bits and Binary Folder (<https://drive.google.com/open?id=0B5vAY-fhOT-ieWhaSmtKcmtmbUU>)

Binary Outline (https://drive.google.com/open?id=18iWW-BoUJrc3odKVsbL_TxaUtf9SVGm6lwAtV79EH-k)

Lesson Plan

TOTAL: 60 minutes

Getting Started Activity

Birthday Game - Pull out the colored card with your birthdate on it. Instructor goes around confirming when teachers were born based on the colors of the cards. The colors represent the places (Ex: green = 2^0 , blue = 2^1 ...).

Discussion: Why doesn't it work for decimal?

Binary: Importance, Conversions

Go over the importance of binary - why do we need to learn binary?

Key point: Everything inside of a computer is represented by a series of binary digits. 1 bit is equivalent to 1 binary digit.

It is important to talk about bits in the context of physical things - hardware. Abstraction introduced by demonstrating that bits can be represented in many different forms.

Specific things that are very important to represent with bits:

- numbers
- real numbers
- fractions
- songs
- images
- characters (ASCII)

Abstraction is a key concept here - crucial for modern computing

"Flip-flop"circuits introduction - circuits that remember the value of a specific bit by refreshing it constantly.

Go over transient vs. volatile memory

Introduction to logic gates - work in conjunction with flip flops to perform digital logic.

Two bits can be used in various operations: AND OR XOR NOR...

- Truth Tables!

Discussion of digits and significance - in particular, differences between decimal counting and binary counting making sure to tie it to what they already know - they know place values in decimal.

Go over conversion:

- Decimal to binary
 - inverted division method
 - Pro: fast, doable for other bases without having to know exponents
 - Subtraction method
 - Pro: students tend to be better at subtraction than division

Logic & Logic Gates

Reasoning in the computer is done through basic logic operations AND, OR, NOT, XOR, etc.

Each is clearly defined with AND, OR and XOR being binary operators and NOT being a unary operator

Define and show truth tables of each.

Flippy Do Worksheet

Flippy Do available at <https://curriculum.code.org/csp/unit1/5/>
(<https://curriculum.code.org/csp/unit1/5/>) and Flippydo (https://drive.google.com/open?id=0B_LG6mwDBugnQV9VVGtGTWgzSIU)

Flipping Cards (https://drive.google.com/open?id=0B_LG6mwDBugnSGwya2ISem5ld00)

Birthday Card Trick (https://drive.google.com/open?id=0B_LG6mwDBugnaHpvYVdUWlpFQW8)

Decimal to Binary Activity (Toe Touches)

Class split up into 6 groups, each group lines up. Need to represent a decimal number as a group in binary by raising hands if they are a 1, crouch down as a 0

Debrief: Doesn't always work, sometimes kids might fight

Alternative game (quieter): Cisco Binary Game available at
<https://studio.code.org/projects/applab/iukLbcDnzqgoxuu810unLw>
(<https://studio.code.org/projects/applab/iukLbcDnzqgoxuu810unLw>)

Extending to Octal and Hexadecimal

Why we use octal and hexadecimal - give a long string of binary digits and explain how hard it would be to take that number to decimal but also how hard it is for people to read in binary

Since Octal is 2^3 and Hexadecimal is 2^4 - these are easier conversions to/from binary

Show examples of where these other bases are used - IPB6 and colors (RGB)

Evidence of Learning

Formative Assessment

Playing the games: toe touches or on-line binary conversions



(<http://www.umbc.edu/>)



(<http://www.umd.edu/>)

(<http://www.nsf.gov/>)



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