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| **UNIT 2** |  |  |

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# Lesson Day 10-12: Binary

## Overview

This lesson introduces the binary number system and how to count in binary. Students willlearn how to convert between binary and decimal numbers in the context of topics that are important to computer science.

## Lesson Summary

## Objectives

**Students will be able to:**

* Count forward and backward in binary.
* Add and Subtract binary numbers
* Explain why binary numbers are important in computer science.
* Use binary digits to encode and decode messages.

## Materials and Prep

* Copy Paper
* Scissors
* Index cards with binary dot representation up to 32 (10 sets)

## Resources

**Student Documents**

* Binary index number card set for groups of 4 students
* Worksheet Activity: Sending Secret Messages (from CSUnplugged)
* Binary Number System Worksheet: More Practice

**Video**

* <http://csunplugged.org/binary-numbers/> (Parts 1, 2, 3)

**Assessments**

* Worksheet Activities

## Notes

* CS Content
* *Provide a brief overview the CS content covered in this lesson*

**Outline of the Lesson:**

**Student Activities:**

1. Journal Entry: How high can you count with your ten fingers?
2. Use the CS Unplugged Videos to introduce binary representation, counting in binary, and email representation.
3. Start with the introductory activity on p. 4 of the activity. (The activity can be downloaded from http://csunplugged.com ) It will be helpful to read through the entire activity in advance, so that you can revise questions, add your own questions, and think about how you might want to structure each part of the activity. The goal is for students to be actively involved in some way and for all students to be able to represent numbers and count in binary.
4. Have 5 students come to the front of the room and demonstrate as you follow the instructions and ask the questions. (Each student should receive a large card with one of the numbers of dots—1, 2, 4, 8, 16)
5. Use the CS Unplugged: Count the Dots activity to explain the binary number system and have the students practice counting forward and backward using index card sets.
6. Journal Entry: Complete the Sending Secret Messages activity on p. 8 of the CS Unplugged: Count the Dots activity. (Solution is on p. 13.)
7. Discussion of why binary numbers are important in computer science
8. Complete the Paper Binary Converter with students as an instructable. Have students complete worksheet attached on last page using the “Analog Converter” showing one from each section as an example.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2^7 | 2^6 | 2^5 | 2^4 | 2^3 | 2^2 | 2^1 | 2^0 |
| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

**Directions for Binary Analog Converter:**

1. Students need one piece of copy paper and a pair of scissors.
2. Have them fold the paper in thirds longwise, while still folded have them fold three times in half. The folding creates guidelines for labels and the cutting.
3. Label a zero in each box across the top.
4. Middle boxes will contain the powers
5. The last row will contain the decimal numbers as indicated in table below.
6. Next cut where indicated in between the zeros. Turn sheet over and label with ones on the backside of the zeros only.
7. When converting flip down the ones if “on” and leaving the zeros up if “off”.

NOTE: When converting from Decimal to Binary work Left to Right

When converting Binary to Decimal work Right to Left.

**BINARY NUMBER SYSTEM WORKSHEET: MORE PRACTICE**

1. Convert the following binary numbers to their decimal equivalents.

a) 1112

b) 11000012

c) 110002

d) 111102

e) 101102

f) 111012

g) 1101012

h) 10010112

i) 000102

j) 011102

k) 101112

l) 1000012

2. Convert the following decimal numbers to their binary equivalents.

a) 710

b) 1910

c) 5810

d) 12310

e) 19510

f) 10410

g) 9610

h) 20310

i) 4910

j) 9110

k) 102910

l) 298410