Math-and Reading in-CTE Lesson Plan

Lesson Title: Number Systems (Binary, Decimal, Hexadecimal)	Lesson # 1

Occupational Area: Computer Science
CTE Concept(s): Programming/Computer Science/CIS
Math Concepts: Number Systems

Lesson Objective:Students will understand the basis of number systems generally and how to convert between several number systems commonly used in CS	
Supplies Needed:None	
Link to Accompanying Materials:	

THE "7 ELEMENTS"	TEACHER NOTES (Answer keys)

1. Introduce the CTE lesson. How do numbers work? Is 10+10 ever equal to 100?	Yes! In binary 10+10 =100
2. Assess students' math awareness as it relates to the CTE lesson. Evaluate:	What are some examples of ways to count? Answers could include our traditional decimal system, counting on fingers, roman numerals, tally marks etc. What do all these systems have in common? They all use a combination of symbols to represent a number. How does the Decimal number system work? Symbols (0-9) and place value (From right to left, 1s,10s,100s, etc)
3. Work through the math example *embedded* in the CTE lesson. Break down decimal numbers explaining the symbols and place values.	A number in decimal is really just a number of numbers. The number 1 means we have 1 from our 1 place value. AKA there is 1. The number 22 really means we have 2 10 place values, and 2 one place values. 2*10 + 2*1 = 22. Show more examples until this sinks in. Very important to understand conceptually as this same system applies to all of the different "base" number systems. The base of our number system is 10. The base of any number system is the number of symbols used to represent values. 0-9 is 10 different symbols. The place values are defined (from right to left) as the base raised to a power. The right most place is 10^0, then 10^1, then 10^2 etc…Binary has base 2. This means

	we have 2 symbols available: 0-1 and the place values from right to left are 2^0, 2^1, 2^2 etc…
4. Work through *related, contextual* math-in-CTE examples. What is binary used for in computing? What is hex used for in computing?	Binary is the basis of all modern computing. Computers are built with logic circuits, taking positive and negative chargers converting to 1s and 0s. The underlying code that you write in any traditional coding language gets converted into 1s and 0s. Although you as a programmer do not frequently need to be able to work with binary, it is important to have an understanding of what it is. Also, hexadecimal is frequently used by programmers and web designers in the context of rgb colors. Understanding these number systems also helps to understand things like standard storage sizes of hard drives/ssds
5. Work through *traditional math* examples. Convert numbers from decimal to binary. Work in the other direction	NOTE: What is 3 in binary? 11 What is 15 in binary? 1111 What is 17 in binary? 10001 What is 37 in binary? 100101 What is 31 in Binary? 11111 What is 32 in binary? 100000 What is 110101 in Decimal?53 Come up with more problems for this After discussing this with the class, work through Hex (very well could take 2 days to cover this well.) Hexadecimal is base 16, so there are 16 symbols, 0-9 a-f (where a is the value 10, b is 11, etc…). The place values from right to left are 16^0, 16^1

	Hex is used in computing because two hex digits is equivalent to 8 binary digits, a binary digit is called a bit, and 8 of those are called a byte. Therefore it is easy to represent one of the base chunks of data in computing with hex digits. Practice hex to decimal and vice versa conversions.
6. Students demonstrate their understanding. Create a worksheet with several problems. Also, introduce a different base that hasn't been discussed (such as base 8 or base 3). Have students convert numbers to one of these bases without any instruction (the same patterns apply here as well) How many binary digits are required to represent the decimal number 255? Hex? How do you figure out the largest number you can make with a certain number of digits in any base?	8 2 If you have 2 digits available in decimal, the largest number you can make is: 99. With binary: 11 (3 in decimal). The math for these calculations is simple and applies to any base: (base^number of places) - 1 10^2 = 100 100 - 1 = 99 2^2 = 4

	4 - 1 = 3
How do you make the largest number possible with any base?	Just use the largest symbol with as many place values as you have. In binary the largest symbol is 1, so all 1s is the largest number you can make with any number of place values. In decimal, all 9s, in hex all f's
Reading: Read the article: https://www.howtogeek.com/367621/what-is-binary-and-why-do-computers-use-it/	In your own words, why do computers use binary? Is it possible for computers to use a base other than binary? Have there ever been computers that used a different base, if so what base did they use? What is boolean logic?

Further Resources

Flippy Do : https://studio.code.org/projects/applab/z6iQr137KHDvkIaz5UNCviWLVkkRnhyteDqWhWBJ56o
Number systems: https://www.perkinselearning.org/activity/tips-and-strategies-teaching-number-system-standa

rds#:~:text=A%20number%20system%20is%20a,in%20whole%20numbers%20and%20som
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