LEARNING MODULES

GK-12 DISSECT at New Mexico State University

Title: Info Graphics

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Discipline or Area: Binary Code

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School: Arrowhead Park Early College High School

Subject of class: Chemistry

Grade: 9th

COVERAGE OF COMPUTATIONAL TOPICS

Students are introduced to the logic behind computer circuits and how they function. Participants will learn the basics of bits and bytes of data and how a computer uses a sequence of 1 and 0s to produce the content that we experience on our personal computers. Audience members will learn how to calculate different binary values and how they are translated into more familiar formats. Additionally, they will grasp how a simple, yet elegant algorithm can produce a vast number of solutions or scenarios. They will create their own algorithms or numbering systems and contrast their efficiency.

OBJECTIVES

Students will understand the logic behind computers and how they function. They will learn how to calculate different values using binary code. Additionally, through their creativity they will explore the fundamental CT concepts of efficiency and algorithms.

EQUIPMENT AND MATERIALS

Powerpoint presentation
Paper
Pencil

BACKGROUND AND REFERENCES

The binary system was created in the mid-17th century as a product of philosophizing the nature of reality. The system became extremely useful during the development of computers as their simple, yet powerful format was congruent with early transistors. Because computer circuits are basically circuits of on and off switches, binary code is very useful in the transformation of mathematics into vernacular language. By relying upon 0 and 1s, circuits are able to produce a startling number of combinations. These combinations have been defined by the American Standard Code for Information Interchange (ASCII) to represent specific alphanumeric values. Consequently, an understanding of their function is essential for an appreciation of the logic behind modern computers.

PROCEDURE

Provide detailed instructions on how this module is taught.

This module can be taught in a single classroom. The presenter begins by showing students various numbering systems used throughout history. Students are then asked to compare and contrast the systems. Questions can be asked regarding their efficiency and ease of use. Subsequently, participants are asked to design their own systems and explain how they chose their structure. An introduction into the history and function of binary code is given and an explanation of how modern computers rely upon this system is provided. An activity whereupon students number their fingers 1 2 4 8 16 (each number on a different finger). Students witness how different summations can arise from different fingers being "held". It is then explained that when a finger is "held" that place value has a 1. Students receive the following explanation:

You have 1 in binary, so you add one to it (2 = 01 + 1) and normally you would get 2 = 2. However, binary does not have a 2, so, instead you (2= 01 + 1), (1 + 1 in binary = 2). However, since binary does not have a two, it is the equivalent of reaching 10 (9 +1 = 10 in the decimal system) and you move into the Tens Spot (10). This means you move 1 into the tens spot for binary (carry over 2 to the 10 spot) where it becomes a 1. Therefore you have 10.

Also, students are shown how they can convert numbers using modifications of the following:

1	0	1	1	1	0	0	1
X	X	X	X	X	X	X	X
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
=	=	=	=	=	=	=	=
128	**0**	**32**	**16**	**8**	**0**	**0**	**1**

Add together

185

Following this, an explanation of ASCII is provided and students are tasked with solving a binary riddle.

What were the "learning goals?"

Students should understand the history and format of binary code, how to calculate various values using the system, and appreciation how a limited number of values can produce a vast array of different combinations and values. Also, Students learn the difference between bits and bytes of information

How did you introduce CT?
CT is introduced by explaining the mechanisms of modern computers and how they ultimately rely upon binary code. This code's efficiency is emphasized and an algorithm for determining different values is established with the students.

How could you assess the understanding of CT in this module?
Students develop their own numbering system and compare/contrast their system with those of other students and the binary code. Also, at the end of the lecture, students are given a fun riddle to quiz their comprehension.

NOTES AND OBSERVATIONS

What were challenges you encountered in the overall development of the module?
For some of the students, understanding binary code was challenging. Because it is unusual from a daily use standpoint, it is unfamiliar and can appear strange.

What was successful?
Student participation makes this module successful. By having students design their own numbering system their participation is encouraged. Also, the tangible manipulation of fingers to represent the system is a fun, interactive format.

How was the students' reception to the content of the module?
Depending on the student's level of comprehension, the module was either intriguing or dull. The student's level of comprehension depends in large part upon the clarity of the presenter. With experience delivering this lecture, the reception of this topic improves.