AP CSP Python with CodeX **Binary Numbers Applications Activity Guide**	**Name:**

Warm Up What do you remember about binary numbers?

Answers will vary

Activity #1 REVIEW: Get a flippy-do. Use it to convert a binary to decimal, and a decimal to binary.

Binary	Decimal	Decimal	Binary
0000 0011	3	6	0000 0110
0001 0001	17	16	0001 0000
0010 1101	45	35	0010 0011
0110 0010	98	110	0110 1110
1001 1011	155	141	1000 1101

Activity #2 Binary numbers applications. Use your knowledge of binary to answer the application questions.

1. There are 30 students in your class. You want CodeBot to display the number of students in class on a particular day, using LEDs and binary. How many LEDs are required to display up to 30 students?
5 bits (goes up to 31)

2. An online store uses 6-bit binary sequences to identify each unique item for sale. The store plans to increase the number of items it sells and is considering using 7-bit sequences instead of 6-bit sequences. Which of the following best describes the result of using 7-bit sequences instead of 6-bit sequences?
   a. 2 more items can be uniquely identified.
   b. 10 more items can be uniquely identified.
   c. 2 times as many items can be uniquely identified.
   d. 10 times as many items can be uniquely identified.

3. A certain programming language uses 4-bit binary sequences to represent non-negative integers. For example, the binary sequence 0101 represents the decimal value 5. Using this programming language, a programmer attempts to add the decimal values of 14 and 15 and assign the sum to the variable total. Which of the following best describes the result of this operation?
   a. The correct sum of 29 will be assigned to the variable total.
   b. An overflow error will occur because 4 bits is not large enough to represent either 14 or 15.
   c. An overflow error will occur because 4 bits is not large enough to represent the sum 29.
   d. A round-off error will occur because 14 and 15 are represented as approximations due to the fixed number of bits used to represent numbers.

4. Which of the following are true about the data that can be represented using binary sequences?
   I. Binary sequences can be used to represent strings of characters.
   II. Binary sequences can be used to represent colors.
   III. Binary sequences can be used to represent audio recordings.
   a. I only
   b. I and II only
   c. II and III only
   d. I, II and III

5. ASCII is a character-encoding scheme that uses 7 bits to represent each character. The decimal (base 10) values 65 through 90 represent the capital letters A through Z, as shown in the table below.

Decimal	ASCII Character		Decimal	ASCII Character
65	A		78	N
66	B		79	O
67	C		80	P
68	D		81	Q
69	E		82	R
70	F		83	S
71	G		84	T
72	H		85	U
73	I		86	V
74	J		87	W
75	K		88	X
76	L		89	Y
77	M		90	Z

What ASCII character is represented by the binary (base 2) number 1001011?

Answer: K

6. The player controls in a particular video game are represented by numbers. The controls and their corresponding binary values are shown in the following table.

Control	Binary Value
←	01000
↑	01001
→	01011
↓	01111
Jump	11000
Run	11001
Pause	11011
Reset	11111

The numeric values for the controls can also be represented in decimal (base 10). What control is represented by the decimal value 27?

Answer: Pause

7. A store uses binary numbers to assign a unique binary sequence to each item in its inventory. What is the minimum number of bits required for each binary sequence if the store has between 50 and 60 items in its inventory?

Answer: 6 bits (max value is 63)

8. A color in a computing application is represented by an RGB triplet that describes the amount of red, green and blue, respectively, used to create the desired color. A selection of colors and their corresponding RGB triplets are shown in the following table. Each value is represented in decimal.

Color Name	RGB Triplet
indigo	(75, 0, 130)
ivory	(255, 255, 240)
light pink	(255, 182, 193)
light yellow	(255, 255, 224)
magenta	(255, 0, 255)
neutral gray	(127, 127, 112)
pale yellow	(255, 255, 160)
vivid yellow	(255, 255, 14)

What is the binary RGB triplet for the color neutral gray?

Answer: (0111 1111, 0111 1111, 0111 0000)

9. The position of a runner in a race is a type of analog data. The runner's position is tracked using sensors. Which of the following best describes how the position of the runner is represented digitally?
   a. The position of the runner is determined by calculating the time difference between the start and the end of the race and making an estimation based on the runner's average speed.
   b. The position of the runner is measured and rounded to either 0 or 1 depending on whether the runner is closer to the starting line or closer to the finish line.
   c. The position of the runner is predicted using a model based on performance data captured from previous races.
   d. The position of the runner is sampled at regular intervals to approximate the real-world position, and a sequence of bits is used to represent each sample.

10. A binary number is to be transformed by appending two 0s to the end of the number. For example, 11101 is transformed to 1110100. Which of the following correctly describes the relationship between the transformed number and the original number?
    a. The transformed number is 2 times the value of the original number.
    b. The transformed number is 4 times the value of the original number.
    c. The transformed number is 8 times the value of the original number.
    d. The transformed number is 100 times the value of the original number.