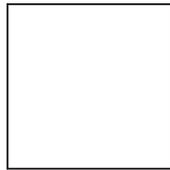


## Use "Cookie Coding" to make binary codes

When you created your 4-bit patterns, you may have noticed that it was easy to miss or duplicate the patterns accidentally. To prevent this from happening, practice generating your patterns of binary code using cookies, bits of cereal, or snack crackers. The rules of Cookie Coding will help you generate binary code in the same orderly way that computer engineers generate binary code for computer systems.

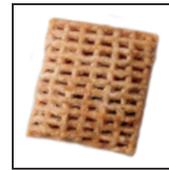
To start off ...

Let's say that a blank space equals 0.



=0

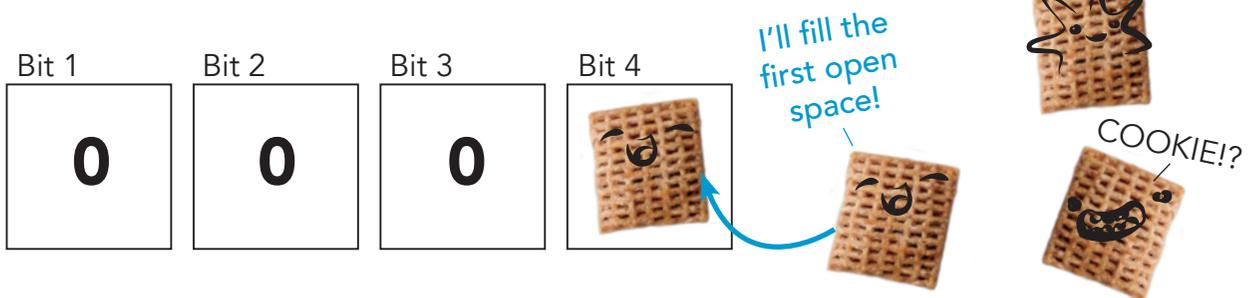
Let's say that space with cereal equals 1.



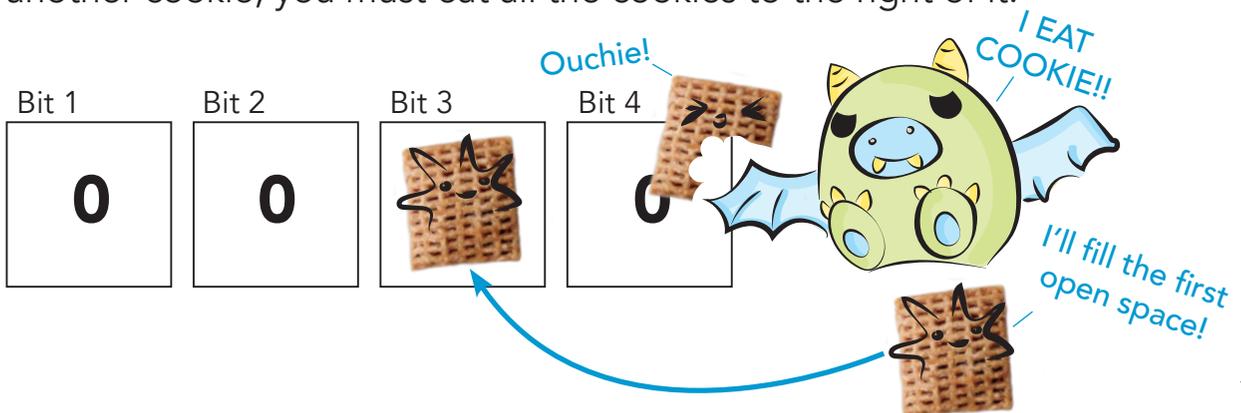
=1

## The steps for Cookie Coding

**Cookie Coding Rule 1:** Always fill the first open space to the right with a cookie bit.



**Cookie Coding Rule 2:** When you place a cookie to the left of another cookie, you must eat all the cookies to the right of it.



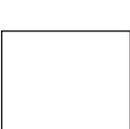
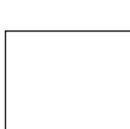
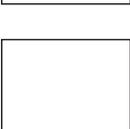
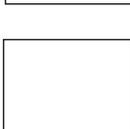
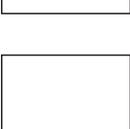
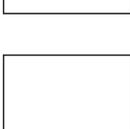
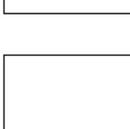
# Let's make all 16 patterns with 4 bits

Now look at how all 16 patterns are made with binary code. Notice how the cookies are placed using the two rules of Cookie Coding.

Pattern 1					1. Start with no cookie bits. This is Pattern 1.
Pattern 2					2. Fill the first open space to the right.
Pattern 3					3. Fill the first open space to the right and eat all the cookie bits behind it.
Pattern 4					4. Fill the first open space to the right.
Pattern 5					5. Fill the first open space to the right and eat all the cookie bits behind it.
Pattern 6					6. Fill the first open space to the right.
Pattern 7					Do you see what's happening?
Pattern 8					
Pattern 9					

## Now you try it!

Use the two rules of Cookie Coding to make patterns 9 through 16. Try doing it yourself first with out peeking at the answers. If you are stuck, look to the answers for help.

Pattern 10				
Pattern 11				
Pattern 12				
Pattern 13				
Pattern 14				
Pattern 15				
Pattern 16				

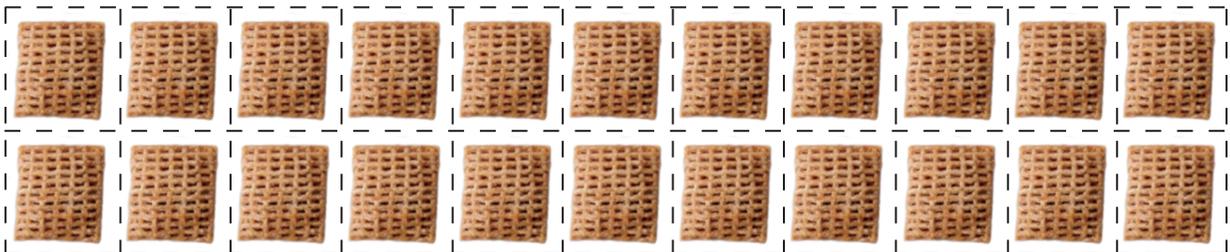
Hint: Start with pattern 9 and fill the first open space to the right.

Hint: Start with pattern 10 and fill the first open space to the right, then eat all the cookies behind it.

Now you are on your own. Have fun!

Cut and lift the flaps to check your answers.

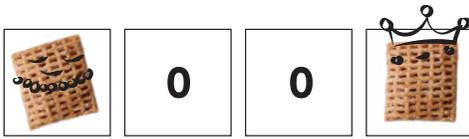
Use these 4 squares with your snacks to practice making patterns with Cookie Coding.



Arrange these cookie bits and glue them in place to make your binary patterns.

# Learn to read binary numbers

Now that you know how to generate binary patterns, you can learn to read them too. These patterns represent number values in computers.



0 0



0



0



0 0



0

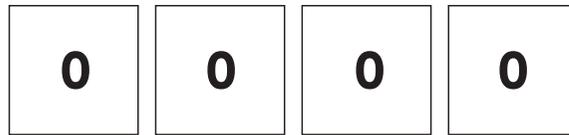


0



Computer operating systems store numbers as binary codes using a simple method in which values making up the pattern are added together to calculate the number that the pattern represents. Each of the four spaces in the pattern represent a numeric value—1, 2, 4, or 8.

+8 +4 +2 +1



Each space's potential numeric value is shown here in brown.

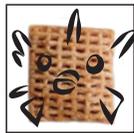
If one of the spaces of the pattern has a cookie bit in it, that space's value is added to the pattern's calculation.

Since there are no cookie bits in this pattern, you would calculate this pattern's value as 0.

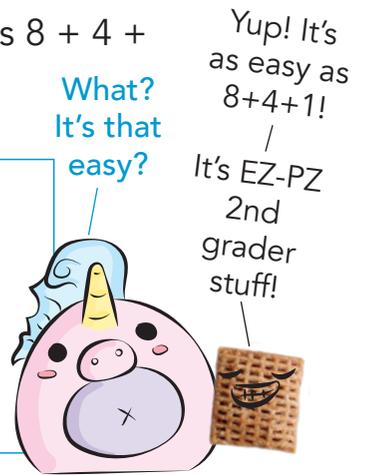
$$0 + 0 + 0 + 0 = 0$$

Take a look at pattern 15, for example. It has a cookie bit in the first, second and fourth spots. Since each cookie bit represents a 1, this cookie pattern represents "1101" in binary code. The number that this pattern represents can be calculated as  $8 + 4 + 1$ . So, the number is 13. "1101" is 13 in binary code!

Example:

	<b>+8</b>	<b>+4</b>	<b>+2</b>	<b>+1</b>
Pattern 15			<b>0</b>	
	<b>8</b>	<b>4</b>	<b>0</b>	<b>1</b>

**8 + 4 + 0 + 1 = 13**



Calculate the numbers that these patterns represent. Show your calculations.

0 0 0 0	_____
0 0 0 	_____
0 0  0	_____
0 0  	_____
0  0 0	_____
0  0 	_____
0   0	_____
0   	_____

 0 0 0	_____
 0 0 	_____
 0  0	_____
 0  	_____
  0 0	_____
  0 	_____
   0	_____
   	_____

<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
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Use your snacks to practice making Cookie Coding patterns here.

## Unlock the treasure chest

You can use the binary number patterns you made to unlock the STEMTaught treasure chest. Follow the instructions to scramble the combination and then use your binary coding skills to unlock the treasure chest. When it is unlocked you can re-scramble the secret treasure combination and try again. You can access this treasure chest on the STEMTaught website or on the next page of this article.

### What you will need:

A pair of scissors

### What you will do (paper play - opposite page):

**Step 1:** Prepare to play. Find a partner to play the game with you. Cut on the dotted lines on the opposite page.

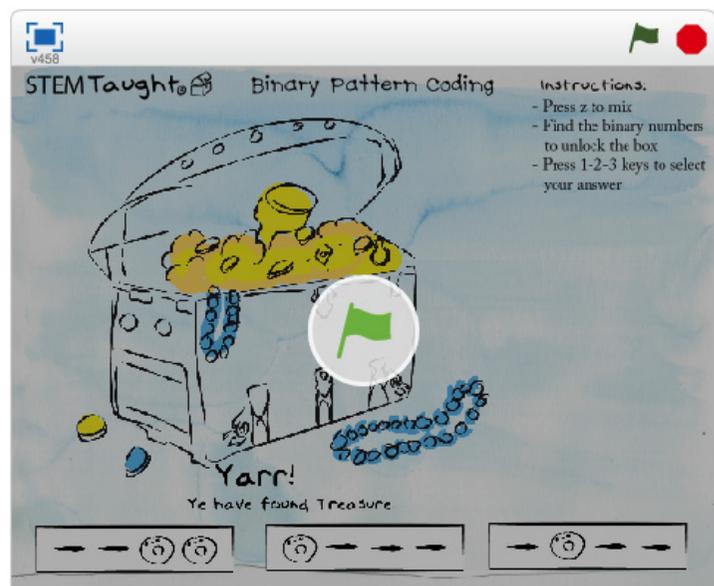
**Step 2:** Create a random binary pattern for your partner by flipping down the "Flip-bit" flaps.

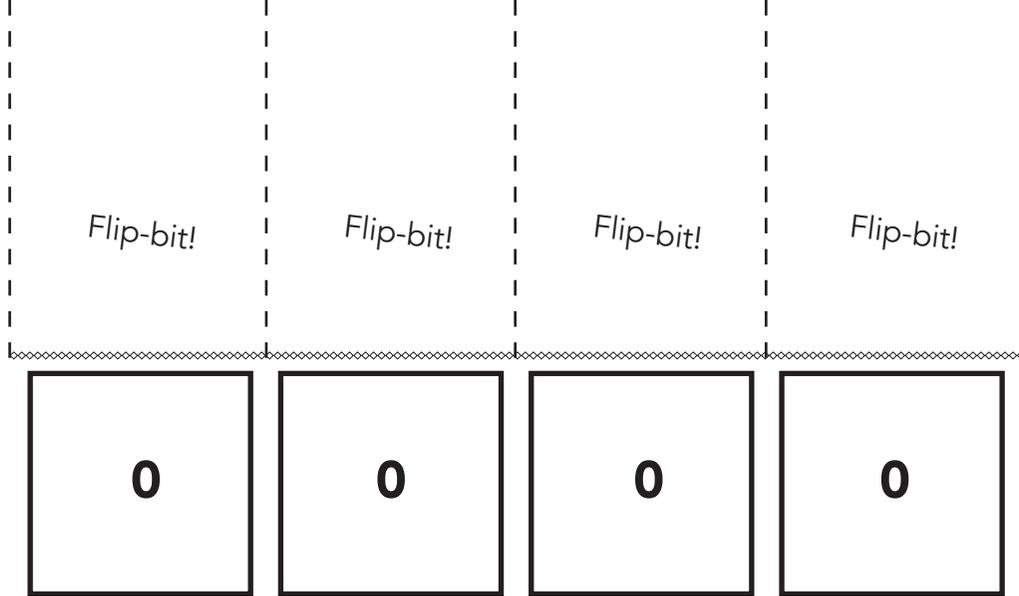
**Step 3:** Have your partner guess the number that your pattern represents.

**Step 4:** If they get the answer right, flip the treasure flap over to reveal the treasure inside! Hooray! You can read binary codes!

**Step 5:** Switch roles and play again.

You can access a Scratch programming electronic treasure chest game on the STEMTaught website to test your skills against a triple combination automatic binary code scrambler. Have your teacher pull it up or access the treasure chest from your home by searching STEMTaught at the scratch website (<https://scratch.mit.edu/>).





### Create a random binary pattern

Create a random binary pattern for your partner by flipping down the flaps.

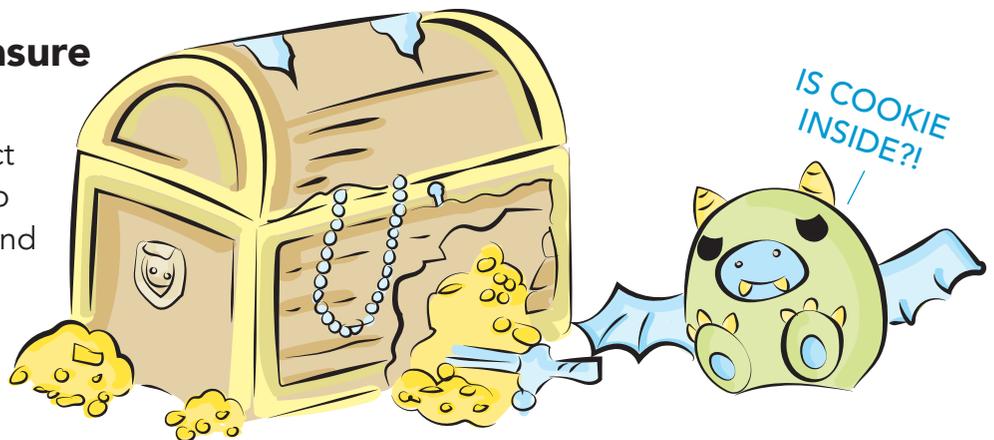
### Unlock the treasure by pointing to the correct number

Point to the pattern's numeric value to unlock the treasure.

0, 1, 2, 3, 4, 5, 6, 7, 8,  
9, 10, 11, 12, 13, 14, 15

### Open the treasure

If your partner identifies the correct number, flip the flap to open the chest and reveal the treasure.



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