

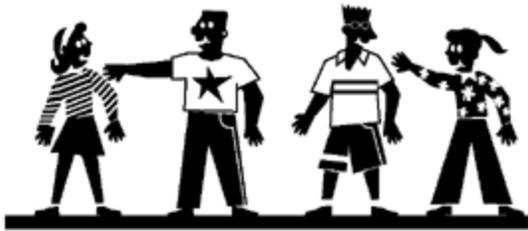
The Journey InsideSM: Digital Information Student Handout: Binary Counter

Binary Counter

Computers use binary codes to store and process information. The binary system uses only two symbols. People usually use 0 and 1 as the two binary symbols. Because binary codes can be used to represent numbers, letters, pictures, and sounds, the computer can work with a wide variety of information.

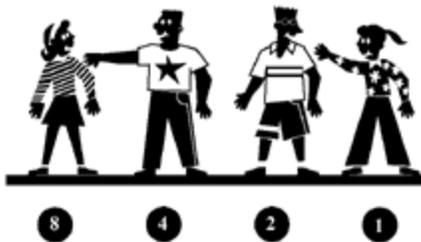
You are used to counting in the decimal or base 10 system with 1, 2, 3, 4, 5, and so on. You could also count using binary numbers with 1_2 , 10_2 , 11_2 , 100_2 , 101_2 , 110_2 , etc. The subscript—the small 2 that appears slightly below the line—indicates it is a binary number. There are many more place holders needed in the binary system to indicate value and, no matter how much you practice, it still takes longer to actually say the numbers if they are in binary form.

In this activity you and several of your classmates will construct a human binary counter. As the count is increased by a value of 1, the binary counter changes to display a visual representation of each number in binary format. The people in the counter will represent the 0s and 1s needed to display the decimal number you will hear. The following diagram shows the binary counter displaying the decimal number 5 in binary representation.



A raised right arm represents a 1. An arm down at the side represents a 0. The diagram is displaying a five as the binary number 0101_2 . The binary number is interpreted or read from the right. The person on the extreme right of the diagram is in the 1's position, the next person from the right is in the 2's position, the third person from the right is in the 4's position, the next person is in the 8's position, and so on.

In this way, the four people are representing 0101_2 .



Activities

1. Select four members of your group to be in the binary counter. Select one other member of your group to be the count monitor. The other members of your group are checkers.
2. The people who are in the binary counter form a line in front of the group. Each person should be able to touch the shoulder of the person to his right with his fingertips. As viewed by the group, the person on the extreme right is in the 1's position.
3. The count monitor gives input to the binary counter by touching the person in the 1's place on the shoulder and verbally indicating the new number. The count monitor must also keep track of the count.
4. The binary counter works as follows:
5. The binary counter is set to zero by having all of its members put their arms at their sides.
6. Each time members of the binary counter are touched, they must complete some particular action.
7. If their arm is held up and out when they are touched they must tap the person to their right on the shoulder and lower their own arm.



8. If their arm is already down when they are touched, then they raise their arm without touching the person to the right.



9. The count monitor counts out loud when tapping the first person in the counter on the shoulder. The count monitor needs to give the checkers time to check the work of the binary counter.

10. The checkers check each number that appears on the binary counter using the following table:

$1 = 1_2$	$5 = 101_2$	$9 = 1001_2$	$13 = 1101_2$
$2 = 10_2$	$6 = 110_2$	$10 = 1010_2$	$14 = 1110_2$
$3 = 11_2$	$7 = 111_2$	$11 = 1011_2$	$15 = 1111_2$
$4 = 100_2$	$8 = 1000_2$	$12 = 1100_2$	$16 = 1\ 0000_2$