

### 3.A Secret Codes

First we will use functions to create codes. Later we will use functions to break codes. Assign a number to each letter of the alphabet. A is 1, B is 2, and so on.

A	1	H	8	O	15	V	22
B	2	I	9	P	16	W	23
C	3	J	10	Q	17	X	24
D	4	K	11	R	18	Y	25
E	5	L	12	S	19	Z	26
F	6	M	13	T	20		
G	7	N	14	U	21		

**Definition:** The text of a message, before it is encoded, is called the *plaintext*.

The easiest code works by replacing each letter by one that follows it at a certain distance in the alphabet. For example, A (letter 1) is replaced with H (letter 8), B (2) is replaced with I (9), and so on. The function used in this example is  $y = 7 + x$ , where  $x$  is the number of the plaintext letter, and  $y$  is the number of the coded letter.

If the number of the coded letter is greater than 26, subtract 26 from it. For example, V's number is 22,  $22 + 7 = 29$ ,  $29 - 26 = 3$ , so the code letter for V is C.

- Copy and complete this table to show the  $y = 7 + x$  code.

Plaintext	Code
A	H
B	I
C	...

- Use  $y = 7 + x$  to encode the words *smile*, *juggle*, *dance*, *puzzl*.
- Choose a number,  $b$ , and use  $y = b + x$  to encode a message for a classmate. (Let classmate know the value of  $b$  so he or she will be able to decode the message quickly.)
- Decode the following message, which has been encoded with  $y = 10 + x$ .  
DRSC COXDOXMO ECOC RKVP DRO VODDOBC SX DRO KVZRKLOD.
- Find the function that would decode the message in problem 4. Check your answer by actually using it on DRSC, and make sure it gives the expected plaintext.
- Use the function  $y = 27 - x$  to encode these names:  
*Bernard*, *Carol*, *Ellen*, *Pet*
  - Describe in words the code obtained from this function.
- Encode your name with  $y = 30 - x$ .
  - Now take the answer to (a) and encode it with  $y = 30 - x$  again.
  - Comment on the result in (b).
- Encode the word *bilingual* with  $y = 8 - x$  and then with  $y = x - 8$ . Do you get the same answer? Explain.
  - Find a decoding function for each function in part (a).
- Report** In this lesson you learned about three kinds of coding functions. Some look like  $y = 7 + x$ , and others look like  $y = 8 - x$ . Write a report on how to decode messages coded by each kind of function and also on functions like  $y = x - 8$ . Give examples using other numbers for each of the three kinds of functions. Mention any special numbers. (For example, what happens when  $y = x + 26$ ?)