IT'S A SECRET

(60 MINUTES)

AT A GLANCE

Students will use patterns to help decode messages.

OBJECTIVES

- Students will use patterns to successfully decode a message.
- Students will communicate strategies and outcomes from an activity.

KEY VOCABULARY

ALGORITHM: A set of steps that are followed in order to solve a mathematical problem or to complete a computer process.

CHRONOLOGICAL: Arranged in the order that things happened or came to be.

CRYPTANALYST: Someone that decodes information from encrypted sources.

CYPHER: A way of changing a message to keep it secret.

DECRYPTION: Changing coded information back into a plain text message.

ENCRYPTION: Taking plain text information and coding it into a secret language.

NEXT GENERATION SCIENCE STANDARDS

SCIENCE AND ENGINEERING PRACTICES:
- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations and designing solutions
- Obtaining, evaluating and communicating information

CROSSCUTTING CONCEPTS:
- Patterns

DISCIPLINARY CORE IDEAS:
- ETS1: Engineering Design

ADVANCE PREPARATION

Use a set of index cards to create coded messages. Number each card and put a code letter on it. Examples on the next page.

CODED MESSAGE

Z 1	L 2	3	A 4	N 5	Z 6	R 7
V 1	F 2	3	F 4	N 5	E 6	N 7

DECODED MESSAGE

| M 1	Y 2	3	N 4	A 5	M 6	E 7
I 1	S 2	3	S 4	A 5	R 6	A 7

MATERIALS PER GROUP

Pencils
Paper

Index cards
Completed ROT13 index card sets

Decoding chart
Bag

WHAT YOU NEED TO KNOW

Cyphers (codes) have been used for centuries in order to protect information. And for centuries people have worked at breaking those codes using a variety of different methods. Most of those methods were rooted in seeing patterns within codes and analyzing them based on the frequency of letters found in any given language. Whether using machines to break the complicated algorithms (step-by-step solutions to completing a pattern series) behind some codes or relying on informants or stolen materials, the art of encryption (disguising information through codes) and decryption (cracking those codes) has been important throughout history. Most of these code breakers, or cryptanalysts, have to understand the language the code is written in incredibly well to crack it. You have to be able to see the patterns and frequency of the letters that are used in a message.
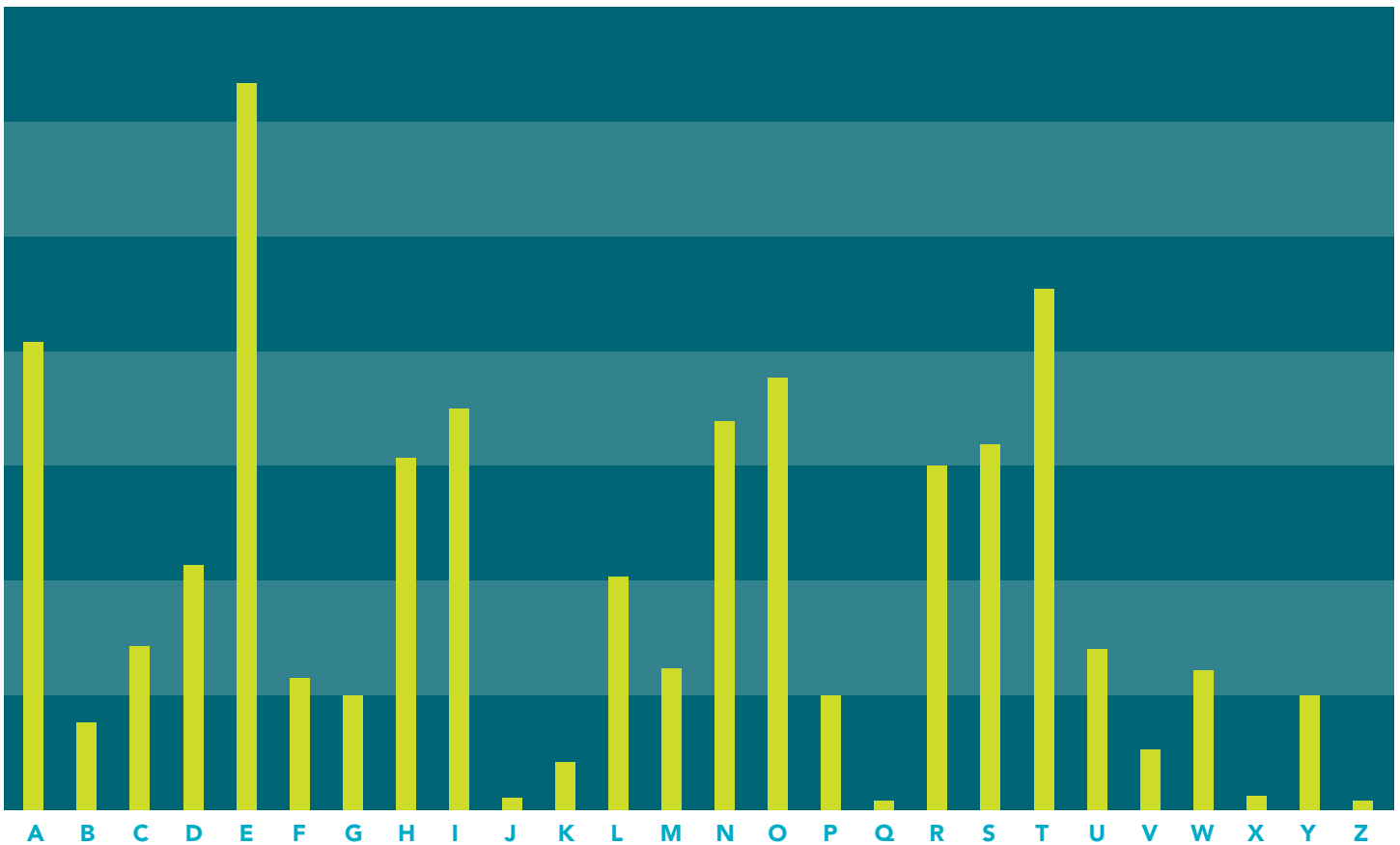
AVERAGE FREQUENCY OF LETTERS IN ENGLISH LANGUAGE
PHOTO CREDIT: HOW STUFF WORKS, 2007

Students will be using a form of coding called a ROT13 cypher for this activity. This cypher involves replacing the letters of the alphabet with the letter 13 characters away from it. See the grid on the next page for more information.

13

A	B	C	D	E	F	G	H	I	J	K	L	M

ROT 13

N	O	P	Q	R	S	T	U	V	W	X	Y	Z

H	O	L	A
U	B	Y	N

WARM UP

1. Students will be creating their own codes to communicate with one another. Ask them to think about when codes might be used and different codes they've used in their lives. Why would people want to use codes?

2. Ask the students if they can think of different types of secret codes. Encourage examples like pig latin (moving the first letter of a word, placing it at the end of the word and adding "–ay" to it, i.e. hello becomes

"ello-hay"), Morse code (a series of percussive taps that stand for letters) or a pigpen cypher (a group of graphics that replace different letters of the alphabet) by directing questions about where and how codes are used.

3. Discuss the fact that codes use patterns and the key is to determine what type of pattern is being used.

ACTIVITY

1. Give each group a bag containing index cards that have numbers and letters on them. Each number is the order of the card in a sentence. The letter represents another letter in the alphabet according to the ROT13/Caesar Cypher used to encrypt the message.

2. Ask the students to explore the cards in their bag.

3. Ask the students what they see on the cards and what those items might mean. Guide them to think about the numbers/order of the cards.

4. Once the students recognize the order, have them order the cards chronologically.

5. Provide the decrypted text on poster paper and ask the students to think about what the code might be. Encourage them to consider the number placement in the alphabet as part of the pattern or to write out the alphabet and write the "decoded" letters down in order.

6. If they cannot immediately find the pattern, ask them to substitute the letters in the decrypted passage into their passages. Can they make guesses at what the statement might be saying?

7. Steer the conversation toward codes you could make up. Explain to students that they will need to create a code and encourage students to walk around during this time in order to foster a large amount of ideas. Have students share their codes with each other.

CHECK FOR UNDERSTANDING

Have students answer the following questions in their teams or as a whole group discussion.

- What type of pattern did your code use?
- Who are some people that might use codes in their jobs?

WHAT'S HAPPENING?

This is a type of shifted coded message. These messages rely on moving the letters of the alphabet a specific number of places and then using the alternate letters to write a message.

DIFFERENTIATED INSTRUCTION

- Give students the same message using different types of code. Have them compare the patterns and how the same message can be written in different types of code.
- Provide students with a code key showing each letter and its substitution.

EXTENSIONS

- Explore computer code. Ask students if they're ever noticed the message that pops up after shutting a computer down incorrectly. It looks like gibberish but is actually the encrypted message that allows the computer to run certain programs. For each program or app that you run, someone had to write that code for the electronic device to work when you push the button. That person is a computer programmer. Computer programmers create the "code" that allows this work to happen. If you are interested in learning this "language," explore www.code.org.

- Have students research and share different times that coded messages have been used throughout history.

ROT 13

13

A	↔	N
B	↔	O
C	↔	P
D	↔	Q
E	↔	R
F	↔	S
G	↔	T
H	↔	U
I	↔	V
J	↔	W
K	↔	X
L	↔	Y
M	↔	Z

H	↔	U
O	↔	B
L	↔	Y
A	↔	N