

Cool Careers in Cyber Security

Frequency Chart and Cipher

Cryptography

Delivery: Can be used as a table demo (hands-on) activity or during a presentation session. Best to have the wheels pre-made. Messaging can be modified to align with event.

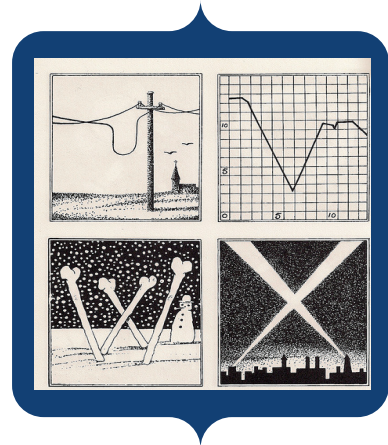
Session Overview:
Cryptography

Objectives:

- Students will become aware of code systems and the art of cryptanalysis.
- Students will be able to encode and decode messages using simple shift ciphers.
- Understand that math can simplify processes and make encoding messages more efficient.

Materials/Supplies:

- Encrypted messages to decode as ice breakers (on cards)
- Cipher wheel
- Frequency table
- Scenario message to decode



Introduction:

Types of Encryption

- *Substitution*
 - Replacing each letter with a different letter or symbol (a=@, b=J, c=2 so that "a cat" = "@ 2@J")
- *Transposition*
 - Rearranging the order of letters of the words of a message. (example: "the letters in each word get moved around = eth tseelr ni ceah drow etg veodm uarndo")
- *Mathematical*
 - Uses advanced formulas to encrypt text
- *Computer or Mechanically Assisted*
 - Using complex algorithms and any single or combination of the mathematical, transposition, substitution and steganography to encrypt plain text.

Scenario:

Can you break the code?

Lesson:

1. Start by asking what cryptography is. Discuss as needed. See notes above. When would encryption be important?
2. Have students look at the first message (see below—message will be on cards). Ask them to solve the encryption. Ask how they think this message was encrypted? (Answer: *substitution*)

CRYPTOGRAPHY IS THE ART OF PROTECTING INFORMATION BY TRANSFORMING IT (ENCRYPTING IT) INTO AN UNREADABLE FORMAT CALLED CIPHER TEXT. ONLY THOSE WHO POSSESS A SECRET KEY CAN DECIPHER (OR DECRYPT) THE MESSAGE INTO PLAIN TEXT.

Can you solve this encryption?

20-15-4-1-25 25-15-21 23-9-12-12
12-5-1-18-14 1-2-15-21-20 3-15-4-5-19

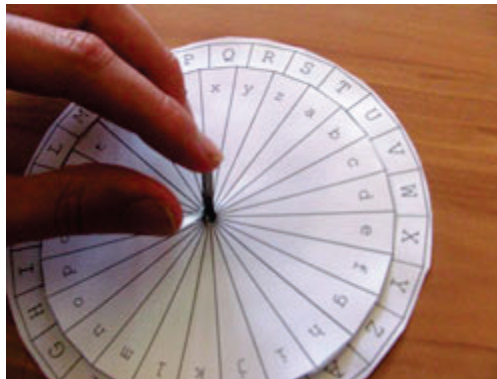
Answer: 1=A, 2=B... Today you will learn about codes.

3. Have students explore the frequency table handout and answer the questions as a group. [next page]
4. Discuss the *shift cipher*. It gets its name from the way we encrypt our message. Simply put, we 'shift' the letter A for example, some number of spaces to the right, and start the alphabet from there, wrapping around when we get to Z. The way in which the shifted alphabet lines up with the un-shifted alphabet is the cipher. For example, a three shift looks like: [Can show below which will be available on a card, as well as, show the Cipher wheel. There should be one for each student]

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

For the photo below, the shift is 7 [Plaintext A is = Ciphertext H].

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



Plaintext outer circle
Ciphertext inner circle

HANDOUT: FREQUENCY CHART

Letter ↕	Relative frequency in the English language ↕
a	8.167%
b	1.492%
c	2.782%
d	4.253%
e	12.702%
f	2.228%
g	2.015%
h	6.094%
i	6.966%
j	0.153%
k	0.772%
l	4.025%
m	2.406%
n	6.749%
o	7.507%
p	1.929%
q	0.095%
r	5.987%
s	6.327%
t	9.056%
u	2.758%
v	0.978%
w	2.360%
x	0.150%
y	1.974%
z	0.074%

Letter ↕	Relative frequency as the first letter of an English word ↕
a	11.602%
b	4.702%
c	3.511%
d	2.670%
e	2.007%
f	3.779%
g	1.950%
h	7.232%
i	6.286%
j	0.597%
k	0.590%
l	2.705%
m	4.374%
n	2.365%
o	6.264%
p	2.545%
q	0.173%
r	1.653%
s	7.755%
t	16.671%
u	1.487%
v	0.649%
w	6.753%
x	0.037%
y	1.620%
z	0.034%

Thinking about Letters....

Which letters do we use most frequently in English?

Which letters do we use less frequently in English?

How could you use this information to decrypt cipher text?

5. Using the frequency table and the cipher wheel, have the students decrypt the message.

The following message was found on the thief's computer.
But what does it mean?

zvybo pbzrofqv fp x dobxq cfbia

Answer: using the frequency table the letter "e" occurs most often. In the message the letter B occurs the most; let b = e

R -3	T -2	S -2	I - 3	Y -2
A -2	U -1	C -2	B -1	E -4
	L -1	F -1	D -1	G -1

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

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

cyber security is a great field
zvybo pbzrofqv fp x dobxq cfbia

Resources:

- Black Chamber http://www.simonsingh.net/The_Black_Chamber/caesar.html
- Krypto kids www.nsa.gov/kids

Final Thoughts:

Points you might want to make:

- Encryption is important in everyday use of computers and the internet. It helps us keep our user names and passwords private, keeps others from viewing messages and is important in online transactions.
- When you connect to a site via https, it uses SSL or Secure Sockets Layer to encrypt the connection between your computer and the website.

Recommendations:

Prepare the cipher wheels ahead of time
Have messages on small notecards

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