Before we begin…

- Please mute your microphone
- Please introduce yourself in the chat by sharing your NAME and SCHOOL
- Please submit your questions via the Google Form shared in the chat
- This presentation, along with the questions and answers, will be posted on the WESO website

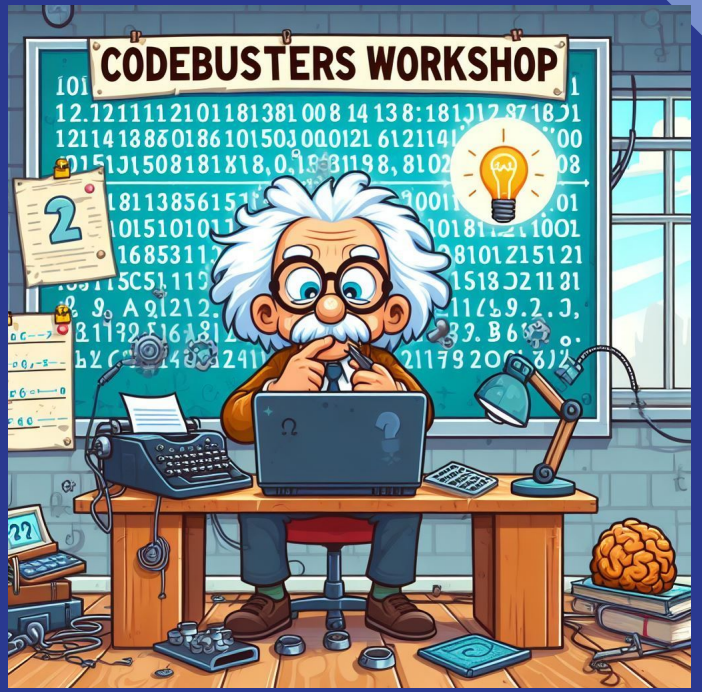
Codebusters

WESO 2026

Event Supervisors:

Jonathan Spencer

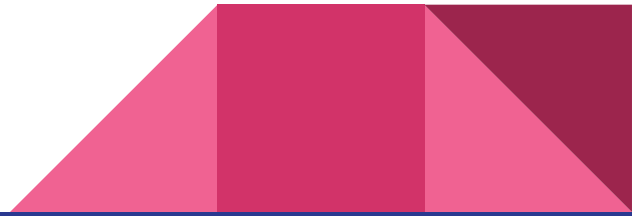
Monica Sieh



Event Overview

Teams will be tested on their ability to decode encrypted messages using historical and modern ciphers, including the Atbash, Caesar, Aristocrat, Vigenère, Tap Code, DancingMen, and PigPen ciphers.

Participants will be given a test packet with the encrypted messages and two reference sheets. They are free to work together to solve the puzzles or they can split up the exam and work on them individually. The questions can be solved in any order.



Event Format

Grade: 4 and 5

Team Size: 1-2 Participants (per grade)

Duration: 30 minutes

Type of Codes Used

Atbash Cipher - The alphabet reversed.

The **Caesar Cipher**, also called a shift cipher, with a shift of no more than 3 characters in either direction. (e.g. ‘a’ can map to x, y, z, b, c, or d).

Mono-alphabetic substitution **Aristocrats** - messages with spaces/word breaks included - with or without a hint.

The **Vigenère** Cipher - Decrypting ciphertext given a key.

The **Tap Code** Cipher - Decrypting ciphertext encoded by a pair of numbers indicating a coordinate in a standard 5x5 table (not provided with the test) with c and k sharing the same cell.

The **DancingMen** Cipher - Decrypting ciphertext encoded by DancingMen symbols based on the Sherlock Holmes story “The Adventure of the Dancing Men.”

The **PigPen** Cipher - Decrypting ciphertext with no mapping table provided.

Scoring

1. Highest score wins.
2. Based on difficulty, each question will be worth a clearly indicated number of points.
3. For all solved ciphers, the final points will be determined based on the number of errors found.
    a. Each spelling error or missed character counts as one error.
    b. Two or fewer errors will result in full credit.
    c. Each additional error results in a penalty of 50 points.
    d. The penalty will not exceed the value of the question. For example, a question worth 200 points with four errors is worth 100 points, whereas the same 200 point question with seven errors would be worth 0 points, not -50.
    e. The scores for each question will be added to determine the exam score.
    f. Tie breakers: For teams that are tied, select questions predetermined by the event supervisor (not shared with the teams), will be used to break the tie using the following criteria in order: score, degree of correctness (number of correct letters), and attempted.

Scoring

Tiebreaker examples:

School A and School B have the same final score of 700 on the exam. The event supervisor predetermined that question 4, 7, and 10 would be tiebreaker questions.

Scenario 1: A and B both answered 4 correctly for full points - the event supervisor will go to tiebreaker question 7.

Scenario 2: A answered the question 4 correctly, B had errors in their answer - the tiebreaker would go go Team A.

Scenario 3: A didn't attempt question 4, B solved the first word - the tiebreaker would go to Team B.

Scenario 4: Neither A nor B attempted question 4 - the event supervisor will go to tiebreaker question 7.

Materials

No materials will be distributed by WESO in advance of the competition day.

All materials needed for the competition will be provided by WESO at the Olympiad. This will include:

- 2 Copies of the reference sheet
- Pencils
- Scrap paper

No calculators, phones, watches, rulers, pens, books, notes or other similar items are allowed.

Coaching Advice

Toebes Science Olympiad Codebusters Website

(https://toebes.com/codebusters/)

Bookmark this website!!!!

It contains just about everything you'll need to coach this event including:

a. Guides for how to use each cipher.
b. Practice tests from previous years.
c. A test generating tool to create your own tests to give your kids.
d. The WESO exam will be generated through this tool, so the students should get used to the format.

Coaching Advice

Introduce a new cipher each practice and work through a few examples. Then create some sample ciphers using the Toebes tool to let your students practice.

Repeat the cipher you taught in the previous practice as the first cipher the students try the next practice so they don't forget how to do them.

Have them practice both as teammates and individually to allow them to identify their strengths and weaknesses with each cipher.

Practice in timed conditions! The biggest problem students have in Codebusters is spending too much time on a difficult cipher. They need to know when it makes sense to abandon a difficult cipher they can't solve so they can try to answer other ciphers and get some points.

Coaching Advice (continued)

Make at least an attempt to answer all of the ciphers. Sometimes the difference between two tests that are tied is which team attempted the tiebreaker question. If your team didn't try, they may not win the tiebreaker.

Divide and conquer! The students do not have to work together on the exam. They can take the exam apart and each work on different ciphers.

The exam will be long and will contain more ciphers than the teams can answer in the allotted time. This will allow the teams to focus on the ciphers they are comfortable with and still gain points for their final score.

Additional Resources

Science Olympiad Codebusters (https://toebes.com/codebusters/)

Codebuster YouTube Channel (https://www.youtube.com/@Codebusters-sciol) - contains videos for how to use the Toebes Tool.

CryptoClub (https://www.cryptoclub.org/) - Online decrypting games.

Puzzle Baron's Cryptograms (https://cryptograms.puzzlebaron.com/) - Online decrypting games.

The Ciphers

Atbash

An alphabet-based cipher originally used to encrypt the Hebrew Alphabet. It is easily adapted to other alphabets as it is simply all the letters reversed. This is a simple cipher for students to encode or decode. One interesting property of this cipher is that encoding text twice produces the original text.

Example:

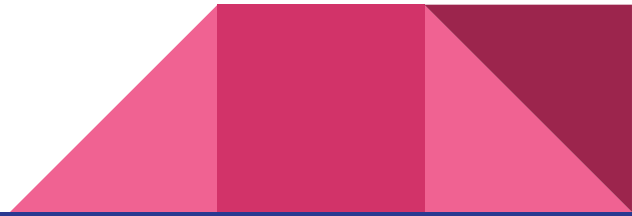
Zgyzhs decrypted would be Atbash!

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

Caesar

One of the earliest known and simplest ciphers. Originally attributed to Caesar for his private correspondence, it is a type of substitution cipher in which each letter in the plaintext is replaced by a letter some fixed number of positions down the alphabet.

For example, when encrypting with a left shift of 3, D would be replaced by A, E would become B, and so on. To decrypt, use a right shift of 3!



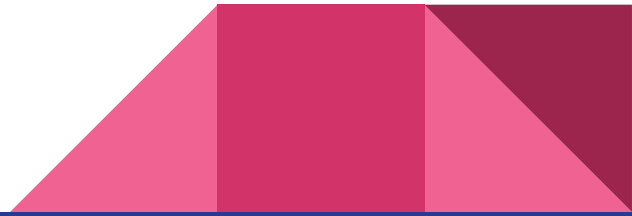
Caesar Example

This word was encrypted with an offset of +2.

UVWFGPV

Shift -2 characters to the left to decrypt!

U - 2 = S
V - 2 = T
W - 2 = U
F - 2 = D
G - 2 = E
P - 2 = N
V - 2 = T



Aristocrat

Most commonly seen in newspapers as Cryptoquotes or Cryptograms, an Aristocrat is the standard substitution cipher with the restriction that no letter maps to itself. This mapping of the alphabet is random.

These can be solved by:

- Letter Frequencies (E, A, T appear more often than X, Q, Z).
- Letter Patterns (single letter words like I or A, conjunctions like WON’T, etc.).
- Hints!

Aristocrat Example

3) **[188 points]** The following quote by Lailah Gifty Akita has been encoded as an Aristocrat. You are told that the word YOUR appears in it twice.

XCUO QACPW JEG NEZG POB YECAW.

CPS QGOWW REBCGSW CKTMOLMPY RTO

YECAW BMRT CAA NEZG WRGOPYRT.

	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
Frequency	5	3	8		6		6			1	1	1	3	2	6	5	2	5	2	4	1		7	1	4	2
Replacement																										

Aristocrat Example

3) **[188 points]** The following quote by Lailah Gifty Akita has been encoded as an Aristocrat. You are told that the word YOUR appears in it twice.

XCUO QACPW JEG NEZG POB YECAW.
OR YOUR O

CPS QGOWW REBCGSW CKTMOLMPY RTO
R O R

YECAW BMRT CAA NEZG WRGOPYRT.
O YOUR R

	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
Frequency	5	3	8		6		6			1	1	1	3	2	6	5	2	5	2	4	1		7	1	4	2
Replacement					O		R							Y												U

Aristocrat Example

3) **[188 points]** The following quote by Lailah Gifty Akita has been encoded as an Aristocrat. You are told that the word YOUR appears in it twice

XCUO QACPW JEG NEZG POB YECAW.
MAKE PLANS FOR YOUR NEW GOALS.

CPS QGOWW REBCGSW CKTMOLMPY RTO
AND PRESS TOWARDS ACHIEVING THE

YECAW BMRT CAA NEZG WRGOPYRT.
GOALS WITH ALL YOUR STRENGTH.

	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
Frequency	5	3	8		6		6			1	1	1	3	2	6	5	2	5	2	4	1		7	1	4	2
Replacement	L	W	A	Z	O	Q	R	J	B	F	C	V	I	Y	E	N	P	T	D	H	K	X	S	M	G	U

Vigenère

The Vigenère cipher is basically a collection of Caesar ciphers based on the letters of a repeated keyword. It was invented in 1553 and resisted all attempts to break it until 1863.

There are three parts to a Vigenère cipher:

Encrypted letter, Keyword letter, and Decrypted letter (your answer).

Vigenère Table

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

Vigenère Example

Keyword = WORK

Encrypted Message =

W RZKICEN

Set up your solution like this:

W		O	R	K	W	O	R	K
W		R	Z	K	I	C	E	N

Vigenère Table

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

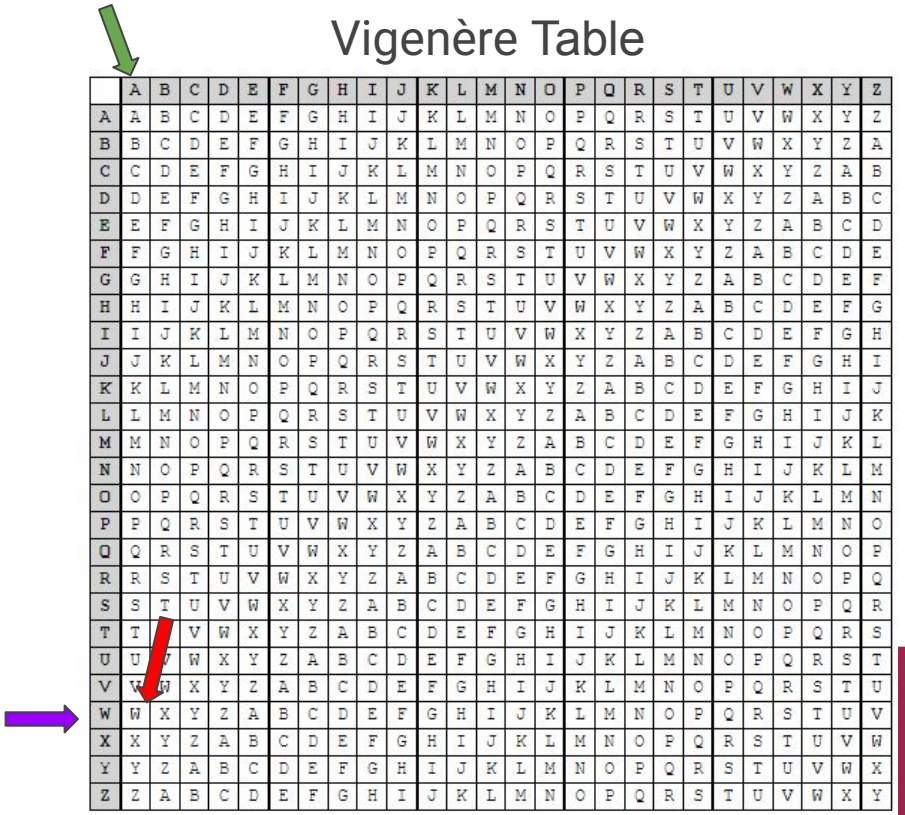
Vigenère

Find the keyword letter in the gray column on the left.

Travel along that row until you find the encrypted letter.

Then travel up from that spot to the top row to find the decrypted letter.

W		O	R	K	W	O	R	K
W		R	Z	K	I	C	E	N
A		D	I	A	M	O	N	D



Vigenère Example

5) **[99 points]** A quote attributed to Henry Kissinger has been encoded as Vigenère cipher using e keyword of WORK. What did they say?

W	O	R	K	W	O	R	K	W	O	R	K	W	O	R	K	W	O	R
R	Z	K	I	C	E	N	E	G	D	O	N	S	C	I	W	Z	L	W	L	C	W
A	D	I	A	M	O	N	D	I	S	M	E	R	E	L	Y	A	L	U	M	P	O	F

K	W	O	R	K	W	O	R	K	W	O	R	K	W	O	R	K	W	O	R
M	K	O	C	D	D	O	K	N	E	R	N	O	H	Z	L	X	Z	S	I
C	O	A	L	T	H	A	T	D	I	D	W	E	L	L	U	N	D	E	R

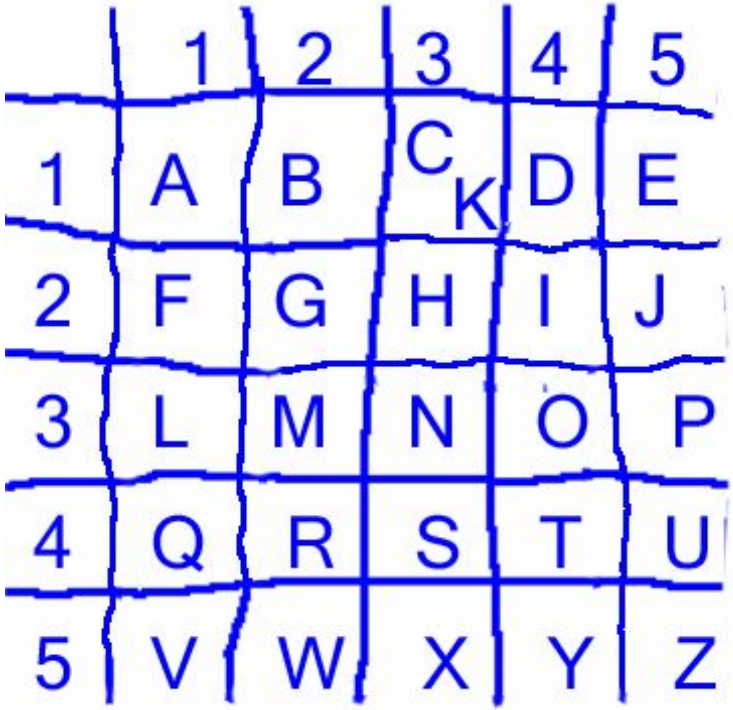
K	W	O	R	K	W	O	R	.
Z	N	S	J	C	Q	F	V	.
P	R	E	S	S	U	R	E	.

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

Tap Code

Also known as a knock code, the Tap Code Cipher was commonly used by prisoners of war in order to communicate with one another using pairs of up to 5 knocks to select a character from a 5x5 alphabet block (both C and K share the same spot).

Olympians must draw their own lookup table!



Tap Code Example

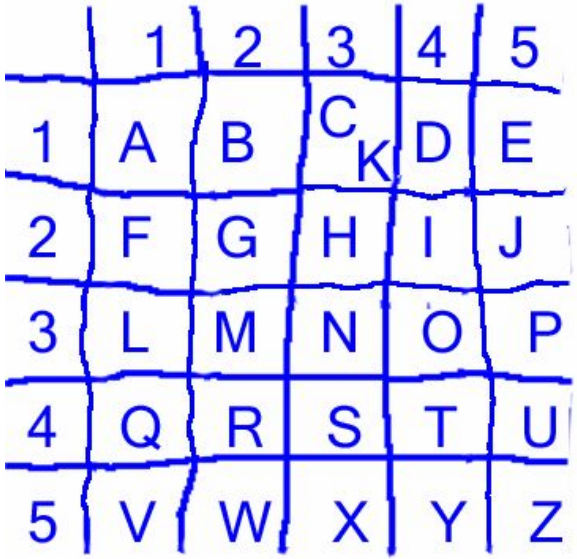
*** * ** **** * ** **** ** * * **** **

***** ****

The first letter is 3 dots followed by 1 dot.

Find the number 3 in your left column and the number 1 is the top row.

They meet at the letter “L”, so the first letter of the decrypted message is “L”!



Tap Code Example

4) **[51 points]** The following quote by Herbert Samuel has been encoded using the Tap Code Cipher. What did they say?

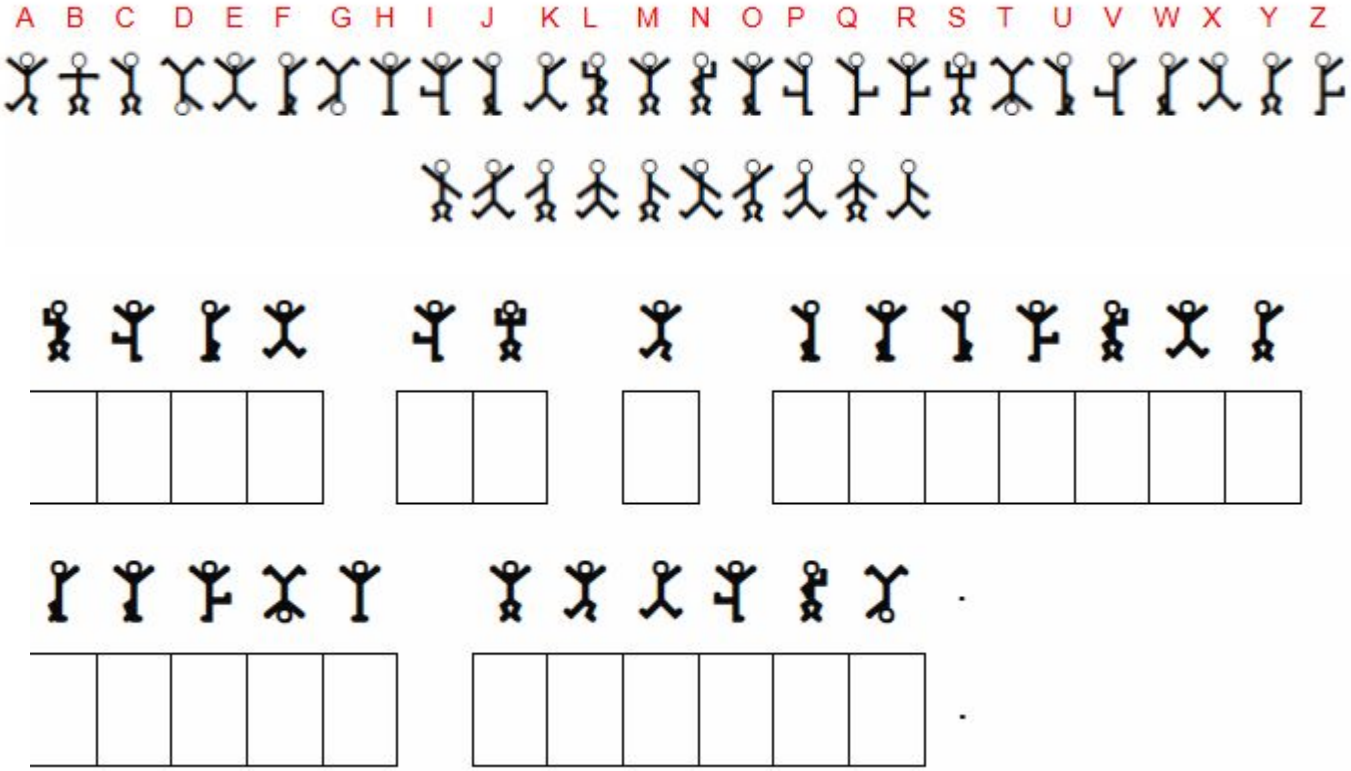
```
• •  ••• • •• •••• • •• •••• •• • • •••• •• ••••• ••••
A    L     I       B    R       A    R       Y

•• •••• •••• •••
I       S

•••• •••• •• ••• ••• •••• •••• ••••• •• •• •• ••• •••• ••••
T         H      O        U          G     H      T

•• •••• ••• •••  • ••• ••• •••• ••• • • ••••
I       N       C     O       L     D

•••• ••• •••• •••• ••• •••• •••• •• • • •• •• • ••••• .
S        T         O        R       A   G     E       .
```

	1	2	3	4	5
1	A	B	C K	D	E
2	F	G	H	I	J
3	L	M	N	O	P
4	Q	R	S	T	U
5	V	W	X	Y	Z

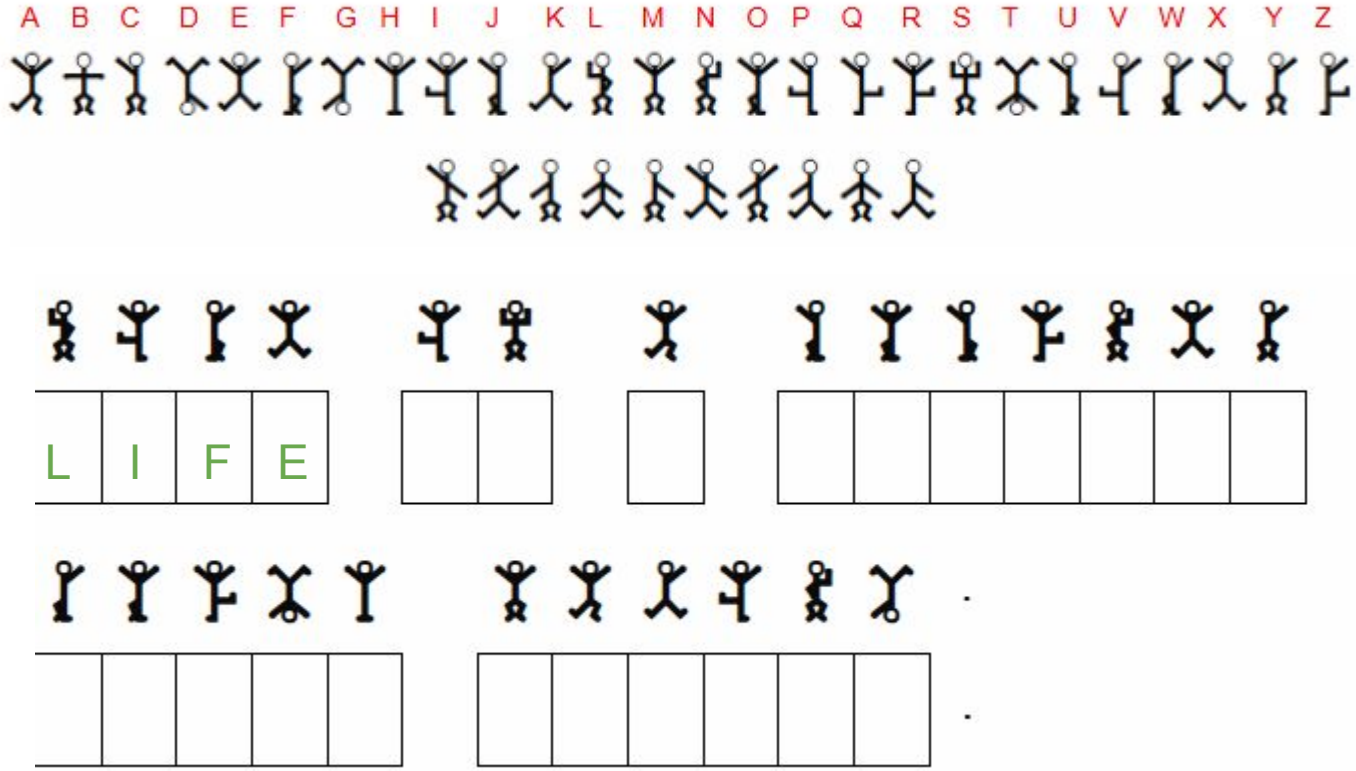
Dancing Man

A symbol-based cipher associated with a Sherlock Holmes book – The Adventure of the Dancing Men written by Sir Arthur Conan Doyle. If a student memorizes the symbols, this can be easily sight-read. We include an unlabeled set of the symbols in the reference guide of the test. Each symbol corresponds to the letters A-Z and the digits 0-9. Students can hand write the letters of the alphabet and the numbers above the symbols if that makes it easier for them.

Dancing Man Example



Dancing Man Example

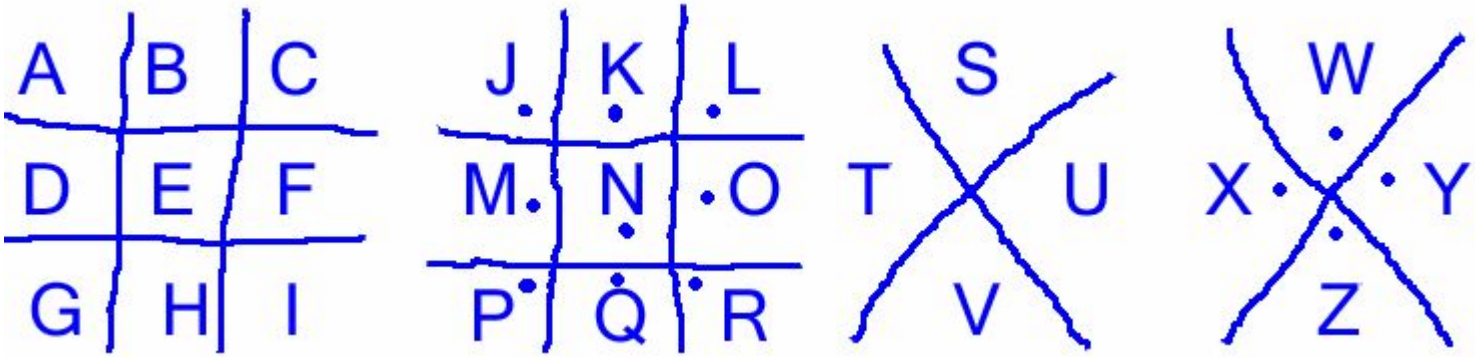


PigPen

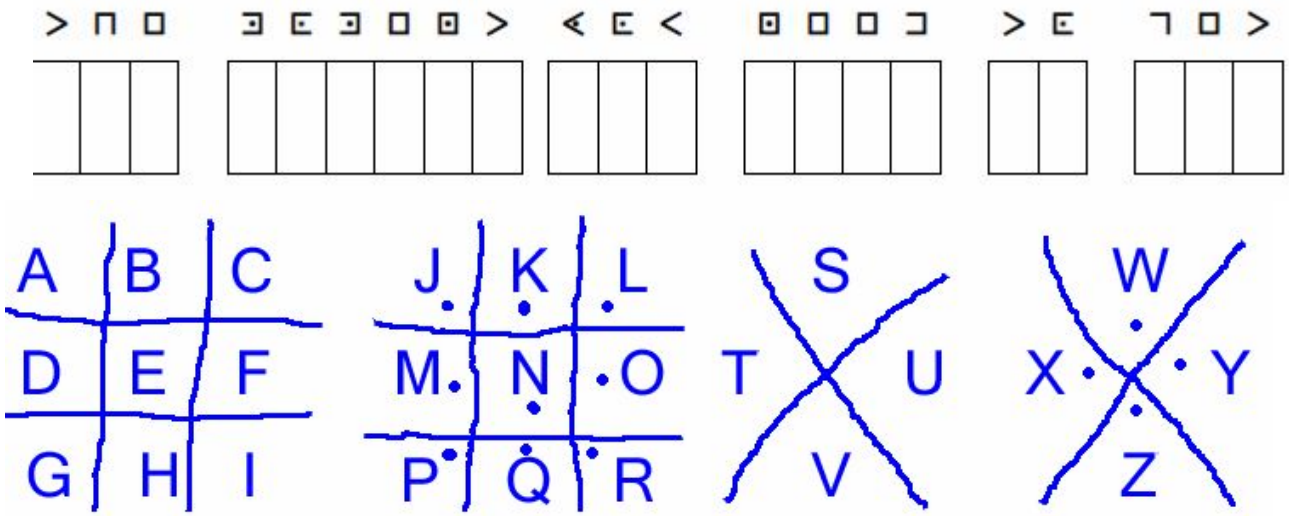
The Pigpen Cipher, also known as the Masonic Cipher, is a simple geometric substitution cipher that replaces letters with symbols made from fragments of tic-tac-toe grids and 'X' shapes, with dots indicating specific letters within those shapes, making it easy to write and decode for fun or basic concealment, famously used by Freemasons and Civil War prisoners.

PigPen

The students will draw four tables - two tic-tac-toe boards and two big X's. Then fill in the tables with the letters of the alphabet and dots on the second tic-tac-toe and X table like this:



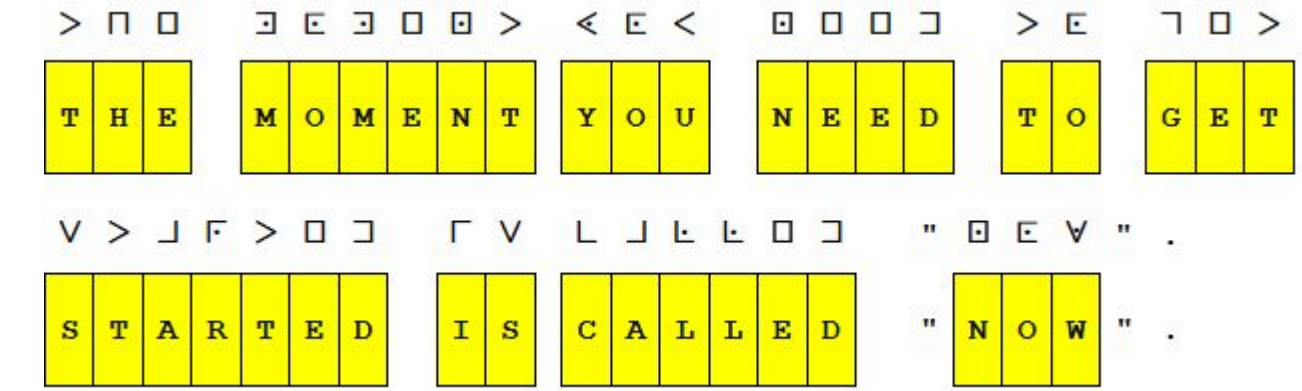
Pig Pen Example:

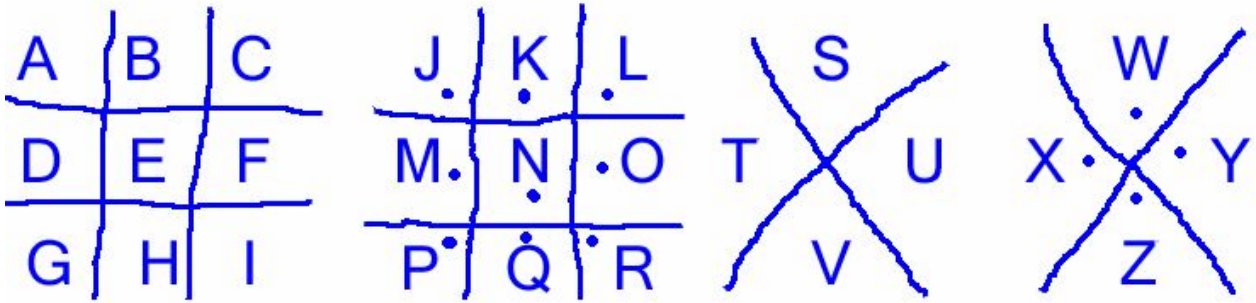


The first shape is a > symbol which matches the letter T in the lookup table.

The second shape looks like an upside down U which matches the letter H in the lookup table.

Pig Pen Example:





Questions after tonight?

WESO Discord Server

- **Every WESO event will have its own channel**
- **Join the WESO server to submit your questions in the event chat**
- **Event supervisors or WESO board members will monitor the discussion and answer questions**
- **Event coaches can use the chat to exchange coaching ideas**
- **Go to** wesoscience.org/events/ **for details on how to join the WESO server and guidelines for its use**

Questions?

Please submit your questions now using the Google form that was shared with you in the chat. We will answer live and post all questions and written answers to the website following the meeting.

THANK YOU FOR VOLUNTEERING AS AN EVENT COACH!