Yay! We have Math Club Today!

Subtitle: Cryptography and a Scavenger Hunt

Speaker: Mary Wiley
Math Teacher
Millburn Middle School
Millburn, NJ
mary.wiley@millburn.org

Today we will discuss how Cryptography can be used as an educative Math Club activity and also highlight what makes any Math Club activity fun. First, we will provide some background on the topic by looking at two famous mathematicians — Alan Turing and Sarah Flannery— who as teenagers were both influenced by their experiences with cryptography. Then we will do a cipher activity created for a scavenger hunt.

The Math Club at Millburn Middle School, where I teach, holds weekly, one-hour meetings after school over eight weeks during both the fall and spring. We organize the topics and activities for each session around a theme. The themes are chosen from math enrichment topics that are normally underserved in the curriculum. For example, we had an eight-week session organized around economics and personal finance, while other sessions covered probability, statistics, circles, triangles and number theory.

With such a rich variety of topics, it is not hard to imagine many engaging activities that would be of interest to middle-schoolers. Over the years it has never ceased to amaze us that certain activities that we were certain our students would love actually bombed, while others that we were not as confident about really captivated them. This trial and error led us to incorporate the following components in our recipe for a great Math Club activity: a game or puzzle-solving activity, with a little collaboration and competition thrown in.

We will share information about the cryptography activities that were used in the final three Math Clubs in a session on number theory. This culminated in a scavenger hunt. Our presentation includes the facts and how-to's of cryptography, which will enable you to do this scavenger hunt with your own students. You will also have an opportunity to crack some codes and decipher with a cipher wheel. As you engage in these decryption activities, think about how they contain the elements that make any Math Club fun: games, puzzles, collaboration and competition.

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Caesar's Cipher

The Caesar's Cipher is a widely known and easy to use encryption technique. It is a substitution cipher in which each letter of the alphabet is replaced by a letter that is a fixed number of positions from the start of the alphabet. If you use a shift of 3 (key of 3), for example, *a* is replaced by D, *b* is replaced by E, and so forth. Here is a Caesar Cipher using a shift of 3 places.

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:	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

To Encipher a message, simply look up the letter in the "plaintext" line and write down the corresponding letter in the "CIPHERTEXT" line. To decipher, do the reverse.

REFERENCES:

Book:

Flannery, S., & Flannery, D. (2001). In code: A mathematical journey. New York: Workman.

Movie:

The Imitation Game [Motion picture]. (2014). Black Bear Pictures.

The Cryptoclub website has more great activities:

University of Illinois at Chicago's Crypto Club Project. (2011). *Teaching guide: Caesar ciphers* [PDF document]. Retrieved from Crypto Club Project Website: http://www.math.uic.edu/CryptoClubProject/CCpacket.pdf

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NCTM Teacher Worksheet

Use your Cipher Wheel to complete the Caesar Cipher messages.

1) Your first decoding task is a quotation by Ben Franklin. Write your plaintext decoded message on the line above the CIPHERTEXT message.

plaintext: _____

CIPHERTEXT: **PDNAA IWU GAAL W OAYNAP**

plaintext: _____

CIPHERTEXT: **EB PSK KB PDAI WNA ZAWZ**

2) Now try to decipher some of the Scavenger Hunt clues. Some of them are done for you. See if you can find the key.

Clue 1: The Key is: _____

plaintext: **go to the auditorium seat u2**

CIPHERTEXT: **KS XS XLI EYHMXSVMYQ WIEX Y2**

Clue 2: The Key is: _____

plaintext: _____

CIPHERTEXT: **IJEF YD QJ JXU BYRHQHO**

Clue 3: The Key is: _____

plaintext: _____

CIPHERTEXT: **YZZK DI OCZ YPIBZJI**

Clue 4: The Key is: _____

plaintext: _____

CIPHERTEXT: **CVPX HC N SBETBGGRA YHAPU**

*3) Now choose a key and **encipher** the last two clues from the Scavenger Hunt!*

Clue 5: The Key is: _____

plaintext: **water fountain on the third floor**

CIPHERTEXT: _____

Clue 6: The Key is: _____

plaintext: **the hunt is over - claim your prize!**

CIPHERTEXT: _____

Worksheet for Students

GROUP MEMBERS NAMES: _____

A Scavenger Hunt using Caesar Ciphers

The first math club scavenger hunt using Caesar cipher secret codes is about to get underway! To those of you who don't know what this event is, get excited! The first clue is given in class, and once it is solved it will send you through a series of clues hidden ANYWHERE!!

You will go in groups of 2 or 3 with your decoders, and your clue sheet. If your group is the first to find all the clues and get back to the club room, with all the clues decoded correctly on this sheet, you will win the ULTIMATE prize!

So here is your first clue: Use a simple Caesar Cipher to decode the following message and go to where it leads you - follow all school rules, but especially: No running, and no copying from other groups!

Good luck!

Clue 1: _____

KS XS XLI EYHMXSVMYQ WIEX Y2

Clue 2: _____

Clue 3: _____

Clue 4: _____

Clue 5: _____

Clue 6: _____

Decoding with Caesar Ciphers