



## **Classroom Teacher Preparation**

### **Technology 4: Cryptography**

**Please use the following to prepare for the next SfS lesson.**

#### **Description:**

Ciphers and codes have been around since the ancient Egyptians, and are one of the oldest forms of secret communication. Cryptography is the science of encoding and decoding secret messages. Students will be introduced to a series of ciphers, including transposition and substitution ciphers, and will discover techniques for encoding/decoding secret messages. Younger classes will explore letter groupings, the Jefferson Wheel, and the scytale and pigpen ciphers. Older classes will complete an alphabetic letter frequency analysis and learn how this process can be used to break a code. All students will investigate a monoalphabetic substitution cipher using a Caesar Cipher Wheel.

#### **Lesson Objectives – SWBAT (“Students Will Be Able To...”):**

##### **3<sup>rd</sup>-8<sup>th</sup>**

- Experience an interesting area of mathematics that is all about pattern problem solving
- Encode and decode messages using a variety of different ciphers, including the Caesar Cipher
- Analyze the strengths and weaknesses of a cipher

##### **6<sup>th</sup>-8<sup>th</sup>**

- Explore and calculate letter frequency
- Understand how frequency analysis can be used to break a cipher

#### **Disciplinary Core Idea (DCI):**

*PS4 Waves and their Applications in Technologies for Information Transfer – PS4.C Information Technologies*

- (3<sup>rd</sup>-5<sup>th</sup>) Patterns can encode, send, receive and decode information.

#### **Science & Engineering Practice (SEP):**

*Using Mathematics and Computational Thinking*

#### **Preparation:**

This is an introductory lesson. No prior knowledge of the subject matter is necessary.

#### **Room Set Up for Activities:**

Students will work in pairs or small groups at tables or desks.

#### **Safety:**

There are no safety precautions for this lesson.



## Related Modules:

This lesson may be taught as part of a sequence or group of related Technology modules on **Codes**. Modules include:

*Technology 1: Binary Code, or How to Speak Computer* – Introduces the binary number base, which is the system that computers use to communicate information. Students have an opportunity to both encode and decode English alphabetic characters to binary code.

For other module sequences and groups, look here: [www.sciencefromscientists.org/sequences](http://www.sciencefromscientists.org/sequences)

## Standards Covered:

Please click the following link to our website to review the standards covered by this lesson, listed by state:

<http://www.sciencefromscientists.org/standards/>

Lessons are matched to both national NGSS and local state standards. This technology lesson is also aligned with Common Core Math Standards.

## After Our Visit:

*Extend this lesson by providing students with two additional opportunities to learn new ciphers. The first activity teaches an easy polyalphabetic cipher called the Date Shift Cipher. The second activity is to discover the secret of the Dancing Men Cipher, created by Sir Arthur Conan Doyle for one of his Sherlock Holmes stories.*

Access this Extension activity by visiting the Classroom Post found on our website at [sciencefromscientists.org/cohorts](http://sciencefromscientists.org/cohorts). Use the name of your school/cohort and password to log in.

To help Evaluate, check out our Open Response questions online at [sciencefromscientists.org/open-response-questions](http://sciencefromscientists.org/open-response-questions). They are freely available for all of our lessons for current teachers. Use the password supplied by your instructor to log in.

## Additional Resources:

### Videos:

- Cryptography: The Science of Making and Breaking Codes Video SciShow (8:20) <https://www.youtube.com/watch?v=-yFZGF8FHSg>
- Intro to Cryptography Video Khan Academy (1:31) <https://www.youtube.com/watch?v=Kf9KjCKmDcU>
- Caesar Cipher Video Khan Academy (2:35) <https://www.youtube.com/watch?v=sMOZf4GN3oc>
- Polyalphabetic Cipher Video (Khan Academy (2:26) <https://www.youtube.com/watch?v=BgFJD7oCmDE>

### Websites:

- Count On Codebreaking Website: <http://www.counton.org/explorer/codebreaking/index.php>
- Secret Code Breaker – An Online Cryptanalyst’s Handbook: <http://www.secretcodebreaker.com/>
- Frequency analysis tools for different types of writing and different languages: <http://letterfrequency.org/>

**Book Suggestion:** For students interested in learning more about codes and ciphers

- *Top Secret – A Handbook of Codes, Ciphers, and Secret Writing* by Paul Jaceczko (2004)
- *Code Talker - A Novel about the Navajo Marines of World War Two* by Joseph Bruchac (2006)