Lesson 2.1: Cryptography: Then, Now, and Future

https://codehs.com/course/21597/lesson/2.1

Description	In this lesson, students will learn about different encryption techniques and their historical significance. They will discover the limitations of certain methods and the evolution of cryptography throughout history. Lastly, students will also explore the future of cryptography and its potential applications.
Objective	Students will be able to: • Decode messages encrypted with Caesar and Vigenere ciphers • Explain the concept of encryption and its role in secure communication • Identify and compare different historical and modern encryption techniques • Analyze the limitations of certain decryption methods (brute force, letter frequency analysis) • Discuss the potential future applications of cryptography
Activities	2.1.1 Video: Cryptography: Then, Now, and Future - Part I 2.1.2 Article: Caesar Wheel 2.1.3 Video: Cryptography: Then, Now, and Future - Part II 2.1.4 Notes: Brute Force and Letter Frequency 2.1.5 Video: History of Cryptography 2.1.6 Free Response: History of Cryptography Submission 2.1.7 Video: Future of Cryptography 2.1.8 Free Response: One Minute Reflection
Prior Knowledge	No prior knowledge needed.
Planning Notes	• There is an online version of a Caesar wheel included in this lesson. There are also printable versions that can be used for a more tactile approach. Here is an example: Printable Caesar Wheel • This is a longer lesson and will likely take more than one class period. Consider setting a goal for students to achieve for each class period.
Standards Addressed	
Teaching and Learning Strategies	**Lesson Opener:** • Have students attempt to solve a cryptogram. This website provides many different puzzles. [5 mins] • Have students brainstorm and write down answers to the discussion questions listed below. Students can work individually or in groups/pairs.

Have them share their responses. [5 mins]
- (Optional) Have students create their own cryptogram and trade with a partner to solve. [15 mins]

Activities:

- Watch the first lesson video and complete the corresponding *Caesar Wheel* activity. [10-15 mins]
    - This is also a great site to use to encrypt and decrypt messages using different ciphers: Cryptii
- Watch the second lesson video. [5-10 mins]
    - Consider having students pause the video and use the Caesar Wheel to connect the Caesar cipher to the Vigenere cipher.
    - These can be found in the *Why Encrypt?* lesson. These activities will be merged into this lesson over the summer.
- Complete the *Brute Force and Letter Frequency* interactive learning page. [10 mins]
    - Stop to discuss why brute force and letter frequency do not work with the Vigenere cipher.
- Complete the *History of Cryptography* choice board. [20 mins]
    - Students can choose to learn about the Hebern Rotor Machine, the Enigma Machine, or the Navajo Code Talkers. Then, they will choose to create a quiz, advertisement, collage, or flowchart to demonstrate their newfound knowledge.
- Complete the *Future of Cryptography* interactive slidedeck. [5 mins]
    - Students can choose to watch a video on quantum key distribution, block chain encryption, of confidential computing.
    - The concepts in these videos can be advanced. Encourage students to pull out at least one interesting fact to share with the class.
- Complete the *One Minute Reflection* activity. [5 mins]
    - Consider allowing students alternative choices, such as sketching for one minute including graphics that summarize what they have learned, or creating a one-minute audio or video recording of what they have learned.

Lesson Closer:

- Have students reflect and discuss their responses to the end-of-class discussion questions. [5 mins]

Discussion Questions

Beginning of Class:

A cryptogram is a puzzle in which a phrase is “hidden” by replacing each letter with a different letter. For example, all E’s could be replaced with W’s. Here is a cryptogram: FID ZMZ MP!

- What makes this difficult to crack?
    - *There are 26 different letters that could be used which makes for a lot of different encryption options.*
- What strategies could be used to help figure out the hidden phrase?
    - *The smaller words can be limited to frequently used words, such as is, in, to, of etc. Also, there are letters that are used more frequently such as e and s.*
- Can you figure out the example cryptogram?
    - *You did it!*

	End of Class:
	• Think of a reason that people might need to encrypt information in times before computers were invented. What was at risk?
	  ◦ *There was still secret information such as battle routes and plans that needed to be encrypted in case the messenger or the message was intercepted. Loss of secrecy was at risk.*
	• Today, why do people need to encrypt information? What is at risk?
	  ◦ *Today, messages are sent much, much faster but they still need to be protected from being stolen or intercepted. Encryption is an added layer of security so that the information remains secret in the case that it is intercepted. The risks are identy theft, fraud, etc.*
	• Did you ever use a secret code or have a secret language as a kid? How did you do it:?
	  ◦ *Sample Response: My friend and I would speak in Pig Latin. I've used an invisible ink pen, etc.*

Resources/Handouts	

Vocabulary

Term	Definition
Cryptography	The practice of encrypting information so only authorized people can read it.
Encryption	A process of converting information into an unreadable form to keep it secure from unauthorized access.
Brute Force	The process of breaking an encryption by trial and error.

Modification: Advanced	Modification: Students Needing Additional Support	Modification: English Language Learners
• After learning about the Caesar and Vigenere ciphers, present students with a more complex encrypted message that requires them to combine their knowledge of both ciphers to decode it. • Have students design their own original cipher system, complete with encryption and decryption methods. They can then challenge classmates to crack their code.	• For the History of Cryptography project, offer additional support for students by providing templates or outlines for their chosen project format (quiz, advertisement, collage, flowchart).	• Incorporate kinesthetic activities, such as acting out the process of using a Caesar wheel or creating a physical model of a rotor machine, to reinforce understanding.