

Cipher Space

Overview:

A cipher is a generic term for a technique or algorithm that performs an encryption. The cypher key is a way to decode that encryption. In this activity students will learn how to use a Caesar cipher to decode and encrypt messages.

Goals:

- Understand the terms cybersecurity, encryption, and decipher as they apply to computer science.
- Use a Caesar cipher to encrypt and decipher messages.
- Understand the importance of cyber security on Earth and in space.

Time Required: 30-45 minutes

Materials:

- Cipher Wheel
- Relay Race Answer Sheet
- Dry Erase Marker (for relay)

Procedure:

1. Suggested introduction:

“We use computers and the internet in many different ways in everyday life. Our society depends on computers for banking, communication, entertainment, education and even space exploration! Much of this technology is supported by a vast network of satellites currently orbiting our planet. Think of some of the ways you use the internet—online shopping, research for school, managing a bank account, downloading videos, streaming music, and more. Now think of the information you or your family members have typed into a computer, tablet or smartphone lately—login information, passwords, addresses, phone numbers, birthdays and other identifying information. As we use technology to communicate over the internet, it is important that we maintain privacy and control over who can access our private information. Private information in the wrong hands can have serious, negative consequences!

Long before computers were invented, people were sending private messages using their own secret systems of communication. Encryption is a way to hide a message in plain sight. One of the earliest known uses of encryption is the Caesar Cipher Wheel, which dates back to 100 A.D. and was named after Julius Caesar. Caesar used this type of encryption to send secure messages to military officials. Today, we use similar modes of encryption to keep vast amounts of personal and confidential information safe as it travels the internet with the support of satellites.”

from 4-H Galactic Quest Cipher Space lesson



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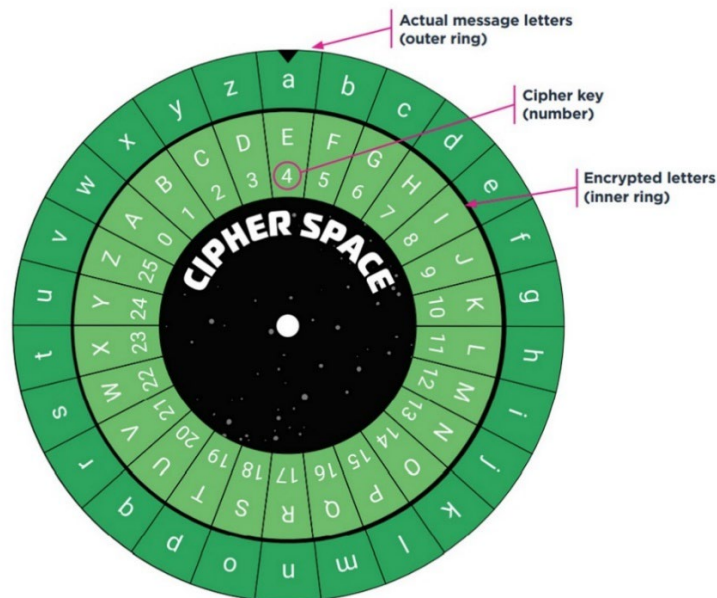
2. Ask the group the following questions to anchor them in the learning experience and stimulate wondering:
 - a. What questions do you have about cybersecurity?
 - b. What questions do you have about encryption?
 - c. What questions do you have about ciphers?
 - d. (These questions can be repeated at the end of the activity too, what did you learn about...)
3. Review the following terms:
 - Cipher- The generic term for a technique or algorithm that performs encryption.
 - Cybersecurity- The use of technologies and strategies to protect computer systems and their electronic data from unauthorized access, damage, disruption, and theft.
 - Encryption- The process of taking a normal message and scrambling it into a highly complex code which can only be unscrambled by “authorized” people.
 - Decipher- To take a secret message and reproduce the original plain text; to reverse encryption.

Using the Cipher:

1. Pass out the cipher wheels, one for each group of 2 students.
2. The cipher wheel has an inner circle on top that should move relative to the base.
3. In a Caesar cipher, every letter in the alphabet is shifted a certain number of spaces over. The number of spaces the letters are shifted is called the “key.” If you know the cipher key, then you can break the code to read the message.
 - The outer base serves as the letters of the actual message. The inner wheel letters correspond with the encrypted code.
 - With a key of “0,” and “A” on the inner wheel line up with the letter “a” on the outer base and there is no encryption. “A” in the code is equal to “a” in the actual message.
 - With a cipher code key of “4,” shift the inner circle so that “4” and “E” line up with “a.” “E” is the encrypted letter and “a” the deciphered letter. At this setting, an encrypted “L” would be deciphered to the actual letter of “h.” “LIEZ” is deciphered to “head.”
4. Have youth practice by solving the codes on their worksheet.
 - Solutions for Cipher Practice:
 - Decipher the Code: CYBERSECURITY
 - Encrypt the Code: OMZVOT
 - Find the Cipher Key: 6
5. Now that the youth should feel more comfortable using their cipher wheels, have them encrypt three words related to space and write them in the space provided on their worksheet.
6. Have youth trade messages with a partner and try to decipher them.



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Space Relay Race:

1. Set up an area for a relay race.
 - Place a table or surface for each team at the far end.
 - One each table, place the cipher wheel, pencil, and cipher answer sheet. (If outdoors, use tape to secure the answer sheet to the table.)
 - Each team will need a pencil or marker to record their answers.
2. Divide the youth into two or more teams.
3. Give the participants the scenario for the relay:

“Imagine a satellite is about to collide with an object in space and hackers have disabled the primary communication center you have with the satellite - now you can’t send a message with instructions for the satellite to change its position to a safer location! Use the Cipher Answer Sheets to race and gather the proper information to send a new encrypted message to your satellite and override the hacker’s instructions in order to save the satellite!”
4. Explain the premise of the relay and rules:
 - At the start of the race, each team member will race down to the far end (one person at a time). Decipher the first letter on the answer key using the cipher wheel, record the deciphered letter, and race back to the line. The next person will take their turn as soon as the first person returns.
 - There are no spaces between words in the encrypted text or the solution space. Youth can draw a line between words to more easily read the phrase.
 - If a team member discovers a mistake in the deciphered message, they can use their turn to “debug” the code.
 - If a team member cannot solve their step in the code, they can put a slash in their solution square and run back to the line. Team members will have a chance to go back and “debug” the code after the rest of the spaces have been filled in.



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5. The first team to completely solve their message (all spaces in the solution are completed with the correct letters) and shout it out wins!
 - Solutions to Answer Sheets in the Relay Race
 - RACE #1: SPACEDOMAIN
 - RACE #2: ALWAYSABOVE
 - RACE #3: DEFENDINGTHESPACEDOMAIN
 - RACE #4: GUARDINSAREALWAYSABOVE
6. Giving all participants a chance to reflect on what they have learned is an important part of the experiential learning process. Have youth answer the following questions with a partner (pair sharing).
 - What were the most and least difficult parts of deciphering for you?
 - How does this activity relate to cybersecurity?
 - What were some strategies you used to make deciphering faster or easier?
 - What did you observe others doing that might affect how you would use encryption in the future?
 - What are some ways you could share your cipher knowledge with others?
 - Where else can the principle of encryption be applied in real life?

Common Problems / Additional Guidance:

- Before deciphering a whole word, demonstrate the use of the cipher wheel with younger youth with single-letter examples; whereas older youth may be able to use the cipher wheel with little instruction.
- Allowing youth to work together in pairs or small groups enables them to more comfortably ask questions and troubleshoot use of the cipher wheel.
- For individuals who may feel intimidated by the pressure of deciphering code in the relay activity, adjust the rules of the race to allow individuals to bring the encrypted code back to their group. Solving each step can be a team effort.
- Allow youth to brainstorm other games that would simulate cybersecurity or involve data protection.

Adapted from the following lesson:

- 2021 4-H STEM Challenge, Cipher Space: <https://4-h.org/parents/4-h-stem-challenge/galactic-quest/> available for purchase at: <https://shop4-h.org/collections/stem-challenge-curriculum/products/laminated-answer-card-and-set-of-2-cypher-wheels>
- Learn about some other ciphers and make your own Caesar Cipher wheel: <https://www.giftofcuriosity.com/secret-codes-for-kids/>

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