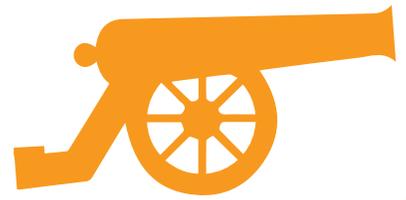




Virtual
Field Trips



Spies of the American Revolution



Roper Mountain
Science Center

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Field Trips



Spies of the American Revolution

Teaching Guide: Spies of the American Revolution

Thank you for choosing ***Spies of the American Revolution: South Carolina's Secret War***! In this lesson, students will learn about several methods of communication used by patriot spies during the American Revolution. Two of these methods, Caesar ciphers and letter masks, will be used by students to decode messages themselves. While the letter mask will be used as is, we're providing you with two options for using the Caesar cipher: the line cipher and the wheel cipher.

Students really enjoy using the wheel cipher; however it has to be cut out and assembled before the lesson, which takes a bit more time than printing off the line ciphers. Simply choose the option that is best for you and your class then let our instructor know which one you'll be using the day of the program. We'll modify the lesson accordingly.

Before the Program Instructions:

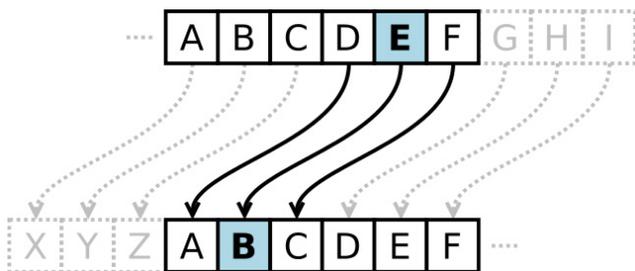
- Review all instructions on how to use the letter mask and Caesar cipher
- Decide which Caesar cipher you'll be using during the virtual field trip, the **row cipher** or **wheel cipher**.
- Print enough row ciphers or wheel ciphers for students to use with a partner.
- If using the wheel cipher, it's recommended that you use students to help construct them in order to save prep time for yourself.
- Print off enough copies of Abigail's Letter and Letter Masks for students to use with a partner.
- Use the **Pre-Visit Activity (Caesar Cipher's: Encrypting and Decrypting)** to give students practice in encoding and decoding secret messages.

Instructions for Day of the Visit:

- Arrange students in three groups (Patriots, Neutral, and Loyalists) as shown on the **Classroom Setup** page.
- Distribute row ciphers or wheel ciphers for partners
- Distribute "Abigail's Letter" for partners
- Distribute "Letter Mask" for partner when asked to do so by instructor
- Students will need paper and a pencil to decrypt the messages.

Background Information for Teachers: Caesar Ciphers

Caesar ciphers are named after Julius Caesar, who is said to have created this system to send messages to his generals over 2000 years ago. With a Caesar cipher, each letter in the plaintext message is replaced by a letter fixed some number of positions down the alphabet. For example, with a left shift of 3, D would be replaced by A, E would become B, etc. The number of letters shifted is called the KEY; therefore, in this example, the KEY=3.



Since the Caesar cipher shifts the alphabet, it is also known as a *shift cipher*. They can be used with two alphabets aligned in a row (**row cipher**) or aligned as wheels (**wheel cipher**).

Because students can quickly understand the patterns, shift ciphers are good for introducing them to cryptography, allowing them to decrypt and encrypt messages fairly easily.



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Pre-Visit Activity

The following activity should be used with students to give them a chance to familiarize themselves with a row cipher and/or wheel cipher before the day of the lesson. You can choose to use one or both techniques.

Provide students with the two-page handout, **Caesar Ciphers: Encrypting and Decrypting**, review the instructions with them, then lead them in practicing how to encode and decode secret messages.

Helpful Directions for Using the Wheel Cipher

To **encrypt** with a cipher wheel, students turn the inner wheel counterclockwise, shifting the number of letters specified by the key. They then match the plaintext and ciphertext letters as shown on the wheel. Example below shows the KEY=0 (a=A) and KEY=3 (a=D).



KEY=0 (a=A)



KEY=3 (a=D)

To **decrypt**, students set the wheel to the appropriate key, then match the ciphertext letter on inner wheel with the plaintext letter above it on the outer wheel. This plaintext letter is the decoded letter. Continue on to each of the ciphertext letters in the secret message to decode its meaning.



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Common error: When using a cipher wheel, students sometimes get confused about how to count the shifts.

Solution: Ask them to begin by setting their wheels so that plaintext **a** matches ciphertext **A**. This is a zero shift. Then have them turn their inner wheels *counterclockwise* (according to the arrow), counting the letters as the wheel turns. Matching **B** to **a** is a shift of one. Continue turning to show other shifts.

Common error: There is often confusion between plaintext and ciphertext.

Solution: Whenever possible, follow these conventions:

Write plaintext in lowercase and ciphertext in upper case.

Write plaintext on the top line of a message and ciphertext on the bottom line.

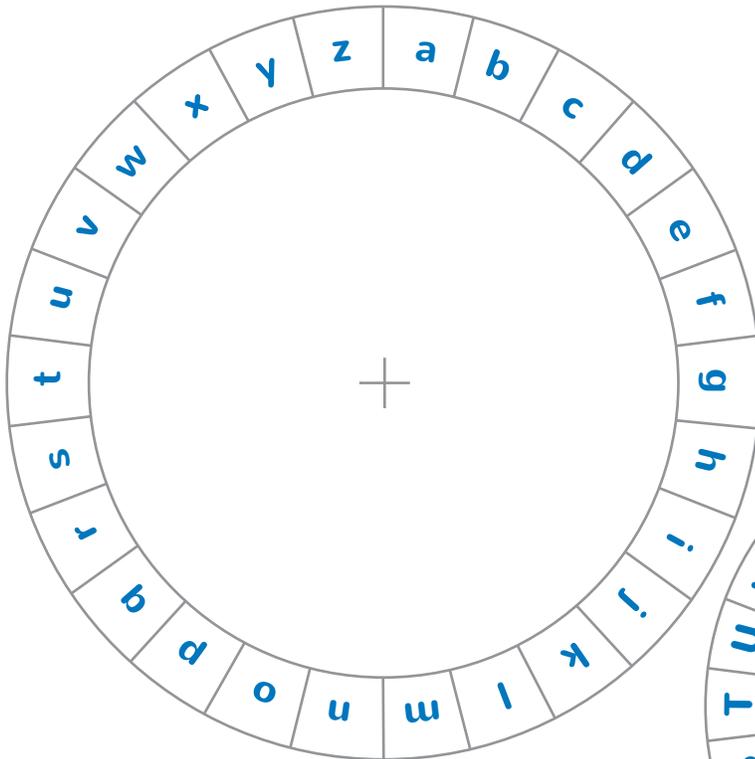
Point out to students that these conventions are used in the cipher tables and the sample messages. Show them this convention is also used on the wheel—the lowercase letters on the outer wheel are plaintext and the uppercase letters on the inner wheel are ciphertext. Putting the plaintext on the outer wheel is consistent with the convention of putting it on the top row of a table, since that is where it would be if the wheel were made by wrapping a table around a circle.

Using the Letter and Letter Mask

Make enough copies of the letter and letter mask for students to use with a partner. You'll notice that the letter mask contains outlined blocks. When the letter mask is placed on top of the letter, and the two are held up to the light, a word is revealed within each box. Reading the words in each box reveals the hidden message within the letter.

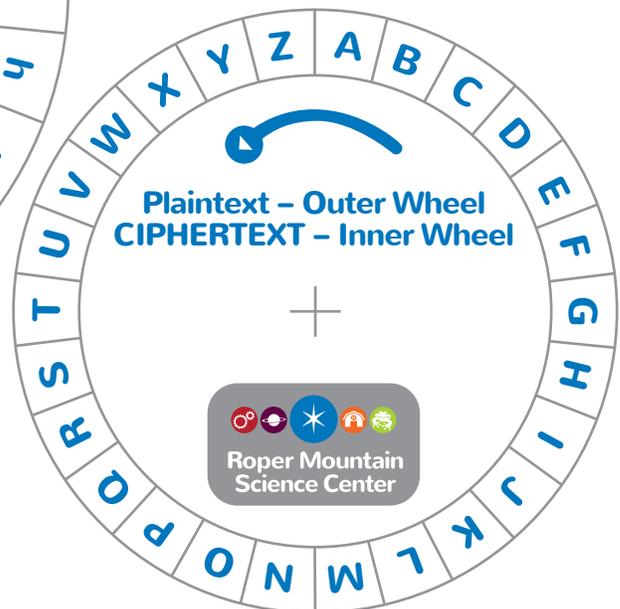
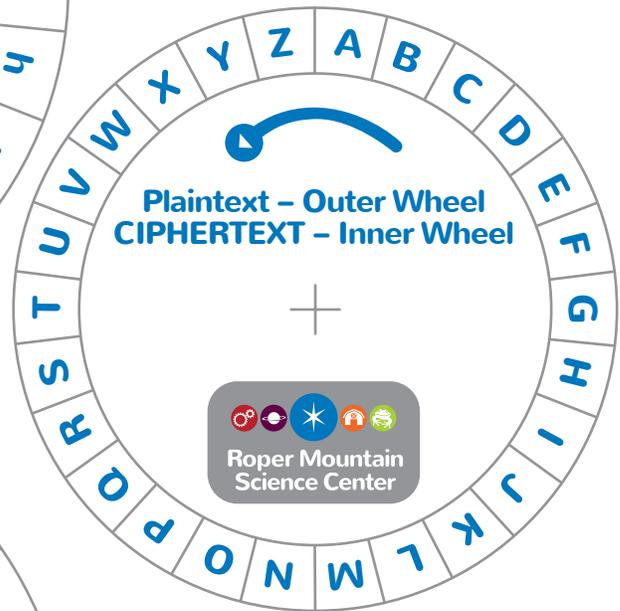
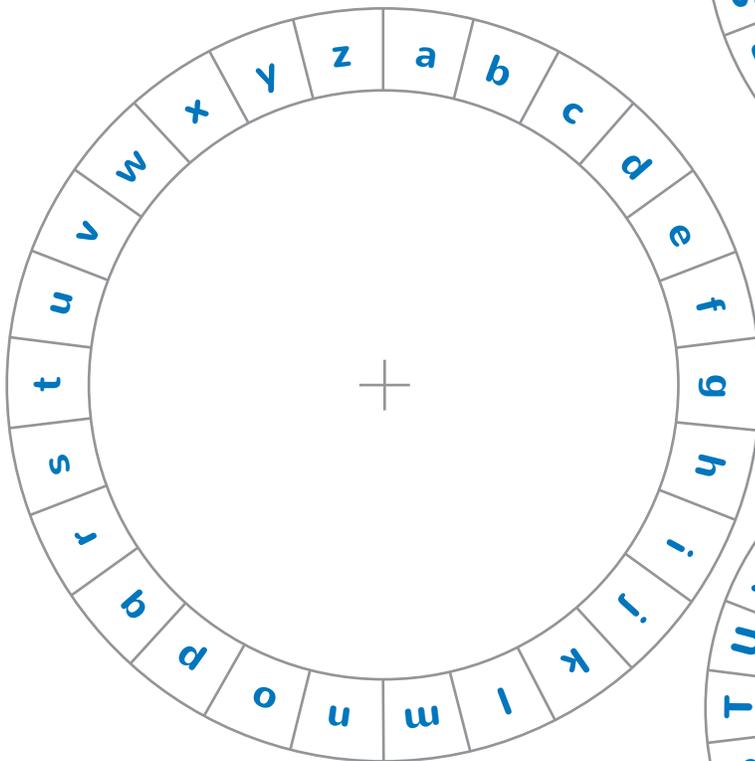
You can give students the letters prior to the lesson, but please wait to distribute the letter masks when asked to do so by the instructor.

Wheel Cipher



Directions

1. Cut out wheels.
2. Place inner wheel on top of outer wheel, lining up the X on each
3. Attach together with paper fastener or thumb tack



Row Cipher

Directions

1. Cut out a row for each set of partners.

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

Caesar Cipher with Key=20

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

Caesar Cipher with Key=20

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

Caesar Cipher with Key=20

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

Caesar Cipher with Key=20

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

Caesar Cipher with Key=20

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

Caesar Cipher with Key=20

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

Caesar Cipher with Key=20



Spies of the American Revolution Teacher Guide

Practicing with the Row Cipher: Encrypting and Decrypting

Each letter in a Caesar cypher is replaced by a letter further along in the alphabet. This can be thought of shifting the alphabet to the left. The KEY shows the number of places that should be used for this shift. In the following example, the top row is plaintext while the bottom row is the cipher text and the key is equal to 3 (KEY=3).

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

Caesar Cipher with Key=3. Each letter is shifted 3 places to the left.

Use the table above to encrypt and decrypt the following with Key=3:

Encrypt:

| | | | | | | |
|------------|---|---|---|---|---|---|
| plaintext | h | i | d | d | e | n |
| CIPHERTEXT | K | L | G | G | H | Q |

Decrypt:

| | | | | | | | |
|------------|---|---|---|---|---|---|---|
| plaintext | m | e | s | s | a | g | e |
| CIPHERTEXT | P | H | V | V | D | J | H |

Practicing with the Wheel Cipher: Encrypting and Decrypting

To use the wheel cipher, line up your inner and outer wheels so that "A" and "a" are together. Now, using KEY=4, move the inner wheel 4 letters to the left. Use your cipher wheel to encrypt and decrypt the two messages, remembering that the plaintext is the actual word and the ciphertext is the encoded word.

Encrypt:

| | | | | | | |
|------------|---|---|---|---|---|---|
| plaintext | s | e | c | r | e | t |
| CIPHERTEXT | W | I | G | V | I | X |

Decrypt:

| | | | | | |
|------------|---|---|---|---|---|
| plaintext | r | o | u | t | e |
| CIPHERTEXT | V | S | Y | X | I |

Practice your decryption skills by answering the following questions using your wheel cipher.

1. What did George Washington call the chemical solution used as invisible ink?

Answer (Key=3)

| | | | | | | | | | | | | | | | | |
|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| plaintext | s | y | m | p | a | t | h | e | t | i | c | s | t | a | i | n |
| CIPHERTEXT | V | B | P | S | D | W | K | H | W | L | F | V | W | D | L | Q |

2. British spies rolled up letters and small notes and placed them inside many common items such as?

Answer (Key=10)

| | | | | | | | | | | | | | |
|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|
| plaintext | f | e | a | t | h | e | r | q | u | i | l | l | s |
| CIPHERTEXT | P | O | K | D | R | O | B | A | E | S | V | V | C |

| | | | | | | | |
|------------|---|---|---|---|---|---|---|
| plaintext | b | u | t | t | o | n | s |
| CIPHERTEXT | L | E | D | D | Y | X | C |



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Practicing with the Row Cipher: Encrypting and Decrypting

Each letter in a Caesar cypher is replaced by a letter further along in the alphabet. This can be thought of shifting the alphabet to the left. The KEY shows the number of places that should be used for this shift. In the following example, the top row is plaintext while the bottom row is the cipher text and the key is equal to 3 (KEY=3).

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

Caesar Cipher with Key=3. Each letter is shifted 3 places to the left.

Use the table above to encrypt and decrypt the following with Key=3:

Encrypt:

| | | | | | | |
|------------|---|---|---|---|---|---|
| plaintext | h | i | d | d | e | n |
| CIPHERTEXT | | | | | | |

Decrypt:

| | | | | | | | |
|------------|---|---|---|---|---|---|---|
| plaintext | | | | | | | |
| CIPHERTEXT | P | H | V | V | D | J | H |

Practicing with the Wheel Cipher: Encrypting and Decrypting

To use the wheel cipher, line up your inner and outer wheels so that "A" and "a" are together. Now, using KEY=4, move the inner wheel 4 letters to the left. Use your cipher wheel to encrypt and decrypt the two messages, remembering that the plaintext is the actual word and the ciphertext is the encoded word.

Encrypt:

| | | | | | | |
|------------|---|---|---|---|---|---|
| plaintext | s | e | c | r | e | t |
| CIPHERTEXT | | | | | | |

Decrypt:

| | | | | | |
|------------|---|---|---|---|---|
| plaintext | | | | | |
| CIPHERTEXT | V | S | Y | X | I |

Practice your decryption skills by answering the following questions using your wheel cipher.

1. What did George Washington call the chemical solution used as invisible ink?

Answer (Key=3)

| | | | | | | | | | | | | | | | | | |
|------------|---|---|---|---|---|---|---|---|---|---|---|--|---|---|---|---|---|
| plaintext | | | | | | | | | | | | | | | | | |
| CIPHERTEXT | V | B | P | S | D | W | K | H | W | L | F | | V | W | D | L | Q |

2. British spies rolled up letters and small notes and placed them inside many common items such as?

Answer (Key=10)

| | | | | | | | | | | | | | | | |
|------------|---|---|---|---|---|---|---|--|---|---|---|---|---|---|--|
| plaintext | | | | | | | | | | | | | | | |
| CIPHERTEXT | P | O | K | D | R | O | B | | A | E | S | V | V | C | |

| | | | | | | | |
|------------|---|---|---|---|---|---|---|
| plaintext | | | | | | | |
| CIPHERTEXT | L | E | D | D | Y | X | C |

Abigail's Letter

January 15, 1781

Dearest Anna,

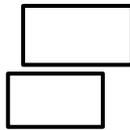
I hope that you and yours are all well. And I shall be happy to hear so. You'll be glad to know that I received your package containing the lovely gloves, along with your letter dated December 11, too. They are greatly appreciated. Mother and I are doing as well as could be expected for two ladies currently fending for themselves during such a bleak winter. The men of our house are on a hunting expedition in hopes of landing two or three deer that can, on condition of their size, provide a measure of relief from hunger.

Our cousin Tom is moving his business affairs from Georgetown to Charles Towne. I had believed that he would hold fast to his vow to remain close to family. Yet he is prudent in looking toward the day when he and Elizabeth shall be wed.

There is never a moment of boredom here. Yesterday, the cow became frightened and broke through the pens. We struggled mightily to recapture her. The exertions were nearly exhausting and in doing so, my favorite green dress become muddied as I attempted to extract the stubborn animal from the river and drag her down the road to the barn. Oh what laughter the situation would have evoked from father had he but witnessed the event.

Your most affectionate cousin,
Abigail

Letter Mask





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Classroom Setup

