

SPY SCIENCE

40 Secret-Sleuthing,
Code-Cracking,
Spy-Catching
Activities
for Kids



DEVISE A COOL
DISGUISE



PERISCOPE
IT OUT



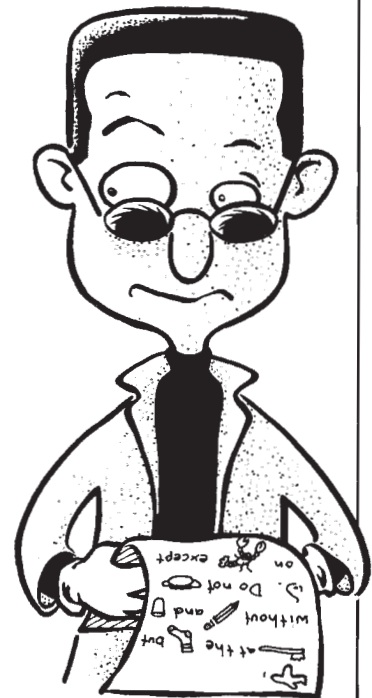
CRACK A SECRET
CODE

JIM WIESE



Cipher Secrets

Making (and Breaking) Codes



Secret agents know that one of the best ways to send a secret message is to use a code. A **code**, also called a **cipher**, is a method of changing words and sentences in order to hide their meanings. A code is often a system of symbols in which each symbol represents something else, usually a letter or a word. The symbols of a code can be letters, numbers, words, or even pictures.

When you change a message into a code, you **encode** or **encipher** it. When you translate an encoded message back into its regular form, you **decode** or **decipher** it. A message written in code or cipher is called a **cryptogram**. **Cryptology** is the study of making and breaking codes.

By now, you shouldn't be surprised to learn that science helps spies make and break codes. Try the following activities to learn some spy cipher secrets.



Project 1

Words in the Way

There are many ways to use codes to hide secret messages. A secret message can be hidden in an ordinary letter. Try the following activity to see how.

M A T E R I A L S

pencil
sheet of paper

P R O C E D U R E

Read the letter below. In it is a message.

Jack,

Thomas says hello. He now lives out in the country, but he does not enjoy it. Heard from Sarah. Recently she changed schools, but she seems to be doing fine. Initially, my school year was slow. Teachers were nice, and so were the other students. About two weeks ago, I turned in my term paper and things got better. My belief is that it is the best paper I have ever written and I hope to get a good grade. Hal, my English teacher, is an excellent teacher and I enjoy his class. In general I do better in great classes. I better end now. My neighbor is at the door and he wants me to mow his lawn. Until later.

J.

- 2 To decode the hidden message, use the pencil and paper to write down the third letter in the first word and then the third letter after every punctuation mark.
- 3 Divide the letters into words to read the secret message.



MORE FUN STUFF TO DO

Use this method of secret writing to send a message to a friend. Begin by writing something easy, such as "Meet me after school." Try different ways of hiding the message. Use the first or second letter after every punctuation mark, rather than the third, to indicate the letters that make up your message, or use the first and last letters of each sentence.

EXPLANATION

The punctuation marks in the letter are the comma (,) and the period (.). If you write down the third letter after each punctuation mark, you get the message “Contact is a double agent.”

The code used in this activity tells you that every third letter after a punctuation mark is important. The person receiving the message must know the code in order to read the secret message. This type of code writing is difficult because you must place words with specific letters at specific places in each sentence to spell out your message. It can be very hard to spell out the message and make the letter sound natural at the same time.

However, this is a difficult code to break. If the letter is written well, an enemy agent may not realize it contains a secret message. Even if the agent realizes there is a hidden message, if he doesn’t know the code, it may be impossible to figure out which words spell out the message.



During the seventeenth century in England, Oliver Cromwell, a religious and political leader, overthrew the English king, Charles I, and ruled the country for a brief time. During Cromwell's rule, many people remained loyal to the king.

They were called Royalists and were imprisoned if caught. One of those caught was Sir John Trevenion.

Like other Royalists before him, Sir John would probably have been put to death for **treason** (attempting to betray or overthrow the government). However, several days before his execution, he received a simple letter. In the letter was a hidden message written with the code you just investigated. The secret message read, “Panel at east end of chapel slides.”

Trevenion requested a private hour inside the prison chapel. But instead of spending the entire time in prayer, he escaped out the false panel in the chapel that he had learned about in the letter.



Quick Code

Suppose you need to send a secret message in code but you only have a few minutes. You need a fast, easy method. Try the next activity to learn a simple code to send secret messages.

M A T E R I A L S

pencil
sheet of paper

P R O C E D U R E

- 1** Write the message “MEETING CALLED OFF. I’M BEING FOLLOWED.” on the paper.
- 2** That message in code would read, “GNITEEM DELLAC FFO. M’I GNIEB DEWOLLOF.” Can you figure out the code?



MORE FUN STUFF TO DO

Try to decode the phrase “PLEH DEEN I.” What’s different about this code? Write secret messages to your friends, using this code and the one from the original activity.

EXPLANATION

In the original activity, the message is encoded by writing each word backwards. In the More Fun Stuff to Do section, the entire sentence is written backward. This sentence translates to “I NEED HELP.”

These codes are easy to write, but also easy to break. Because the encoded sentences are unreadable, an enemy agent will know right away that they are in code. Like you, a smart agent will be able to quickly break the code by reversing the words or letters.

The artist and scientist Leonardo da Vinci used a variation of this kind of code writing. He wrote backward, reversing each letter and writing from right to left across the page. He used this type of writing for many of his scientific manuscripts so that others couldn't steal his experiments. For backward writing to be read, it must be held up to a mirror. In the mirror the writing is reversed and can be read. Try backward writing and see if you can do it. You should be able to be read it when you hold it in front of a mirror.





Project 3

Caesar Cipher

Historians believe that Julius Caesar, leader of the Roman Empire in 50 B.C., used a secret code made up of two alphabets. Try the following activity to learn one of the oldest secret codes.

M A T E R I A L S

2 sheets of ruled paper
pencil

P R O C E D U R E

- 1 On one sheet of paper, write out the alphabet from *a* to *z*, leaving two blank lines beneath each row of letters.
- 2 Write the alphabet again underneath the first alphabet, only this time begin by placing the letter *a* under the letter *d* of the first alphabet so that the whole alphabet shifts to the right by three letters. Continue the alphabet from *a* to *z*. When you reach the letter *z* of the first alphabet (when you write the letter *w*), go back to the letter *a* in the first alphabet and finish the second alphabet.
- 3 On the second sheet of paper, decode the message “Ybtxob, Zxbpxo. Yorqrp fp x qoxfqlo!” Find each letter of the message on the second alphabet and replace it with the letter from the first alphabet. For example, replace the letter *x* with the letter *a*, the letter *y* with the letter *b*, and so on.



MORE FUN STUFF TO DO

Use this method to write secret messages to your friends. Can they decode your messages? Try moving the second alphabet more or fewer letters to the right to change the code.

EXPLANATION

The message from the original activity reads, “Beware, Caesar. Brutus is a traitor!” Julius Caesar never actually received that encoded message. If he had, he might have learned the truth about his friend Brutus, who later turned on Caesar.

This code, called **Julius Caesar cipher**, uses letters to represent other letters by writing one alphabet below another and shifting the second alphabet one or more letters to the right. Historians believe that Julius Caesar used this simple code in writing his correspondence. This code is called Julius Caesar cipher, regardless of how many letters the lower alphabet is shifted. In this activity, the letters in the second alphabet are shifted three letters to the right. Although this is an easy code to write, it is also an easy code to break, as you will see in the next activity.

Most experts consider Johannes Trithemius, Abbot of Spanheim in Germany, to be the father of modern **cryptography**, the art of writing in code or cipher. In 1510, Trithemius wrote *Polygraphia*, the first printed work on cryptology.

Trithemius also created the first **cipher table**, a square table in which the alphabet is written 26 times. Each alphabet fills one row of the table, and each successive alphabet is shifted one more letter to the left. For example, the first letter of the second alphabet is B; the first letter of the third is C, and so on. Each alphabet in turn is used to encipher each letter of a secret message. The first letter of the message is enciphered with the first alphabet, the second letter with the second alphabet, and so on. Using this method, the word *secret* becomes *Sfeuy*. This method of secret writing was used extensively in the 1500s.



Cracking the Code

Project 4

Spies often intercept messages sent by enemy agents. An encoded message will not help the spy unless she can figure out how to decode it. Try the following activity to learn one way to break a secret code.

MATERIALS

Julius Caesar cipher (see Chapter 5, Project 3, "Caesar Cipher")

pencil

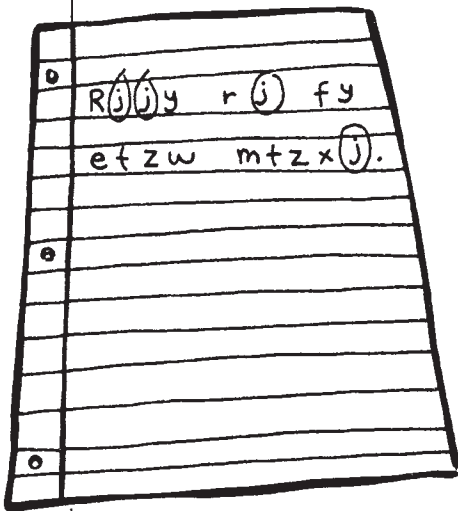
2 sheets of ruled paper

helper

PROCEDURE

1 Have your helper write you a simple message of 10 to 15 words, using the Julius Caesar cipher, the pencil, and one sheet of paper. When she makes the cipher, she should move the second alphabet to the right either more or fewer letters than the three letters used in the Caesar cipher activity.

2 When you receive the message, try to break the code. Begin by writing out the alphabet on the second sheet of paper, leaving two blank lines beneath each row of letters.



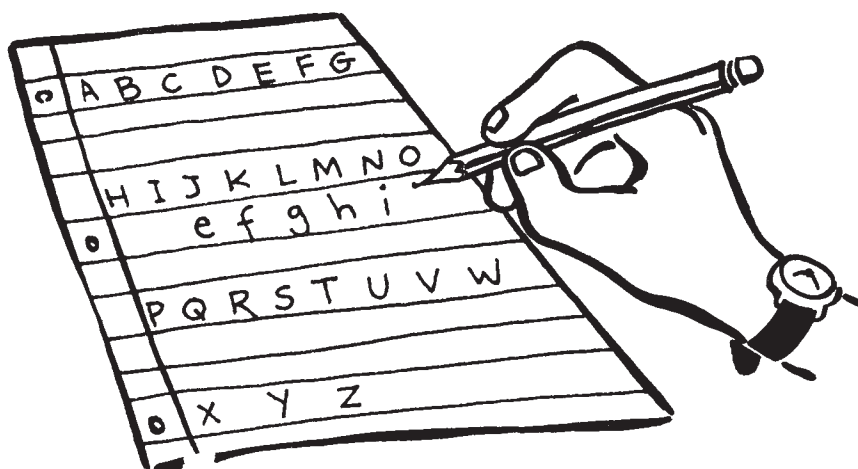
3 Count the number of times each letter is used in the message. Circle the letter that is used most often.

4 On your alphabet sheet, find the letter most often used in the message. Write the letter *e* under the letter.

5 Write the rest of the alphabet under the first alphabet.

6 Decode the secret message on the first sheet of paper, using your alphabet code.

7 If you are unable to decode the message, repeat the activity, trying the letter *t* instead of *e* to stand for the most often used letter. If you are still not successful, continue to repeat the activity, trying the letter *a*, then *i*, *s*, *o*, and *n*, until you find the letter that cracks the code.



MORE FUN STUFF TO DO

The game of hangman helps sharpen your code-breaking skills. To play, have your helper think of a word and then make a series of short blanks for every letter in that word. Begin the game by asking if a certain letter is in the word. If it is, your helper should write that letter in the appropriate blank(s). If it isn't, she gets to draw a part of a body to be hanged, beginning with the head, then the body, arms, and legs. After you have chosen several correct letters, try to guess the word your helper chose. For advanced hangman, use phrases instead of words.

E X P L A N A T I O N

The most commonly used letter in the English language is the letter *e*. After that come the letters *t*, *a*, *i*, *s*, *o*, and *n*. Other commonly used letters are *l*, *d*, *u*, and *g*. The letters *b*, *c*, *h*, *m*, *p*, *v*, *w*, *j*, *f*, *r*, *x*, *k*, *q*, and *y* are used less often. Do you know what letter is used the least often? The letter *z*. The letter *e* is found over fifty times more often than the letter *z*!

Long messages are usually easier to break than short ones. The more letters or symbols there are to analyze, the more chance there is that certain letters will be repeated. Agents can also break a code by figuring out passages at the beginning or the end of a message that are always the same. Once they determine the code for those passages, they can decode the rest of the message. For example, a letter to me usually starts with “Dear Jim” and ends with “Sincerely.” By knowing the opening and closing, a code breaker can use that information to break the rest of the code.



In May 1942, the Japanese were preparing a major attack on the United States to take place in the central Pacific. The Japanese navy had battleships, cruisers, destroyers, aircraft carriers, and submarines that greatly outnumbered the opposing U.S. fleet.

The Americans had broken the Japanese code and knew the major attack was coming, but they did not know exactly where. Japanese communication named the target by the letters *AF*. There were many targets in the central Pacific that could be attacked, such as Oahu in the Hawaiian Islands or the Midway islands.

No one was sure.

To solve the mystery, two naval intelligence officers, Commander Joseph Rochefort and E.T. Layton, thought of a brilliant plan. They had the Americans at the Midway base radio naval headquarters at Pearl Harbor to report that the water distillation plant at Midway had broken down. The message was deliberately sent uncoded.

Two days later, the Americans intercepted a coded Japanese message. The message reported that *AF* was short of drinking water because of a plant breakdown. The Americans then knew that *AF* was Midway. When the Japanese fleet came charging into the Midway islands for their major attack, the American fleet was ready and waiting.



Project 5

Symbols

Not all codes involve using letters to hide a secret message. Try a simple code that uses symbols instead.

MATERIALS

pencil
2 sheets of paper
helper

PROCEDURE

- 1 Write a simple message to send to a helper, such as “Meet me after school by the bike rack,” on the first sheet of paper.
- 2 On the second sheet of paper, use the following code to encode the secret message, substituting each letter for its corresponding symbol. The symbol for each letter is the combination of lines, or the lines and the dot, that the letter occupies.

A	B	C
D	E	F
G	H	I

J.	K.	.L
M.	N.	.O
P.	Q.	.R

	S	
V	X	T
	U	

	W	
Z	••	X
	Y	

For example, the letter *a* is written as , the letter *b* is , the letter *o* is , the letter *u* is , and the letter *w* is . The word *code* would be written    .

- 3 Give the second sheet of paper to your helper. Ask your helper to use the code to decode the secret message, substituting each symbol for its corresponding letter.



MORE FUN STUFF TO DO

Try to invent your own code that uses symbols instead of letters. How well does it work? What problems occur when your helper tries to decode your message?

EXPLANATION

The code in this activity uses a system of symbols to represent letters. This type of code is easy to create, but to decode it, the reader must know the code the writer used. And if the reader knows the code but the code is too complicated, the reader still may not be able to decode it. Today, agents use computers to create and break codes. Because of advanced technology, a secret agent usually uses a code only one time, then uses a new code for the next message.

Most cultures have written languages. The English language uses an alphabet to represent spoken words. Some cultures use alphabets similar to the English alphabet, while others use symbols that are very different. Some cultures use a different symbol for each sound in their language, while others use one symbol for each word or even for a group of words. **Linguists** are scientists who study languages and what they mean. Linguists worked with archaeologists to decode ancient writing, such as the ancient Egyptian writing called **hieroglyphics**.

With all the complicated codes that the US Army, Navy, and Air Force had during World War II, the US Marines had a simple system that the Japanese could not break. The marines recruited Native American Navajos to man their combat radios. Navajos talked to Navajos, and the Japanese were not able to understand what they were saying. The Navajo language was an unbreakable code.



Morse Code

Project 6

There are ways to send encoded messages without writing them down. Try this activity to investigate a classic code.

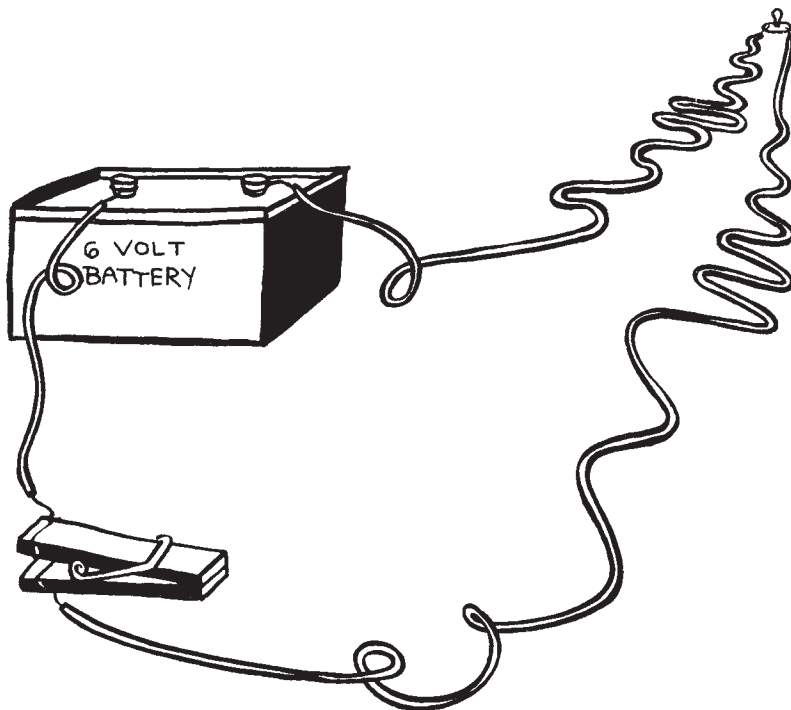
M A T E R I A L S

- | | |
|---|---|
| wire strippers or pliers (to be used only by an adult) | 6-volt dry-cell battery |
| ruler | 4.5-volt lightbulb with bulb holder (available from most hardware stores) |
| two 6-foot (2-m) pieces of insulated 22-gauge copper wire | screwdriver |
| one 12-inch (30-cm) piece of insulated 22-gauge copper wire | pencil |
| spring-type clothespin | sheet of paper |
| | adult helper |

PROCEDURE

NOTE: This activity requires adult help.

- 1** Have your adult helper use the wire strippers to remove $\frac{1}{2}$ inch (1.25 cm) of insulation from the ends of all three wires and an additional 1 inch (2.5 cm) from one end of one of the long wires and one end of the short wire.
- 2** Using the wires with the additional insulation removed, wind the longer stripped ends around each tail end of the clothespin so that the wires touch when the clothespin is pinched.
- 3** Wrap the free end of the short clothespin wire around one of the battery terminals. Wrap the free end of the long clothespin wire around one screw terminal of the bulb holder, then tighten the screw with the screwdriver.
- 4** Use the other long wire to complete the circuit by wrapping one end around the other battery terminal and the other end around the other screw terminal of the bulb holder. When you pinch the clothespin, the bulb should light.



- 5 Place the bulb as far away as the wire will allow. Send long and short flashes of light to your helper by pinching the clothespin together for 3 seconds for a long flash and 1 second for a short flash.
- 6 Have your helper record the light flashes by writing a dot for a short flash and a dash for a long flash.



MORE FUN STUFF TO DO

1. The code shown uses a series of dots and dashes to represent letters and numbers. Each letter in the alphabet and each number has its own symbol.

A · —	J · — — —	S · · ·	2 · · — — —
B — · · ·	K — · —	T —	3 · · · — —
C — · — ·	L · — · ·	U · · —	4 · · · · —
D — · ·	M — —	V · · · —	5 · · · · ·
E ·	N — ·	W · — —	6 — · · · ·
F · · — ·	O — — —	X — · · —	7 — — · · ·
G — — ·	P · — — ·	Y — · — —	8 — — — · ·
H · · · ·	Q — — · —	Z — — · ·	9 — — — — ·
I · ·	R · · ·	1 · — — — —	0 — — — — —

Use this code to send a message to your helper. To indicate the end of one letter and the beginning of the next, flash for 5 seconds between letters. Flash for 7 seconds between words. Can you think of other ways to send this code? Try replacing the bulb with a bell or a buzzer as in Chapter 3, Project 8, "Alarm."

2. With an adult, use a flashlight to send a message outdoors on a dark night. Have your adult helper stand at least 50 yards (50 m) away. Cover the flashlight with your hand. Remove your hand for 1 second for a dot and 3 seconds for a dash. A 5-second flash marks the end of a letter; a 7-second flash, the end of a word.

E X P L A N A T I O N

The code you used in this activity is called **Morse code**, invented by Samuel Morse and first demonstrated in 1844. Morse also invented a machine called a **telegraph** to send messages in his code. In this activity, you built a model of Morse's telegraph.

Both Morse's telegraph and yours work because of electricity. For electricity to flow, electrons must travel from a source of energy—in this case, a battery—in an electric circuit. The circuit you made begins at one terminal of the battery, runs through the wires to the bulb, continues through the other wire, and ends at the other terminal of the battery.

In your telegraph, the circuit is not complete until the wires in the clothespin touch. When you pinch the clothespin, the wires touch, closing the circuit between the battery and the bulb. Electricity flows from the battery to the bulb and back to the battery, and the bulb lights. Your message is sent.

In Morse's telegraph, the operator presses a key to send signals. Pressing the key closes the electric circuit, allowing electricity to flow. The electricity activates either a clicker that clicks out long or short sounds that are recorded as dots or dashes, or an inkler that actually prints out the dots and dashes. The dots and dashes are then decoded into words, using Morse code.