Secret Agent

You are a secret agent. There are 3 other agents in your spy ring.

Each of these agents has sent you a secret message. Unfortunately they have all used different ciphers!

Work out what the messages say, and send a secret reply to each of them.

Messages

Message 1
gnetrg frra yrnivat ubgry rvtugrra uhaqerq ubhef gnvyrq gb onax juvpu gnetrg ragrerq sbe frira zvahgrf gnetrg gura erghearq qverpg gb ubgry cyrnf nqivfr ba nal shegure npgvba erdhverq

Message 2
lnlixvm lxxg wxeboxkbgz itvdtzx mh ftg hg vhkgxk hy abza lmkxxm tgw vhoxgmkr ptr ftg kxvxbobgz itvdtzx tiikhqbftmxer mabkmr rxtkl hew fxwbnf axbzam ukhpg atbk pxtkbgz uenx cxtgl tgw uetvd wnyyxe vhtm

Message 3
bizomb ammv mvbmzqvo zmabiczivb bpqzbmmv pcvlzml pwcza aczdmqttivkm kwvbqvcml wcbaqlm cvbqt nqnbmmv pcvlzml pwcza wv mvbmzqvo zmabiczivb nwcvl bpib bizomb pil tmnb bpm xzmuqama bpzwcop bwqtmb eqvlwe epmzmijwcba wn bizomb vwe cvsvwev

Caesar cipher
A cipher is a way of coding all the letters in a message. Ciphers can work in different ways. Your agents have been trained to send Caesar ciphers.

In Caesar ciphers, each letter of the alphabet is replaced with a letter from a fixed number of positions along the alphabet.

For example, in a Shift 3 cipher, all

letters are shifted by 3 places:

A becomes D, Q becomes T.

What would 'cats and dogs' become in

a Shift 3 cipher?

ABCDEFGHIJKLMNOPQRSTUVWXYZ

DEFGHIJKLMNOPQRSTUVWXYZABC

Cipher Wheel

If you know the shift you can decode a Caesar cipher using a cipher wheel.

Use the cipher wheel on the next page to create your own cipher wheel.

Print the image on card. Cut it out and make your own cipher wheel.

The inside wheel rotates around and allows you to translate ciphers quickly.

In this example A in the cipher decodes to U in the real alphabet.

Cipher Wheel

The **Inside** wheel acts as the **Coded alphabet**

The **Outside** wheel is the **Real** alphabet
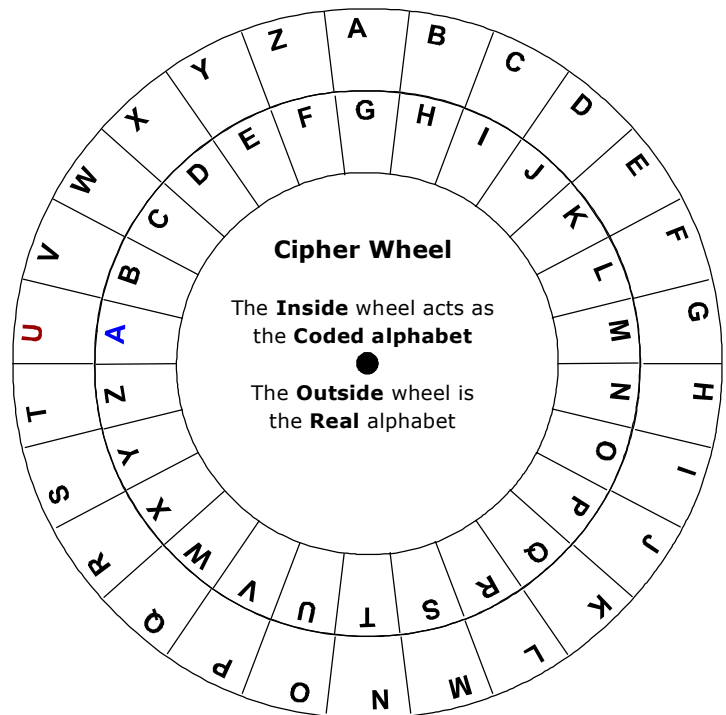
Create your own

You could use your Caesar cipher wheel to create your own coded message. Think about what shift you would like to use in your message.

You could use a reverse alphabet cipher, where A goes to Z, B goes to Y and so on.

ABCDEFGHIJKLMNOPQRSTUVWXYZ
↓ ↓
ZYXWVUTSRQPONMLKJIHGFEDCBA

You could try a rearranging cipher where each word in your message is made into an anagram.
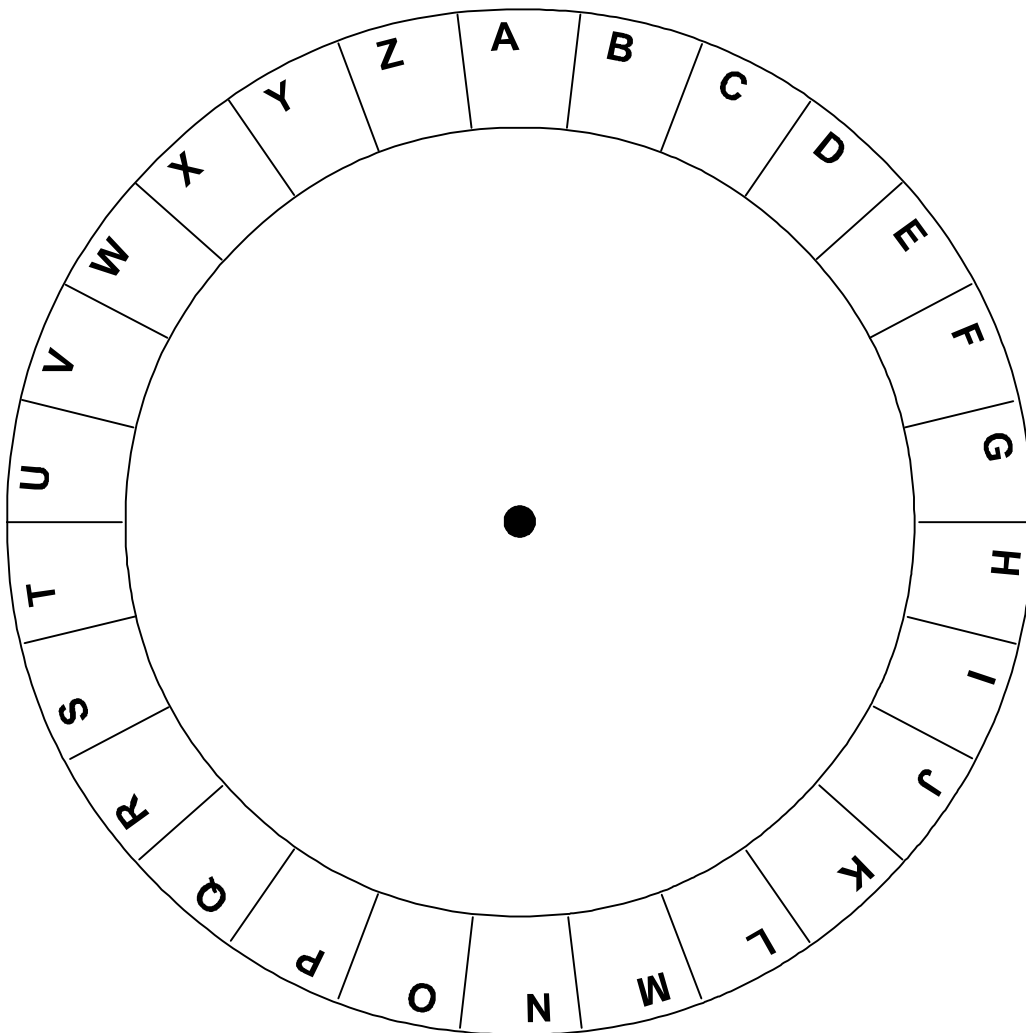
Maybe you could use a numerical cipher where each letter is turned into a number?
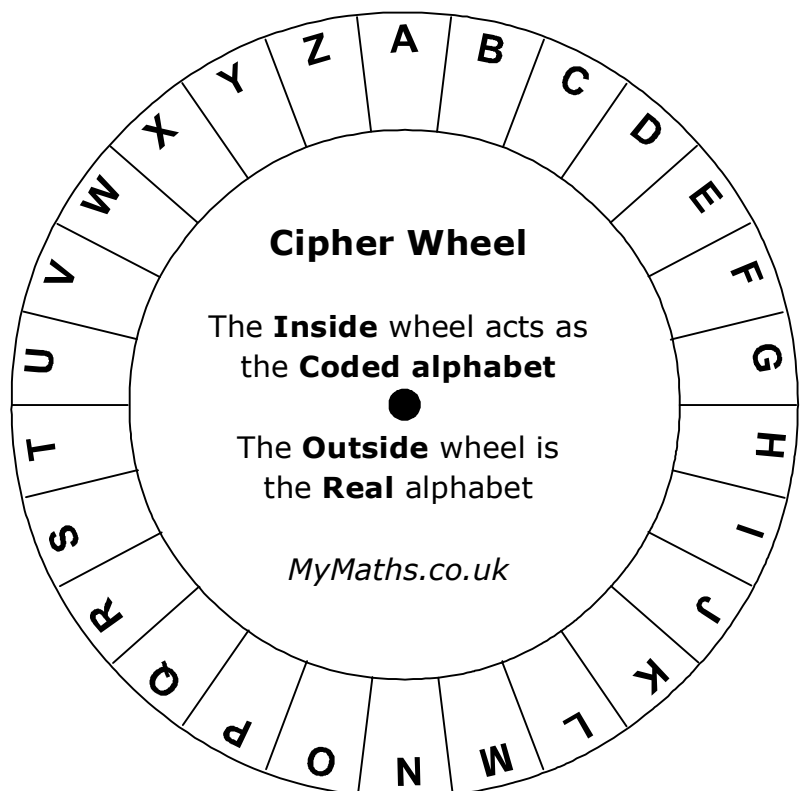
Which cipher would you like to use?
Which cipher do you think is hardest to crack?

Cipher wheel

Cut out the two circles.
Place a split pin
through the centre.

Cipher Wheel

The **Inside** wheel acts as
the **Coded alphabet**

The **Outside** wheel is
the **Real** alphabet

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Letter frequency

Some letters in the English language occur more often than others.

The letter E occurs the most often and the letter Z occurs the least often.

The table shows the frequency with which each letter occurs, as a percentage to 1 d.p.

The most common double letters are: SS, EE, TT, FF, LL, MM, OO, …

The most common 2-letter words are: of, to, in, it, is, be, as, …

The most common 3-letter words are: the, and, for, are, but, not, you, …

Letter	Frequency (%)	Letter	Frequency (%)
E	12.5	M	2.5
T	9.3	F	2.3
A	8.0	P	2.0
O	7.6	G	2.0
I	7.3	W	1.9
N	7.1	Y	1.7
S	6.5	B	1.5
R	6.1	V	1.0
H	5.5	K	0.7
L	4.1	X	0.2
D	4.0	J	0.2
C	3.1	Q	0.1
U	2.7	Z	0.1

Letter counting tool

If you go to the last data page you will find a letter counting tool that counts how many of each letter are in a piece of text.

Extension Ideas

- Compare the advantages and disadvantages of a number of ciphers.
  Think about:

  ◦ how easy is it to decrypt a message if you are given the key?
  ◦ how easy is it to decrypt a message without knowing the key?
  ◦ what is the most secure way of sending a secret message?

- Find out about modulus arithmetic and explain how it is used in ciphers.

- Research occasions when cracking codes has played an important role,
  e.g during the Second World War at Bletchley Park.