# Make a code wheel

Investigation - Decoding and analysing information

## Purpose

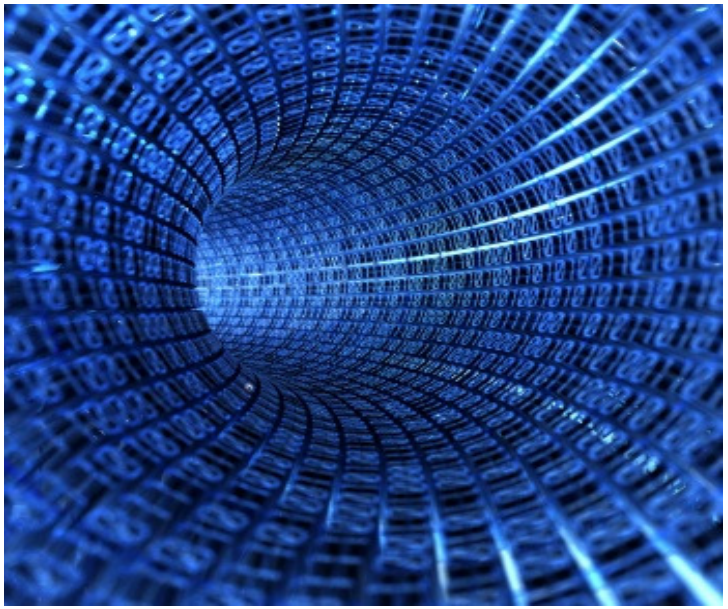
To make a code wheel and demonstrate the concepts of coding and code keys in a physical way.

## Age range (years)

7 8 9 10 11 12 13 14 15 16

## Subjects

Art and Design, English, Mathematics





## Background

Using codes to keep information secret is important for spies. But codes are used in all walks of life - from banking to the exchange of emails.

This activity introduces the process of coding using a 'code wheel' - a simple 'substitution cipher' where individual letters and symbols in a message are substituted for others to create a coded message.

## Steps

**You will need:**

- A copy of the code wheel and activity sheets on pages two and three for each student. For the code wheel sheet thicker paper works best.
- Scissors for students
- Paper fasteners

1. Write the following:

   **P@YZK@YGHMYZEHG@**
2. Explain this is 'ciphertext' – an encoded message.
3. Give students the code wheel and activity sheets (pages two and three).
4. Ask them to follow the instructions - assembling their code wheels, decoding the message (the answer is 'we are not alone') and creating their own encoded messages to pass to each other.

## Extension

For older students:

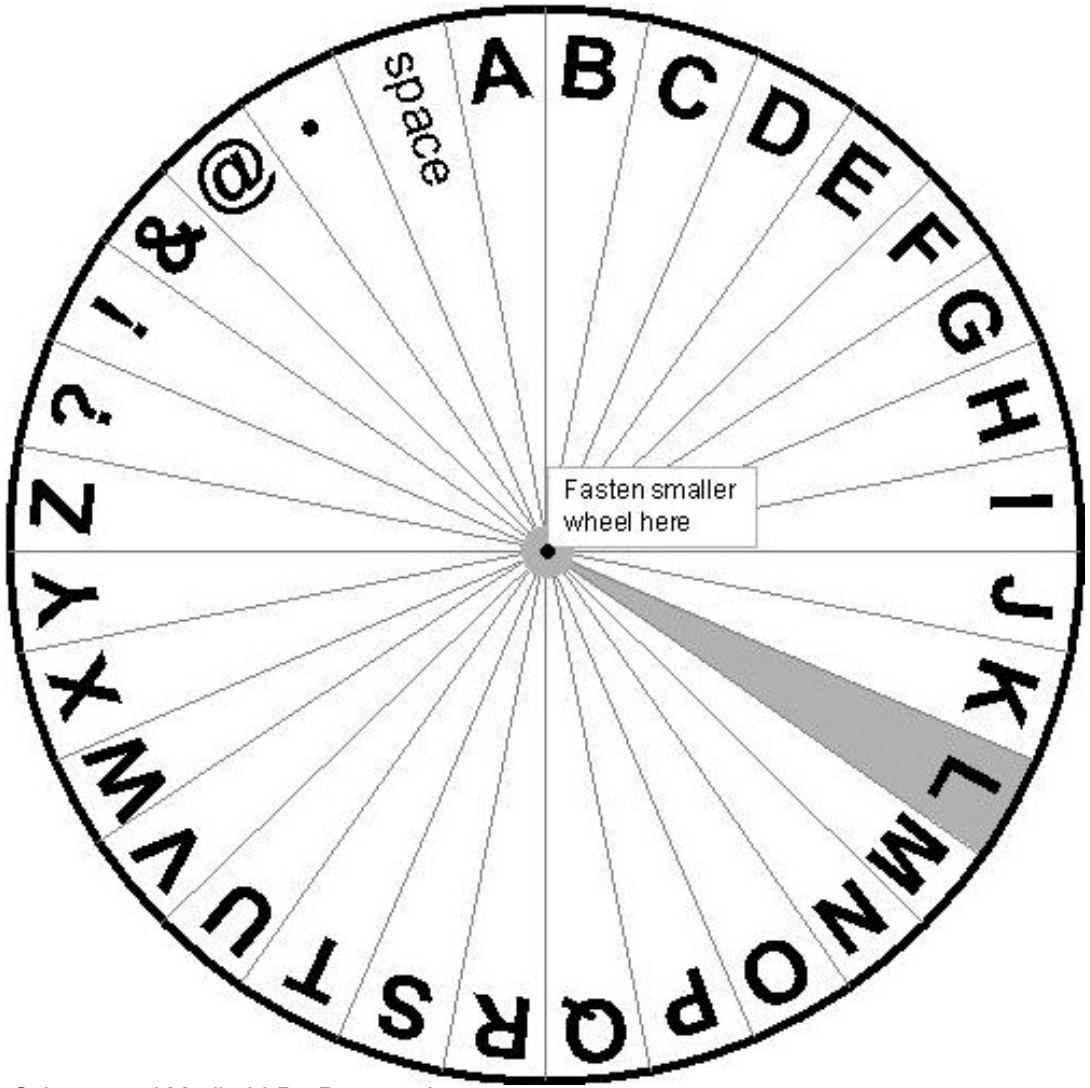
- How do you think you could break a code made with this code wheel?

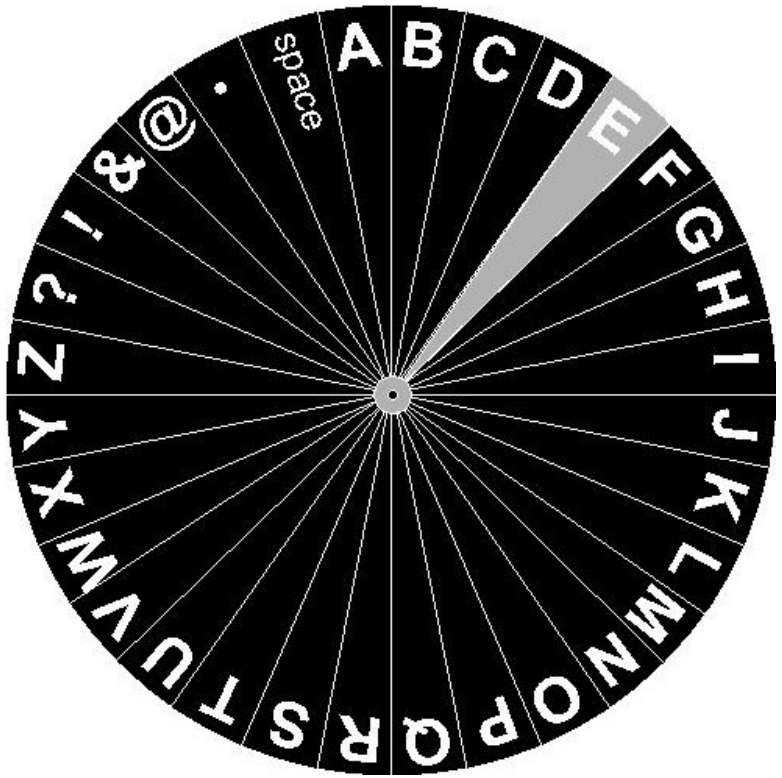
Frequency analysis is the most direct method. This is where the frequency of individual letters (or combinations of letters) in the ciphertext is studied to guess which 'real' letters or words they might represent.

For instance, in English the letter 'e' is common, as is the word 'the'. So, finding the letter in the ciphertext that occurs most often makes it a good candidate for representing 'e' in the original un-coded, message. Frequency analysis works best on larger messages. Ask students why this is.

the science of... SPYING

# Make a code wheel - code wheel components



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# Make a code wheel – activity sheet

1. Carefully cut out the code wheel components.
2. Place the black wheel on top of the white one, and fasten them together being careful to line up the two letters that are highlighted in grey (the 'L' on the white wheel and the 'E' on the black wheel)
3. Decode the following coded message:

**P@YZK@YGHMYZEHG@**

To do this:

- Take each letter or symbol in the coded message and find it on the black wheel
- Replace it with the corresponding letter or symbol on the white wheel
- Use the table below to help you. The first three parts of the message have been decoded to get you started

| **Code** | P | @ | Y | Z | K | @ | Y | G | H | M | Y | Z | E | H | G | @ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Message** | W | E | __ | | | | | | | | | | | | | |

4. Now you have *decoded* a message try the reverse process by *encoding* these two messages:
   - Message 1: **Find the clue**
   - Message 2: **Are you happy?**

   To do this:
   - Take each letter or symbol in the message and find it on the white wheel
   - Replace it with the corresponding letter on the black wheel
   - Use the tables below to help you.

| **Message** | F | I | N | D | __ | T | H | E | __ | C | L | U | E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Code** | • | B | G | | | | | | | | | | |

| **Message** | A | R | E | __ | Y | O | U | __ | H | A | P | P | Y | ? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Code** | | | | | | | | | | | | | | |

5. Think of, and encode your own message. Now pass it to a classmate to decode.
6. If you have time, try lining up the letter E on the black wheel with a different letter on the white wheel before coding a message.