

AIMING FOR
AWESOME

2018

1918



Code breaking

Student's
Guide



ROYAL
ACADEMY OF
ENGINEERING



The aim of this resource is to give students the opportunity to investigate the impact of science, technology, engineering and mathematics (STEM) on code breaking and security.

Espionage

Following the Second World War, tension increased between the Eastern Bloc (the Soviet Union and its satellite states) and the Western Bloc (the USA and its NATO allies).

This period was called the 'Cold War' because there was no fighting between the two sides. The Cold War started after the Second World War and lasted into the 1990s. However, its height was in the 1960s.

Secrecy and spying, or espionage, were a big part of the tension in Europe during this period. There are three main features to the espionage operations that took place during the Cold War:

- » The collection of documents and evidence by the spies.
- » Counter intelligence.
- » Covert operations.

In films and television, spies are shown as glamorous individuals who have exciting adventures. In reality, spies were people who led ordinary lives, and did not stand out from the crowd. They did not want to draw attention to what they were doing, especially as they usually worked on or had connections with top secret work.

TIME TO MAKE

There are many ways to code, or encrypt, a message to keep it a secret from your enemies.

One way to encrypt your message is to use a substitution cypher, which replaces one letter with another. There are many ways that you can use this cipher but the easiest is substituting for the next letter in the alphabet, this is called Caesar Shift 2. For example, 'a' becomes 'b', 'b' becomes 'c' and so on.

If you wanted to encrypt the word 'engineering' using this cipher it will become 'fohjoffsjoh'.

- » Try encrypting your name using this cipher.
- » What would your name be if you encrypted using a Caesar shift 2, where each letter is substituted with the letter two places along in the alphabet?

Working out each letter individually is very time consuming. To speed up the process you could encrypt the alphabet first.

To make a machine to encrypt the alphabet you will need:

- » Card or cardboard
- » Split pin
- » Code breaking support sheet one

Method

1. Stick the support sheet onto card or cardboard and then cut out the code wheels.
2. Fix the smaller wheel inside the larger wheel, securing it with a split pin.
3. You can now spin the inner wheel so that it matches a different letter on the outer wheel.
4. Write a message you would like to send to a friend.
5. Find the letters for your message on the inner wheel. Use its partner on the outer wheel to write it in code.

Use Caesar Shift 14 to send your coded message to a friend. Can you decode the message they sent to you?

To decode the message, you must find each letter in the outer wheel and write down its partner in the inner wheel.

STRETCH AND CHALLENGE

To ensure easy transfer of messages, the same encryption would be used for all messages in a day.

The encryption would change each day at midnight to stop the other side from working out the encryption and decoding all the messages.

You have intercepted a message that says:

D NZIO TJP V AJJY KVXFVBZ WT XVM

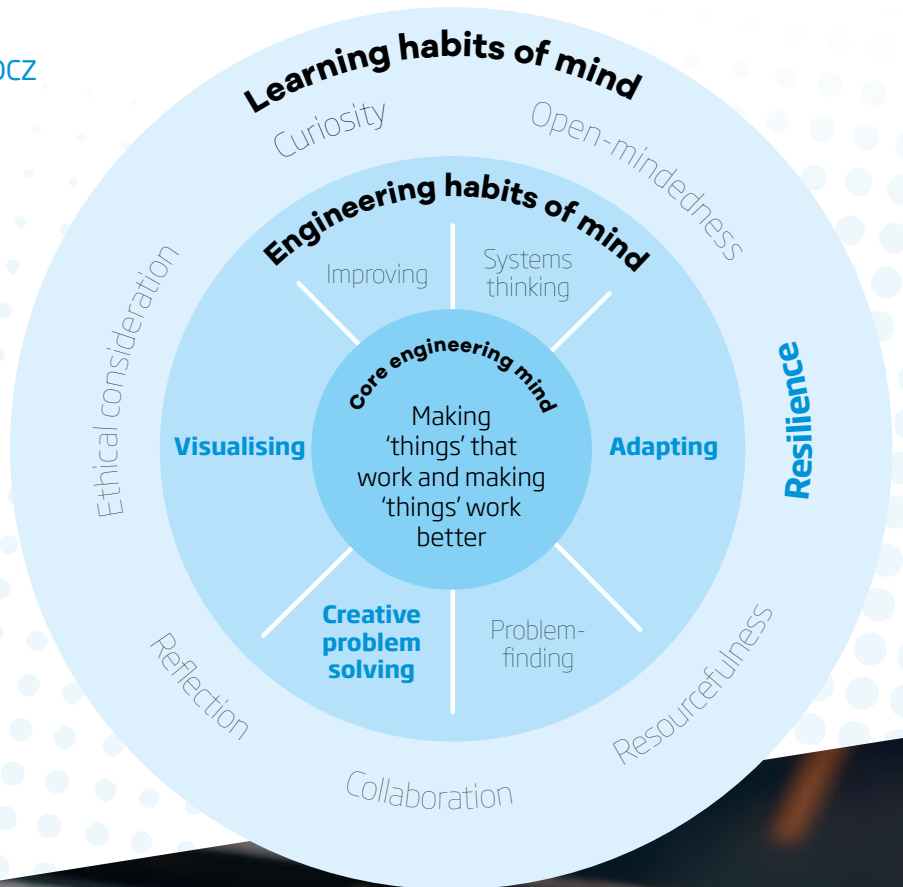
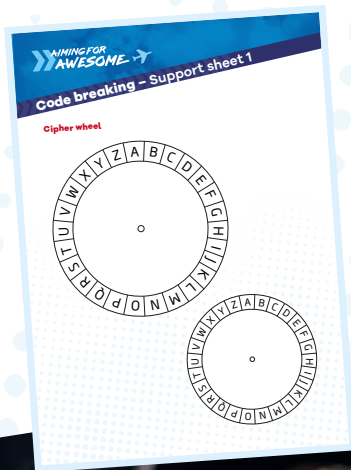
Work out what the message says and therefore the encryption code.

Now you know today's encryption key, you can decode all the messages for the day. What do these messages say?

1. [OCZ XVM RDGG YZGDQZM OCZ KVXFVBZ OJ NXCJJG](#)
2. [OCZ AJJY KVXFVBZ XJOVDIN V HVK](#)
3. [OCZ HVK RDGG NCJR OCZ GJCVODJI JA OCZ NZXMZO GVWJMVJMT](#)

With today's encryption key, you can now send false messages to confuse enemy spies. Code a message with today's encryption key and send it to a friend to make them think that the delivery location has changed.

Decoding each message letter by letter can be time consuming. Use Excel to create an automatic decoder.





ROYAL ACADEMY OF ENGINEERING

Royal Academy of Engineering

As the UK's national academy for engineering, we bring together the most successful and talented engineers for a shared purpose: to advance and promote excellence in engineering.

We have four strategic challenges:

Make the UK the leading nation for engineering innovation

Supporting the development of successful engineering innovation and businesses in the UK in order to create wealth, employment and benefit for the nation.

Address the engineering skills crisis

Meeting the UK's needs by inspiring a generation of young people from all backgrounds and equipping them with the high quality skills they need for a rewarding career in engineering.

Position engineering at the heart of society

Improving public awareness and recognition of the crucial role of engineers everywhere.

Lead the profession

Harnessing the expertise, energy and capacity of the profession to provide strategic direction for engineering and collaborate on solutions to engineering grand challenges.



The RAF 100 Youth & STEM programme has been designed to engage and inspire young people by building their interest in engineering and technical career pathways.

From cyber specialists to aerospace, aviation, electronics and mechanical disciplines, the RAF is committed to using our centenary celebrations to extend opportunity to all and to encourage greater diversity in this critical area of national skills shortages.



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