AIMING FOR AWESOME

1918

2018

Code breaking

Student Booklet

Royal Academy of Engineering

THIS IS ENGINEERING

ROYAL AIR FORCE Youth STEM

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.

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:
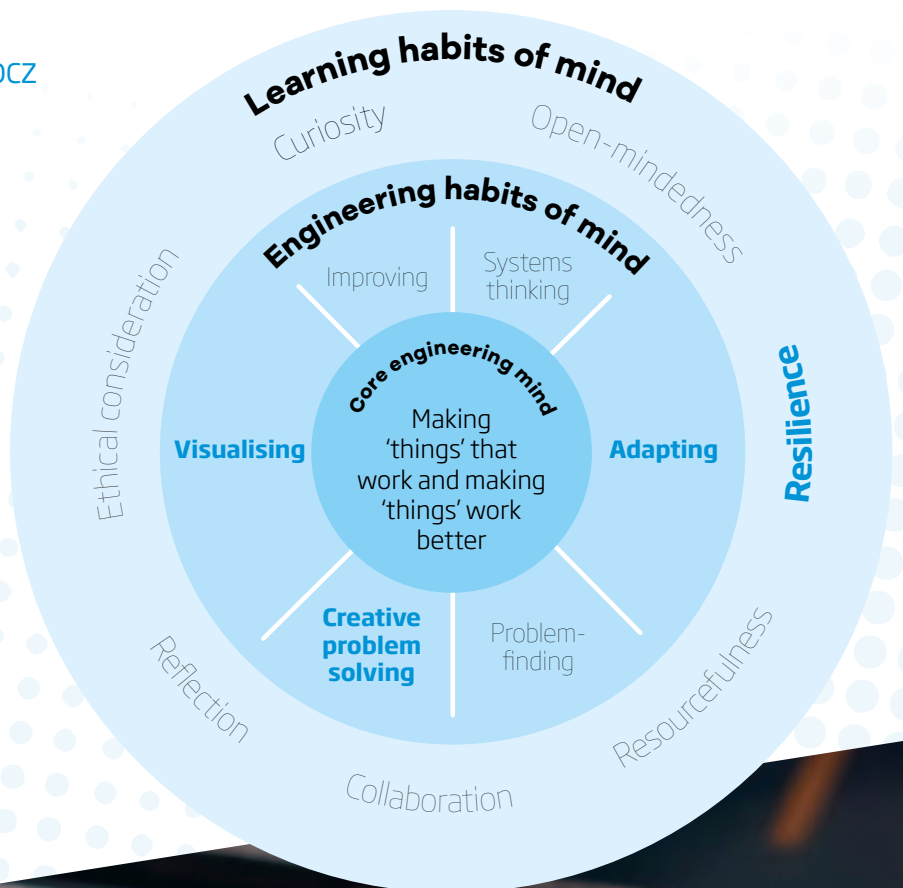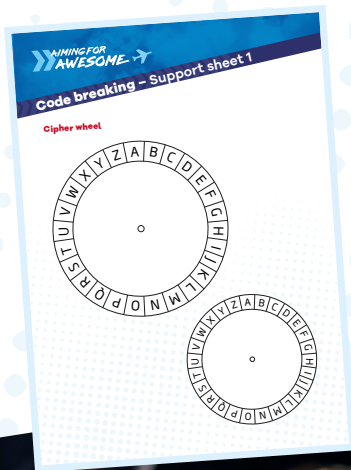
D NZIO TJP V AJJY KVXFVBZ WT XVM

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 GVWJMVOJMT

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.

Learning habits of mind
Curiosity
Open-mindedness
Engineering habits of mind
Ethical consideration
Improving
Systems thinking
Core engineering mind
Visualising
Making 'things' that work and making 'things' work better
Adapting
Resilience
Creative problem solving
Problem-finding
Reflection
Resourcefulness
Collaboration

Code breaking

Royal Academy of Engineering

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

What we do

Talent & diversity

We're growing talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession.

We're developing skills for the future by identifying the challenges of an ever-changing world and developing the skills and approaches we need to build a resilient and diverse engineering profession.

Innovation

We're driving innovation by investing in some of the country's most creative and exciting engineering ideas and businesses.

We're building global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to collaborate on creative innovations that address the greatest global challenges of our age.

Policy & engagement

We're influencing policy through the National Engineering Policy Centre – providing independent expert support to policymakers on issues of importance.

We're engaging the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers.

ROYAL AIR FORCE
Youth STEM

The RAF Youth STEM programme is 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 widening participation in STEM, extending opportunities to all, and encouraging greater diversity in this critical area of national skills shortages.