





GCHQ

Language, History, Maths and Computer Science





Introduction

What is GCHQ?

- GCHQ is the UK's intelligence, security and cyber agency
- Its mission is to help keep the country safe

Task:

- See if you can work out what some of the jobs at GCHQ are by matching the job title with the correct definition on your worksheet



Why is GCHQ Important?

GCHQ's Five Mission Areas:

Counter Terrorism	Cyber Security	Strategic advantage	Serious and organised crime	Support to defence
Stopping terrorist attacks in the UK and against our interests overseas	Making the UK the safest place to live and do business online	Managing threats from overseas and promoting UK prosperity around the world	Reducing the social and financial harm that serious and organized crime causes to the UK	Protecting the UK Armed Forces and their assets

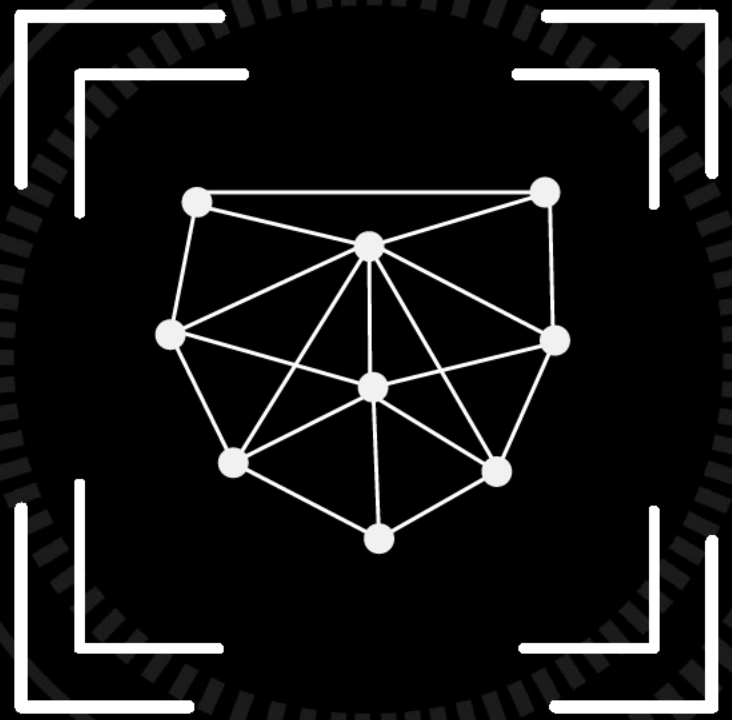
Introduction

GCHQ utilises skills from lots of different subjects in lots of different ways.

Today you will learn about and practice some skills that you use in:

- Languages
- History
- Maths
- Computer Science

- As well as this, you will explore how GCHQ uses these subjects and the history of GCHQ as an organisation.



Choice of Tasks

Select a task, by clicking on an option.

Language Task

History Task

Maths Task

Computer Science Task



Language Task - Ciphers

- During WW2 messages would be encrypted so that if enemies intercepted them, they wouldn't be able to read them without a key.
- One of the roles of GCHQ during WW2 was to try and decrypt messages sent by Britain's enemies. When something is encrypted, words or phrases, or even a whole message is translated into different letters or numbers - like a different language.
- One of the most well-known ciphers is the A1Z26 cipher.
- This is where each letter of the alphabet is replaced by a number. So, in this case, A = 1 and B = 2. This goes all the way to Z = 26.
- For example, some called John Smith would write their name as:

10-15-8-14 19-13-9-20-8

J O H N S M I T H

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Language Task

- On the worksheet, have a go and translating your name into numbers using the A1Z26 cipher

1	2	3	4	5	6	7	8	9	10	11	12	13
A	B	C	D	E	F	G	H	I	J	K	L	M

14	15	16	17	18	19	20	21	22	23	24	25	26
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

Your name: _____

Your encrypted name: _____

- Then have a go at creating your own cipher

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Language Task

- In this example, numbers are kind of like a language and so deciphering something is like translating something from one language into a language you understand.
- And this is what Britain had to do during WW2 when they were at war with Nazi Germany.

Decipher:
To crack codes or puzzles in order to understand secret messages.



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Language Task

- However, the Nazi's weren't sending messages in German, which could have easily been translated into English.
- Instead, Nazis encrypted their messages using a cipher machine called Enigma so that countries like Britain couldn't read them.
- But this was like translating the message into a brand-new, made-up language which only the Nazis knew.
- So, it was the Government Code and Cypher School's (or GCHQ as it is now known) job to try and work out a way to 'translate' this new language.



Enigma Machine





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Language Task

Final task:

- You need to find out some information about 3 important people in GCHQ's history
- Unfortunately, their name and some of the information about them has been encrypted using a cipher
- In order to answer the questions about the people, you will first need to decipher the names and information of the three people
- But, there are some letters missing from the cipher key
- As you fill in the letters you know, you might have to think what other letters could go in the gaps
- When you figure out the gaps, you should be able to complete the cipher key and decipher the rest of the information

Encryption:
A way of changing information into a secret code so that only certain people can read it. GCHQ uses encryption to protect important information and keep it safe from anyone who shouldn't see it.

Cipher:
A secret code used to hide the real meaning of a message. At GCHQ, ciphers are used to protect information or to decode messages from others to understand what they're saying.

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Language and GCHQ

- Language is an important part of how GCHQ keeps Britain safe from threats
- There are lots of languages in the world and sometimes there are threats in language which need translating
- This is what GCHQ's Language Specialists do
- You can learn more about language specialists and what they do here: https://www.gchq-careers.co.uk/our-careers/specialist-roles/language-specialists.html

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History Task

- This activity is an ‘Escape Room’. You are trapped in Bletchley Park, where GCHQ was founded, and need to ‘escape’ by completing the following mission:

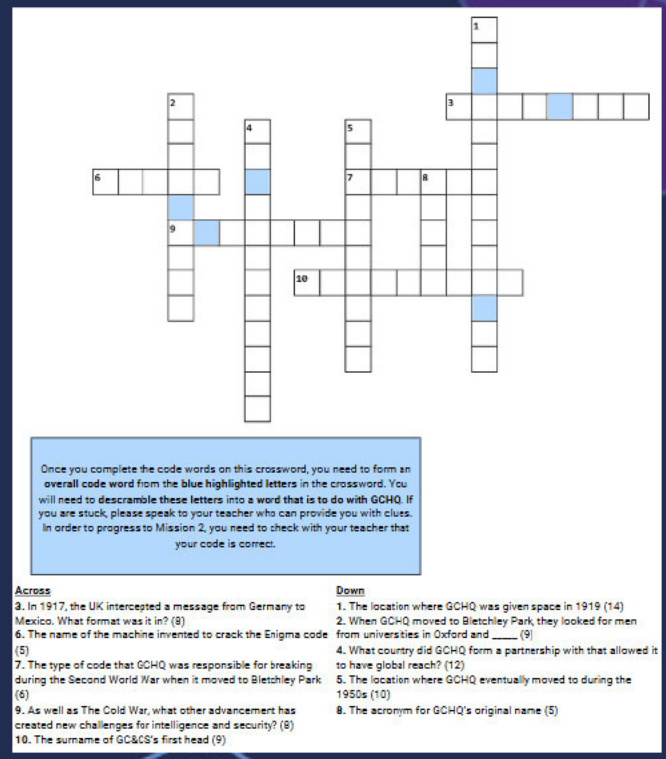
- **Step 1:** You need to read the information about the history of GCHQ

- **Step 2:** Complete the crossword using the information you have read.

- **Step 3:** Once you complete the crossword, use each letter highlighted in blue to form a code word related to GCHQ.

- **Step 4:** When you have worked out the code word, let your teacher know.
  If stuck, please ask your teacher for clues (which are in the teacher pack) as well as answers.





Once you complete the code words on this crossword, you need to form an **overall code word** from the **blue highlighted letters** in the crossword. You will need to **descramble these letters** into a **word that is to do with GCHQ**. If you are stuck, please speak to your teacher who can provide you with clues. In order to progress to Mission 2, you need to check with your teacher that your code is correct.

Across

3. In 1917, the UK intercepted a message from Germany to Mexico. What format was it in? (8)
6. The name of the machine invented to crack the Enigma code (5)
7. The type of code that GCHQ was responsible for breaking during the Second World War when it moved to Bletchley Park (6)
9. As well as The Cold War, what other advancement has created new challenges for intelligence and security? (8)
10. The surname of GC&CS's first head (9)

Down

1. The location where GCHQ was given space in 1919 (14)
2. When GCHQ moved to Bletchley Park, they looked for men from universities in Oxford and _____ (9)
4. What country did GCHQ form a partnership with that allowed it to have global reach? (12)
5. The location where GCHQ eventually moved to during the 1950s (10)
8. The acronym for GCHQ's original name (5)

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History Task

Extension Task:

- For this next mission, you need to create a timeline about the history of GCHQ over time.
- **Step 1:** Using your answers and the information from the first mission, identify which events took place during each of the dates
- **Step 2:** Add a 2-sentence description about each event in the correct box on your timeline. **Make sure to include all the answers from the crossword**!
- **Step 3:** When you have filled out the timeline, circle the ten crossword answers you have included to escape.

Timeline:
A timeline shows the order of events that happened in history by marking them along a line.



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History and GCHQ

There are lots of skills that history teaches you, such as:

- Interpretation
- Investigation
- Chronological understanding
- Comprehension
- Knowledge of and understanding of events
- Knowledge of people and changes in the past
- Gathering, organising, presenting and communicating information and ideas

All of these skills are important in GCHQ in investigating threats, knowing about past threats to make sure they don't happen again and communicating this information to others in a team.



Maths Task

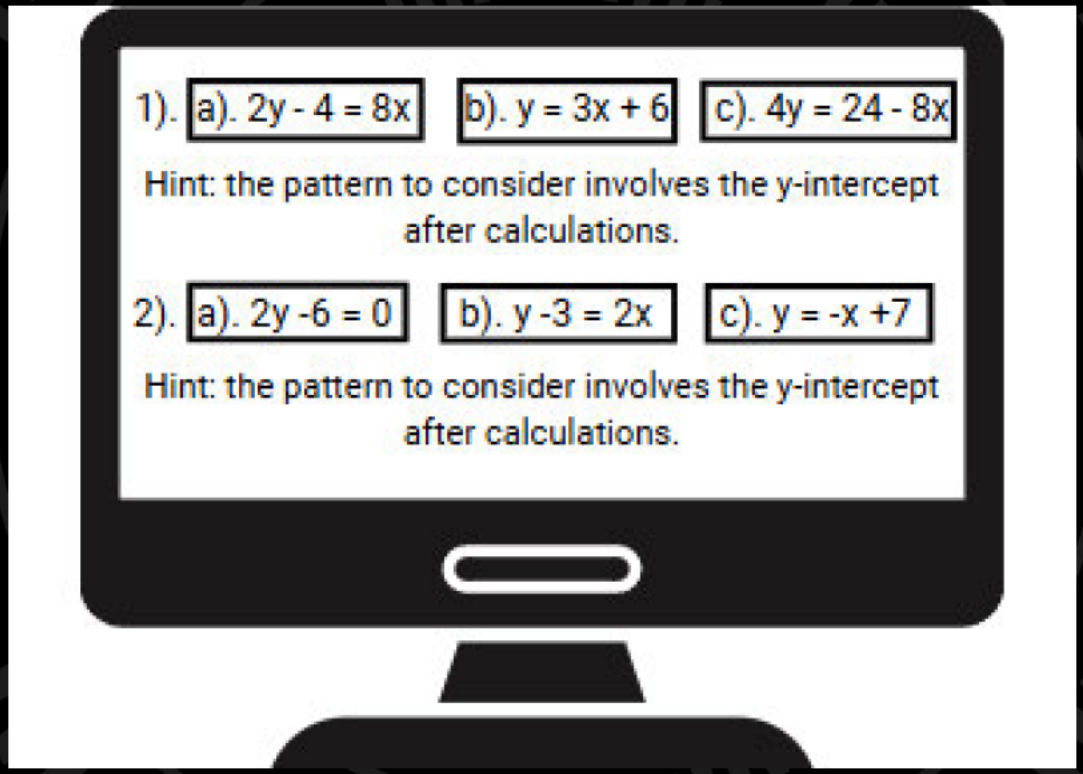
You have been presented with a new mission as shown on the worksheet.

You need to secure a bank system.

To do this, you will need to figure out which linear equation in each row is the odd one out, with a focus on y-intercepts.

This is a practice example, which you have 10 minutes to complete.

Hints have been provided. When you get onto your mission, your teacher will provide the hints to you, if needed.



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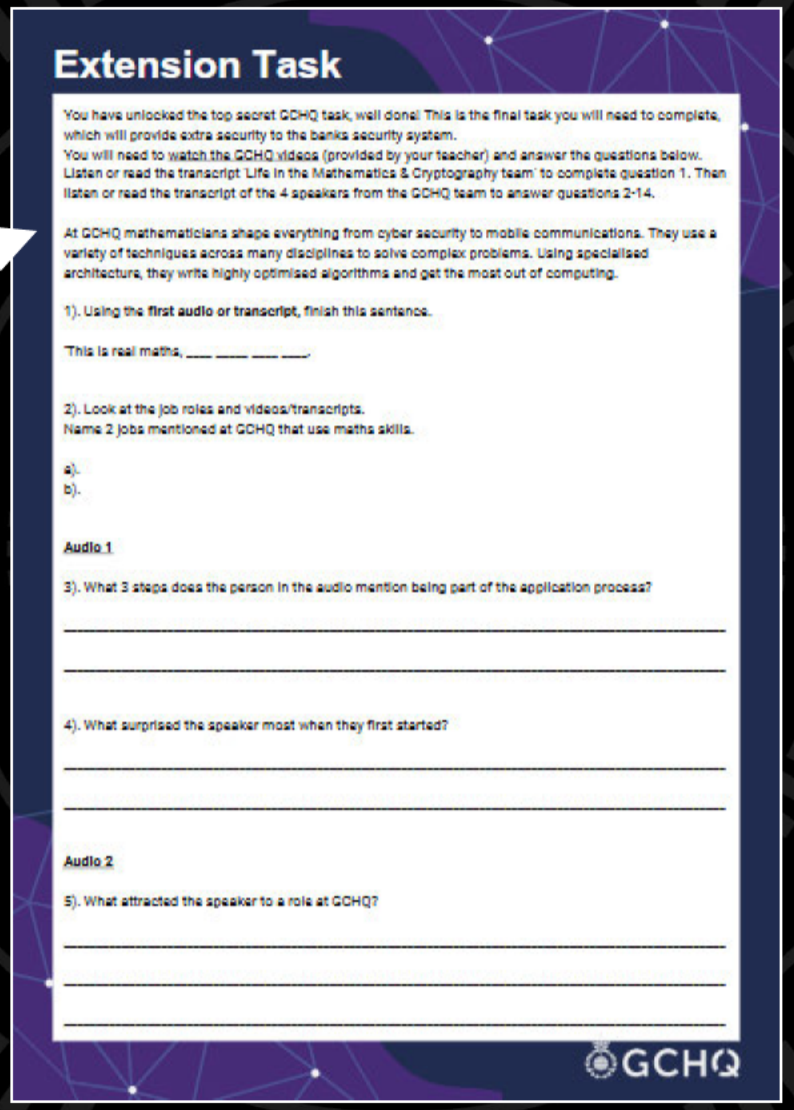
Maths Extension Task

Step 1:
Read through the instructions at the top of your worksheet.

Step 2:
Watch/listen/read what your teachers provides for you.

Step 3:
Answer the questions on your worksheet.



Extension Task

You have unlocked the top secret GCHQ task, well done! This is the final task you will need to complete, which will provide extra security to the banks security system.
You will need to watch the GCHQ videos (provided by your teacher) and answer the questions below. Listen or read the transcript 'Life in the Mathematics & Cryptography team' to complete question 1. Then listen or read the transcript of the 4 speakers from the GCHQ team to answer questions 2-14.

At GCHQ mathematicians shape everything from cyber security to mobile communications. They use a variety of techniques across many disciplines to solve complex problems. Using specialised architecture, they write highly optimised algorithms and get the most out of computing.

1). Using the **first audio or transcript**, finish this sentence.

'This is real maths, ____ ____ ____ ____.'

2). Look at the job roles and videos/transcripts.
Name 2 jobs mentioned at GCHQ that use maths skills.

a).
b).

Audio 1

3). What 3 steps does the person in the audio mention being part of the application process?

_____

_____

4). What surprised the speaker most when they first started?

_____

_____

Audio 2

5). What attracted the speaker to a role at GCHQ?

_____

_____

_____

GCHQ

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Maths and GCHQ

- Mathematics is really useful in cryptography and cybersecurity, providing tools to secure systems, analyse data, protect sensitive information and detect anomalies in data.
- During the covid-19 pandemic, the National Cyber Security Centre (NCSC) which is part of GCHQ, played a vital role ensuring the NHS and more widely, the Health sector, kept their systems secure and protected from cyber threats.
- If, for example, the NHS' data was at risk, one way threats to cybersecurity can be identified is by using linear algebra to analyse patterns in data and detect deviations in data, which can signify a cyber threat. Especially when dealing with large data sets or encrypted messages.

Cryptography:
The science of creating and solving secret codes to keep information safe. At GCHQ, cryptography is used to protect sensitive information and to decode messages that could help keep the country secure.

Cyber security:
Protecting computers, networks, and online information from being accessed or damaged by hackers. At GCHQ, cyber security helps keep important data and systems safe from online threats.

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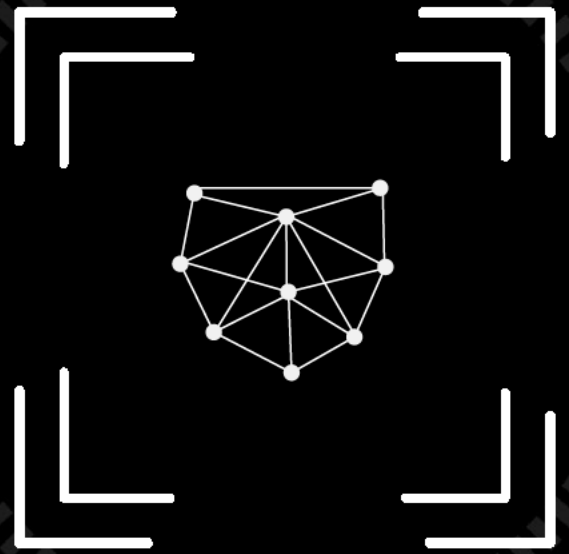
Maths and GCHQ

- Maths is an important subject for lots of jobs within GCHQ
- Within cryptography, GCHQ combines mathematical ideas with computer security skills to find weaknesses in their systems, hardware and protocols
- GCHQ needs to be able to recognize patterns in large data sets, in order to detect anomalies and understand what the data is i.e. Does the data indicate a cyber threat?
- GCHQ handles lots of statistics and it takes a lot of maths to be able to pull together the data, present it in an understandable way and to learn what the data is telling us



Find out more about how GCHQ uses maths here:
https://www.gchq-careers.co.uk/our-careers/specialist-roles/mathematics-cryptography.html

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Computer Science Task

- For this next activity, we are going to be learning about computer programs
- We are also going to be learning about how they work
- But first… we need two volunteers!

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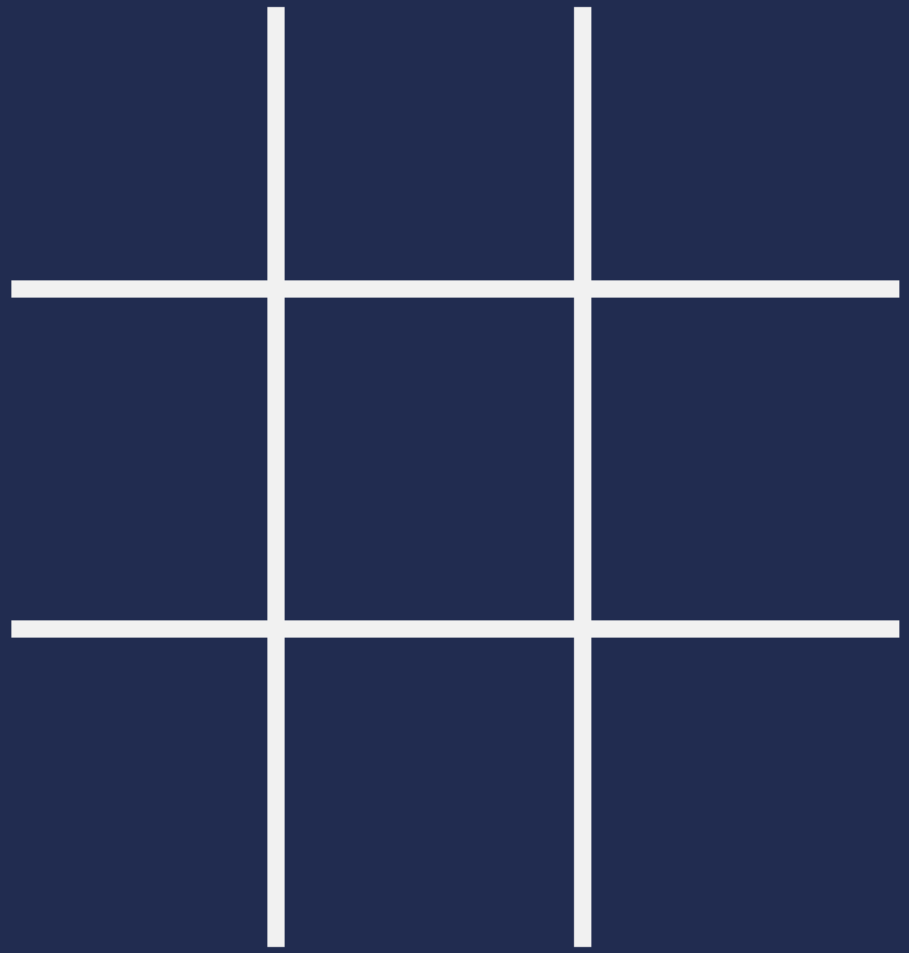
Computer Science Task

Noughts and Crosses board:



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Computer Science and GCHQ

- Computer programs are essentially instructions that computers should follow in certain situations.
- For example, a laptop is programmed so that when you press the ‘A’ key on the keyboard, it displays the letter ‘A’ on the screen.
- AI works in a similar way where we give it an instruction and it will respond in an appropriate way.
- However, AI is able to respond in smarter, more intelligent ways than traditional computer programs.

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Computer Science and GCHQ

- Remember the intelligent piece of paper?
- Its instructions included words like ‘IF’ and ‘THEN’ and ‘ELSE’
- This is similar to how computer programs work because they are being told ‘IF’ something is the case, ‘THEN’ respond in a certain way.
- AI systems though, are a little more intelligent than this and can handle more complex problems and find solutions to them.
- AI can be used as a tool to tackle specific problems that require skills normally only available to humans. For example, analysing images, translating languages, manipulating objects, or making simple decisions
- However, AI is a long way from what me might see in films like Iron Man and the ‘J.A.R.V.I.S’ AI we see in that.



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Computer Science and GCHQ

- GCHQ is exploring different ways that AI can help keep our country safe from a number of threats

- For example, AI could help combat cyber threats by:
  - Helping to identify malicious software by analysing large amounts of data quickly (quicker than a human could)
  - Helping us to increase our knowledge of what malicious software looks like and does, as it keeps changing and updating
  - Helping us to trace malicious software to its origin so we can take threats down at the source
  - Helping us find holes in our own security so we know where they are and fix them before treats find them
- Find out more about how GCHQ is using AI to help keep the country safe

Malicious:
Something that intends or wants to do harm to something else.

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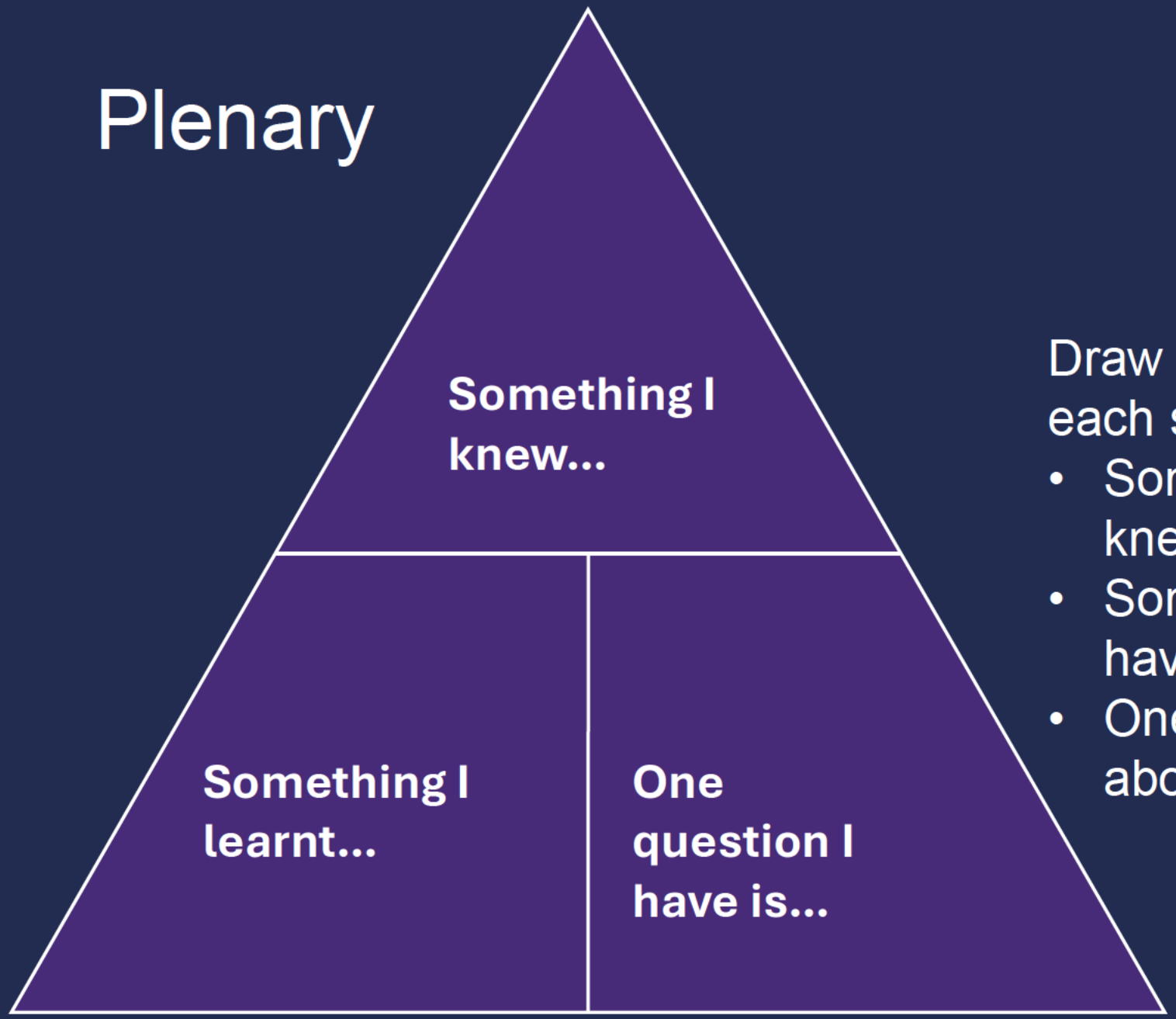
Plenary



Draw the triangle and fill in each section with:

- Something you already knew about GCHQ
- Something new you have learnt
- One question you have about GCHQ

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