**Introduction to cryptography**

**Lesson 1: What is cryptography?**

**Introduction**

In this lesson students develop their understanding of cryptography, encryption and ciphers. They learn how they have been used over time, focusing on 3 different ciphers and learning about Turing and code-breaking during World War Two. They crack and create ciphers, developing their abilities to use logical reasoning to solve problems.

**Time:** approx. 60 minutes

**Learning objectives**

* To know what cryptography is and how it has been used over time to encrypt data and information
* To create and solve ciphers using logical reasoning
* To appreciate the importance of code breaking in World War Two through learning about Alan Turing

**Materials needed:** Lesson plan, lesson guide, code cracking sheets for pairs, code cracker stickers, rough paper.

**Lesson summary**

1. Crack the code (5 minutes)
2. Cryptography & ciphers (15 minutes)
3. Create and break ciphers (15 minutes)
4. Code breaking in WWII (15 minutes)
5. Encryption in our lives today (5 minutes)
6. Review & wrap up (5 minutes)

**Introduction: Crack the code (5 minutes)**

* Give out copies of the **code cracking sheet** to pairs and ask students to crack the code (slide 2)
* Discuss as a class and award some **code cracking stickers** to the pair who cracks it first if you wish (solution on **slide 3**).
* Highlight they had to use the computational skill of logical reasoning to problem solve and work out the code (**slide 4**) and get them to think/pair/share *how* they worked it out.
* Share the learning objectives on **slide 5** if you wish.

**Introduction: Cryptography & ciphers (10 minutes)**

* Invite students to share their current understanding of cryptography and use **slide 6** to support class discussion.
* Ask students to discuss in small groups, then share any examples of code breaking/ciphers they know (they may have come across them in Maths for example).
* Highlight they used a substitution cipher in the first exercise (letters were substituted by Roman numerals).
* Use **slides 7-9** to introduce and discuss different types of ciphers (Pigpen, Atbash, Caesar).
* Ask students to consider what was technically incorrect about the cipher they used in the first task *(Augustus was an Emperor after Caesar, so would probably have used his great-uncle’s shift cipher, rather than a substitution cipher. The Caesar cipher was used for hundreds of years after Caesar’s death!).*

**Create and break ciphers (15 minutes)**

* In pairs or individually, ask students to complete the cipher challenge task B on their sheet (**slide 10**).
* Share their learnings as a class, encouraging students to consider *how* they solved the cipher, thus developing their understanding of logical reasoning (**slide 11**).

**Code breaking in WW2 (15 minutes)**

* Explain to students that they have already seen how ciphers and cryptography have been used in history.
* Highlight that one of the most recent and famous examples is during World War Two and invite them to think/pair/share their knowledge and understanding around code breaking in WW2 (**slide 12**).
* Give students 10 minutes individually or in pairs to research the story around Turing, Enigma and Bletchley park, make brief notes and discuss as a class. You could ask them to make rough notes, a slide or 1 page summary, depending on your preference.
* This is also an opportunity to bring PSHE into your lesson if you discuss Turing’s prosecution.

**Encryption in our lives today (5 minutes)**

* Use **slide 13** to lead a discussion to highlight how encryption remains very important in our lives today, linking to previous cyber security lessons on hacking.
* Invite students’ examples of how they / their parents rely on encryption for safety of personal data and information.

**Review and wrap up (5 minutes)**

* Invite students to think/pair/share the questions on **slide 14** and review the learning objectives if you wish on **slide 15**.

**Extension**

* Students could create a class display on cryptography and/or the Enigma story with students conducting additional research and creating suitable display materials (e.g. a timeline, posters, example ciphers)
* You could watch The Imitation Game (certificate 12A) as a class.
* You could ask students to make a note of instances where they think encryption is being used in their lives over the next week and discuss as a class at the start of next lesson.

**Differentiation**

**Support:**

* Students can be given simpler codes to crack according to their ability if needed. They may find one cipher easier to work with and so should focus on creating a simple code. Working in supportive pairings may also help.
* Students may find it challenging to articulate how they have cracked codes (logical reasoning), so reward attempts generously.

**Stretch & challenge:**

* You could ask students to write an algorithm for how to solve a substitution cipher.
* Students could explore the Mathematical code cracking challenges on: <https://nrich.maths.org/2197>

**Opportunities for assessment:**

* Informal observation of students’ responses during the activities.
* Informal assessment of logical reasoning from responses to questions and cipher creation and solving.
* More formal assessment of students’ research and ciphers if wished.