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|  | **Founding Communications** |
| **Code breaking with the Rosetta Stone** |
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| Learn about spies and codes |
| **Subjects:** Science, Design & Technology, Mathematics**Approx time:** 10 minutes |  | **Key words / Topics:*** Encode
* Decode
* Frequency
* Signal
* Substitution code
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| **Stay safe** Whether you are a scientist researching a new medicine or an engineer solving climate change, safety always comes first. An adult must always be around and supervising when doing this activity. You are responsible for: •        ensuring that any equipment used for this activity is in good working condition•        behaving sensibly and following any safety instructions so as not to hurt or injure yourself or others  Please note that in the absence of any negligence or other breach of duty by us, this activity is carried out at your own risk. It is important to take extra care at the stages marked with this symbol: ⚠ |
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| **Suggested Learning Outcomes**  |  |  |
| * Understand how mathematics can be used to break encryption
* Understand how to collect and represent frequency statistics e.g. of individual letters in English words
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| **Introduction**  |  |  |
| From founding communications, such as the fire beacon, to being able to communicate with space, there is no denying that developments in communication have advanced at a rapid speed. This topic presents students with communications of the past, present and future, helping them to understand the principles that form the basis for these developments.The discovery of the Rosetta Stone was a complete breakthrough in deciphering Egyptian hieroglyphs. It dates from the 2nd century BC and was a text written by priests to honour a pharaoh. At this time, Egypt was ruled by the Greeks, so the text was written on the stone in two languages and in three different scripts: hieroglyphs (used by priests for important documents), demotic script; the written form of the Coptic language (used by common people); and Greek script (used by the foreign rulers).The stone gave parallel text so the Coptic/demotic script could be translated. This then gave big clues as to the meaning of the hieroglyphs and more informed guesses could thus be made about their meanings. This discovery was the first big breakthrough in translating unknown written languages and these methods have been used in code-breaking ever since. |
| **Purpose of this activity** |
| The ‘Rosetta code 1’ and ‘Rosetta code 2’ activities introduce students to a mathematical solution to code breaking by using a simple substitution code. Students will make a survey using the frequency of letters in English sentences, match up an encoded passage to these frequencies and then apply common sense to make a coherent message from what is decoded. |

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| **Activity**  |  | **Teacher notes** |
| 1. Have a class discussion to gauge student awareness of the following:* Hieroglyphs
* Rosetta Stone
* That the Rosetta stone is at the British Museum in London
* Second World War code breakers
* Bletchley Park
* The Enigma machine
* Alan Turing
* First use of computers

2. Distribute **Rosetta Stone** handoutto the students.icon-doc **Rosetta Stone (Handout).**The students can work individually or in groups.Students will learn about spies and codes. The story will fill in gaps in knowledge about how codes are broken. |  | *10 minutes*The story in the **Rosetta Stone** handout is reasonably easy to read and should be within the grasp of most students.The structured questions associated with the story would work as a starter activity. The students can work individually on paper or this could be used as a class activity. |
| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| The Code breaking with the Rosetta Stone activity can be made more accessible if the text is read to the students. Students should work in groups for additional support. |  | Use the **Analogue and Digital** presentation as an extension, discussing how this may affect the transmission of information and the ability to interpret it. Discuss and investigate possible sources of interference to electromagnetic or telephone wire signals.icon-ppt **Analogue and Digital** **(Presentation)** |
| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| The Code breaking with the Rosetta Stone activity can be made more accessible if the text is read to the students. Students should work in groups for additional support. |  | icon-doc **Rosetta Stone (Handout)**icon-ppt **Analogue and Digital** **(Presentation)** |
| **Additional websites*** Wikipedia ([www.wikipedia.org](http://www.wikipedia.org)): Information on the Rosetta Stone (<http://en.wikipedia.org/wiki/Rosetta_stone>).
* Ancient Egypt ([www.ancientegypt.co.uk](http://www.ancientegypt.co.uk/writing/rosetta.html)): The story of the Rosetta Stone can be found within the ‘Writing’ section of the website (<http://www.ancientegypt.co.uk/writing/rosetta.html>).
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| **Related activities (to build a full lesson)** |  |  |
| **Starters**  * ACTIVITY:Rosetta Code 1
* DISCUSSION: Another starter would be a discussion of codes and code breaking. Let the students research the terms Ultra (Second World War), Enigma, and Bletchley Park.

**Main**  * ACTIVITY: **Rosetta Code 2**
 | **Extension*** ACTIVITY: **Analogue and digital.**

**Plenary*** A possible plenary of a discussion session is suggested in the teacher notes for the substitution codes activity.
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| **The Engineering Context** film |
| * **The story:** Communications of the future
* **Communications technology being used today:** Radar - Communications for safety
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| **Curriculum links**  |
| **England: National Curriculum**Science* KS4 1b, 2a, 7d

Design & Technology * KS3 3d

Mathematics* KS3 9a

  | **Northern Ireland Curriculum**ScienceKS3 and KS4 Developing Pupils’ Knowledge, Understanding and Skills* develop skills in scientific methods of enquiry to further scientific knowledge and understanding

KS3 and KS4 (Objective 2) Developing pupils as pupils as Contributors to Society* Cultural understanding: consider how the development of scientific ideas or theories relate to the historical or cultural context

Technology & DesignKS3 and KS4 Developing Pupils’ Knowledge, Understanding and Skills* Design
* Communication
* Manufacturing
* Control

KS3 and KS4 (Objective 1) Developing pupils as Individuals* respond to a personal design challenge

KS3 and KS4 (Objective 2) Developing pupils as Contributors to Society* Explore technical innovations
* Design cost-effective and appropriate solutions

KS3 and KS4 (Objective 3) Developing pupils as Contributors to the Economy and the Environment* Pursue design solutions
* Identify product needs and pursue sustainable harmonious design solutions in a local outdoor/indoor context
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| **Scotland: Curriculum for Excellence**Science* SCN 3-11a, SCN 4-11a, SCN 4-16a

Technologies* TCH 3-01a, TCH 3-09a, TCH 3-13a, TCH 3-14a, TCH 4-01aTCH 4-09a, TCH 4-12a, TCH 4-13a, TCH 4-14a, TCH 4-14b, TCH 4-14c, TCH 4-14d
* KS3 and KS4 TCH 3-01a, TCH 4-01a

Numeracy and Mathematics* MNU 3-03a, MNU 3-04a, MNU 3-07a, MNU 3-10a, MTH 3-11b, MNU 3-20a. MNU 4-01a, MNU 4-03a, MNU 4-10a, MNU 4-10b, MTH 4-11a, MTH4-11b, MTH 4-15a, MTH 4-17b
 | **Wales: National Curriculum** Science* KS3/4 Skills (Communication: 1, 2, 3 Planning: 1, 2), (Enquiry)
* KS3 Range (How things work: 3, 4, 5, 6)
* KS4 Skills (Data, evidence, theories and explanations 1,2,3), (Enquiry and practical skills: 1, 2, 3, 4)

Design and Technology* KS3 and KS4 Skills (Designing: 1, 2, 3, 4, 5, 6, 7, 8, 9), (Making: 1, 2, 3, 4)
* KS3 and KS4 Range (activities in which they investigate, analyse and evaluate products), (activities in which they learn about the responsible use of materials), (activities in which they develop and practise certain skills, activities in which they design and make products)

Mathematics* KS3 and KS4 Skills (Solve mathematical problems), (Communicate mathematically)
* KS3 Range (Number 2, 3), (Algebra 1)
* KS4 Range (Handling data)
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| **Assessment opportunities** |
| * Ask the students to compare their frequency count in the **Rosetta Code 2** activity with a frequency count from an internet source. Ask them to evaluate the validity of their evidence from a small sample of words.
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| **Personal, learning & thinking skills (PLTS)** |
| * Creative thinkers
* Team workers
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