Enigma: Cracking the Code

Key Learning Content

This film tells the story of The Enigma Machine, a device used for sending secret German messages in the Second World War. It relates how a team of code-breakers at Bletchley Park in England managed to crack the code, despite the great number of different coding permutations that Enigma allowed. The mathematics of The Enigma Machine is shown on screen. A full understanding of the permutations and combinations theory that lies behind the numbers is not necessary in order to understand the film.

Core Outcomes

Learning Points

- Be able to use code to transform one sequence of numbers or text into another.
- Be able to use index notation and index laws for multiplication of positive integer powers.

Suggested Activities

- Create codes by mapping each letter of the alphabet on to another and send messages using these codes.
- Work out how many different ways strings of letters of different lengths can be made.

The Enigma Code transformed typed plaintext into different encoded letters, or cyphertext.

Extension Outcomes

Learning Points

- Be able to understand and use estimates or measures of probability from theoretical and experimental models.
- Be able to use the theory of permutations and combinations to work out the likelihood of events.

Suggested Activities

- Sample a page of ordinary text to calculate the frequency of different lettersand use this to help crack codes.
- For any given method of coding, work out how many different ways a message can be coded.

Related Films

To use before the lesson plan:

Number Theory: Gauss	This film relates how one of the greatest ever mathematicians spent his life looking for patterns in numbers.

To use after the lesson plan:

Algorithms: Turing	This film gives an overview of Turing's work and his legacy.
Can Monkeys Write Shakespeare?	This film looks at the probability of an extremely unlikely yet possible event.
Binary: The Alien Language	This film tells the story of a probe sent into deep space which, in the event that it might be found by aliens, contained a coded message giving interstellar distances in binary.
Tank Wars	This film gives an example of how complex mathematics was used to help bring the Second World War to an end.
Perspective: Dazzle Camouflage	This film highlights the clever use of perspective to protect ships from submarine attack.
Benford's Very Strange Law	This film provides an interesting and surprising perspective on the frequency with which the numbers 0 to 9 appear in everyday life.

Guide Lesson Plan

Introduction

Write on the board: 'gnikcarc edoc od ew yadot' and ask the students to work out what the lesson is about. Give some context to code breaking and the Second World War before showing the film.

Show Film

Enigma: Cracking the Code

Main Activity

Foundation

Get students to make up their own version of an Enigma code by writing down the letters A to Z in one column, then writing down the same letters in a different order in a second column, so that each letter is paired up with only one other letter. Compose, code, send and decode messages with other students using these letter pairings.

Main Activity cont ...

Advanced

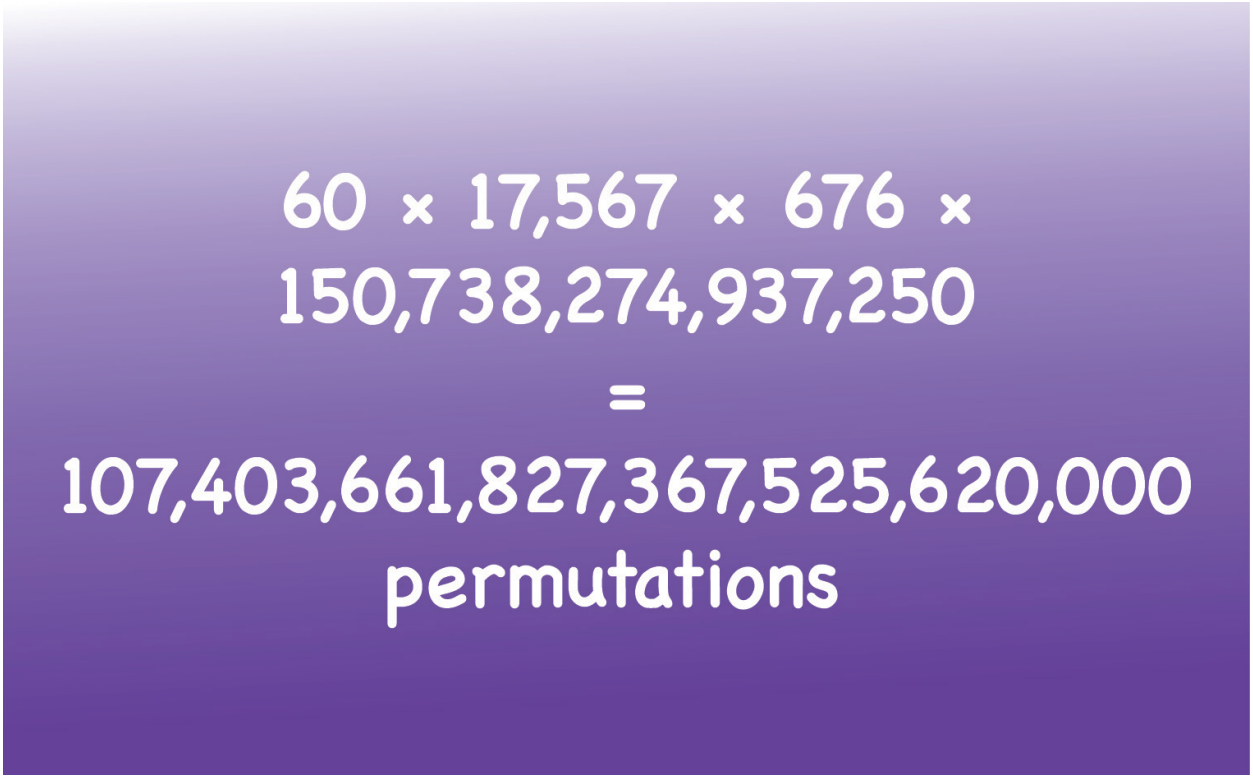
Get students to work out from first principles how many different arrangements of three letters are possible using the 26 letters of the alphabet, allowing repetition of letters and taking a different order of letters as a different arrangement. What is the answer for four letters, five letters, or n letters? Do the same exercise for combinations of numbers from 0 to 9.

Extension Activity

Take any page of text and count how often different letters appear. Then, by comparing the frequency of letters occurring, try to crack some of the codes used for sending messages earlier in the lesson. (Note: many word processing software packages allow letters to be highlighted or even counted automatically).

Optional Extra

There is a whole mathematical topic called Permutations and Combinations, with expressions such as nPr and nCr, which are found on most calculators. Give students the basic definitions of n!, nPr and nCr with examples, then set simple problems, e.g. How many different ways can the letters in the words BACON, EGGS and TOMATO be rearranged?



Enigma machines could disguise messages in over 100 billion trillion permutations.