Key Stage 3 – Encryption

Notes for teachers

At a glance

Light - there’s more to it than meets to the eye. Data from one computer is converted into super-fast pulses of light which can be sent down optical fibres to others all around the world. However, information sent via the internet is at risk from eavesdroppers - how can science help keep our secrets? In this computer science lesson students are introduced to encryption. They model the way that information is transmitted by the internet and try and protect their messages using different keys.

Learning Outcomes

- Students state what encryption means and describe why it is important
- Students can explain how information is transmitted over the internet
- Students can use simple encryption

Each student will need

- Copy of the pupil worksheet

You may also need (optional)

- Small LED/laser pointer
- Optical fibre
- Plastic bottle with small hole in the side

http://www.oxfordsparks.ox.ac.uk/run-for-your-light
**Possible Lesson Activities**

1. **Starter activity**
   - Before revealing the objectives, write on the board the word 'Noitpyrcne' (encryption backwards) and ask them to work out what this lesson is all about.
   - When they have solved this, ask them to come up with a definition of the term encryption. Explain that it means putting information into a code so only the people for whom the information is intended can understand it. Discuss the need for encryption when sending information over the internet.

2. **Main activity 1: Communication**
   - Tell the class that they are going to model sending information over the internet. Divide the class up into groups of three and ask them to think of a team name. Two students from each team sit at one end of the classroom and the remaining person at the opposite end. Tell them that they will be passing messages to each other. Assign two teams as 'eavesdroppers'. Their job is to try to intercept and read the messages.
   - Give the pairs in each team a small piece of paper. Ask them to write their team name and one secret word. One person from the pair must then walk to their teammate at the other end of the classroom and pass them the word to read. Inform the teams that anyone found running will immediately forfeit that word. The teammate should record the word on another piece of paper. Give the class 5 minutes for them to repeat this and pass on as many words as they can.
   - During this activity the members of the spy teams can intercept and stop anyone they wish and ask to see the word (but not take the piece of paper). They record the team name and their word on a piece of paper.
   - At the end of the 5 minutes the teams count up how many words they successfully passed between them. The eavesdroppers then read out which words they intercepted. For every word the eavesdroppers got, the team must remove that word from their list. The team with the highest number of words wins the round.

3. **Main activity 2: Using a code**
   - Discuss the fact that it was far too easy for the eavesdroppers to find out the secret words.
   - Give each student a copy of the pupil worksheet and ask them to read through the information on encryption.
   - Repeat the activity but this time teams use their choice of encryption to pass on keys and then the secret words. You can swap the teams that act as eavesdroppers for this round. Their task is now harder as they have to intercept and decode the words using the information on the pupil worksheet.
   - To extend the more able you could ask the students to think up their own ideas on how to send the encryption key securely. Suitable ideas might be to send the key with a guard (which is how early keys were transported) or have a code book and change the key every day (like the Enigma machine in World War II).
   - Discuss how this method offers better protection. However, it is much more time consuming if...
humans are doing the encryption - thankfully nowadays we have computers to do this for us!

- Play the video ‘Run for your Light’ to the class. Discuss how in real life the code that passes from computer to computer along fibre optic cables as pulses of light. The information is first converted into binary format - a series of 1s or 0s (light on or light off).
- You may wish to demonstrate how an optical fibre works. This can be done by shining an LED or laser at one end of an optical fibre or use a stream of water from a bottle as shown in the video in the weblinks below. Turn the light on and off to model the binary data.

4. Plenary

- Discuss how work being carried out at the University of Oxford using single photons (packets of light) will make encryption more secure in the future. Protons are quantum particles, which means they cannot be divided or tapped; therefore data sent in this way is 100% securely encrypted.

Weblinks

http://www.oxfordsparks.ox.ac.uk/run-for-your-light
Run for Your Light animation

http://www.bbc.co.uk/education/clips/zyd6pv4
Animation showing simply what is meant by encryption.

https://www.youtube.com/watch?v=s6YLLCYCpms
Video which explains how optical fibres work.

News story suitable for teachers on quantum technology.