TOP SECRET

School and Visitors Guide

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Contents

Exhibition overview

In Top Secret: Licence to Spy the visitor acts as a secret agent, uncovering facts and investigating leads to determine which of the suspects, if any, can be implicated in the crime.

Based around a James Bond-style fantasy of exotic locations, high-tech equipment and, of course, a mystery to solve, Top Secret: Licence to Spy focuses on the science and technology of spying and espionage.

On arrival at the exhibition, the visitor is presented with a scenario and six suspects. Armed with a Spy File, the visitor is challenged with gathering intelligence from selected exhibits to uncover information on the suspects, leading them on a journey of discovery into the secret world of spies.

Audience appeal

Top Secret caters for a wide audience and encourages families and students to collaborate to piece together the clues and fulfil the mission. Older children and teenagers will especially enjoy the challenge of working through the entire exhibition. Younger children can also benefit from the experience with stand-alone interactive exhibits such as the *Laser maze* and *Photo disguise*.

Key learning outcomes

This exhibition is an excellent vehicle for demonstrating how scientific thinking can be used to solve problems in many aspects of everyday life. Visitors also have the opportunity to use various espionage-related technologies, learn how they work and how they can be used in the wider world.

Key messages

1. Technology plays an important role in spying

Technology is used by spies to obtain information and gain an advantage over someone else. It can improve the ability of spies to both gather and hide information, such as bugging a room with microphones and cameras, or using equipment to detect and remove such devices.

2. Spy technology has some basic foundation in science

Much of the technology used in espionage has some basic foundation in science, and scientific principles have been applied to design and create spy technology. For example, the *Laser listening* exhibit uses sound vibrations as the basis of a laser beam device that can detect noise from a distance.

3. The spying process mirrors the scientific process

A spy must use the procedures of surveillance, monitoring, research and interpretation to collect a significant amount of information. In doing so not everything that is found is useful, and not everything that is useful may be found. As such, the spy must weigh up the evidence they can collect and draw conclusions. Scientists employ similar methods by making observations, collecting data and analysing results in order to come to a reasonable conclusion about a scientific case.

Exhibit descriptions

Top Secret: Licence to Spy consists of 21 interactive science exhibits, graphics panels and extensive supporting sets and equipment.

A spy file accompanies the exhibition. This is presented as a folded A4 flyer that can be printed and provided to visitors as a guide to navigate the exhibition. Inside the file, there is information about the suspects and room to record findings as they move through the exhibits and the Code Room.

Q's workshop

Taking its name from the James Bond films, this exhibit comprises gadgetry commonly used by spies and provides a scene-setting entry into the exhibition. There is a shoe phone, an umbrella that can double as a satellite dish and a brief case with a false bottom. As well as these static displays, *Q's Workshop* also includes two interactive exhibits: *Find the bug* and *Hidden camera.*

SCIENCE LINKS: Technology

Hidden camera

Visitors can see a screen displaying four security images which shows *Q's Workshop* from different angles. Their challenge is to locate the hidden cameras that are the sources of these images.

SCIENCE LINKS: Observation, Problem Solving

Find the bug

Radio bugs have been strategically placed throughout *Q's Workshop.* Visitors can locate the bugs by watching the reactions on an oscilloscope while tapping various objects around the room.

SCIENCE LINKS: Observation, Problem Solving

Spy satellite

By placing their thumbprint on a scanner visitors can access satellite technology to zone in on an area of suspicious activity. They can narrow the field of view using the latitude and longitude coordinates to direct the spy satellite and get a closer look. Eventually, they will reveal a boat with the name See Saw on the roof, a clue to the owner's identity.

SCIENCE LINKS: Technology, Geography

See in the dark

A night vision camera allows visitors to search for clues in a room that is otherwise shrouded in darkness and reveal a potential hostage, ID tags and items used for a disguise.

SCIENCE LINKS: Biology, Physics (light), Technology

Hidden image

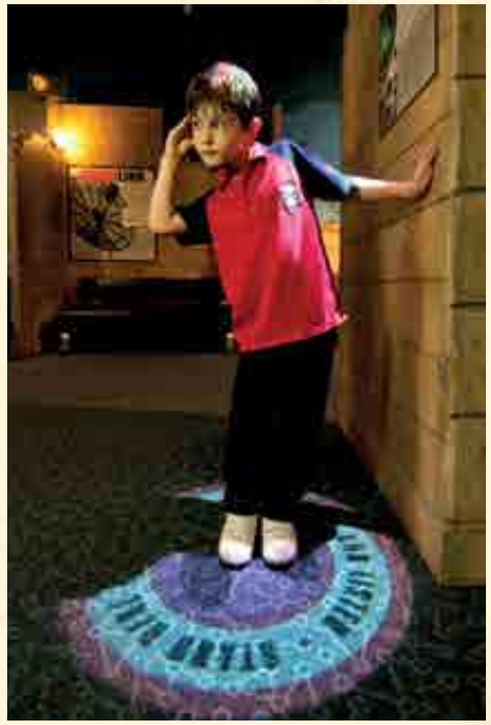
Another agent's cover has been blown and he has left behind a hidden message. By quickly waving their hands over a bush, visitors reveal a light projection of the CROWN logo.

SCIENCE LINKS: Cryptography, Technology

Sound beam

When they walk across an intersection in the exhibition visitors will overhear a private conversation between two key characters related to the mission. By listening carefully they pick up clues that will assist them in the *Guess the password* exhibit.

SCIENCE LINKS: Acoustics, Observation, Problem Solving



Downlink

To receive important information from the Agency head office, visitors need to access a secure satellite transmission. To do this, they must turn a satellite dish to the correct azimuth and elevation angle. Once the dish is positioned correctly, they will receive a message, but need to check that they have tuned into the correct satellite.

SCIENCE LINKS: Technology, Mathematics

Guess the password

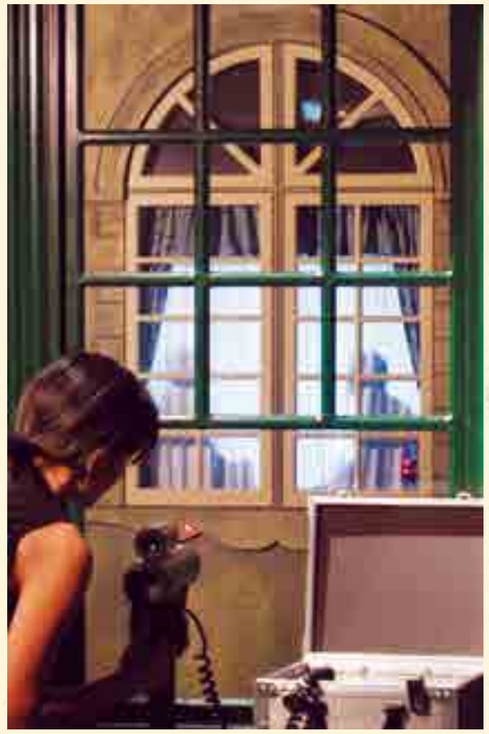
Visitors are presented with picture clues from Iwanda Wye's desk. Using these clues and remembering what they overheard at the *Sound beam* exhibit, they need to try and enter the correct password on the exhibit screen so they can disable the CROWN.

SCIENCE LINKS: Problem Solving

Laser listening

Visitors see two people through a window who appear to be having a secret meeting. Even though they can't hear the conversation through the glass, they can use the laser beam listening device and so detect the vibrations in the glass to listen in.

SCIENCE LINKS: Physics (sound and light)



Microdot

A newspaper clipping contains a microscopic dot that will reveal a clue. By slowly scanning the newspaper using a microscope, visitors can locate the dot and discover the hidden information.

SCIENCE LINKS: Cryptography

Data dump

Visitors can inspect rubbish belonging to three persons of interest. By looking at items in the rubbish, they can collect information, which may help them to solve the crime.

SCIENCE LINKS: Forensic Science, Observation

Safe breaker

This exhibit challenges visitors to crack open a safe containing important documents. A transparent combination lock shows the internal workings so they can open it section by section. When they successfully align each section, the safe opens to reveal the documents.

SCIENCE LINKS: Problem Solving, Technology

The Brainiac tapes

Security cameras at Brainiac HQ have captured some unusual behaviour. When visitors view the tapes they can uncover a number of clues regarding the theft of the CROWN.

SCIENCE LINKS: Observation, Critical Thinking

Phone tap

Two probes on a telephone cable distribution point allow visitors to tap into phone conversations. By listening into the correct conversation, they will uncover more information about their mission.

SCIENCE LINKS: Technology, Observation

Code room

Visitors explore codes and ciphers used throughout the centuries via eight interactive experiences that encourage cooperative learning. Each code reveals a little clue about the mystery and a picture on the wall has more to it than meets the eye... their mission.

SCIENCE LINKS: Cryptography

Code computer

Visitors learn some of the key terminology used by spies in this extensive data base of spy words.

SCIENCE LINKS: Science/Spy Vocabulary, Technology

Photo disguise kit

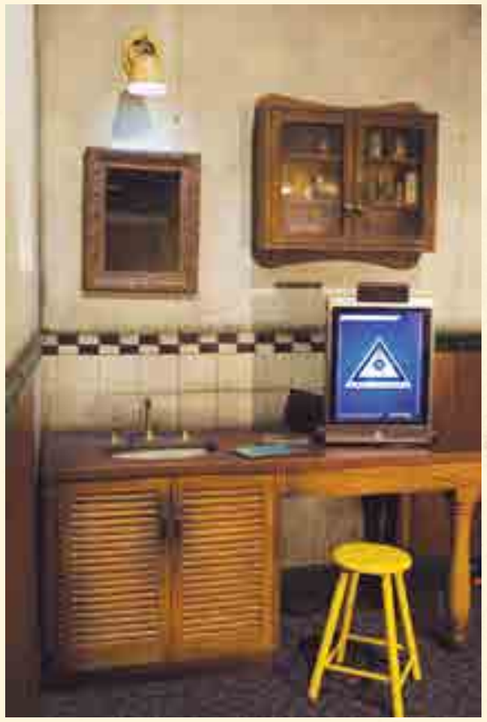
Spies and criminals are the masters of disguise. At this exhibit visitors have a photo taken on screen and use the computer to create various virtual disguises and select the one which best hides their identity.

SCIENCE LINKS: Creative Thinking, Problem Solving

Who's talking?

Visitors enter an unsecure area and need to use a device to apply effects to disguise their voice. An audio spectrum analyser displays the waveforms of the various sounds to show the effect of the distortion.

SCIENCE LINKS: Acoustics



Laser maze

Visitors are challenged to navigate a room full of laser beams without setting off the alarm.

SCIENCE LINKS: Technology, Physics

Debriefing room

When the visitor has completed the mission, they can enter the Debriefing room. Here they can view a video revealing the plot, the persons of interest involved and discover if they were successful in establishing who stole the CROWN computer. Included in this area is the spy technology corner that reveals some of the technology currently being used by professional spies; and the spy profiler, which looks at some famous spies throughout history.

SCIENCE LINKS: Technology

Research Questions

Welcome, Secret Agent! Your mission, should you choose to accept it, is to help us solve the crime of the Quantum Computer. Go to each exhibit listed to find clues that will help solve the mystery, and you will learn about spy technology along the way.

The following questions relate to this 'People of Interest' file:

Research Questions, Ages 4-8

Scytale (code room)
Question 1: What does the coded message say?
TREMBLE LOVES __ __ HE _____ ABOUT THE _____ CHIP

Letter Grille (code room)
Question 2: What does the coded message say?
WATCH ____ SHE ___ THE PROFESSOR _____

Picture Message (code room)
Question 3: What does the coded message say?
IWANDA WYE ___ ___ _____

Safe Breaker
Question 4: What two things are in the safe?

1. _____

2. _____

(Hint: Line up the gaps in the wheels to open the safe)

Microdot
(Hint: Look at the dots on Lee Li Li)

Question 5: What time will the boat sail?_____

Question 6: Where will the criminals be meeting?

_____

See in the dark
Question 7: Who is tied to the chair? _____

Laser Listening
Question 8: Who is behind the window? _____

_____

Brainiac Tapes

Question 9: Who kidnapped Wye? _____

Question 10: What was the name of the boat?

_____

Did you know
In 1982, a British man found the skeleton of a WWII carrier pigeon in his chimney. There was a secret coded message still attached to its leg. The pigeon perished on its way to deliver the message, and as of 2015, the message still has not been decoded – maybe you can help!

Now go to the debrief room to see the results of your investigation.

Research Answers, Ages 4-8

Scytale (code room)
Question 1: What does the coded message say? TREMBLE LOVES LI LI. HE KNOWS ABOUT THE COMPUTER CHIP.

Letter Grille (code room)
Question 2: What does the coded message say? WATCH DAWE SHE HAS THE PROFESSOR HOSTAGE.

Picture Message (code room)
Question 3: What does the coded message say? IWANDA WYE HAS THE COMPUTER

Safe Breaker
Question 4: What two things are in the safe? Passports and money.

Microdot
Question 5: What time will the boat sail? 16:00
Question 6: Where will the criminals be meeting? At the shipping office

See in the dark
Question 7: Who is tied to the chair? Iwanda Wye

Laser Listening
Question 8: Who is behind the window? Marjorie Dawe and Julian Tremble

Brainiac Tapes
Question 9: Who kidnapped Wye? Marjorie Dawe and Lee Li Li
Question 10: What was the name of the boat? See Saw

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Research Questions, Ages 8-12

Microdot

Question 1: What is the hidden message in the microdot?
(hint: look at the dots in Lee Li Li's name)

See in the Dark

Question 2: Who is tied to the chair?_____

Laser Listening

Question 3: Who is talking? _____
Question 4: How does the laser help you hear the conversation?

_____

Data Dump

Question 5: What did you find out about Dr. Lee Li Li?

_____

Question 6: What did you find out about Dr. Marjorie Dawe?

_____

Did you know
The very first laser beam was produced in 1960 and was said to have the power of one Gillette, as it could burn through one Gillette razor blade.

Safe Breaker

Question 7: What is inside the safe? _____
Question 8: Who does the passport belong to and why?

_____

Spy satellite:

Question 9: What is the name on the roof of the boat? _____
Question 10: Where is the boat? _____
Question 11: What is a satellite? _____
Question 12: Name two uses for human made satellites.

The Brainiac Tapes

Question 13: Who kidnapped Wye? _____

Question 14: Where did they take him? _____

Question 15: Who was waiting on the boat? _____

Now go to the Go to debriefing room to find out the results of your investigation.

Research Answers, Ages 8-12

Microdot

Question 1: What is the hidden message in the microdot? Meet at shipping office. Sail at 16:00

See in the Dark

Question 2: Who is tied to the chair? Professor Wye

Laser Listening

Question 3: Who is talking? Dr. Dawe and Julian Tremble
Question 4: How does the laser help you hear the conversation? The laser beam picks up tiny wobbles in the glass from the sound waves made by the voices. This is then converted back to sound via the speakers.

Data Dump

Question 5: What did you find out about Dr. Lee Li Li? She owes a lot of money (and therefore may have a motive to steal the computer).
Question 6: What did you find out about Dr. Marjorie Dawe? She is under pressure from her university to get results (another possible motive).

Did you know?
As more satellites are launched the chances of a crash increases.
In 2009, two communications satellites - one American and one Russian - collided in space.

Safe Breaker

Question 7: What is inside the safe? A Hong Kong passport and Polish money
Question 8: Who does the passport belong to and why? Most likely Lee Li Li as she is from Hong Kong.

Spy satellite

Question 9: What is the name on the roof of the boat? See Sawe
Question 10: Where is the boat? In the South China Sea
Question 11: What is a satellite? Anything that orbits around the earth. Any answer the student gives that includes a reference to this is correct.
Question 12: Name two uses for human made satellites. Correct answers include: telephones/communication, TV, finding people or things, monitoring the climate/ weather, as a base for telescopes to look at the stars, etc.

The Brainiac Tapes

Question 13: Who kidnapped Wye? Marjorie Dawe and Lee Li Li
Question 14: Where did they take him? To a boat at the shipping office.
Question 15: Who was waiting on the boat? Julian Tremble

Now go to the debriefing room to find out the results of your investigation.

Activity 1.0: Ciphers

A cipher is a system in which each letter of the alphabet in a message is replaced by a letter, number or symbol. This type of cipher is called a substitution cipher. Julius Caesar invented a simple cipher system that moved the alphabet three places to the right. This is shown in the table below.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W

Convert the following message into code:

The leaping duck quacks loudest

□□□ □□□□□□□ □□□□ □□□□□ □□□□□□□

Decode the following message:

Q E F P J B P P X D B F P Q L M P B Z O B Q

□□□□ □□□□□□□ □□ □□□ □□□□□□

Make up your own coded message for a friendly agent to decode.

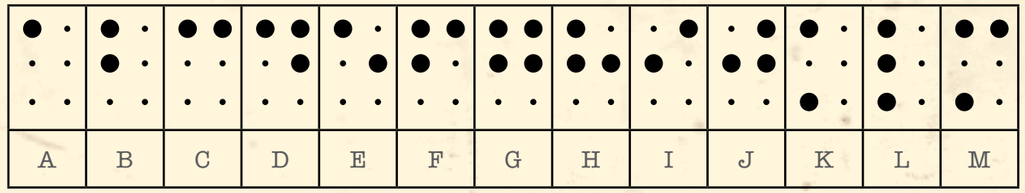
Who is this person in this picture?

G R I F R P Z X B P X O

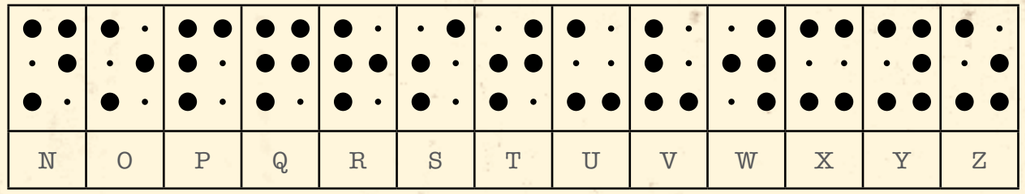
□□□□□□ □□□□□□

Activity 1.1: Braille

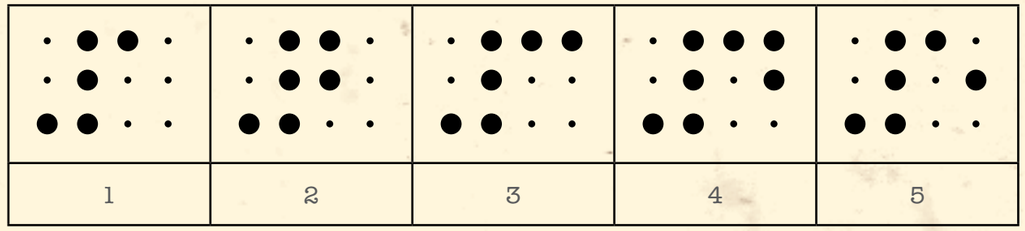
Braille is a special form of writing used by blind people. It was invented by Louis Braille (1809 – 1852). He invented it when he found out about an army code that used raised dots on pieces of paper to send messages in the dark.Raised dots are grouped in patterns to form words. Spies can use Braille to send and receive messages.



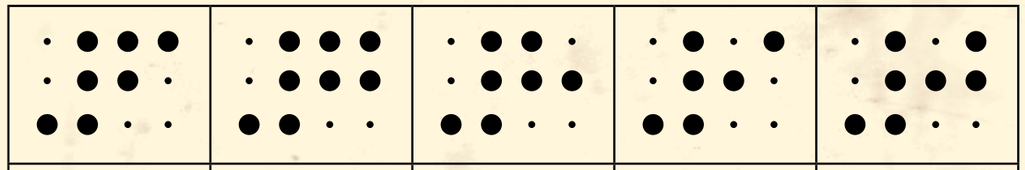
A	B	C	D	E	F	G	H	I	J	K	L	M



N	O	P	Q	R	S	T	U	V	W	X	Y	Z



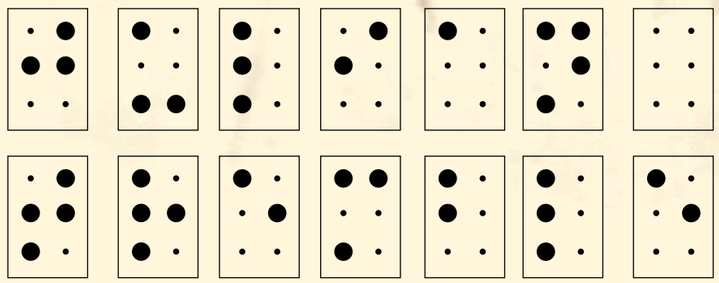
1	2	3	4	5



6	7	8	9	10

Questions

1. What is this secret message? _____



Activity 1.2: Acid/Base Secret Writing

Some chemicals change colour when they are in the presence of other chemicals. These chemicals are called indicators and they can be very handy for writing secret invisible messages.

There is a natural acid/alkaline indicator (a pigment called flavin) found in apple skin, grapes and red cabbage (amongst other things) that changes colour in acidic and basic solutions. To see the acid/alkaline indicator working, put a little cabbage water in the bottom of a glass and note the colour. Add some white vinegar (which is acidic) and note the colour change.

What you will need

- White vinegar
- Fine paint brush
- Paper
- Half a red cabbage
- Boiling water
- Bowl
- Strainer
- Spray bottle

What to do

1. Use a fine paint brush to write a secret message on a piece of paper using some white vinegar.
2. Allow the message to dry.
3. Chop the red cabbage and place it in a bowl.
4. Cover the cabbage with boiling water and let it stand for five minutes.
5. Strain the liquid into the spray bottle. The liquid is called an indicator because it turns different colours in acid and alkaline solutions.
6. Spray the cabbage indicator over the invisible writing to show the message.

Activity 1.3: Stick scrambler

Ancient Greeks used the first known device for scrambling letters. During wars, they sometimes sent secret messages known as skytales. The message sender first wound a strip of leather or heavy paper around a wooden stick. He wrote the message on the strip, unrolled it, and sent it.

The letters made no sense when the strip was unrolled. To read the message, the receiver had to wind the strip around a stick that was the same size.

What you will need

- 2 sticks or cardboard rolls with the same thickness
- Ribbon of paper
- Adhesive tape
- Writing equipment

What to do

1. Work in groups of two.
2. Wrap a strip of paper around the stick, it must not overlap. Tape it in position.
3. Write your message along the stick, one letter at a time on each division.
4. Swap your unwrapped piece of paper with a partner and see if you can read each other's messages.

Activity 1.3: Periscope

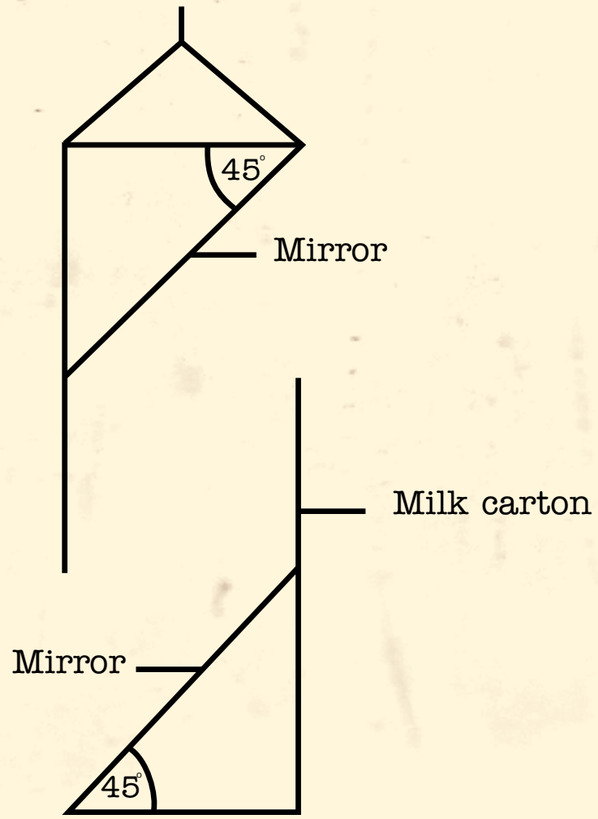
This will help you see around corners or over walls without being noticed. It works because light bounces off a mirror at the same angle as it arrives. Light from a distant object is reflected from the top mirror onto the bottom mirror and into your eye.

What you will need

- a 1-litre milk carton (washed and dried)
- two unbreakable plastic mirrors 70 mm x 100 mm
- Cardboard cutter
- Masking tape

What to do

1. Cut a square hole 70 mm x 70 mm at the bottom
2. Cut another square hole 70 mm x 70 mm at the top on the opposite side to the first hole
3. Tape the mirrors into position so they make an angle of 45 degrees with the side and bottom
4. Start spying



Activity 1.4: Making a compass

Finding your way across country is much easier if you use a compass. A compass consists of a small permanent magnet that is free to move. The magnet will point to the north in most places. They really point towards the north magnetic pole of the Earth which is not located at the North Pole, so be careful when you are on assignment in the Arctic Circle!
The first thing you have to do when you make a compass is to make a permanent magnet. You can do this by magnetising a steel nail.

What you will need

- A bar magnet
- A steel masonry nail
- Paper clips
- Plastic cup
- Plastic jar lid

What to do

1. Stroke the nail in one direction with one end of the magnet. Always use the same end of the magnet and always start at the same end of the nail.

Results table

Number of strokes	Number of paper clips picked up
0	
10	
20	
30	
40	
50	
60	

2. See how many paper clips the nail will pick up after the following number of strokes.
3. Fill the cup with water.
4. Float the lid on the surface of the water.
5. Carefully place the nail on the lid and watch what happens.

Questions

1. What happened to the strength of your steel nail magnet as you stroked it with the bar magnet?
2. Had the nail become a permanent magnet?
3. How could you tell?
4. In which direction does the nail come to rest in the water?
5. Which end of the nail is a north-seeking pole?
6. What happens to your nail as you bring a bar magnet near the cup?

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