

TOP SECRET – LICENSE TO SPY - Key Messages for Exhibition

1. Technology plays an important role in spying

Technology is utilized by spies to obtain information and gain an advantage over someone else. New technologies improve the ability of spies to gather information, but also improve the ability of spies to hide information.

For example, in espionage, spies may use technology to bug a room with microphones and cameras. However, spies may also use technological equipment to detect and remove such devices.

Technology is important not only in spy techniques, but in everyday parallels. For example, satellites may be used to monitor and collect data, but are also used for communication and security.

2. Spy technology has some basic foundation in science.

Much of the technology used in espionage has some basic foundation in science and applies simple scientific principles to design and create the technology. The 'Laser Listening' exhibit uses the simple concept of sound vibrations as the basis of a laser beam device that can detect noise at a distance.

3. The spying process mirrors the scientific process

The agent must use the procedures of surveillance, monitoring, research and interpretation to collect a significant amount of information. In spying, not everything that is found is useful, and not everything that is useful may be found. The agent must weigh up the evidence and draw conclusions.

Scientists must use scientific methods including observations, data collection and analysis that are accurate, sufficient and relevant to make a reasonable conclusion about a case.

Key Words

Here are some key words to use when talking about *Top Secret: License To Spy*:

Emotive words	Technical words	Scientific words
Discover	Surveillance	Evidence
Confidential	Monitoring	Clues
Predict	Codes	Data
Query	Locks	Database
Intrigue	Lasers	Analysis
Mystery	Bugs	Identify
Dramatic	Microdot	Investigate
Crime	Disguise	Communicate
Top Secret	Footprints	Corroboration
Identity	Satellites	Mission

TOP SECRET

LICENCE TO SPY



scienceworks
museum

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TEACHER RESOURCE BOOKLET

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			investigating	energy and change	natural and processed materials	science in daily life	earth and beyond	materials	prealgebra and algebra	viewing
1. coded messages	1.1 ciphers	3							✓	
	1.2 pig pen cipher	4						✓		
	1.3 top secret word find	5							✓	
	1.4 braille	6						✓	✓	
2. communications centre	2.1 invisible ink	8		✓	✓					
	2.2 acid base writing	9		✓	✓					
	2.3 passing on messages	10					✓			
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SECTION 1: CODED MESSAGES

Spies often have to send and receive secret messages.
To keep the messages secret they can use codes and ciphers.

Activity 1.1: 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

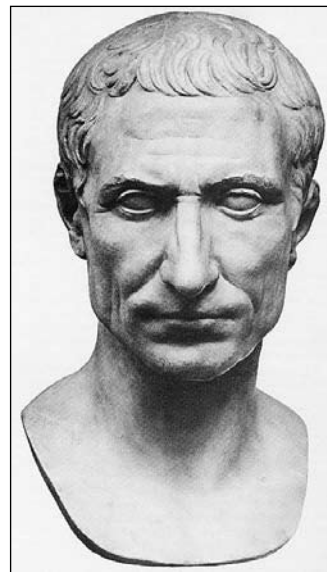
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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

Who is this person?

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

--	--	--	--	--	--	--	--	--	--	--	--



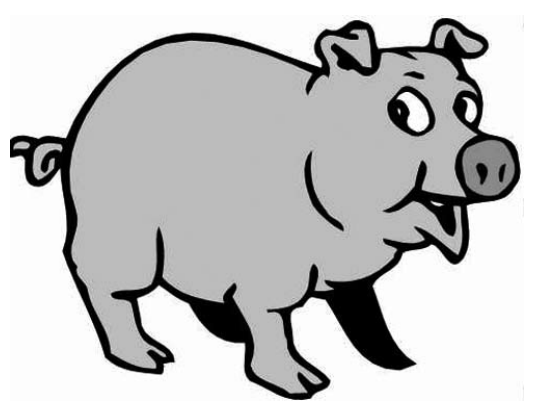
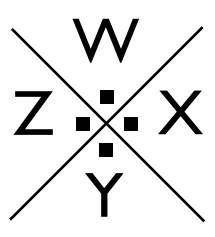
Activity 1.2: Pig pen cipher

This cipher was developed in the sixteenth century by Giovanni Porta from Naples.

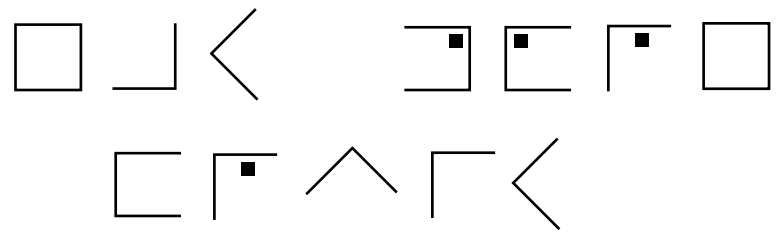
A	B	C
D	E	F
G	H	I



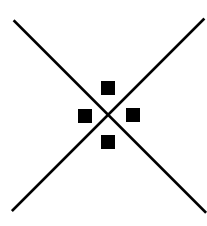
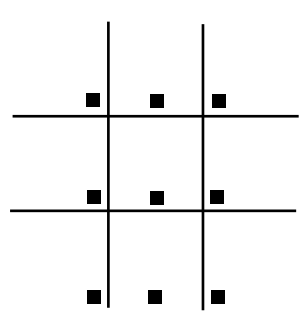
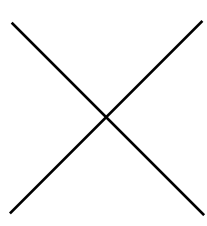
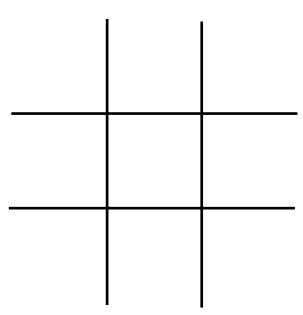
J	K	L
M	N	O
P	Q	R



What is this message?



Make your own pigpen cipher and write a message to another spy.



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Activity 1.3: Top Secret Word Find

A secret 5-word message has been hidden in the following Word Find puzzle.

Find the words in the list below.

Circle the unused letters starting at the top left-hand corner.

Write them out to discover the message.

Good luck secret agent!

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

AGENT BREAK BRIEFING CAMERA CODE CLUE DANGER DECIPHER
 DISGUISE DROP ENIGMA ESPIONAGE GAME IDENTITY LASER
 MISSION NAME QUEST RING SATELLITE SECRET SPY

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Activity 1.4: 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

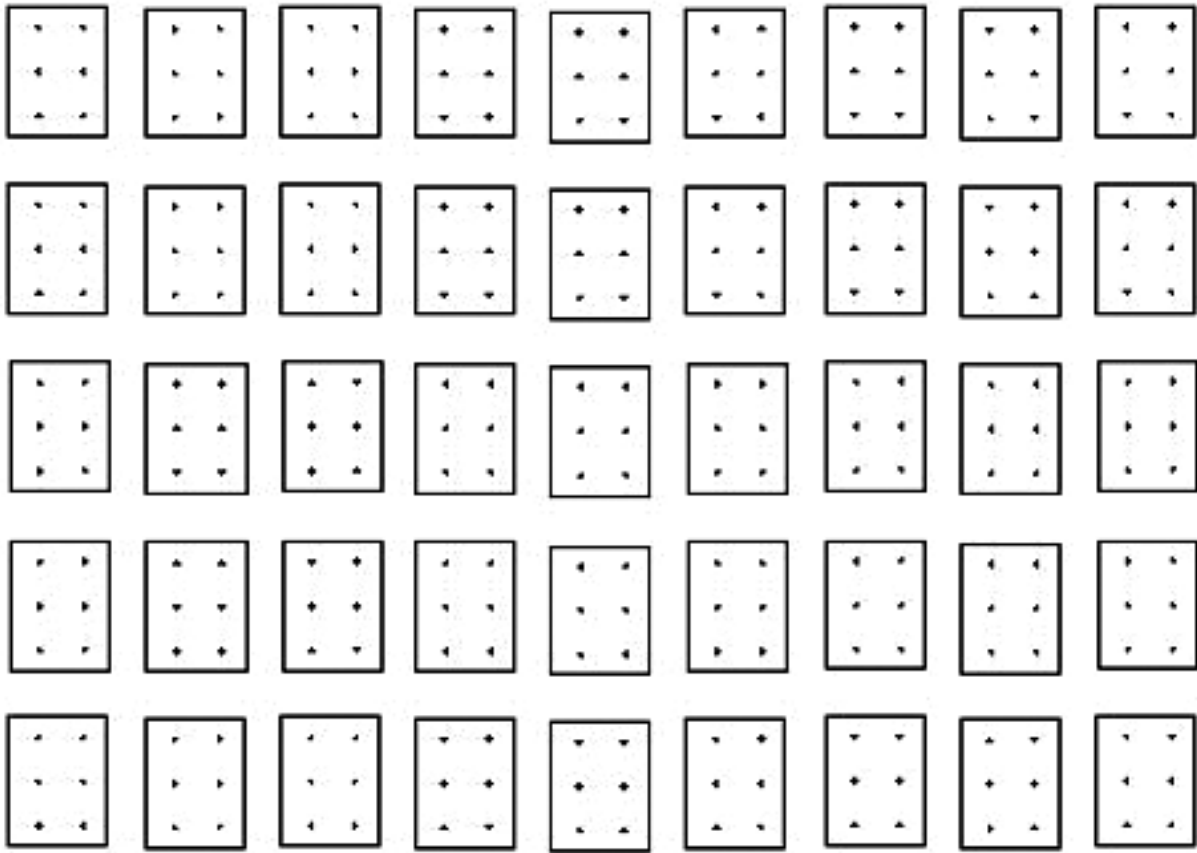
1	2	3	4	5	6	7	8	9	10

Questions

1. What is this secret message? _____



2. Write a secret message using this grid. Make bigger dots over the reference dots.



3. Decode your partner's message. Write the answer here.



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SECTION 2: COMMUNICATIONS CENTRE

Spies don't just rely on encrypting their messages in code; they also try to hide the messages entirely.

Activity 2.1: Invisible ink

What you need

- a small bowl
- some lemon juice
- some paper
- a small paintbrush
- a desk lamp

What to do

1. Write a secret message to a friend on the paper using the paintbrush dipped in lemon juice.
2. Allow the message to dry and give it to your friend.
3. When your friend suggests there is no message, very carefully heat the paper by holding it above the globe in a desk lamp.

What's happening?

The writing appears gradually because heat causes a chemical change in the lemon juice. The lemon juice burns at a lower temperature than the paper, so the writing appears faint and brown.

Activity 2.2: Acid/base invisible 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 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.

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Activity 2.3 Passing on messages

Sometimes spies have to pass on a message to another operative without using codes. Here are some easy ways to write messages and pass them on without being noticed.

Balloon

1. Blow up a balloon.
2. Write your message.
3. Let the balloon down and pass it on to your partner.

Rubber band

1. Stretch out a thick rubber band.
2. Write your message in biro.
3. Pass the rubber band to your partner.

Postage stamp

1. Write your message on the back of a stamp (or a sticker).
2. Post it to your partner on an envelope.

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Activity 2.4: 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.

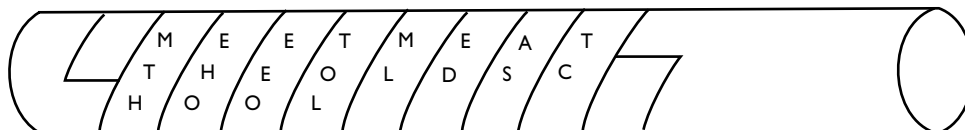
The letters made no sense when the strip was unrolled. To read the message, the receiver had to wind the strip around a stick that was the same size.

What you 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.



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SECTION THREE: UNDER SURVEILLANCE

Sometimes spies need to gather information without being noticed. These devices will make it easier.

Activity 3.1: Periscope

MAKE A PERISCOPE

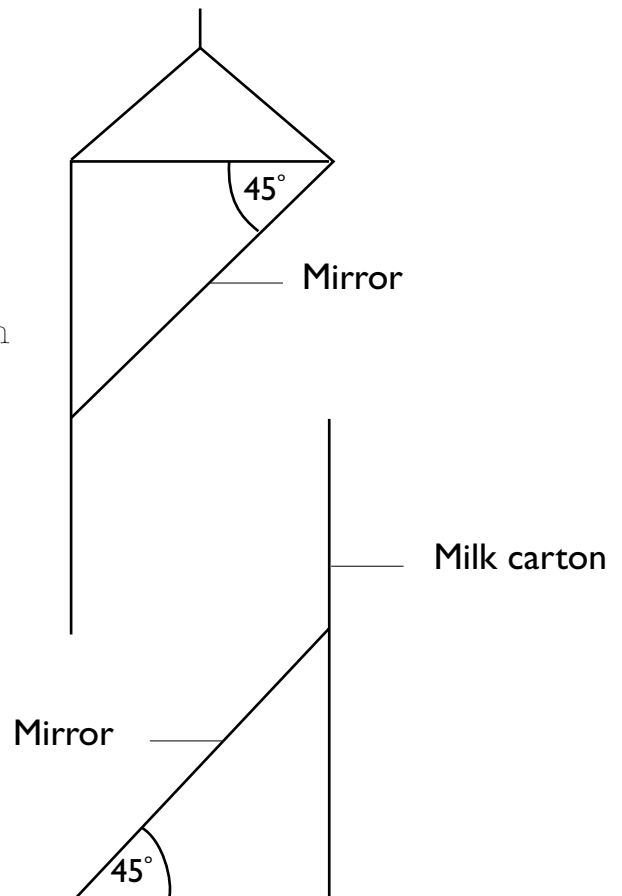
This will help you see around corners or over walls without being noticed. It works because light bounces off a mirror at the same angle as it arrives. Light from a distant object is reflected from the top mirror onto the bottom mirror and into your eye.

What you 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

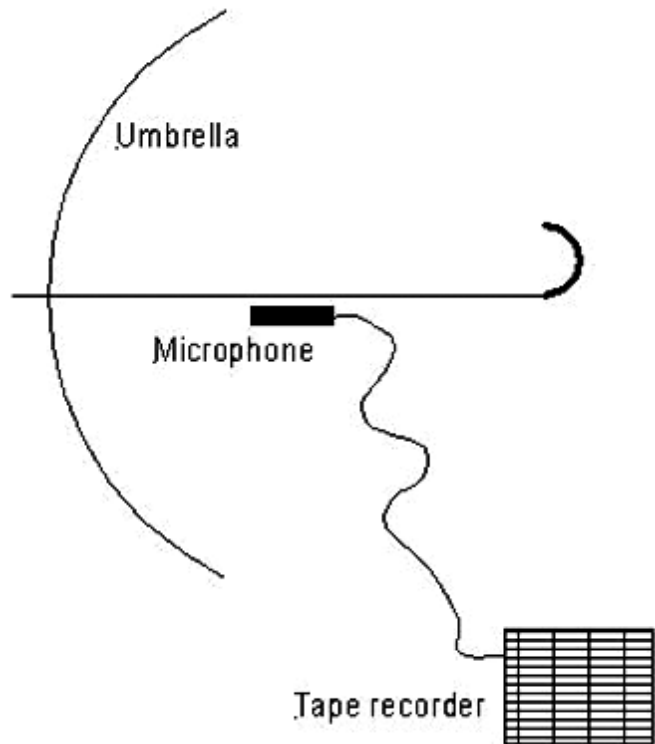


Activity 3.2: Umbrella eaves-dropper

In this activity an umbrella is used to reflect sound to a focal point just like a mirror. This makes the sound much louder. The sound is detected by a microphone at the focal point.

What you need

- Tape recorder
- Microphone
- Umbrella
- Head phones
- Radio
- Adhesive tape



What to do

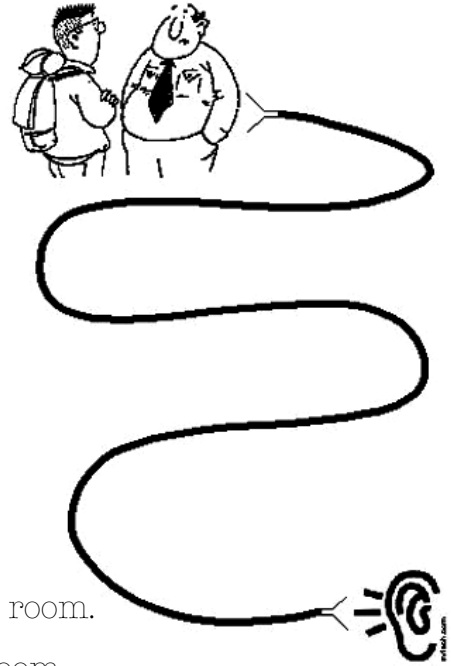
1. Connect the microphone and headphones to the tape recorder.
2. Turn on the radio
3. Move a distance, 10 metres or so, from the radio. Point the handle of the open umbrella at the radio.
4. Put the tape recorder to record. Put on the headphones and move the microphone along the handle until the sound is loudest. Tape the microphone to the handle at this point.
5. Turn off the radio. Have a partner move away from you and say a message. Point the handle of the umbrella at the partner and listen to or record the message.

Activity 3.3: Extendable ear

Sound is carried along the inside of a pipe or hose with very little loss. A pipe was once used in ships to communicate between the engine room and the bridge. Pipes and funnels were also used in buildings to overhear conversations in other rooms. The sound-gathering funnel was of course hidden or disguised.

What you need

- Large funnel
- Small funnel
- Long length of hose
- Two rooms with windows next to each other



What to do

1. Work in groups of at least two.
2. Connect a funnel to each end of the hose.
3. Put the large funnel just inside the window of one room.
4. Run the hose out the window and into the other room.
5. Put the small funnel to your ear and listen in to what other members of your group say in the other room. (They should say a special message that you can repeat.)

Questions

1. Was it easy to hear what your partners said?
2. How could a spy use this system to gather information?

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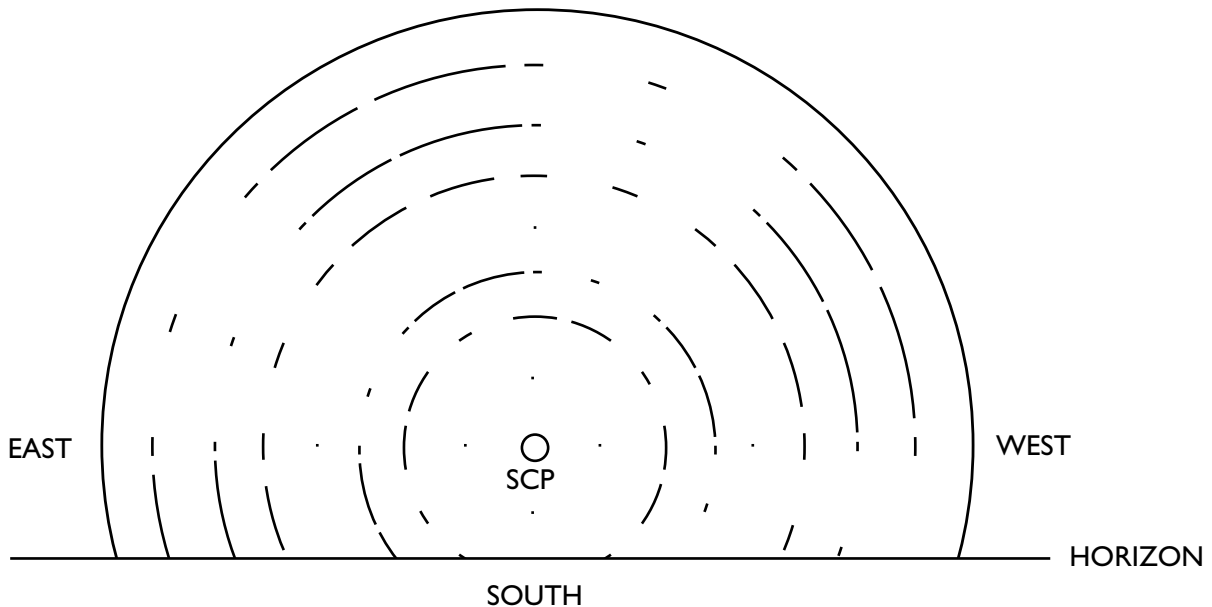
SECTION FOUR: UNKNOWN TERRITORY

These activities will help you find out where you are on the Earth without using complicated equipment. This is just the thing for spies who get lost in strange countries.

Activity 4.1: Star navigation

BACKGROUND INFORMATION

One of the things that makes finding stars and constellations difficult is that stars seem to move slowly across the sky, during the night, rising in the east and setting in the west, just like the Sun during the day. From southern Australia, if you watched the stars for a few hours they would move like this (if you are facing south):



Some stars travel in a curved line across the sky, then disappear below the horizon. Other stars never 'set' below the horizon but trace a circle in the sky. At the centre of these circles is a point called the South Celestial Pole. This part of the sky is directly above the South Pole of the Earth. That is, if you stood at the South Pole, the South Celestial Pole would be directly overhead. During summer at the South Pole the Sun circles the sky and never sets meaning it is daytime continuously. During winter the Sun never rises and it is constantly night.

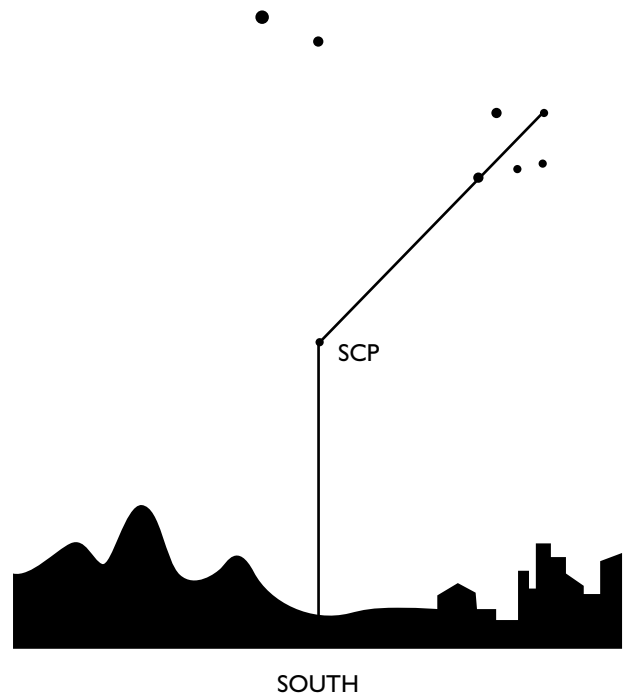
In the Northern Hemisphere, a star called Polaris or the Pole Star marks the Northern Celestial Pole. There is no star near the South Celestial Pole, so instead southerners must use the Southern Cross to find south.

Once you are familiar with finding the Southern Cross, it can be used to find the direction of south, at any time of night, at any time of year because the Southern Cross never sets in our night sky, when viewed from the southern part of Australia.

What to do

To find south:

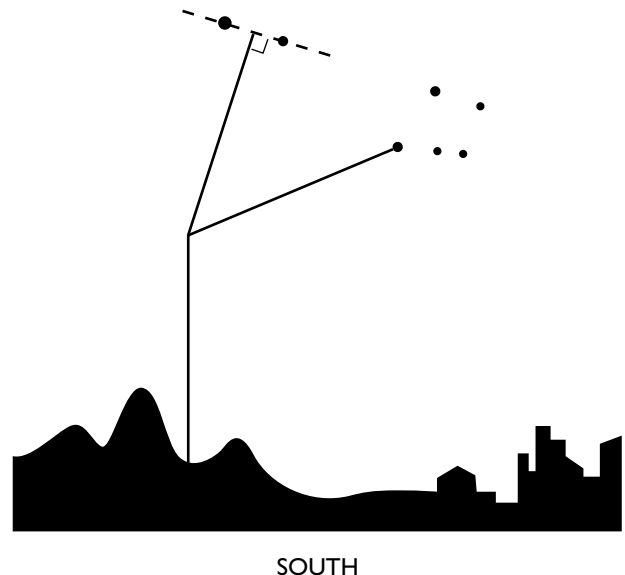
1. Find the Southern Cross.
2. Draw an imaginary line through the long axis of the Southern Cross beginning with the star that marks the top of the cross (note: during summer the Southern Cross is low in the sky and therefore upside-down).
3. Extend the line four and a half times the length of the cross.
4. This will bring you to the point in the sky called the South Celestial Pole.
5. From this point, drop a line vertically down to the horizon. This gives you the direction of True South. Compasses find magnetic north/south, not True North/South, so a compass will measure magnetic south to be 11 degrees west of True South in Victoria.



Alternative method of finding south:

This method involves using the two bright pointer stars – Alpha Centauri and Beta Centauri – that lie near the Southern Cross in the constellation of Centaurus.

- After step 2 right, draw a perpendicular bisector between the two pointers, that is, a line starting at the mid-point between the two pointers and coming out at right angles. This line should cross the line you drew in step 2.
- The intersection of these two lines is close to the South Celestial Pole.



Activity 4.2: Finding north (in the daytime, without using a compass)

METHOD 1

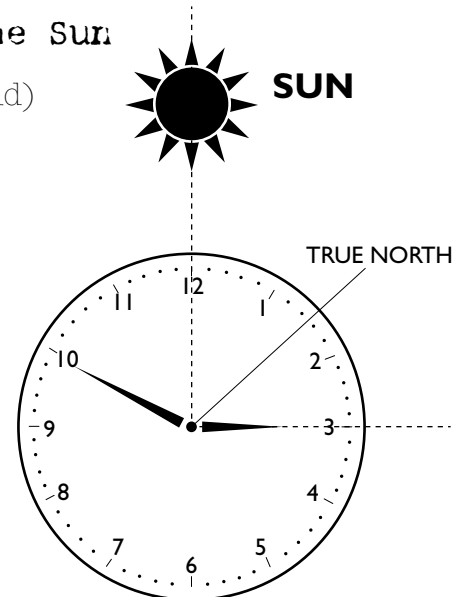
Find the Sun in the sky.

Point the number 12 on your watch to the Sun

In between the number that the hour hand (small hand) points to and the number 12 is True North.

Example

If it is 2:50pm and the 12 of your watch is pointing towards the Sun, north will be in between the number 12 and the number 3 so due north will be approximately in the direction of the number 2 on your watch.



METHOD 2

Finding north using local noon time

When the Sun is at its highest point in the sky, the Sun will be on the North/South line. True North will be in the direction of the Sun. You can find this time by subtracting the sunrise time from the sunset time. The Sun will be at its highest point half way between these times because it takes the Sun exactly the same amount of time to rise and reach its highest point as it takes it to descend and set.

Example

If the Sunrise is at 7:16am and Sunset is at 5:16pm, the Sun will be on the north/south line or at its highest point at 12:16pm. In this case, north will be in the direction of the Sun at 12:16pm.

METHOD 3

Finding north using the shortest shadow

On a sunny day, go outside in the school yard with a piece of chalk. Using the shadow cast by the vertical pole of a net ball ring or a stick in the ground in the school yard, mark the length of the shadow every 5-10 minutes for about 2 hours, close to noon time. The shortest shadow will indicate when the Sun was at its highest point. North will be in the opposite direction to the shadow cast by the pole or stick.

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Activity 4.3: 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 need

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

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

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.
3. See how many paper clips the nail will pick up after the following number of strokes.
4. Fill the cup with water.
5. Float the lid on the surface of the water.
6. 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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LICENCE TO SPY