# S.C.I.S.P.Y.

## top secret activity dossier for junior intelligence agents

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## SERIOUS SCIENCE
## SERIOUS FUN!

James Bond, Tom Cruise and Charlies Angels may do their secret investigative work with the latest in technological gadgetry. But junior spies can copy all the basic elements of spying with the most basic of household items.

The following set of activities involve creating and using the elements of the S.C.I.S.P.Y kit. With these home-made devices, your kids will be able to send and receive instructions confidentially, conduct undercover surveillance and report back to base.

All are of course TOP SECRET, so Mum's the word, OK?

MISSION 1:

Receiving your instructions

- Creating and deciphering codes
- Invisible ink

MISSION 2:

Gathering information

- Listening in
- Looking around corners

MISSION 3:

Reporting back

- Morse Code
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# Creating and Deciphering Codes

One of the safest ways of sending information is in code form. This relies on both the sender and the receiver knowing the 'key' which unlocks the code. Even if a coded message is intercepted, it will take time for the interceptor to crack it and by then it might be too late for the information to be of any use.

## How to Make a Code Wheel

A simple way of encoding a message is by use of a code wheel. To make one of these, you need paper, scissors, two split pins and a pen. You'll need to make two wheels, each with the same code so it's easiest to make both at the same time.

1. For each code wheel cut out two circles of paper, one 10 centimetres across and the second 12 centimetres across.

2. In the smaller circle cut a small $1cm^2$ window, about 3 centimetres from the centre.

3. Attach the two circles together at their centres using the split pin so that the small circle can turn over the second larger circle.

4. Write the alphabet around the edge of the large circle.

5. Draw an arrow on the smaller circle, pointing to one of the letters on the large circle.

Now onto the code itself.

6. Turn the small circle until the arrow points to the letter '**A**'. Write the letter which you want to represent '**A**' in your code in the centre of the window - let's say you choose '**G**'. Make a note on a spare piece of paper that this letter has been used up. (It makes it easy if you make it a two person job, one writes in the two wheels, the other reads off an alphabet, ticking the random letter choices off as they go along.)

7. Then turn the wheel so the arrow points to '**B**'. Write another letter in the centre of the window, say '**T**'. Do this for all the letters in the alphabet. Once your wheel is complete you can start to encode your message.

8. Everywhere there is an '**A**' in your message you write down the letter you see in the centre of the window, in this case '**G**'. Where there is a '**B**' you write '**T**' and so on.

9. For your ally to decode your message, they need to use the second code wheel. Turning the small circle so that the first letter of the coded message appears in the window ('**G**'), the arrow will point to the first letter of the real message ('**A**').

### Variations

If you don't want to use letters in your code you can use symbols instead - or if you have enough colours you can try these! Remember, the less your message looks like meaningful information the less likely you are to get caught out.

Be careful not to let your code wheel fall into enemy hands. Not only will they be able crack your code and find out what you are doing, you may never even know that they know! And if you're very unlucky they may feed you false information.

## What real spies do

Today making and breaking codes is big business - not just for spies but for everyone who wants to buy or sell something over the internet. Coding material today is known as encryption and it involves scrambling the data randomly. When the information is sent over the internet only people who have the 'key' to unlock the code can see the real data - everyone else sees rubbish.

# Invisible Ink

Even if you haven't agreed on a code beforehand you can still send or receive a secure message. It requires some shared information but not nearly as much as for a code.

To make an invisible message you need a piece of paper, a cotton wool bud and some lemon juice.

1. Give the lemon a good pummel to make it more juicy.
2. Take the cotton bud and dip it into your lemon juice.
3. Use the juice as your ink and write your instructions on the piece of paper. While it's wet, it's still visible. But when it dries ...
4. Send the message to your ally.
5. To read a message written in lemon-juice invisible ink, run over it with a hot iron. (Be very careful not to burn yourself or the paper!) Slowly you will see the message appear...

## How does it work?

The lemon juice is very nearly clear so does not show up on the paper when it's dry. But when you heat the lemon juice it starts to burn. Like all organic material (i.e. anything that was once living) the lemon juice contains carbon. When it burns it releases some of the carbon in the same way a candle releases soot. The brown writing is just the carbon that has come out of the charred lemon juice.

You can try this with other organic compounds like milk.

### What real spies do

Today inks are available which can only be seen under ultraviolet light. Under normal light the message is invisible but under ultraviolet light all becomes clear! These inks absorb ultraviolet light and re-emit normal light that we can see, so they appear to glow.

# Listening In

**Note for parents**: you may not want your junior spies to know how to hear what's going on in the next room of your house ... if so, hide this and the following page!

**Note for junior spies**: You can't always be in the room when important matters are being discussed but if you get close enough, like the room next door, you may still be able to pick up all the information you want.

All you need is a glass, so if someone walks in you won't have any incriminating equipment. Just practice your innocent smile first!

Here's what to do:

Place the rim of the glass flat on the wall. Position your ear on the base of the glass... Sounds in the next room should come through loud and clear.

But make sure you keep your other ear alert for anyone who might catch you in the act!

## How does it work?

When we speak or make any sound we produce a sound wave by forcing the air molecules to vibrate. At the point closest to where the sound is made, the air molecules are squashed together. These molecules then hit the molecules next to them and this compression travels outwards away from the person who made the noise – a bit like the way in which ripples extend out from where you threw that rock into the water! When someone is speaking they create a series of these compressions which travel through the air all around them.

We can hear sound because these compressions cause our eardrums to vibrate. But the sound waves also cause all the other surfaces in the room to vibrate too - including the walls and windows. Not only that, but sound travels through solids as well as liquids and gases, so the compression continues through the wall where you can pick it up....

Why use a glass? Putting a glass against a wall means that the air molecules contained in the glass receive the vibrations from the wall. The glass is better than just putting your ear against the wall because the glass forms a better seal and all the vibrations from the air hit the glass no matter what direction they are travelling in. This produces an increased area to collect the vibrations that your ear turns into recognisable sounds. Try experimenting with different sizes of glasses to see which works best.

### What real spies do

Real spies use a very **similar** but more **hi-tech** version of this. Instead of a glass they bounce **lasers** off the **windows** of the room they are listening in on. The **reflected light** is measured and any **vibrations** or **movements** in the glass can be **analysed** to **reproduce** the conversation going on inside.

# Looking Around Corners

Spies are often required to observe comings and goings, and secret meetings. But how do you get to see them without being seen? By making your own periscope! A periscope will allow you to remain hidden behind a bush or around a corner whilst still being able to see clearly what's going on.

To make a periscope you'll need a long thin box (or two empty orange juice cartons taped together) and two mirrors which are small enough to fit inside your box.

1. Cut a hole in the side of the box, right at the very end. The hole should be a similar size to your mirrors.

2. Next cut a hole in the side of the box at the other end, on the opposite side of the box as your original hole. Again this should be about the size of your mirrors.

3. The tricky bit is to insert the mirrors. The mirrored surface needs to face outwards and it should sit at an angle of 45 degrees to the hole. Tape the first mirror into place.

4. The other mirror goes in the other hole, again facing outwards and at an angle of 45 degrees to the hole. You may need to adjust each mirror slightly to make sure you can see through the periscope properly.

## How does it work?

You can hide behind a wall with only the top mirror of your periscope poking up. Light from the image of the secret meeting you're observing will hit the top mirror, then be reflected downwards towards the second mirror.

The light is reflected again at your eye, so you can see the meeting clearly in the bottom mirror.

### What real spies do

Instead of periscopes, spies use optical fibres pushed through tiny holes in the wall. These are very long thin strands of glass coated in a second material. A bundle of them is required to make a picture but since each is extremely fine, only about 0.1 mm across, it isn't hard to get a whole bundle through even the smallest gap. When light enters the optical fibre it's reflected again and again off the boundary between the glass and its coating by a process called total internal reflection. This takes the light all the way along until it comes out at the other end. This light is then fed into a camera to produce an image on a screen.

# Morse Code

Any message you send out has to be clear for your allies to decode. Morse code is a classic and reliable system as the signal is made up of only three parts - a long 'on', the dash; a short 'on', the dot; and an 'off' signal. It can be transmitted over large distances by a number of methods, including radio, tapping on pipes, or light. If you and your contact both have transmitting and receiving devices, then you can send signals to each other.

Using light to transmit Morse code gives you a cheap receiving device - your eyes. You can send messages across many miles, particularly if you have a pair of binoculars to magnify the signal. Both you and your contact will need a Morse code table so that you can encode and decipher your messages. You'll find one on the next page.

Decide on the message that you want to send, then using the Morse code table send it as a series of long and short torch flashes. As a light source at night, you could use a torch that you can switch on and off rapidly, or cover with a black piece of card. On a sunny day, you could use a small hand-held mirror or even the shiny surface of a CD to reflect light in the right direction. The receiver, unless they have managed to memorise the table, will have to note the series of flashes down on paper to decode later.

## How does it work?

Morse code was devised in the 1830s when the telegraph was invented, allowing electrical signals to be transmitted by wires. A simple system of dashes and dots and gaps makes a robust way to transmit information - even if the signal is not very clear at the far end, there should be enough difference between the three types of signal to distinguish between them, so the message remains unscrambled.

The choice of dashes and dots to signal a letter is related to how often they are used in the English language. Frequent letters have a short code, such as E, which is just one dot. Less used letters have be assigned a longer code, e.g. Z has two dashes then two dots.

### What real spies do

Although Morse code is a code, it's one that everyone has the key to, so if anyone intercepts the signal they will be able to understand it. To make a transmission secure they encode the signal using another code that only the sender and receiver know.

Spies can also use radio transmission, but security agents may be scanning the frequencies on the lookout for suspicious transmissions. Even if they cannot decode the message, they could still home in on the transmission location and capture the spy. To avoid this, both sender and receiver arrange to broadcast on a varying sequence of frequencies, changing after a pre-determined time. Another way of avoiding detection is to pre-record the information and then send it in a high information 'burst' transmission, rather than in real time. This drastically reduces the length of the broadcast, making it far harder to spot.

# Morse Code Table

| | | | | | |
|---|---|---|---|---|---|
| **A** | .- | **N** | -. | **1** | .---- |
| **B** | -... | **O** | --- | **2** | ..--- |
| **C** | -.-. | **P** | .--. | **3** | ...-- |
| **D** | -.. | **Q** | --.- | **4** | ....- |
| **E** | . | **R** | .-. | **5** | ..... |
| **F** | ..-. | **S** | ... | **6** | -.... |
| **G** | --. | **T** | - | **7** | --... |
| **H** | .... | **U** | ..- | **8** | ---.. |
| **I** | .. | **V** | ...- | **9** | ----. |
| **J** | .--- | **W** | .-- | **0** | ----- |
| **K** | -.- | **X** | -..- | **/** | -..-. |
| **L** | .-.. | **Y** | -.-- | **+** | .-.-. |
| **M** | -- | **Z** | --.. | **=** | -...- |

| | | | |
|---|---|---|---|
| **.** | .-.-.- | **,** | --..-- |
| **?** | ..--.. | **(** | -.--. |
| **)** | -.--.- | **-** | -....- |
| **"** | .-..-. | **:** | ---... |
| **;** | -.-.-. | **$** | ...-..- |

# Microdots

Rather than using a code, which may draw attention to itself, you could simply hide your secret information in an innocent looking document and send it by normal routes. Even if suspicious security staff inspect the document, they will only see a boring old report about pigeon breeding, or whatever, and miss the covert contents.

Microdots work by shrinking words or letters until they become unnoticeable in a standard sized document. The receiver then magnifies the dots to read your message.

You can use the word processor package on a computer to shrink the font size of individual letters until they are barely noticeable, then hide them in a normal text as full stops. Here are two ways to do it:

### Version One

Write a boring article, then type out your secret message. Using the format command on your word processor, select the whole of your message and change its font size. If your normal font size is 12, make the shrunken font size about 1 or 2. (You may find that you want to change the font of the shrunken letters as some fonts are more condensed than others.)

Now go through the document, and replace each full stop with one of the shrunken letters by cutting and pasting them in. You may need to fiddle with their size or alter them to bold or *italic* to make them appear as similar to full stops as possible. Even if your message is finished half-way down the document, you may want to replace the rest of the full stops with random letters, just so they all look the same.

Now print out the document and send the paper version to your contact... They will be able to read your message by looking at each full stop through a magnifying glass.

### Version Two

This version has to be written, sent and unscrambled on a computer. And it's very effective! This way you can hide the complete message in just one full stop.

Write your secret message, then 'Select' it and shrink it to fontsize 1 or 2. Now select 'character spacing' from the Font menu, choose the 'condense' command and make the writing as condensed as possible. This forces the letters to be typed over the top of each other.

Email the innocent looking document to your contact who will be able to unscramble the full stop by highlighting the whole document, choosing the condense command and restoring the text to normal.

## What real spies do

Real spies used to use photography equipment to shrink down large amounts of text or pictures until they all fitted onto one full stop. This could then be blown up again by whoever received the message.

Nowadays, you can hide a text message inside a computer image file, such as a JPEG, and send it over the Internet. Because an image file is very large, the information that forms the text is only a tiny part of the whole, and is very hard to spot - people think that you are only sending an innocuous picture...

# D.I.Y. Telephones

Establishing a secure two-way connection with an ally can be difficult, but it allows for rapid communication of data and is invaluable if plans have to be changed at the last minute...

Here are some instructions for a low tech telephone kit. It's fully portable, and has an important advantage over mobile phones, in that there's no signal that can be intercepted electronically.

**You will need:** two plastic drinking cups or tin cans (make sure they are empty and clean) and a long piece of string or nylon twine.

1. Pierce the bottom of the cups with a needle (tins will need a skewer and hammer – be careful!).

2. Thread the string through the holes in the cans. Secure it by either tying a knot on it, or taping a loop of it to the inside of the bottom of the cup.

3. To work, the string has to be pulled tightly between the two cups. You and your ally can take turns to listen and speak to each other.

4. To transmit, hold the cup up to your mouth and speak into it. (Or you could tap out a code on the can instead for extra security!) To receive, hold the cup up to your ear.

## A word to the wise...

You may feel that you can now have a private conversation, but is your transmission secure? Enemy agents may be able to tap into the signal and listen to every word. They could do this by simply tying a third cup to the middle of the long piece of string, and if so, they'd be able to monitor your communications. As long as they stay silent, keep hidden (and don't jiggle the line due to giggling), you may never know they are there. So be careful!!

## How does it work?

Sound waves are vibrations that can be carried through the air and solid objects. When you speak into the cup, you cause air molecules to vibrate and the vibration is transferred to the cup and then the string. If the string is held taught, the vibrations can travel down the string to the second cup, where the vibrations set the cup vibrating and the cup causes the air to move! By tying a third cup to the string the vibrations in the string are divided between all three cups.

### What real spies do

It may seem rather obvious if someone ties a third cup to your telephone string, but in real life phones are tapped all the time without people knowing. This is particularly true for mobile phones since the signal from your mobile phone can be picked up by anyone with the right equipment.

Mobile phones transmit signals to the local receiving station, where they are re-transmitted to a satellite or another base station. A spy can scan all the frequencies that the receiving station can pick up and so listen in to any phone call made in that area.

Mobile phones are continually giving out signals to the nearest base station in readiness for any incoming or outgoing calls, hence real spies try not to use mobile phones as they are very easily traced.

In a city, base stations can be as close as 100 metres apart so tracing the position of the phone can easily lead to tracing the position of the spy.

# Interrogation

Despite their best efforts spies may still get caught or come under suspicion. If you were headed for interrogation, how well would you be able to lie? And how would the enemy be able to tell if you were lying?

## Spotting a lie

Try questioning your friends. Think up a set of questions and get them to purposely lie for some of the answers and see if you can spot the truth. Start off with easy questions like what they had for dinner last night, or when they last had a bath. Then try something more difficult, like who they fancy!

Pay close attention to their body language when they are answering the questions. According to psychologists, lying makes most people feel very uncomfortable, and their movements can give away clues. Hands on the face, especially the mouth, are said to often indicate that someone is 'covering' a lie. A person who's trying to conceal the truth may very slightly shake their head when they are answering yes, or nod yes when they are saying no. If so, their body is giving them away!

Crossing arms and legs is considered a protective instinct – are they protecting the truth? Watch their eyes – are they continually looking towards the door or window? Will they look you in the eye when answering? If they're not fully focused on their answer it could be a lie.

## How does it work?

Lying makes people anxious and this has an effect on the body. The nervous system is affected by higher emotions producing physiological effects that can be detected. Their palms may begin to sweat; the pupils of their eyes constrict and their heart rate will increase.

The way someone answers a question can also offer some indication of whether it's the truth or not. Talking fast or mumbling is often a subconscious way of believing that the lie won't matter. Being over friendly and smiling when replying can also be a dead give away.

### What real spies do

Spies are trained not to crack under interrogation but the best ones can also conceal the truth by controlling their body's reactions. A spy under suspicion may be given a polygraph test to measure their heart rate, blood pressure, respiratory rate and how sweaty their hands are as they are asked a series of questions.

By causing themselves pain whenever they answer a question – whether it's the truth or not – the spy can confuse the results. The surge of chemicals through their body every time they bite their tongue or jab a drawing pin into their foot can swamp the body's tell tale response to the lies. Other tricks include using antiperspirant on their hands and taking sedatives to reduce their respiratory and heart rates.