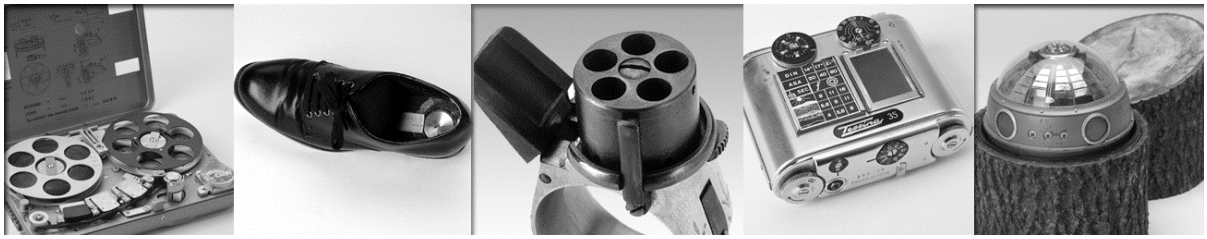
EDUCATOR SPY GUIDE

# Science + Technology

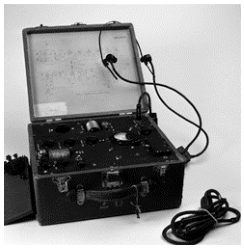


**Of the 1000 artifacts on display at the International Spy Museum, several hundred relate directly to science and technology. The first half of the permanent exhibition is dedicated to tradecraft—the tools and methods spies use to communicate, gather intelligence, and secure their privacy. The second half of the exhibition features famed spy technology as it was used through history, ranging from code machines to spy satellites. The need for tradecraft in espionage has inspired creative breakthroughs in the realms of chemistry, physics, computer science, and engineering design. Spy tech innovations are an exciting way to bring the applications of science to life both at the Museum and back in the classroom.**

## IN THE MUSEUM

**Exhibit areas in bold**. See map for location.

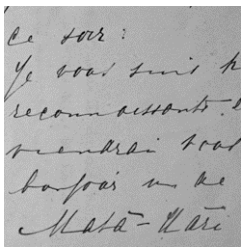
## Covert Communication – Radio Waves and Chemical Reactions



The Museum contains several spy radios used to covertly transmit and receive messages. Look for them in **Cloak**, **Shadow** and **D-Day**. Radios are a challenge for engineers working in espionage—while they provide a method for communication, radio waves are inherently public and need to be protected.

To discuss with students:

- How does radio communication work? What makes it a good way to communicate in the field?
- Is radio transmission a "secret" way to communicate? What kinds of innovations have made it more secure?



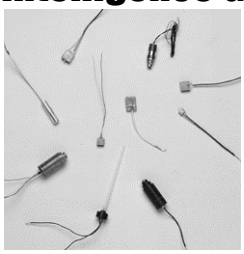
Check out the Secret Writing area in **Ninja**. Scientists use both chemistry and physics to create undetectable secret inks that develop when needed. Dating from ancient times, these secret formulas range from simple kitchen chemistry to high-tech composites.

To discuss with students:

- How can you create invisible ink using the physical light spectrum? Could you design invisible sounds as well?
- Which secret inks seem most and least effective to you?

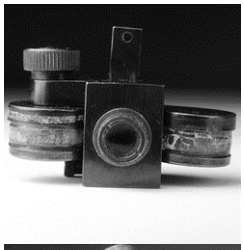
 

## Intelligence Gathering – Electronics, Chemistry, and Imaging



Bugs are key devices used by spies to gather audio information covertly. Watch the bugging film in **Ninja**, explore the bug display in **Cloak**, and investigate the Great Seal replica bug in **Shadow**. During the Cold War, spies raced to develop the smallest, most ingenious bug, and their race fueled technological innovations in acoustics, robotics, and miniaturization of electronics.
To discuss with students:

- How has the bug evolved over time? Describe some of the mechanical, electrical, and design innovations that have changed the bug.
- How do spies detect bugs? What makes a bug easy or difficult to find?



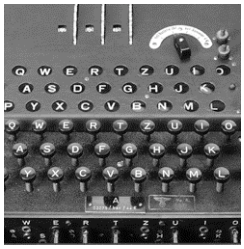
Spies use concealed cameras to collect visual information in the field. In **Cloak**, you can examine spy cameras and microdot technology used to take and transmit pictures securely. Take a closer look at overhead imaging from WWI to today in **Pigeon Camera** and **Silent Sentries**.
To discuss with students:

- Examine the ingredients needed to produce a microdot. Why is it important for spies to use everyday kitchen chemistry in the field?
- What kinds of special functions and features did the pigeon cameras have to enable their use? How would you design a camera for a fish or an insect?
- Check out the satellite images in the **Ops Center**. Are they digital or analog images? What's the difference? What are advantages and disadvantages of going digital?

## Security – Computer Technology and Ethics in Science

Spies need to secure their innovations under lock and key. Watch the lock-picking video in **Ninja**, and study the stories of the **Atomic Spies**. The question of what to secure is often as complicated as the question of how to secure it.
To discuss with students:

- How would you decide what scientific work should be kept secret? Whose responsibility is it to make that decision?



Spies have used codes and ciphers for centuries to protect information. Check out some early cipher machines in **Earliest Espionage**, and then study the Enigma machine in **Code Breaking**. The evolution of cipher machines follows the classic engineering cycle: as old codes are cracked, scientists work feverishly to invent new systems for impenetrable ciphers and codes.
To discuss with students:

- Is the Enigma machine a computer? Why or why not? What about the bombes and the Colossus machine used to crack many Nazi ciphers?
- The Enigma machine was first developed for business use. How have commercial and military technologies intersected over time?

# CLASSROOM CONNECTIONS

Artifacts in the International Spy Museum are a great springboard for discussion and experimentation back in the classroom. Here are some ideas to get you started.

- Explore different kinds of "bugs" in everyday life (e.g., tape recorders, baby monitors, microphones). Set up a bugged room and challenge students to find and deactivate the devices. Which of these everyday bugs are active devices and which are passive?

- Build an AM crystal radio. Use a kit or consult web resources, such as www.midnightscience.com/sciencefair.html#Quaker%20Oats, to design and construct the device. Experiment with receiving different signals. How can you improve the radio? How can you conceal the radio for covert monitoring?

- Build a Morse code transmitter/receiver using a buzzer, a 9V battery, and two long wires. The Morse code alphabet is available at www.babbage.demon.co.uk/morseabc.html. Practice sending and receiving signals. Splice in a second wire and buzzer to set a wire tap on the communication system. Can the original users detect the bug? How can you conceal or safeguard the system so it is more difficult to tap?

- Bring a landline phone and a cell phone into the classroom. Discuss the difference between wired and wireless technology. How could each be intercepted? How can each be made more secure?

- Explore some invisible ink recipes published on the web, such as those at www.kidzworld.com/site/p601.htm and painting.about.com/b/a/062196.htm. Experiment with different concentrations and formulas. Test the secret inks for visibility, ease of use, and ease of development.

- Cryptographers are now experimenting with sending cipher keys securely by transmitting single light photons in random polarizations. Use three light polarizers and a laser pointer to demonstrate how light "chooses" one of two polarizations. Consult a quantum cryptography resource, such as Simon Singh's *The Code Book*, for information about how to perform theoretical experiments in completely secure quantum key exchange.

- Investigate and report on famous scientific secrets from history. What was covered up? Why? How did the scientists feel about it? The World Wide Web has dramatically changed public perspectives on what information should be open to all and what should be private. Discuss the ethics behind the balance of privacy and openness in today's information world.

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