AERIAL RECONNAISSANCE
PHOTOGRAPHIC INTELLIGENCE

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THE SECOND WORLD WAR TO THE COLD WAR

In this activity, the focus is the development and techniques of intelligence-gathering used by the RAF during the Second World War and Cold War. For further information about specific incidents of the Cold War or its historiography, visit the resources section on the RAF100 schools site or the HA main site, www.history.org.uk.

INTELLIGENCE DURING THE SECOND WORLD WAR

During the Second World War, intelligence-gathering (collecting information) was one of the most important aspects of fighting the enemy. Nazi Germany and the Axis powers dominated Europe, and to defeat them the Allies had to use all their resources.

Many people are now familiar with the role that Bletchley Park played in the intelligence war (see information in the topic Codebreakers), but just as important were the wider intelligence-gathering mechanisms.

All over the UK, sites were created that gathered information from Europe and around the world, such as secret messages and information from spies living in occupied and neutral countries and from reconnaissance missions (see below). These sites also collected public information – things that the enemy might think were unimportant, such as holiday parades or train timetables, but which might be used to plot enemy movements and to verify information collected from elsewhere. One of the most important ways to gather information was from photographs.

PHOTOGRAPHIC INTELLIGENCE UNIT – RAF MEDMENHAM

The RAF had started aerial photography during the First World War, and it became a key tool for intelligence-gathering. Fixing cameras to aircraft and learning the best ways of taking photographs from the air became an essential element of the RAF's role. The RAF developed a Photographic Intelligence Unit (PIU). Once the photographs had been taken, the film (pre-digital technology) was taken to the PIU, who developed the film. The men and women in this unit then set about analysing and studying the images for intelligence purposes – that is, to gather information.

During the Second World War, as part of reconnaissance activities, RAF pilots flew specially modified Spitfire aircraft, which contained no weapons to allow them to be lighter and fly faster. The aircraft were painted a blue/grey colour to blend against the sky and had five cameras attached so that they could take lots of photographs in each sortie (trip). The aircraft flew at about 30,000 feet to take their pictures, and were expected to outmanoeuvre and fly faster than the enemy due to their lack of weaponry.

The Central Interpretation Unit (CIU) was created during 1942 and 1943, as part of the intelligence-gathering and interpretation (analysis and reaching a conclusion or outcome) carried out during the war by the RAF. The RAF's Photographic Interpretation Unit was part of the CIU, based at RAF Medmenham in Buckinghamshire.

In 1945 daily intake of material averaged 25,000 negatives and 60,000 prints. By VE-day the print library, which documented and stored world-wide cover, held 5,000,000 prints from which 40,000 reports had been produced. ***www.forces-war-records.co.uk/units/4125/raf-medmenham/***

Part of the work carried out in the PIU was the simple examination of the image and the comparison of that information with other sources, such as secret messages or reports from spies.

If one of the men or women in the PIU spotted something important in a photograph, it was arranged for another reconnaissance sortie to go to the same area. This time, the pilot would fly the aircraft in a straight line to take lots of photos of a particular position – this would create a series of photographs that would then be used for specialist photographic interpretation using 3D stereoscopic methods.

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HOW DOES PHOTOGRAPHIC INTERPRETATION (PI) WORK?

PI TECHNIQUE

A fundamental of gaining intelligence from air photographs (or imagery) has always been the use of overlapping pictures to permit stereoscopic examination.

In ideal circumstances, the reconnaissance aircraft takes a series of photographs that overlap each other by 60%. This 'run' of photography covering a given target or area will then allow the interpreter to examine in three dimensions (stereoscopically) all but 40% of each end 'frame' or picture. The aircraft, by taking overlapping photographs, is emulating the function of the human eyes to see each object from two different positions. The normal separation of an individual's eyes is about two and a quarter inches. The separation of the photographs may be hundreds of feet, thus the impression of depth will be exaggerated.

All normally sighted people have the ability to see in three dimensions, exploiting something called 'parallax' (an apparent displacement of an object in relation to its background) to enable the brain to estimate the distance that objects are away from the individual. Eye movement is interpreted by the brain and turned into a depth appreciation by the individual. The ability to replicate this function with overlapping pictures has been appreciated since the earliest days of photography in the mid-1800s. The tool used to enhance the three-dimensional (stereoscopic) pictures is the stereoscope.

Air photography has normally been limited to daylight and good weather conditions. This has allowed enemy movement and activities to be carried out while the camera was unable to see what was happening. In order to improve the intelligence capability of air reconnaissance, efforts have been made since the 1950s to see through poor weather conditions and at night. Special efforts have also been made to detect activity. The handicaps of early reconnaissance have now been largely overcome by the use of digital, Infrared and RADAR imaging, from both 'air breathing platforms' (aircraft) and satellites. Generally, the techniques in use today are referred to as a 'Multi Sensor' package and the exploitation as Imagery Analysis (IA).

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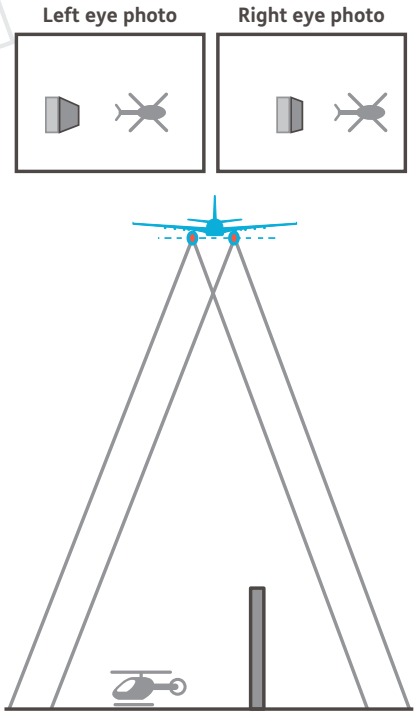
HOW IT WORKS IN PRACTICE: SEEING THINGS IN THREE DIMENSIONS

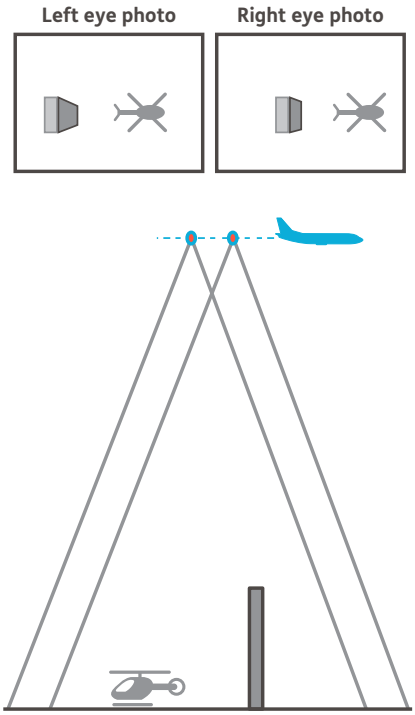
We can see in three dimensions because our two eyes are not in the same position in our heads. If the same object is viewed from two slightly different positions, there appears to be a shift in the position of the object relative to the background. The size of the apparent shift is called the parallax and depends on the distance of the object from the observer. You can see this by holding up your finger and shutting one eye at a time. The finger will appear to move. If you move your finger further away and try again, you will observe a smaller parallax. The brain exploits this difference to see the world in three dimensions.

In aerial photography, stereo photographs can be created by using two cameras or by using a single camera and exploiting the motion of the aircraft (see Figure X). When the photos are returned to the ground, they are developed and then viewed side by side. Objects in the overlapping part of the picture display parallax and appear (to most people) to be three-dimensional.

A camera in each wing can be used to take stereo photographs.



A single camera can be used to take two overlapping photographs in quick succession, as the aircraft flies over the landscape.



OPERATION CROSSBOW

In 1943, a pilot took photographs of some buildings near Peenemünde in northern Germany. The images showed new buildings and shapes on the ground that were not immediately recognisable to those in the PIU at Medmenham. After further analysis, and because the buildings were obviously military but it was not clear for what purpose, the RAF was instructed to attack the facility in August 1943. Of course, all the images of the site were kept in case they had a use in the future.

In 1944, information was sent to the British by the French Resistance (French men and women who were opposed to the Nazi occupation of France and were bravely spying on what the Nazis were doing and trying to stop them) about new German military buildings on the French coast. The reconnaissance pilots led a special low-level flying mission to photograph the site, which was very risky because of the enemy firing at them. The amount of enemy response to the reconnaissance aircraft helped to convince the RAF that they had come across something very important. Comparisons with the images taken at Peenemünde in 1943 also showed a few similarities.

Using the 3D imagery technique, the PIU was able to work out the size of the buildings and see that some of the new shapes were rocket launchers. The team working together had diascovered the sites of the V-1 and V-2 Rockets. Peenemünde was one of the factories that made the rockets, and the sites in France were where they were to be fired from.

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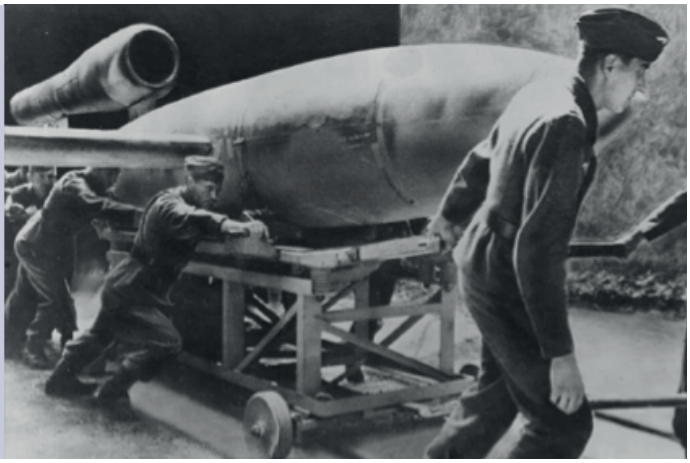
The V-1 (known as buzz bomb or doodlebug) and V-2 Rockets were flying bombs. The rockets were filled with lots of explosives and could be fired from long distances to reach a target. This meant that the Germans could fire the rockets from occupied France to land in the south east of England. The Nazis were able to bomb London without using any aircraft or, therefore, risking their own equipment or pilots. The V-1 rockets made a whistling or buzzing sound as they approached, but the V-2 were silent.



German soldiers moving a V1 rocket to the launch site, August 1944.

The Allied bombers set about bombing V-1 and V-2 rocket bases. The rockets could be launched from mobile sites – this meant that it was difficult to destroy all of the launch sites. However, because of the PIU, the mobile sites could soon be recognised and identified from the air and then destroyed by Allied bombers. The Allies codenamed their identification of the rocket sites and the raids to destroy them Operation Crossbow.

The Germans had built one of the key factories that built the rockets in a mountain so that its importance could not be identified from the air – and, most importantly, so that it could not be bombed by aircraft. This meant that the production of the rockets could not be stopped until the Allies had started the attack back into Western Europe. However, the success of Operation Crossbow in identifying the firing sites meant that the V-1 and V-2 Rockets were not able to disrupt the D-Day invasion.

V-1 and V-2 rockets were fired at the UK and caused damage and death. As they were not dropped from aircraft, it was difficult to detect the bombs' arrival until they were very close to their target. Being able to stop the bombs from hitting their targets was extremely difficult. However, constantly having to move the firing locations for the rockets limited the number that could be fired and subsequently limited the level of damage and destruction.

The work carried out at Medmenham was arguably even more important than that at Bletchley Park, and it was said that 80% of all intelligence in the war came from aerial photography. Writer: Taylor Downing
www.rafmuseum.org.uk/london/whats-going-on/events/spies-in-the-sky/

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INTELLIGENCE IN THE COLD WAR
INTRODUCTION TO THE COLD WAR

Finding a specific date for the start of the Cold War is difficult, but most historians would agree that by autumn of 1947, the friendly wartime relationship between the Western democracies and the Soviet Union was at an end. Relations between the Allies had been awkward at various points throughout the Second World War; after all, for many, this was a relationship born out of need and not friendship.

Immediately following the end of the Second World War, tensions rose to the surface as the Soviet presence appeared permanent in the recently liberated Eastern European countries, with the establishment of communist governments there. Opposing the communist spread were the Western Allies. US president Harry S Truman announced to the American Congress, on 12 March 1947, his government's specific intention to counter and roll back the Soviets' geopolitical advance. The Truman Doctrine, as it became known, moved the USA's usual position of staying out of other countries' disputes to one of intervening in them to prevent the Soviets from expanding their physical and ideological (communist) empire. The Greek civil war (1945–48) emphasised the new split, with the Soviets supporting the communists and the Americans actively supporting the other side.

The appeal of left wing politics in Europe was encouraged by slow economic recovery, with continued shortages and hardships throughout a Europe that was still recovering from war. In the summer of 1947, General George C Marshall made the offer of financial aid on behalf of the USA government to the countries of Europe – the Marshall Plan. The Soviet Union and the Eastern European countries refused the offer, while the countries of Western Europe responded favourably. It was now clear whose sphere of influence all the different nations of Europe were under.

Soviet attempts to take the whole of the German capital, with the Berlin Blockade in 1948, ensured that Europe now acknowledged that it was divided. Churchill's infamous speech of March 1946, declaring that "From Stettin in the Baltic to Trieste in the Adriatic, an iron curtain has descended across the continent", had become true in less than 18 months.

The Cold War did have 'hot' moments, as both sides supported wars elsewhere – conflicts where the two superpowers supported opposing sides in Asia, Southeast Asia, Africa and South America. In October 1962, the Cuban Missile Crisis was the closest that the two sides came to fighting directly, and while the peaceful resolution of that event did not bring the two sides together, it did mark a new stage in the belief that MAD (mutually assured destruction – nuclear war) was a real possibility.

However, unless you lived in Berlin, or close to the division of East and West, the Cold War seemed far away. The lack of any real fighting immediately on most people's doorsteps in Western Europe led to a sense that the war was an idea rather than a reality. Cold War espionage films and thrillers were the imagined reality for many, along with James Bond and John Le Carré novels (such as *Tinker Tailor Soldier Spy*). In such books and films, the focus is usually on elaborate spy stories; the reality was just as serious, but with a daily routine that seemed quite mundane.

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PI STEREOSCOPIC IMAGERY AND THE COLD WAR

The Royal Air Force Intelligence Branch was created in 1939. In 1964, it was disbanded and its work was absorbed into the Defence Intelligence Unit. However, even when it was absorbed, it continued to carry out its main roles in aerial reconnaissance and analysis.

The apparent lack of action that many perceived during the Cold War was deceptive. Both sides were constantly on the lookout to see whether the other was planning to do anything or to outmanoeuvre the other in terms of strength or influence. The RAF, as part of the UK Armed Forces, had bases across Western Europe and the Mediterranean during the Cold War (this map indicates where the RAF bases were: **www.raf100schools.org.uk/map/world).**

The bases had a number of purposes, but a key role for many was aerial reconnaissance. Most days, reconnaissance aircraft would fly over set areas to take pictures of buildings, military bases and areas that were believed to have Soviet military activity.

The images would be used by analysts to monitor what the Soviets and their allies were doing. They would be looking to see whether there was any new equipment, whether new military bases were being developed or whether large numbers of troops were being taken to places where they shouldn't be.

Satellites were also being used during this period to take images. These images would be compared with the images taken by the reconnaissance aircraft. Sometimes it was due to something suspicious in a satellite image or a piece of intelligence gathered from people in those countries that would lead to particular places being photographed by the RAF aircraft.

The images taken by the reconnaissance missions were incredibly detailed (far more so than a satellite could take at that point) and provided far greater detail about what was happening. Furthermore, the aircraft could fly across the interesting site multiple times and at different times of the day so that a more complete picture of what was happening there could be built up.

AROUND THE MEDITERRANEAN

Many people focus on the Berlin Wall and the events in Central and Eastern Europe during the Cold War, but a lot of intelligence-gathering occurred slightly further south.

During the Cold War, it was popular practice for armaments (military vehicles, guns, artillery and so on) to be moved around by land and sea. Nuclear weapons were often carried aboard submarines, ready to be used in an attack. Using submarines was particularly important because it meant that a nuclear threat was not just based in one location.

Russia, and later the Soviet Union, had a geographical problem with moving things around by sea. The location of Russia means that many of its ports are not usable during winter, because they are blocked by ice. This meant that during the time of the Soviet Union, the ports in the Crimea and the Ukraine, which are on the Black Sea, were very important to the Soviet naval fleet. The Black Sea opens on to the Mediterranean Sea, and anyone travelling from there needs to go past Gibraltar to get out to the Atlantic.

Throughout the Cold War period, some of the most important bases for the British were those around the Mediterranean – Malta, Cyprus, Gibraltar and so on – as they were used for reconnaissance missions and analysis stations to watch the Soviet fleet and to look for submarine activity in the area.

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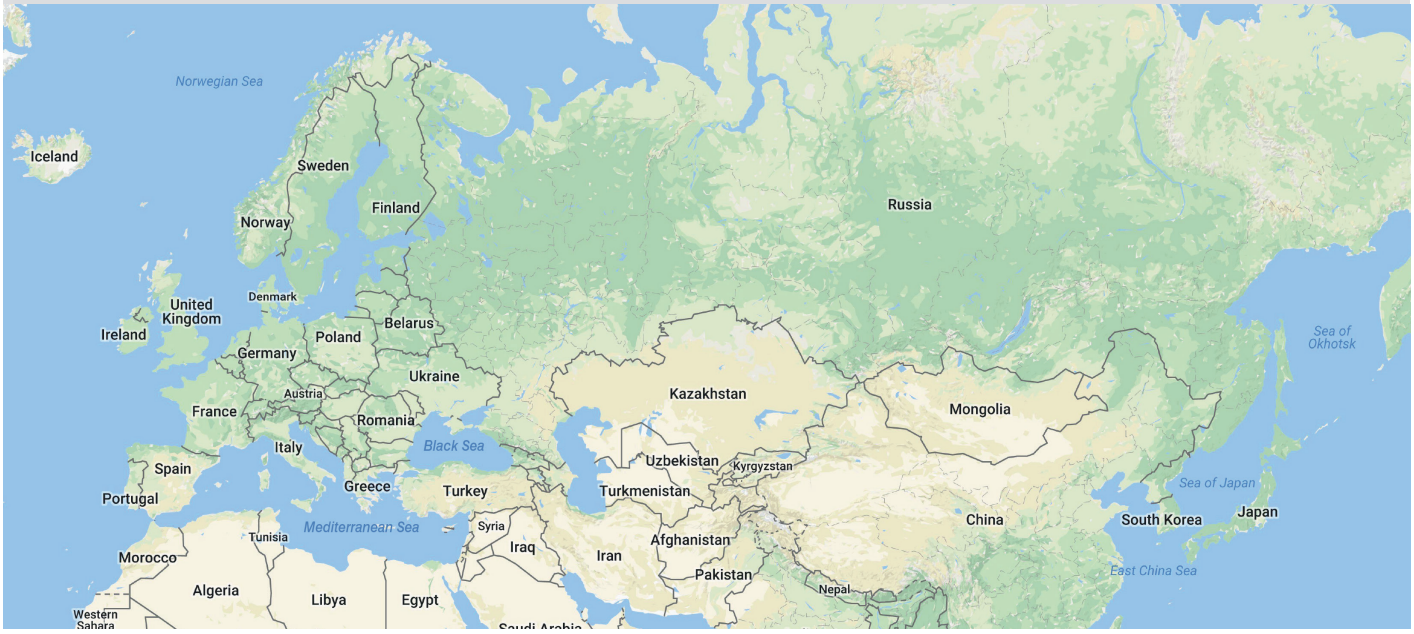
Aerial reconnaissance and PI were used to keep a check on all of the key Black Sea ports and some of the quieter ones. Using PI, the analysts were able to identify submarine docks and distinguish between normal warehouses and military warehouses. Without the3D effect, the submarine stations would be difficult to distinguish from other inlets along a rocky coastline.

The UK and NATO response to any unusual activity was further monitoring and analysis. If the activity was deemed serious, then NATO troops or resources might be moved to an area near the Soviet military build-up, to deter any possible acts of violence. Questions might also be raised at the UN or through the non-aligned countries (countries that claimed to be neutral in the East versus West split, such as Yugoslavia).

Collecting intelligence from the Mediterranean area and comparing it with intelligence from other parts of the Soviet Union meant that the Russian military, and especially the nuclear threat, was monitored all of the time. It is one of the factors that ensured that that the Cold War never turned really hot in Europe.



THE END OF THE COLD WAR

After many years of internal resistance and political pressure from the West, the countries of Eastern Europe began to push the Soviets out. In 1980, the Berlin Wall was brought down by the German people, and the communist government of East Germany began to collapse.

Over the following couple of years, all over the Eastern Bloc, countries began to break away from the Soviet Union until it also had a dramatic change of government in the autumn of 1991.

Aerial reconnaissance and PI is still used today – now it is to monitor other conflicts and warzones. The detail and information it can produce is still seen as an invaluable tool for understanding international events and affairs.

Fall of the Berlin Wall By Sharon Emerson Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=8883480

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USING THIS INFORMATION

This historical information can be combined with the introductory film and resources from the resource section for exploring some creative ideas in a school club or informal club, or for a more curriculum-based lesson.

Below are some ideas and enquiry questions that these materials could support.

In addition to the historical information above, case studies and extra information are available in the resource section of this website. These include biographies and aircraft technology case studies.

KEY QUESTIONS FOR EXPLORATION IN ANY SETTING:

- Why was Operation Crossbow important in limiting the attacks by the Germans on the UK?
- How important is it to have 3D images rather than just a photograph?
- How did 3D images affect the UK during the Cold War?

HOW TO USE THIS MATERIAL IN A HISTORY CLUB OR LUNCHTIME/ AFTER-SCHOOL/INFORMAL CLUB

These ideas are suitable for a mixture of age groups and abilities. They can also be used with the interactive map on this website to begin a local history investigation concerning the RAF.

SHOW THE FILM: *RECONNAISSANCE – THE COLD WAR*

PROVIDE THE HISTORICAL INFORMATION OR READ IT TO STUDENTS.

Key question:

Why does aerial reconnaissance provide valuable intelligence information?

Ask the students to explain the importance of aerial reconnaissance by creating one of the following

(you might want to use some of the questions from the box to get them thinking):

- An information poster about how Photographic Intelligence works.
- A newspaper story about Operation Crossbow.
- A display for the school/class/group noticeboard on how RAF intelligence-gathering worked during the Cold War.

Or, ask them to look at the **activity to understand PI below and see whether they can do it.**

Extension: Find out the history of the RAF base in the Mediterranean.

Now use this information to start investigating the local history of an airbase near you – this can be done starting with the interactive map. Over the course of the last century, over 1,500 airbases or places have been used by the RAF, so even if you don't live near to one now, there will have been one nearby at some point. Alternatively, students might want to investigate one of the Cold War bases used during that period.

Find out about the base. Identify what other information or understanding of an historical period is needed to tell the story of that base.

AERIAL RECONNAISSANCE
PHOTOGRAPHIC INTELLIGENCE

LESSONS IN SUPPORT OF THE CURRICULUM AND/OR EXAMINATIONS

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GUIDANCE ON HOW THIS MATERIAL COULD BE USED IN A LESSON ABOUT:

1. The Second World War/Britain Since 1945
2. The Technology of Warfare/War and British Society

1. BRITAIN SINCE 1945

Ages 11 years and above

This is a suggested lesson, which can use additional information from the RAF100 schools site (such as images, biographies and the information on NATO) and/or the main HA site (www.history.org.uk) to develop it further if wanted.

Suggested key question:

Why did intelligence-gathering matter during the Cold War?

Show the film: *Reconnaissance – the Cold War*

Use the information above to explain photographic intelligence and 3D intelligence a bit further.

Ask students to list the reasons why 3D images make a difference to intelligence information.

Now ask the students to go to the **www.raf100schools.org.uk** site and look at the interactive map – world bases (**https://www.raf100schools.org.uk/map/world**). Set the time parameters for the Cold War on the map.

Using the map, ask the pupils where the RAF bases are across Europe.

Can they suggest some of the roles carried out at these bases? Why are they in those locations and not at other locations in Europe? (You might want the students to investigate a bit more about those bases.)

Using some of the images marked '*Images for stereoscopic use*' in the resources section of the RAF100 website, ask students whether they can see any key buildings and features. Why would being able to see the images in 3D make a difference?

Share the information about NATO with the students.

Using the resources you have, ask the students to list what the key threats were for the Western Allies during the Cold War and how they monitored and responded to the threats.

Ask the students to debate the following: Aerial intelligence is not as important as military power.

Conclude the lesson with some ideas around intelligence-gathering.

2. THE TECHNOLOGY OF WARFARE

In this suggested lesson, students are being introduced to a key method of collecting intelligence data during the twentieth century. They are able to explore how technology is used to combat conflicts in different ways.

Dependent of preparation time and ability, you may want to show the film and use the historical information, followed by carrying out the activity below – **An activity to understand PI**.

Alternatively, after showing the film, you might want students to investigate the following question (suggested key question):

Why is intelligence-gathering an important element of defence during times of conflict?

Working in groups, ask the students to make notes from the film. Using that information and the information above, they should list the components needed to carry out effective aerial reconnaissance.

Then ask the students (still in groups) to create a map based on **https://www.raf100schools.org.uk/map/world** to plot a timeline of when aerial reconnaissance was used.

Ask the students to compare the information on Operation Crossbow with the information on PI during the Cold War. Do they think that aerial reconnaissance made a difference to those times?

Can they identify what those differences were and what the overall impact might have been?

Conclude by discussing the importance of intelligence-gathering in times of conflict.

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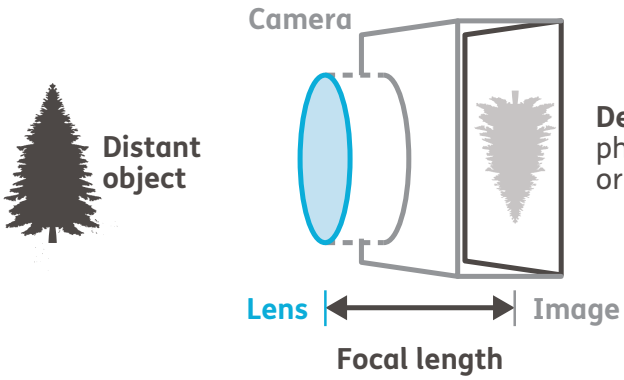
AN ACTIVITY TO UNDERSTAND PI CAMERAS AND STEREO IMAGES

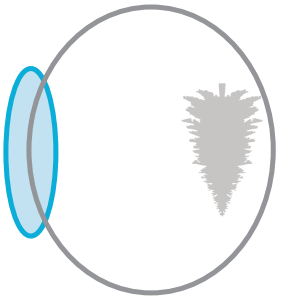
During the Cold War, cameras were used to take two overlapping photos to make 3D images. In this activity, you will investigate how the size of the image captured by a lens depends on its focal length and investigate how we can see things in three dimensions.

WHAT YOU AND YOUR PARTNER WILL NEED: YOU'LL NEED:

- 2 x lenses with a large curvature
- 2 x lenses with a small curvature
- graph paper, set square and ruler
- sticky tape or masking tape
- cleaning tissue
- Scissors
- wall, paper or card to form a screen
- a cardboard virtual reality viewer (with lenses removed)
- a copy of the *Stereo Diagrams*



Focal length:
The image of an object can be captured by using a lens to focus light on to a detector. If the object being viewed is far away, the distance between the lens and detector is known as the focal length.



WHAT YOU NEED TO DO

1. Work out the focal lengths of your lenses

a) Feel the surfaces of your lenses with your fingers to work out which one is fatter.

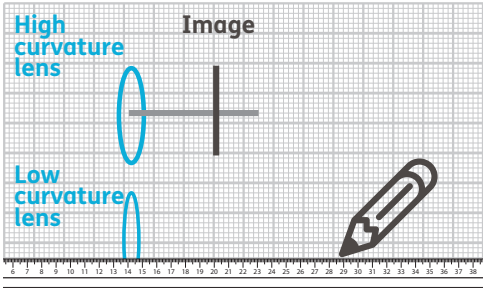
b) Hold the fat lens a few centimetres away from a wall or a sheet of paper and focus the image of a distant window (or lamp).

c) Measure the distance between the image and the lens. This is the focal length.

d) Repeat with the thinner lens. Is the image made by the thinner lens bigger or smaller, brighter or dimmer?

e) Draw two diagrams to scale on the same sheet of paper to show the position of the lens and image for the fat and thin lenses.

f) Label which image was the largest and which was the brightest.



DISCUSS

If you were designing a camera for aerial reconnaissance, which would be better: a lens with a high or low focal length? Why?

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2. Take stereo photographs

Working with your partner:

a) Use sticky tape to join two sheets of A4 graph paper together to make one single long sheet of paper.

b) Measure 4 cm in from one of the short ends of the paper and draw a line across the paper. Mark the centre of this line "nose".

c) Use a ruler to measure the distance between the centres of your partner's eyes. Measure this distance on your paper along the line and mark the positions of your left and right eye either side of the nose.

d) Draw another line, at right angles to the first line from the point labelled nose. Measure and label distances of 20 cm, 30 cm and 40 cm along this line.

e) Attach blu-tack to the end of a pen or pencil and place it so that it stands upright at the 20 cm mark

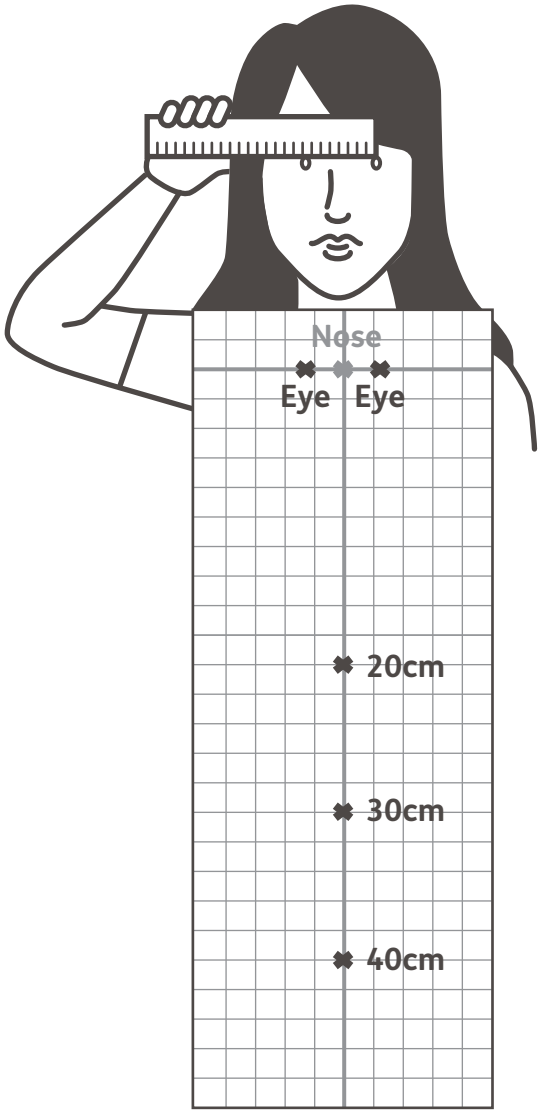
f) Add blu-tack to a different coloured pen/pencil and stand it upright at the 30 cm mark.

g) Look at the back of your mobile phone and locate the position of the camera lens.

h) Hold your phone upright on the line with the eyes marked on it. Use a ruler and/or set square to line up the centre of the camera lens above the left eye position and take a picture.

i) Repeat for the right eye position to capture a second image. Compare your photos. How are they different?

j) Move the second pen/pencil to the 40 cm position. Take another two pictures from the left and right eye positions.
Is there any difference between this set of photos and the first pair?



DISCUSS

Your eyes send two different images to your brain. How do you think your brain can work out which objects are far away and which ones are nearer?

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3. Make a stereo viewer

You and your partner will need one cardboard viewer between you.

a) Mount the two long focal length lenses into the viewer. You may need to attach two small pieces of tape to each lens to hold them in position.

b) Use your Stereo Diagrams sheet. Hold the viewer at a height equal to the focal length of the lenses above one pair of diagrams.

c) Look at both diagrams through the viewer at the same time. Each eye should see a slightly different image and they should merge to create a 3D image. Let your partner have a look as well.

d) If it doesn't work try:

- Relaxing your eyes by trying to look past the two images
- Holding a sheet of paper, or an exercise book straight down from centre of the viewer so that your left eye can only see the left diagram and the right eye the right diagram.
- Slightly titling you head back and forth or side to side.
- Repositioning the diagrams.

e) Once you've tried one set of diagrams try the others.

DISCUSS

What are advantages are of using a stereo pair of photos rather than a single photo or a map for aerial reconnaissance?