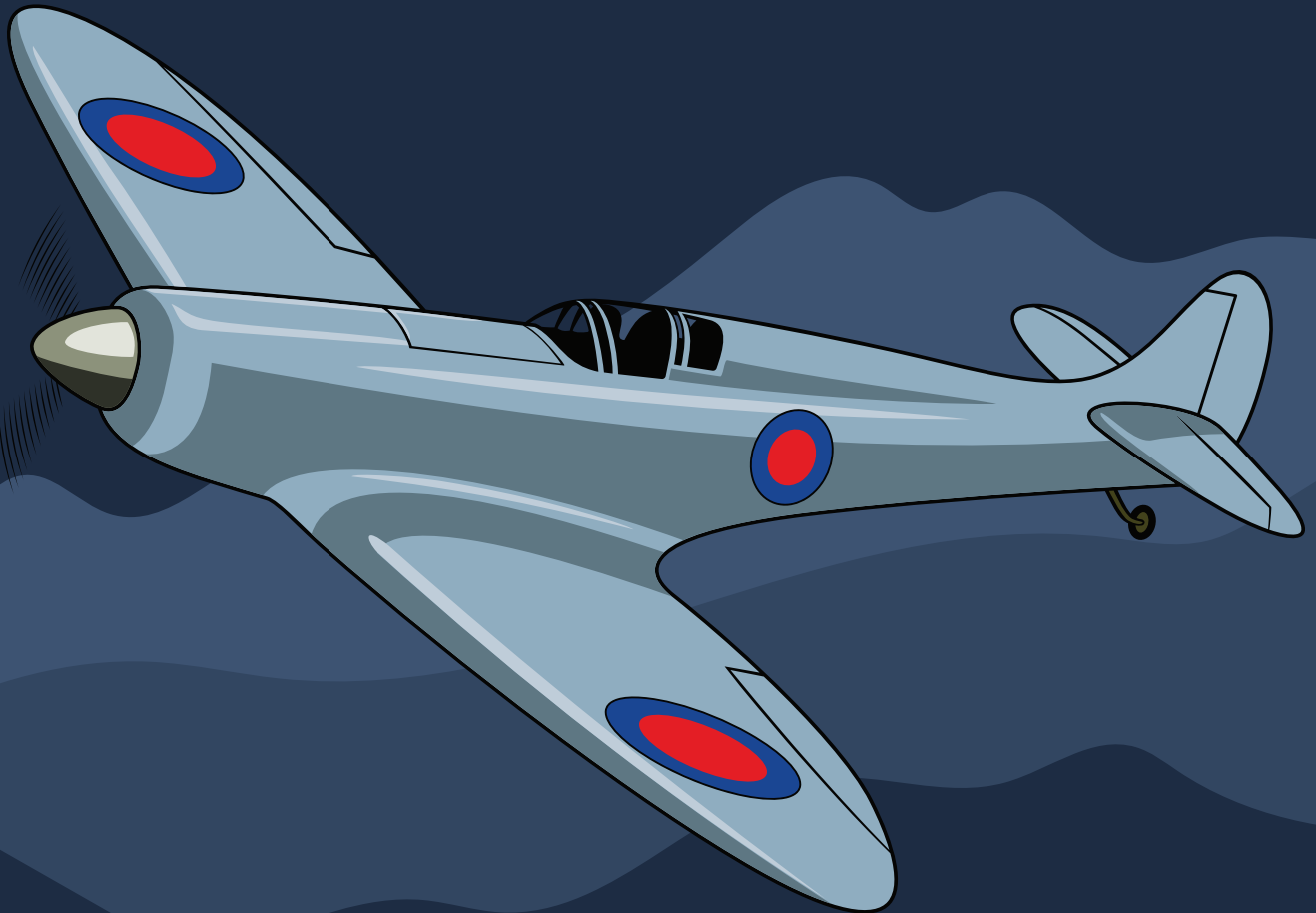


RECONNAISSANCE, IMAGE ANALYSIS, AND SPITFIRE AA810

ACTIVITY WORKPACK 2



 **ROYAL
AIR FORCE
Youth STEM**

 **ROYAL Charitable
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ABOUT THESE MATERIALS

This resource pack provides students with the opportunity to explore the science and history underpinning the development and deployment of Spitfire AA810 during WWII. The materials form part of a suite of five resource packs exploring a particular area linked to Spitfire AA810. These resources concentrate on **reconnaissance and image analysis**. Curriculum links for KS3 learners are provided below to support embedding the content within your structured delivery or teaching sessions.

CURRICULUM LINKS



History / STEM

- ✓ **Science in Society:** Exploring the role of scientific advancements in historical events, such as the Cold War, and how reconnaissance technology impacted global politics.
- ✓ **Working Scientifically:** Developing skills in analysing data from reconnaissance images, interpreting visual information, and making scientific deductions based on evidence.

Physics

- ✓ **Forces:** Investigating how forces are used in flight and the physics behind aircraft movement, particularly in reconnaissance missions during WWII.
- ✓ **Light:** Understanding how light is used to create images, particularly in stereo imaging, which is crucial for interpreting reconnaissance photographs.

ABOUT SPITFIRE AA810



Spitfire AA810 is a famous aircraft from the Second World War. It is known for its important role in taking photographs of enemy areas. This particular Spitfire was used by a special group that flew deep into enemy territory to gather information through aerial photography. Unlike regular Spitfires, AA810 had no guns but instead carried lots of extra fuel and cameras. This allowed it to fly 2,000 miles to complete some of its missions. Today, there is a project to restore Spitfire AA810 so it can fly again. This project helps remember the brave pilots who flew it and it teaches people about their contributions during the war. You can find out all about this by [clicking here](#).

GUIDANCE NOTES AND ANSWERS

This pack has been designed so that it can be comfortably delivered in a 1-hour facilitated session with secondary pupils. This pack forms part of a series of resources designed to explore the history and science linked to Spitfire AA810. Each pack in the series contains web-links and QR codes to suitable background and contextual information to inform your delivery of the content. Answers to tasks and activities, where relevant, are provided below:

PAGE 9: Test your knowledge and understanding of the Cold War and how reconnaissance was used by answering the questions below.

1. What does NATO stand for?

NATO – North Atlantic Treaty Organisation.

2. What was built in Germany after NATO and the Warsaw Pact countries split?

Berlin Wall.

3. What was the confrontation between East and West called?

Cold War.

4. What were the image analysts looking for on the aerial photographs?

Significant activity or major equipment moves.

5. Using the F-95 camera for stereo imaging, how many photographs were taken of everything on the ground?

At least two.

7. What was special about F-95 photography?

The ability to look at the images in 3D.

8. Why was reconnaissance important during the cold war?

Responses might include: A few ideas:

Identifying Enemy Positions: Helped locate and identify enemy troops, fortifications, and supply routes, aiding strategic planning.

Planning Operations: Crucial for the success of key operations like the D-Day invasion by providing detailed images of enemy defences.

Monitoring Movements: Enabled tracking of enemy force movements to anticipate and counteract strategies.

GUIDANCE NOTES AND ANSWERS

Technological Advances: Innovations in aerial cameras and night-time photography improved the quality and usability of intelligence gathered.

Deception Tactics: Supported deception operations such as Operation Fortitude, misleading the enemy about invasion plans.

Real-time Updates: Provided timely intelligence on battlefield conditions for dynamic strategy adjustments.

Strategic Advantage: Offered a significant advantage by enhancing the effectiveness and precision of military operations.

PAGE 12: Look at the stereo images below, taken by an aircraft flying high above the ground, and circle similarities you can see between the images.

Take another look at the images and highlight any overlapping areas. Overlapping areas have been identified on the second image below.

The bottom image on page 12 overlaps at this line with the top image.



GUIDANCE NOTES AND ANSWERS

PAGE 20: With your knowledge and understanding of Operation Crossbow and stereo imagery techniques, answer the following questions.

- 1. What is the Spitfire well-known for?**
The Spitfire is well-known for its role in the Battle of Britain.
- 2. What did the Spitfire discover in Operation Crossbow?**
In Operation Crossbow, a Spitfire discovered an airfield with three concrete-and-earth circles at Peenemunde.
- 3. What was Peenemunde?**
Peenemunde was a vast research centre developing the V-missiles which the Nazis believed would help them win the war.
- 4. When did Operation Crossbow begin?**
Operation Crossbow began in 1942.
- 5. When were the reconnaissance flights sent to investigate Peenemunde?**
Reconnaissance flights were sent to investigate Peenemunde in 1943.
- 6. When did the bombing raids on Peenemunde take place?**
The bombing raids on Peenemunde took place on 17 and 18 August 1943.
- 7. Why was Peenemunde an important target for British intelligence?**
Peenemunde was an important target because it was a research centre developing the V-missiles, which were considered a significant threat.
- 8. Why did British intelligence bug a conversation between captured German generals?**
British intelligence bugged the conversation to gather information about the V-missiles being developed at Peenemunde.
- 9. Why were the bombing raids on Peenemunde crucial?**
The bombing raids were crucial to disrupt the V missile program and eliminate the launch platforms and senior Nazi scientists involved in the development.

GUIDANCE NOTES AND ANSWERS

10. How did the British discover the significance of Peenemunde?

The significance of Peenemunde was discovered after a Spitfire reconnaissance flight spotted the airfield with three concrete-and-earth circles and subsequent analysis of photographic evidence.

11. How did photographic interpreters identify the V-missiles at Peenemunde?

Photographic interpreters used 3D imagery to spot an upright tube in one of the circles and deduced from its shadow that it was a rocket about 14 meters high.

12. How low did some reconnaissance flights go to get clear images?

Some reconnaissance flights flew as low as 30 meters to get the clearest possible images.

13. How did the bombing raids affect the V-missile programme?

The bombing raids disrupted the V missile program and killed senior Nazi scientists, delaying and hindering the development and deployment of the V-missiles.

RECONNAISSANCE, IMAGE ANALYSIS, AND SPITFIRE AA810

For many years intelligence-gathering has been used by security services, armed forces and governments to help maintain peace and stability in places of unrest and conflict. Even before the birth of flight, ancient armies stood on high ground to observe the battlefields below. Hot air balloons, in the 18th and 19th century, were another way of visualising the ground below, be it for pleasure or for intelligence gathering during the French Revolution and American Civil War.



Aerial reconnaissance also developed over the trenches of the Western Front in France and Belgium during the First World War, but it was the Second World War (WWII) that transformed this method of intelligence gathering. Aerial reconnaissance carried out by the RAF Photographic Reconnaissance Unit (PRU) played an essential part in the allied victory over Nazi Germany by 1945.

DID YOU KNOW?



The RAF's last operational use of the Spitfire was for photo reconnaissance on the 1st April 1954. The task for the aircraft was to carry out reconnaissance duties to stop communists seizing control of Malaya as the Cold War intensified.

RECONNAISSANCE, IMAGE ANALYSIS, AND SPITFIRE AA810

Analysis of aerial photographs, as a way of gathering intelligence, played a crucial role during WWII. During the Cold War, and more recently, image analysis has been actively used to help protect and defend people and secrets.



One of the reconnaissance aircraft used extensively during the Cold War was the U-2 (pictured here). It had an extraordinary range and could fly 14 miles high while photographing in astonishing detail. One of its major objectives was to find out the extent of Soviet nuclear weaponry.

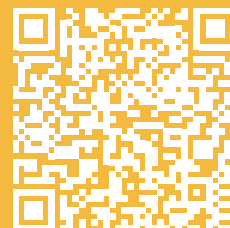
RECONNAISSANCE



'Reconnaissance' is a term used to describe military observation of enemy activity to gather valuable information. This helps military leaders to plan and carry out missions to defeat the enemy.



Scan the QR code or [click here](#) to learn more about the history of image analysis and reconnaissance





Test your knowledge and understanding of the Cold War and how reconnaissance was used by answering the questions below.

What does NATO stand for?

What was built in Germany after NATO and the Warsaw Pact countries split?

What was the confrontation between East and West called?

What were the image analysts looking for on the aerial photographs?

Using the F-95 camera for stereo imaging, how many photographs were taken of everything on the ground?

What was special about F-95 photography?

Why was reconnaissance important during the cold war?

STEREO IMAGES AND YOUR EYES

WHAT IS STEREO VIEWING?



Stereo viewing uses technology to create the illusion of depth by showing two slightly different images to each eye. This tricks the brain into seeing a 3D image.

HOW IT WORKS



- **Stereoscopic Displays:** Devices like 3D glasses, VR headsets, and certain computer screens show two images taken from slightly different angles.
- **3D Imaging:** These devices rely on the brain's ability to combine two images into one, creating a sense of depth.

USES



- **Entertainment:** 3D movies and virtual reality games create immersive experiences.
- **Medical Imaging:** Used in operating theatres to provide better depth perception for surgeons.
- **Scientific Research:** Helps in understanding complex data in fields like astronomy and biology.



STEREO IMAGES AND YOUR EYES

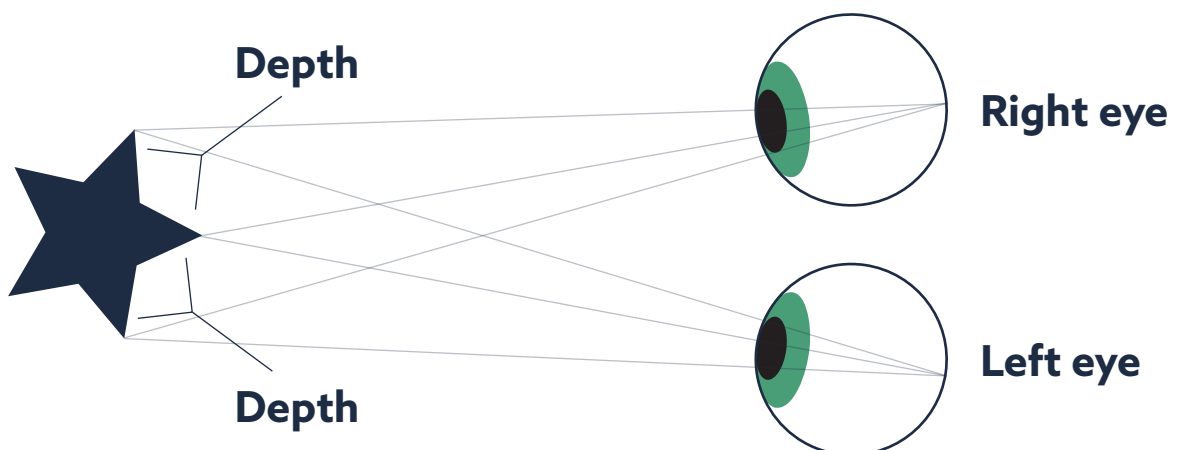
TRY THIS



To understand how stereoscopic vision works, try this simple experiment:

1. Cover your right eye with your palm and focus on an object at a distance using the left eye.
2. Switch and cover your left eye and observe the object with the right eye.
3. Look at the object with both eyes.

You'll notice that you can see the object with one eye, but you'll need both to perceive the object's size and distance. Stereoscopic vision is the brain's ability to create cohesive 3D images using visual information from both eyes.



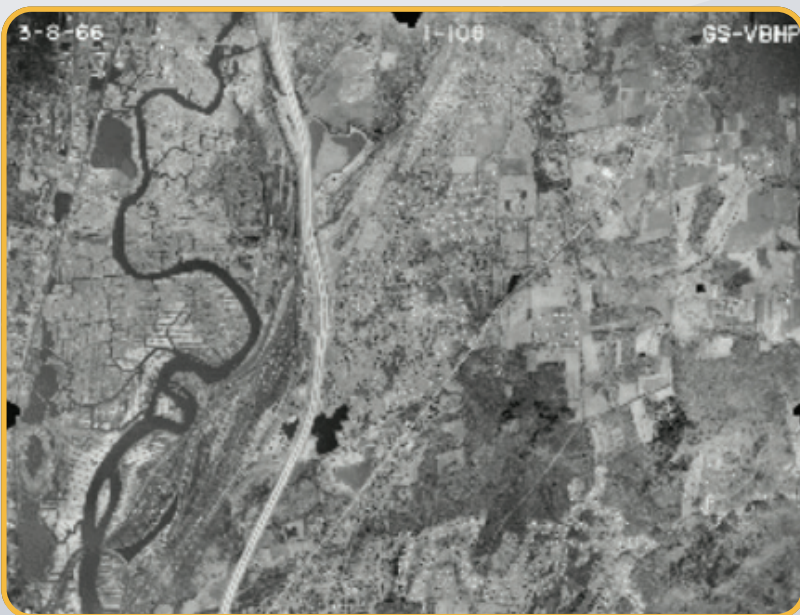
STEREO IMAGES

PHOTO RECONNAISSANCE

Look at the stereo images below, taken by an aircraft flying high above the ground, and circle similarities you can see between the images.



Take another look at the images and highlight any overlapping areas.

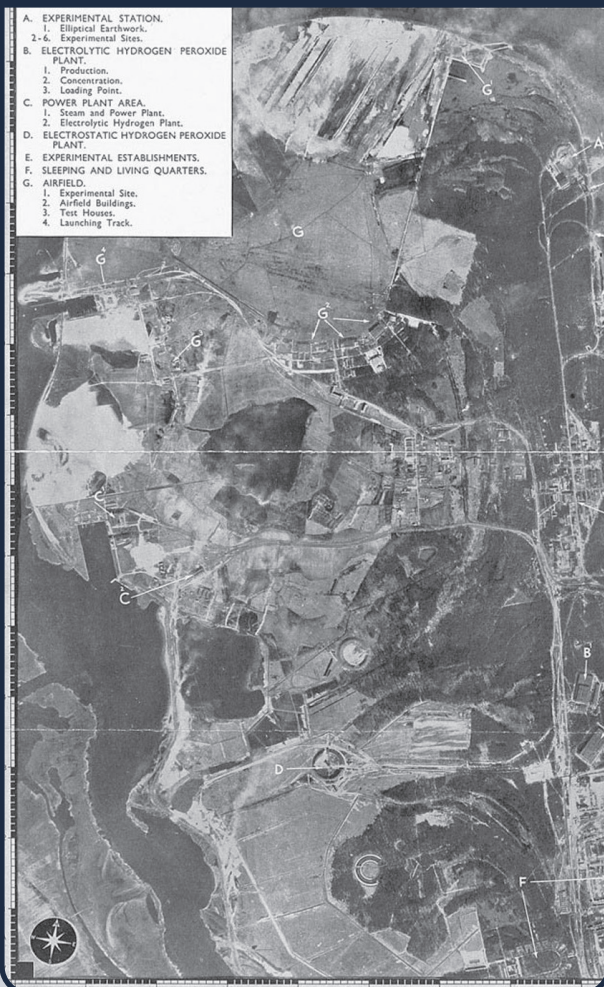


STEREO IMAGES

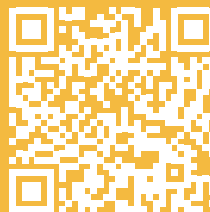
PHOTO RECONNAISSANCE

60% of each of the two images on the previous page are identical so there should be plenty of similarities to find. This is important because when these two perspectives are combined, to a point where there is 60% overlap, the result is a 3D image. The overlap allows the viewer to see a the image differently because it allows depth perception.

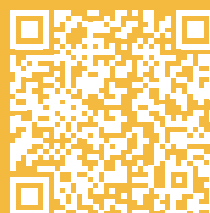
A RECONNAISSANCE IMAGE TAKEN BY RAF PILOTS DURING WWII



Scan the QR code or [click here](#) to find out more about the types of reconnaissance aircraft used since WWII



Scan the QR code or [click here](#) to learn about aerial photography and the First World War

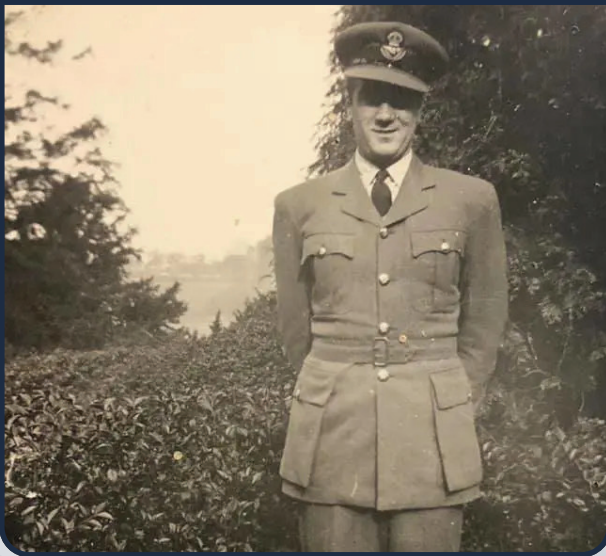


STEREO IMAGES

HUNTING TIRPITZ

During WWII Alfred Fane and Alistair 'Sandy' Gunn flew Spitfire AA810 to Norway to gather intelligence on the Tirpitz, a large German warship. The Tirpitz could disrupt allied shipping and supply routes. Fane photographed Tirpitz in early 1942, taking high altitude and low altitude photographs. In March 1942, Gunn made attempts to capture further reconnaissance imagery of the ship but was sadly shot down, leading to his capture and imprisonment by the Germans.

ALFRED FANE



ALISTAIR 'SANDY' GUNN



Scan the QR code or [click here](#) to read documents about photographic reconnaissance that were secret during WWII



STEREO IMAGES

CREATE A STEREO VIEW



You can recreate a stereo view similar to the ones generated by the early reconnaissance missions of Spitfire AA810. Look online for stereo images or scan the QR codes below or click the links for a few good sources. Once you found some, try the activity on the next page.



Scan the QR code or [click here](#) to find out more



Scan the QR code or [click here](#) to find out more



STEREO IMAGES

CREATE A STEREO VIEW

DID YOU KNOW?



During the Second World War, Cymru RAF bases and Welsh aircrew played an important role in the war effort. RAF Rhosneigr, now a fast jet training base known as RAF Valley, served as a fighter training base and an American transit base. Today it is home to 4 Squadron who fly the Hawk T2 jet. During the war however, they flew photo reconnaissance missions, often at low level to gather information ahead of the allied invasion of Nazi held Europe and were based overseas. Welsh pilots like Edward Gordon Bacon from Y Felinheli and Mervyn Anthony Jones from Llanelli served as photo reconnaissance pilots. Jones was a champion jockey who won the Grand National and went on to take part in several photo reconnaissance missions before sadly being shot down in 1942.

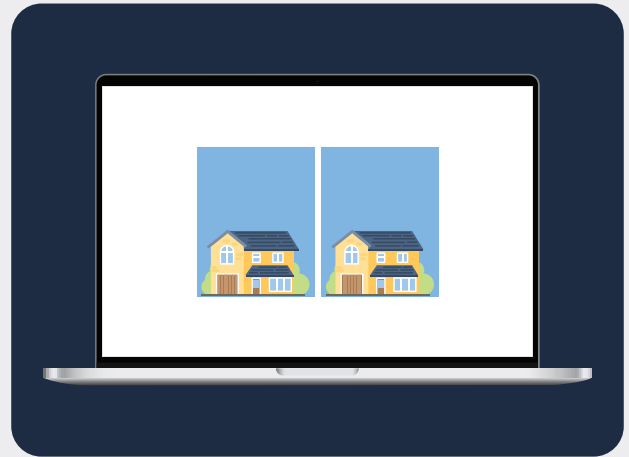
MERVYN ANTHONY JONES



STEREO IMAGES

CREATE A STEREO VIEW

1. When you have a pair of images, centre them in the middle of your screen (ideally they should be around 10-15cm in size each)
2. Place some stiff card between the images to create a barrier and then line your nose up against the card so that your left eye can see the left image and your right the right image.
3. Close both eyes. After a few seconds open your left eye only and focus on the image. Then focus beyond the image (a little into the distance) and slowly open your right eye. You might need to focus a little to make the two images converge. When this happens you should be able to see a stereo-image showing depth and perspective.



STEM 6: STEREO IMAGES
INSTRUCTIONS

RAF 100

CAMERAS AND 3D IMAGES

In aerial reconnaissance two photographs can be used to make a 3D image. In this activity you will investigate how the size and brightness of an image created by a lens depends on its focal length and investigate how we can see things in 3D.

WHAT YOU AND YOUR PARTNER WILL NEED:

- Two fat lenses
- Two thin lenses
- Graph paper, 1st square and ruler
- Sticky tape
- Mobile phone with camera
- A cardboard virtual reality viewer (lens removed)
- A copy of the Stereo Diagrams

Distant object

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.

Detector

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) Look at the surfaces of your lenses 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) Working with your partner, measure the distance between the image and the lens. This is the focal length.
 - d) Repeat with 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 graph paper to show the position of the lens and image for the fat and thin lenses. 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?

IOP Institute of Physics

CAMERAS & 3D IMAGES

Scan the QR code or click here to find out more about stereo images and how we see things in 3D



USING RECONNAISSANCE IN WWII: OPERATION CROSSBOW

The Spitfire is well-known for the role it played in the Battle of Britain, but less celebrated is its critical contribution as a reconnaissance aircraft. Operation Crossbow began in 1942, when an Reconnaissance Spitfire (a specially-adapted aircraft capable of taking high quality photographs), similar to AA810, was flying over Peenemunde in north-eastern Germany. During the flight, the pilot spotted an airfield with three mysterious concrete-and-earth circles in it.

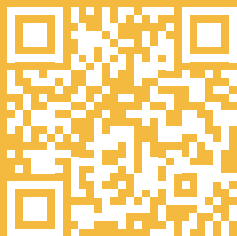
In fact, Peenemunde was a vast research centre developing a new missile system - the V-missile - which the Nazis believed would win them the war.

This plan was disrupted in 1943 when British intelligence successfully (and secretly) recorded a conversation between two captured German generals about the weapon. British spy aircraft scoured Europe and photographic interpreters and analysts were ordered to find clues as to the whereabouts of the missiles. Using 3D viewing techniques (like the one we've covered earlier), a photographic interpreter managed to spot an upright tube in one of the circles at Peenemunde.



From its shadow, the interpreter deduced that it was a rocket some 14m high. Reconnaissance flights were sent to investigate, with some daredevil pilots flying as low as 30m above ground to get the clearest possible images. Back in Medmenham (the RAF's image analysis centre), the Photographic interpreters correctly identified these objects as launch platforms.

On the 17th and 18th August 1943, 500 bombers set off to destroy Peenemunde and related sites. Crews were left in little doubt of the importance of their mission; they were told they would have to go back if the sites were not eliminated. The raids were successful, as they severely disrupted the German V programme and killed senior Nazi scientists working on the project.



Scan the QR code or [click here](#) to find out more about Operation Crossbow and the reconnaissance work carried out to destroy the Nazi V programme



Scan the QR code or [click here](#) to find out more about how your eyes use stereo imaging to see in 3D





With your knowledge and understanding of Operation Crossbow and stereo imagery techniques, answer the following questions.

WHAT?

What is the Spitfire well-known for?

What did the Spitfire discover in Operation Crossbow?

What was Peenemunde?

WHEN?

When did Operation Crossbow begin?

When were the reconnaissance flights sent to investigate Peenemunde?

When did the bombing raids on Peenemunde take place?

WHY?

Why was Peenemunde an important target for British intelligence?

Why did British intelligence bug a conversation between captured German generals?

Why were the bombing raids on Peenemunde crucial?

HOW?

How did the British discover the significance of Peenemunde?

How did photographic interpreters identify the V-missiles at Peenemunde?

How low did some reconnaissance flights go to get clear images?

How did the bombing raids affect the V-missile programme?
