STEM 6: STEREO IMAGES
INSTRUCTIONS

CAMERAS AND 3D IMAGES

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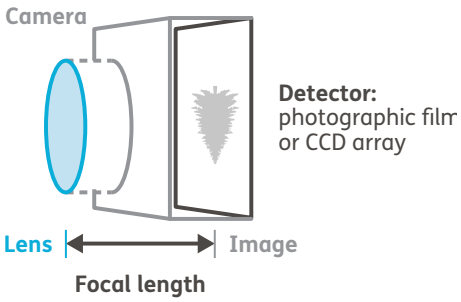
In aerial reconnaissance two photographs can be used to make a 3D image. In this activity you will investigate how the size and brightness of an image created by a lens depends on its focal length and investigate how we can see things in 3D.

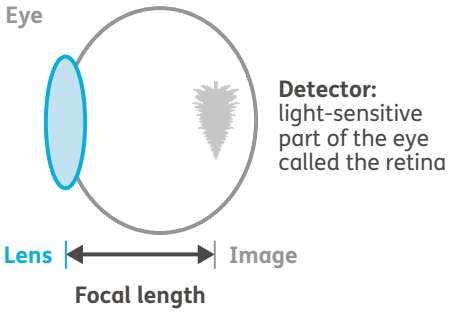
WHAT YOU AND YOUR PARTNER WILL NEED:

- Two fat lenses
- Two thin lenses
- Graph paper, set square and ruler
- Sticky tape
- Mobile phone with camera
- 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) 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?

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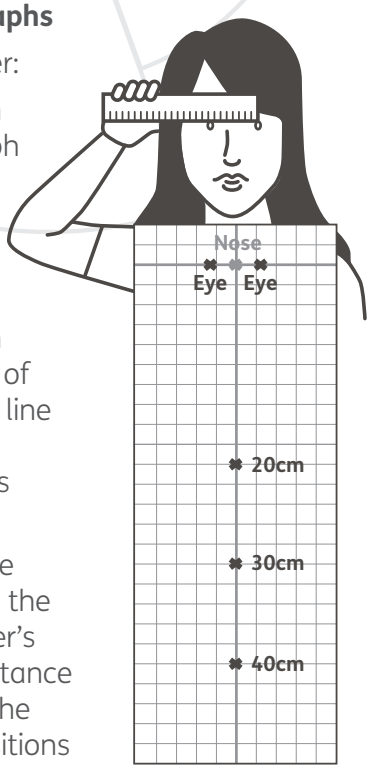
2. Take stereo photographs

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 the 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?

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 your head back and forth or side to side.

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?