Pinhole Camera Workshop

A brief history of the Camera Obscura, the science behind pinhole photography, and instructions how to make your own camera!

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The Camera Obscura &the Pinhole Photography

4th century BC, first reference to a camera made by Aristotle. The Camera Obscura, a dark room with a hole in one end, by the effect of light diffraction, projected an image onto the opposite wall.

1568, Daniello Barbaro added a lens to the hole, improving the sharpness of the image.

Mid 17th century, it was miniaturised down to a box about 30cm square, when a piece of paper was placed opposite the lens it was possible to display pictures on it.

In the first half of the **19th century**, chemistry happened and the photograph was born.

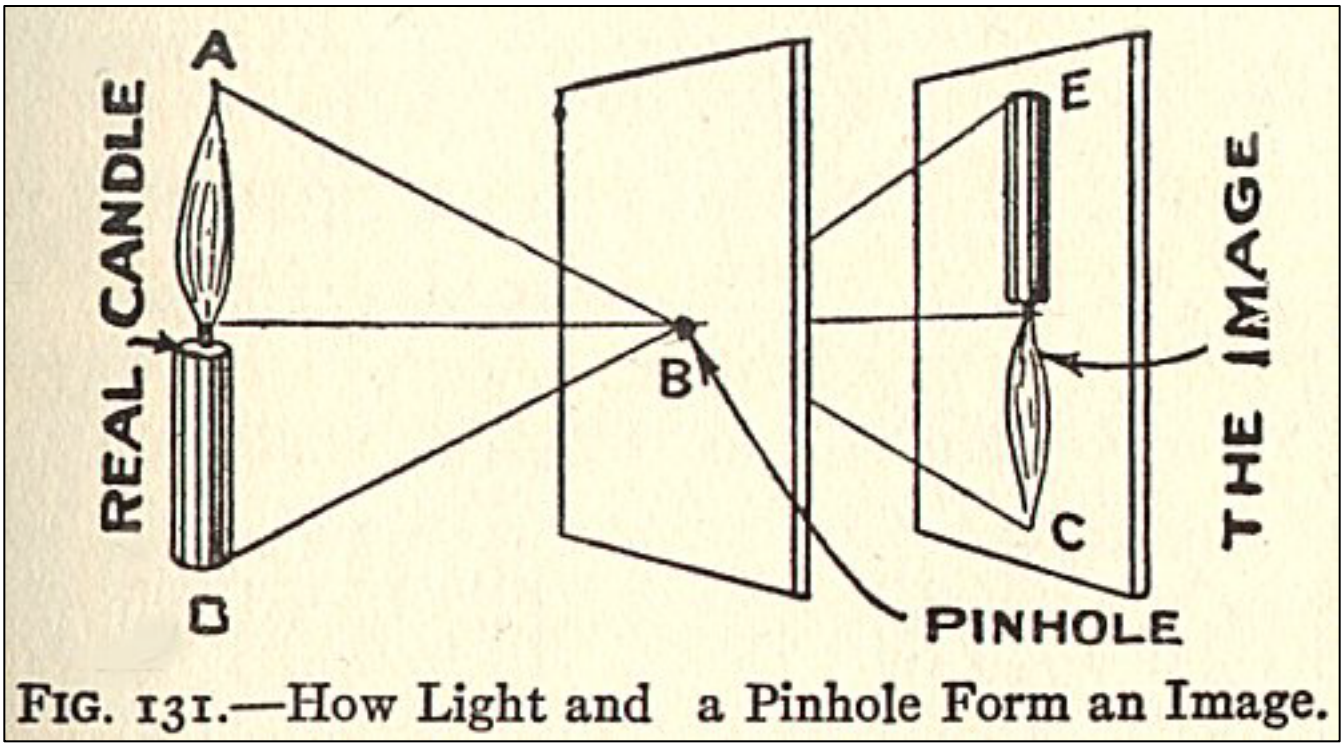
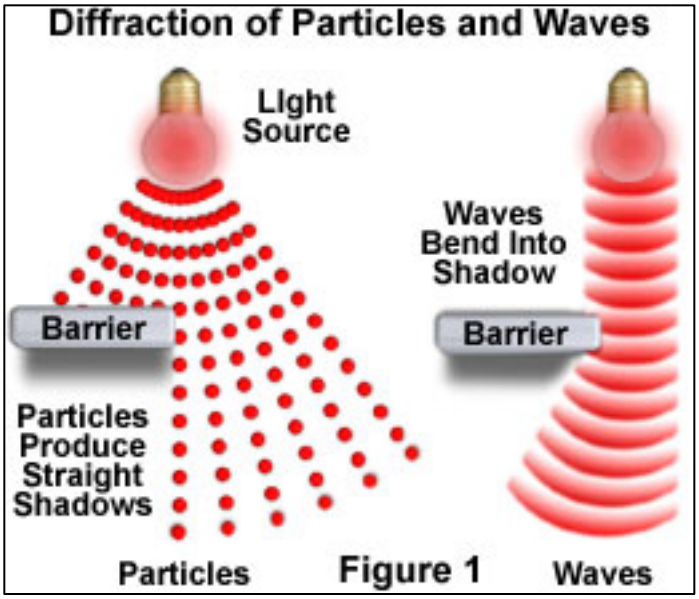


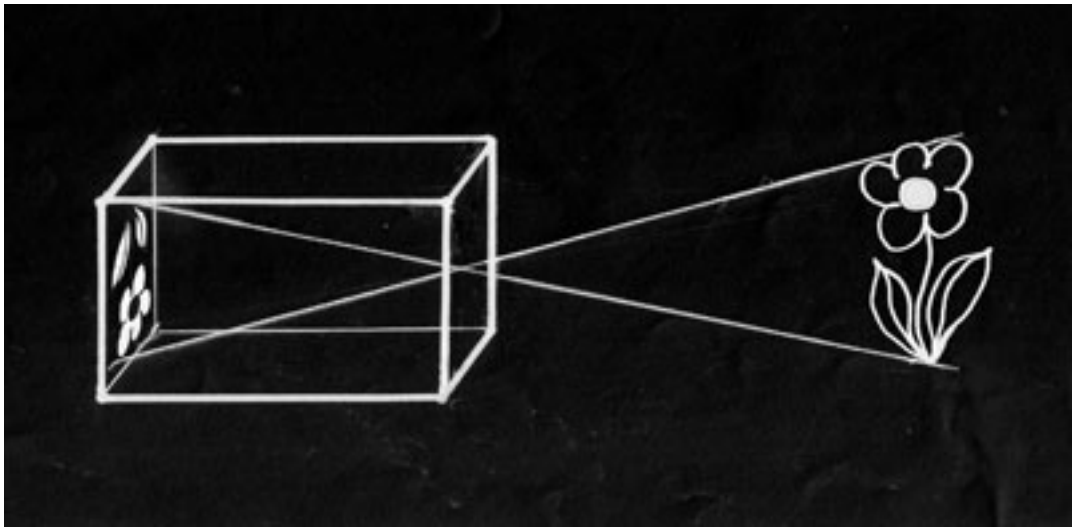
FIG. 131.—How Light and a Pinhole Form an Image.



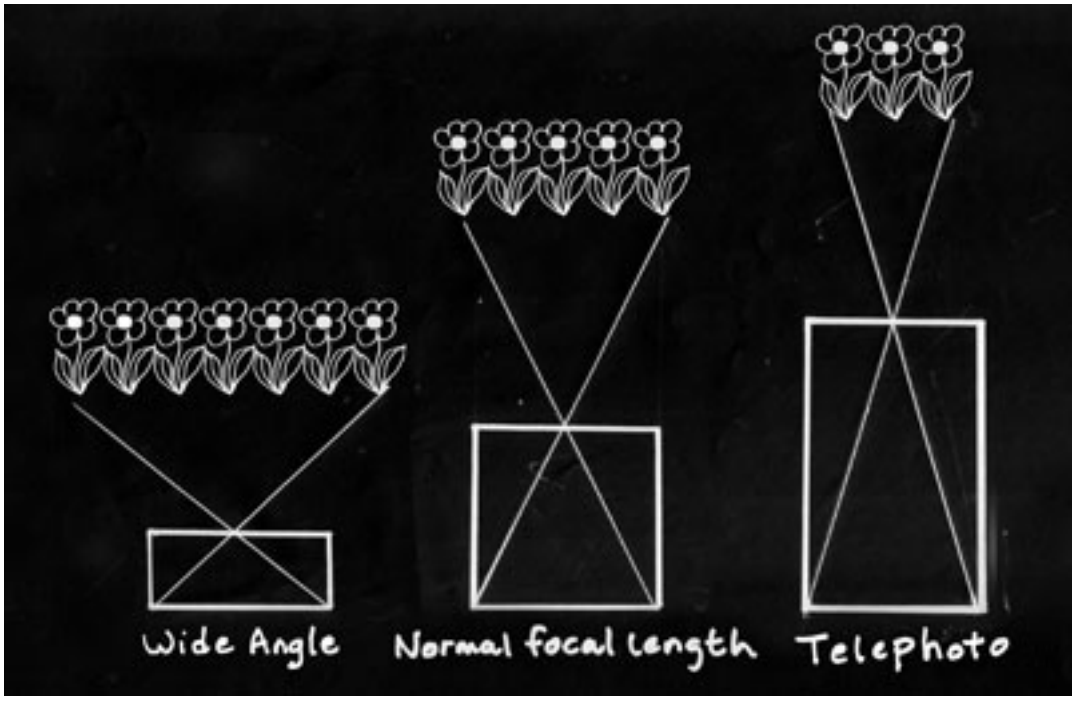
The camera works by using **light diffraction**. The simplest way to understand how a camera works is by looking at the mechanics of a pinhole camera.

Unlike a particle, light waves do not stop, when they encounter a gap or aperture, the waves spread out the other side if this gap. This characteristic of waves to bend around obstacles and spread out past gaps is referred to as diffraction.

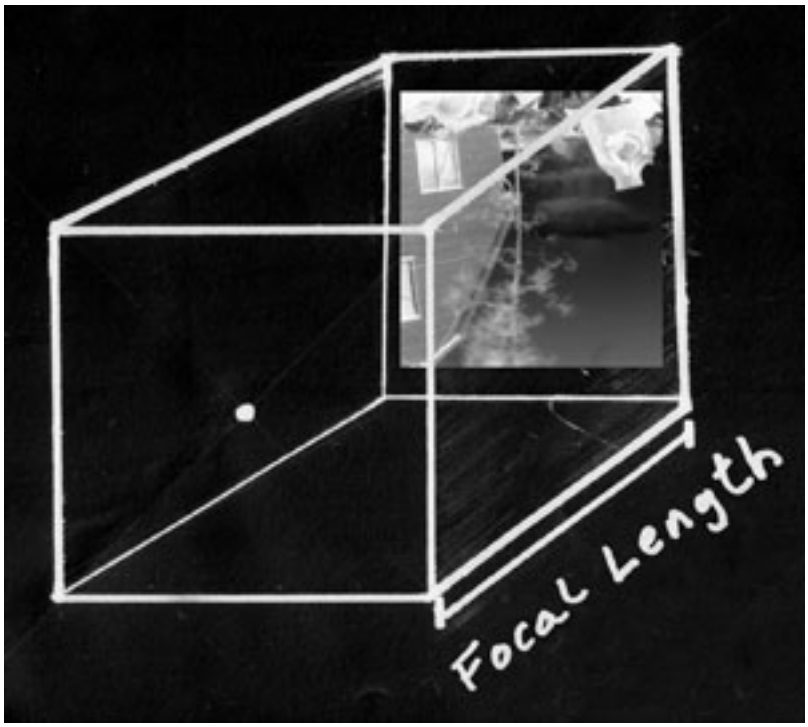
The pinhole of the camera, works using this light diffraction. And modern cameras to this day use this simple discovery and subsequent invention. Because of the way the light waves travel, when they hit the surface opposite the aperture (gap) they appear upside down. Modern cameras use mirrors to reverse the image back, so what you see through your viewfinder is the correct way up.



Pinhole cameras rely on the fact that light travels as a wave, and uses diffraction when it hits a barrier. This makes the image appear upside down in the camera.



A focal length about equal length to the diagonal size of the paper or film is a normal focal length. A shorter focal length is called a wide-angle, and a significantly longer is referred to as telephoto.



The focal length of your pinhole camera is the distance between the pinhole and the paper you have loaded the camera with.

Making the camera

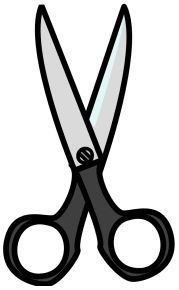
You will need:

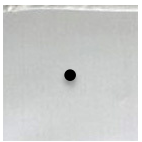
Shoebox
Blackboard paint
Paintbrush
Wooden peg
Size 11 sewing needle
Super glue
Scissors
Disposable aluminum pie tray
Black electrical tape
Emery board (nail file)
Ruler
Beer mat
Sticky back Velcro
Black card (210gsm)
Double sided tape
Elastic bands

1. Paint the inside of the shoe box with matte black paint (we have used blackboard paint as it is thick and non reflective)

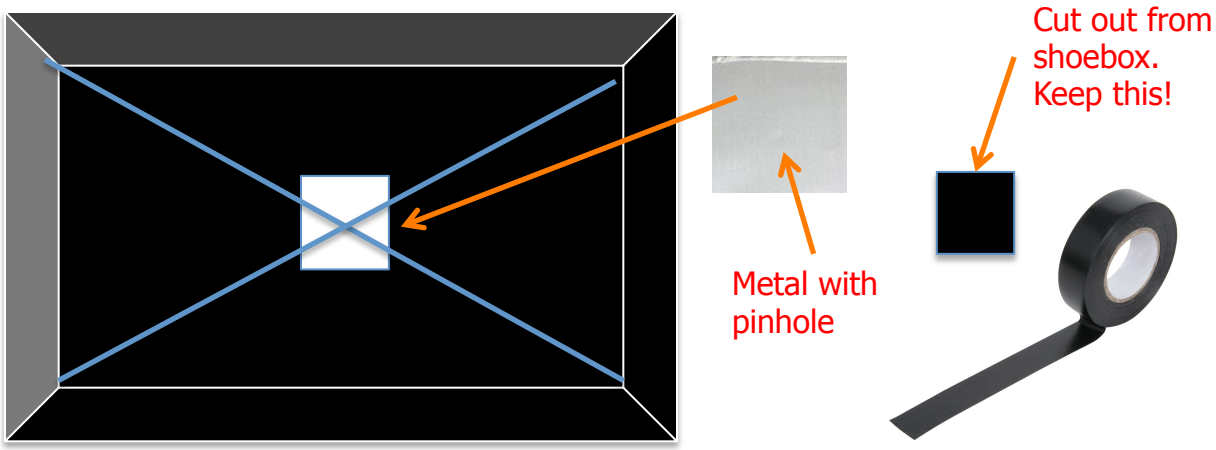
2. Create a needle drill. Glue the sewing needle between the peg and wait to dry.

3. Cut out a 4x4cm square from the aluminum pie tray, drill a hole through the middle using the needle drill (do not pierce, using a drilling motion you will get more accuracy). Sand away any rough edges using the nail file.

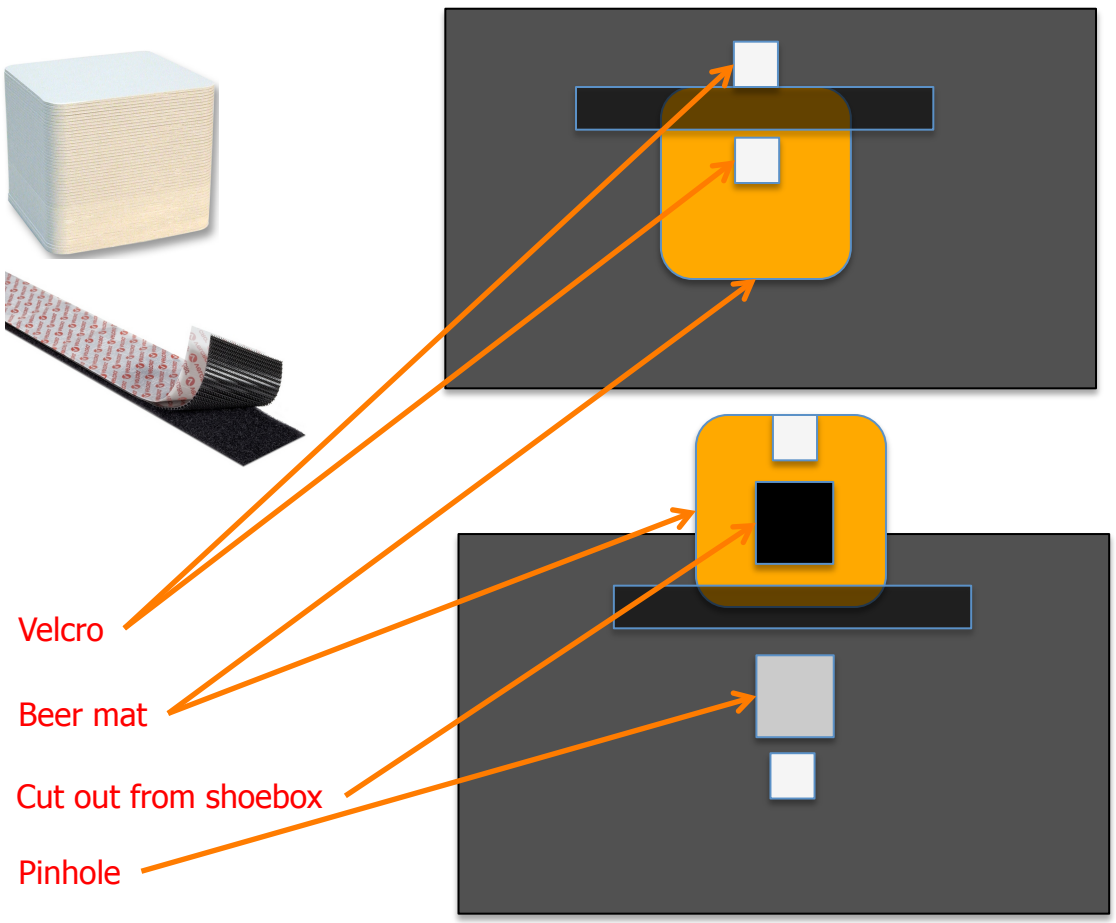


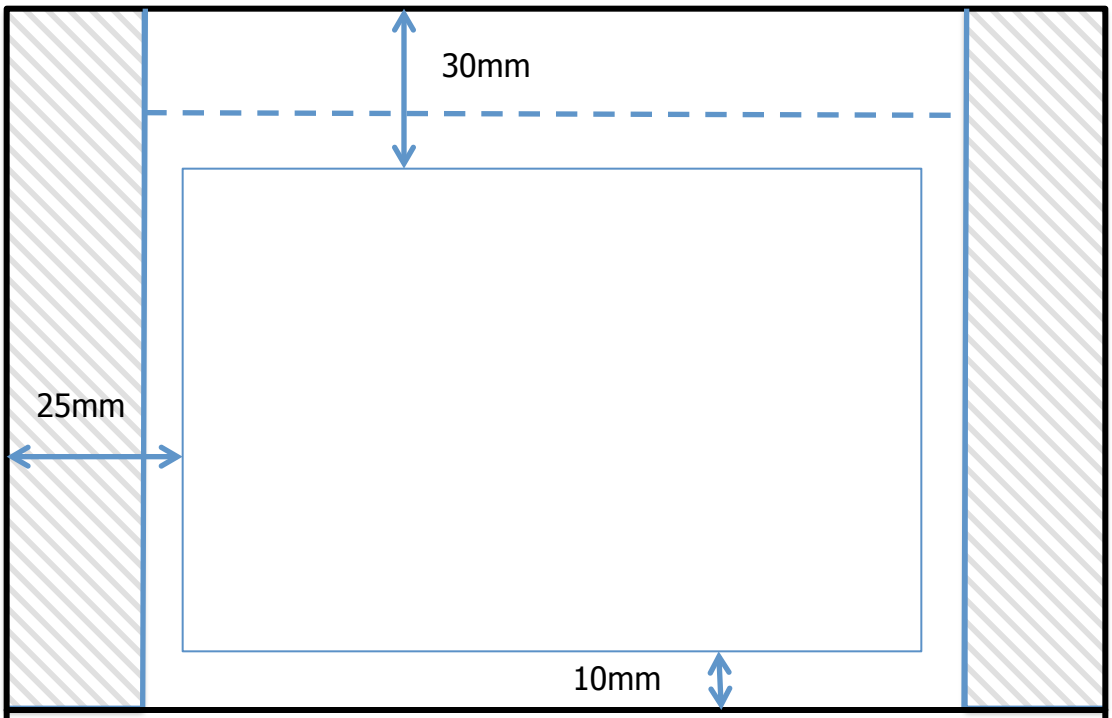


4. Cut out a 2x2cm square from the centre of the shoe box lid. Tape the metal square to the inside of the box using black electrical tape.



5. Make the shutter. Using a beer mat, tape over the pinhole and secure with velcro (stick the discarded square to completely block out the sunlight).

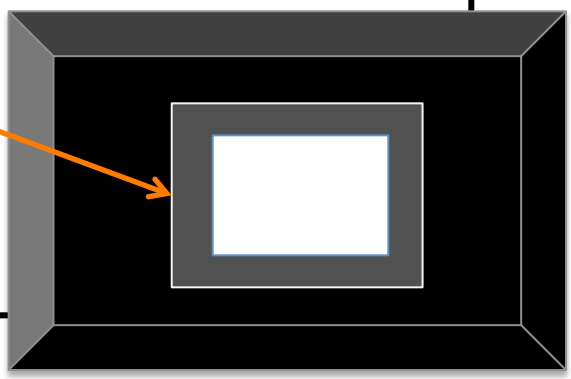




Score and fold

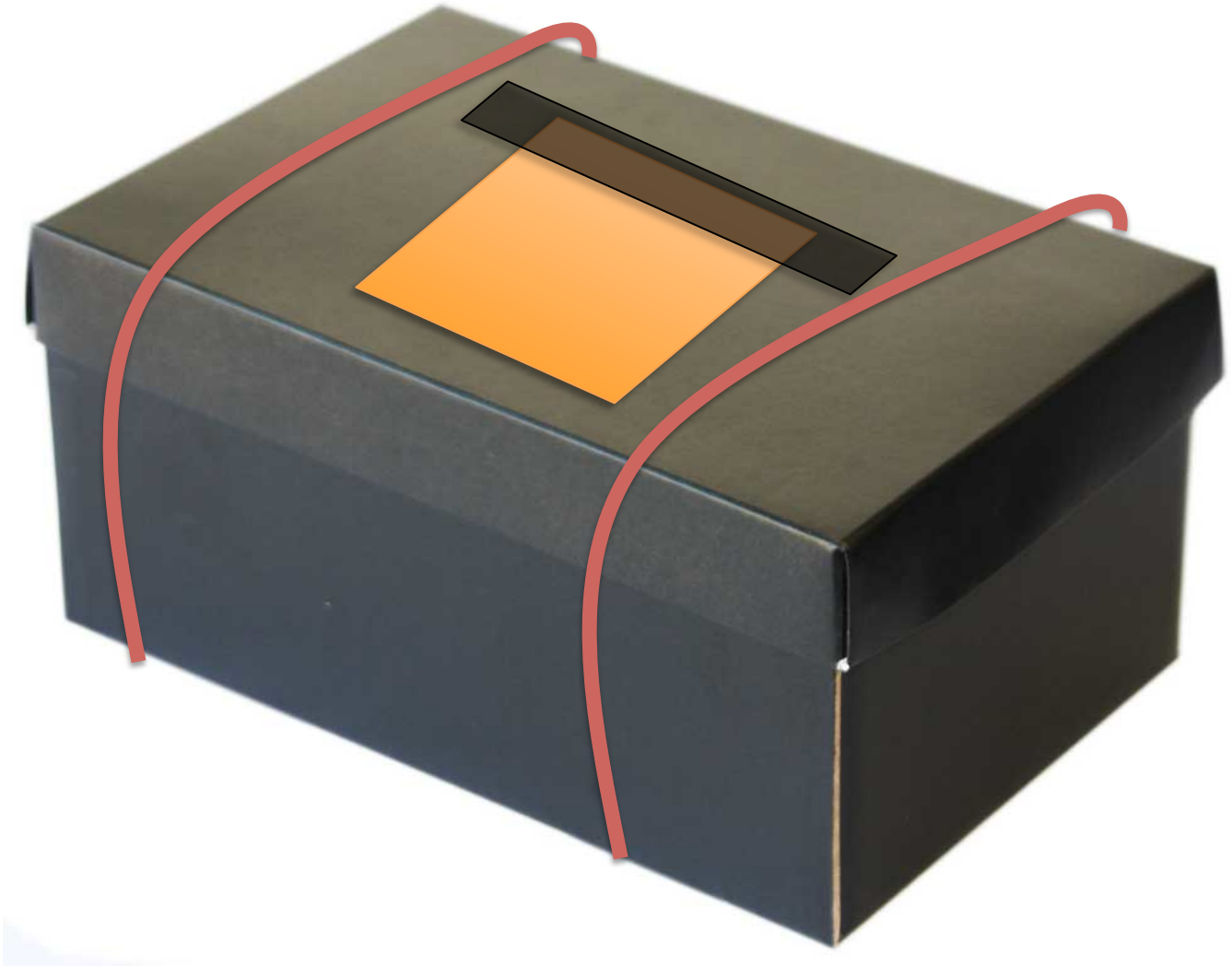
Double sided tape

Inside the bottom of the shoe box



6. Next we have to load the photo paper. Above is the template for the photographic paper holder, using A4 black card. This attaches inside the bottom of the shoe box using Velcro.
Loading the paper is done in the dark so that the it isn't exposed too early to light.

7. Finally, before you head off to take your photo, secure the lid on with elastic bands, as shown below.



8. Using the table on the next page as a guide, take your photo.
Put the camera on a flat surface, with the pinhole facing the subject. Lift the 'beer mat' and time your exposure. When the time is up, fix the 'beer mat' back again, to make it light tight.

The Maths!

Pinhole Diameter	Focal length	f/stop
0.42mm	110mm	f260

Weather Conditions	f/stop	Exposure time
Bright or hazy sun. A scene with light sand or snow.	260	18 seconds
Bright or bright-hazy sun. The shadows are distinct (sharp). Typical nice, sunny day.	260	50 seconds
Weak or hazy sun. The shadows aren't distinct (soft). An OK type day.	260	2 minutes
Cloudy, but bright! No shadows. No sun. No rain.	260	6 minutes
Open shade or heavily overcast. No shadows. Either grey or in the shadow of a tall building	260	15 minutes
Dawn or dusk. Dark out here… Like it says. Early morning or early evening.	260	39 minutes

- Pinhole diameter = the size of the needle.
- Focal length = distance from paper to pinhole.
- The f/stop can be worked using an online calculator – the link is in the resources. We need the f/stop to work out exposure.

- Working out the exposure times is not exact, and requires a bit of trial and error. The chart above is a rough guide, so we have a starting point.

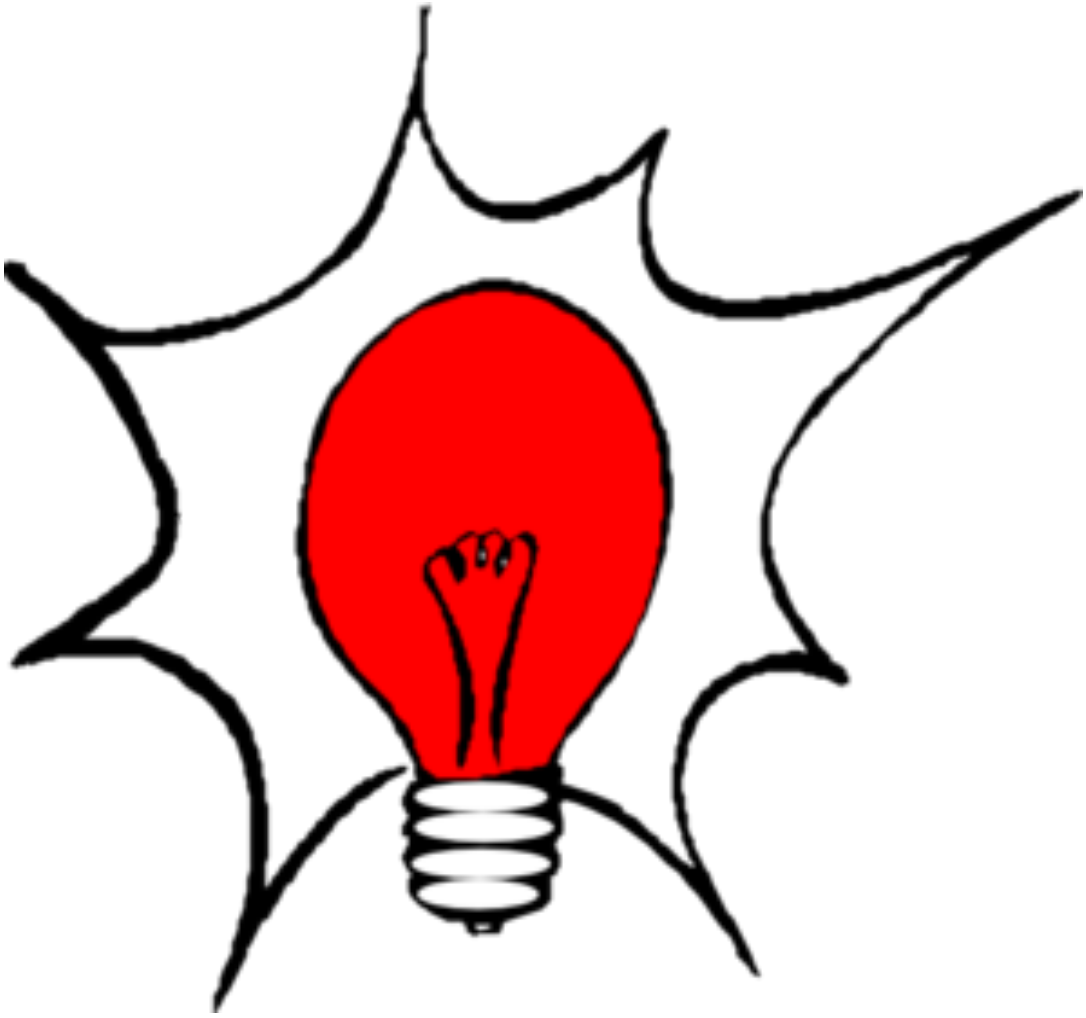
Developing photographs

You will need:

Ilford Multigrade resin coated
Ilford Multigrade developer
Ilford ILFOSTOP
Ilford Rapid Fixer
3 x Trays
Tongs
Red light
Black out cloth

<u>Personal Protective Equipment</u>
Gloves
Apron
Safety goggles
Pegs

Follow the instructions on the bottles when mixing solutions.
Make sure the trays are clean before use.
Always wear personal protective equipment.



Black out the room, making sure there are no light leaks.

Turn on the red light.

Unload the photograph from the pinhole camera.

Get ready to develop your image!

1. First put the photograph in the DEVELOPER for 1 minute

2. Second rinse the photograph in the STOP solution for 10 seconds

3. Thirdly put the photograph in the FIXER bath for 1 minute

Rinse the photograph in clean water.

Hang up to dry!