A pinhole camera is a simple camera without a lens and with a single small aperture, a pinhole – effectively a light-proof box with a small hole in one side. Light from a scene passes through this single point and projects an inverted image on the opposite side of the box.

It is completely dark on all the other sides of the box including the side where the point is created. This part is usually painted black, but black boxes are also used for this purpose. There is also a thin screen which looks like a projector sheet, and is put in between the dark side adjacent to the pinhole.

Up to a certain point, the smaller the hole, the sharper the image, but the dimmer the projected image. Optimally, the size of the aperture should be 1/100 or less of the distance between it and the projected image.

Because a pinhole camera requires a lengthy exposure, its shutter may be manually operated, as with a flap made of light-proof material to cover and uncover the pinhole. Typical exposures range from 5 seconds to several hours.

A common use of the pinhole camera is to capture the movement of the sun over a long period of time. This type of photography is called solargraphy. The image may be projected onto a translucent screen for real-time viewing (popular for observing solar eclipses.

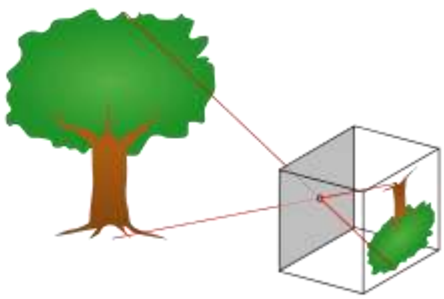
Pinhole devices provide safety for the eyes when viewing solar eclipses because the event is observed indirectly, the diminished intensity of the pinhole image being harmless compared with the full glare of the Sun itself.

The camera obscura was not so much an invention as a discovery and development. The camera obscura works on a naturally occurring phenomenon (the rectilinear propagation of light) and can, for example, often be observed when sunlight filters through dense leaves. Over the centuries many people made contributions to the design of camera obscura as we know it but all are based on the underlying optical laws that apply in nature.

In the 5th century BC, the Mohist philosopher Mozi in ancient China mentioned the effect of an inverted image forming through a pinhole.[3] The image of an inverted Chinese pagoda is mentioned in Duan Chengshi's (d. 863) book Miscellaneous Morsels from Youyang written during the Tang Dynasty (618–907).[4] Along with experimenting with the pinhole camera and the burning mirror of the ancient Mohists, the Song Dynasty (960–1279 CE) Chinese scientist Shen Kuo (1031–1095) experimented with the camera obscura and was the first to establish geometrical and quantitative attributes for it.

The Greek philosopher Aristotle observed the phenomenon in the fourth century BC. In his book Problems, he wrote:

"Why is it that when the sun passes through quadri-laterals, as for instance in wickerwork, it does not produce a figure rectangular in shape but circular?" and further "Why is it that an eclipse of the sun, if one looks at it through a sieve or through leaves, such as a plane-tree or other broadleaved tree, or if one joins the fingers of one hand over the fingers of the other, the rays are crescent-shaped where they reach the earth? Is it for the same reason as that when light shines through a rectangular peep-hole, it appears circular in the form of a cone?"



Principle of a pinhole camera: light rays from an object pass through a small hole to form an inverted image.

Selection of pinhole size

Within limits, a smaller pinhole (with a thinner surface that the hole goes through) will result in sharper image resolution because the projected circle of confusion at the image plane is practically the same size as the pinhole. An extremely small hole, however, can produce significant diffraction effects and a less clear image due to the wave properties of light. Additionally, vignetting occurs as the diameter of the hole approaches the thickness of the material in which it is punched, because the sides of the hole obstruct the light entering at anything other than 90 degrees.

The best pinhole is perfectly round (since irregularities cause higher-order diffraction effects), and in an extremely thin piece of material. Industrially produced pinholes benefit from laser etching, but a hobbyist can still produce pinholes of sufficiently high quality for photographic work.

One method is to start with a sheet of brass shim or metal reclaimed from an aluminium drinks can or tin foil/aluminum foil, use fine sand paper to reduce the thickness of the centre of the material to the minimum, before carefully creating a pinhole with a suitably sized needle.

For standard black-and-white film, a wavelength of light corresponding to yellow-green (550 nm) should yield optimum results. For a pinhole-to-film distance of 1 inch (25 mm), this works out to a pinhole 0.17 mm in diameter. For 5 cm, the appropriate diameter is 0.23 mm. The depth of field is basically infinite, but this does not mean that no optical blurring occurs. The infinite depth of field means that image blur depends not on object distance, but on other factors, such as the distance from the aperture to the film plane, the aperture size, and the wavelength(s) of the light source.