’Where is that?’ cries one child, as another class gasps at the inverted view of the outside world. They are not convinced that it is a real image of a real place, until a teacher runs around outside and is projected upside down on the screen in front of them. No web cam or projector is involved – just a 2500-year-old optical projection (Figure 1)!

What is it?
The camera obscura (Latin for ‘darkened room’) is the earliest optical device and goes back over 2500 years. The small pinhole or lens at the front of the room allows light to enter and this is then ‘projected’ onto a screen inside the room. This differs from a camera, which projects its image onto light-sensitive material. Originally images were projected through a small hole, but from around 1550 onwards, they began to use a lens, which focused the image more clearly. Creating a camera obscura is cheap and easy, and it can be used at all levels to introduce aspects of art, science, history and technology.

I have been teaching photography and pinhole photography for over 20 years but over the past five or so years I have realised the increasing lack of ‘wonder’ within modern technology. However useful and clever interactive smart boards and digital projectors are, I have never seen their use result in a gasp of amazement from a class of tech-savvy primary children. Both the pinhole camera and the camera obscura do just that, whether it be seeing an image appear in the chemicals when developing an image or, in this case, viewing a camera obscura projection. Perhaps it is the lack of opportunity for understanding in our ever-increasing ‘auto’ world, which creates a barrier to
comprehension. I believe inspiring wonder should be the bedrock of education.

By simply blacking out a room, positioning a lens and hanging up the projection sheet you can create a giant two-metre square inverted colour projection of the outside world – a definitive contrast to modern digital imaging and projection.

The obscura works most effectively in a completely blacked out, light-tight room and will work in both sunny and overcast conditions. Blacking out a room can be done with pre-cut cardboard, which can be quickly placed into position with Velcro tape (Figure 2). It is the ‘contrast’ in light from inside to outside that makes the image clearer. The image can be viewed from in front or ‘through’ the sheet.

Creating a scenario

Before you show a projection, cover the lens or hole with some card and light the room with a dim light to allow the children’s eyes to get used to the dark. While their eyes adjust you can tell them about how light works, how stone-age men possibly first noticed inverted images in their caves and how the gaps in a leaf canopy have been projecting the image of the crescent Moon onto the forest floor for millions of years. Then, whip the card cover off the lens et voilà! Instant wonder!

Initially you could get the children to attempt to draw their view of the inverted projection by using a card frame and tracing paper held in a stand, but there are many other ways of using an obscura (Box 1).

The Glenfrome School ‘dark den’

I have always been a fan of removing the idea that ‘complex’

Aristotle. 2500 years ago, Aristotle questioned why the image created by the Sun appeared round when the light had passed through a square hole. What do the children think?

Isaac Newton and the shadow of a hair. Another simple experiment allows you to replicate Isaac Newton’s discovery of diffraction. If your obscura points towards the Sun on a sunny day, hold a human hair in front of the pinhole. The resulting shadow will be larger than it should be due to diffraction. (You don’t have to take my word for it – have a go, and incorporate the great man into a lesson!)

Capturing an image which remains focused. This only works effectively in bright conditions, but if a sheet of tracing paper (ideally held within a frame mount) is moved towards and away from the pinhole, not only does the image stay in focus, but also it enlarges and reduces in size. You can also ‘skew’ the image on an angled plane.

Using the lens projection you can remove the screen and give out laminated tracing paper so the class can find sections of the projection, moving around until the image is in focus (Figure 3).

Stretching the world. A narrow 10 cm long slot instead of a pinhole will project a stretched image of the outside world. If this is rotated through 90 degrees, an alternative plane is stretched. This helps with art and perspective and showing how it can be distorted.

Concave mirrors. Several artists used a concave mirror to project an image of ‘correct’ perspective. Holding a concave (shaving) mirror a few feet from the hole (with no lens) will allow pupils to project the image on to the ceiling or wall of your classroom. You can explore how the image is inverted, whether the size and shape of the mirror has any effect on the image and where else pupils have seen this effect, for example on spoons.

Prisms. If the Sun is projecting through the obscura, using a small hole can create great rainbows of light. Add a bit of dry ice or steam to the room and mirrors can project a stream of sunlight from one mirror to the next.

Digital versus optical projections. The only projections currently seen by people are with digital projectors, making the camera obscura projection even more fascinating. A web cam positioned just below the lens could allow children to compare and contrast digital and optical projections of the same view.
subjects can only be appreciated by older children, which is why I leapt at the opportunity of adapting a reception year’s outdoor den into an obscura (Figure 4). It took about 20 minutes and is used daily by the children in reception, including by my 4-year-old daughter. The dark den (whose previous incarnations had been an ‘ice cream shop’ and a ‘burger bar’!) was made to explore light with torches and mirrors and reflecting material. Adding the obscura was to be just a small part of the den but it soon became the main focus of their exploration and wonder. Although a white sheet is currently hung in the den it works just as well with the children holding a sheet of white card to find the focal point for the image of the area where their friends are jumping around outside – and more often than not trying to stand on their heads!

Aristotle may not be primarily remembered for projecting images of his friends in Ancient Greece dancing around upside down outside his obscura, but he surely created the same smiles on people’s faces as those seen 2500 years later by the reception year at Glenfrome Primary School.

Further information

Instructions on how to make the obscura can be found on my website or, if you want to save yourself a trip to several shops, a kit with instructions can also be purchased: 2500 years of wonder for £1.00 a century!

For information on creating a camera obscura and pinhole photography as well as other projects undertaken, see: www.pinholephotography.org

Justin Quinnell is a freelance pinhole photographer and lecturer in photography and is a part-time lecturer at University College, Falmouth. Email: justinquinnell@hotmail.com