Activity 3. Light Box

Learning Intentions
To understand the concept of reflection and how it enables us to see.
Learning outcomes:

- Understanding that light travels in a straight line
- That light reflecting off objects and into our eyes enables us to see
- The angle of incidence is equal to the angle of reflection

Before the experiment:
Students build a light box to help them understand how light reflects off objects to allow us to see. You need to find yourself a shoebox or something similar with a good lid that won't let in light. Find some small funky objects that will fit into the shoebox at one end. The funkier the better as you want your students to be able to describe some details of what they see.

Your hypothesis
Get the student to ask whether they expect to see anything in the box without a light source and write and explanation for why. What does the student expect to happen when look into the box when they use the light source to shine into the box? Get them to write down a reason for this.

Materials

- A cardboard box about the size of a shoe box Make sure it has a lid or is sealed on all sides, but with access through the top to enable you to place objects in the box before sealing it or closing the lid again.
- A torch or similar light source
- Box knife or scissors to cut holes in the box
- Variety of cool objects that will fit into the box

Teacher Notes

What is happening?
Light travels in straight lines at least until it hits some form of matter such as dust particles, objects, or other mediums such as water. When it hits the matter, light will reflect (bounce off), be absorbed or, if it passes through a transparent medium, refract – see teachers' resource, *Reflection, absorption, Refraction, Diffraction – the basics.* In this instance we only need to consider reflection.

When light is reflected, the angle it hits the object at (angle of incidence) is the same as the angle it reflects off the object (angle of reflection). It is the reflected light that enters our eyes and our brain uses to process and form images.

Concepts for students to understand

- Light travels in straight lines.

Teaching Notes: Running the activity

Method
Use the box cutter to cut a peep hole at one end of the box, but only big enough for the student to see through. The student must be able to press their eye up to the peephole without letting ambient light through. To improve this, use a toilet roll to mark and cut a circle where your peep hole would be. Insert the toilet roll and look through the toilet roll. See Figure 1 below.

Cut a second hole (with flap) in the side or top of the box where you can insert the light source. Seal with a bit of gaffa or masking tape to block light when not using the light source. See Figure 1 below.

Place an object in the box. Without any light source, students place their eye over the peep hole and describe what you see? Ask students what they could do to enable them

• We see objects when light reflects off the objects back to our eyes. • Some materials reflect light better than others. Cardboard tends to absorb light. Mirrors reflect light well. • Angle of incidence (i) = Angle of reflection (r)	to see the object? Hopefully, they say something such as, use a torch. Position the torch at the access hole for the light source cut into side or top of the box. Turn the light source on. Ask students to look again and describe the object. Get students to adjust the angle of the torch to find out the angle that illuminates the object best. **Results** Get students to describe what they see without a light source? In theory, there will be no light getting in and students will see nothing. What did students see with the light source? Get students to record their findings in a table. Working in small groups, get students to describe and draw, using ray diagrams, how the light source is allowing them to see the object. Ask students why some torch angles are better than others. Get students to develop theories about why this is the case? Figure 2. Is an example of a ray diagram, where arrows or lines are used to depict angles of incidence and reflection. **Extension** This works best with a laser light and mirror. Stand the mirror up and place the laser light on the table shining into the mirror at an angle. Use a protractor to measure and calculate the angle of incidence and reflection. See the teacher's resource, *What is reflection*? And Figure 2. below

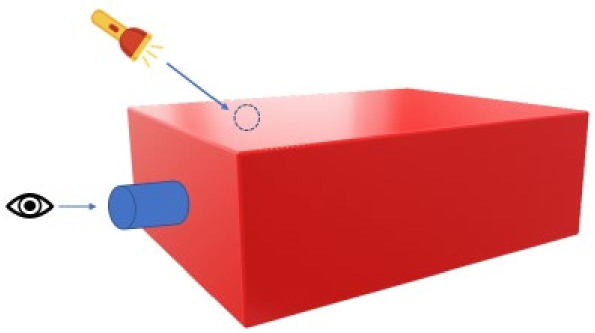

Figure 1. The light box. Use a section of cardboard tube as the eye piece to look inside the box. Cut a hold the size of your light source to shine into the box. (Torch image is by Unknown Author and is licensed under [CC BY-NC](CC BY-NC))

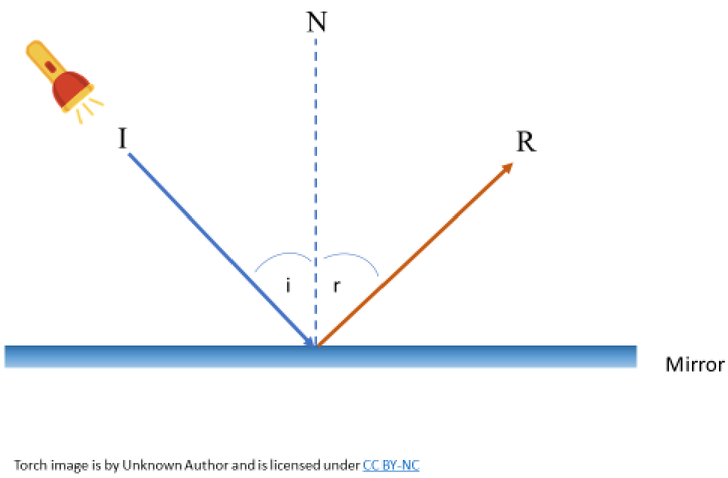

Figure 2. Reflection of light off a mirror, with incident (I) and reflected (R) rays; and the angles of incidence (i) and reflection (r). i=r. N= the normal line that is perpendicular to the surface the light is reflected off.