Common Misconceptions

Seeing the Light

Ruth Shallcross, PSTT Regional Mentor, tells us how she helps children understand the **Principles of Light.**

What children need to know:

- *that light travels in straight lines*
- *that objects are seen because they emit light (sources) or reflect light into the eye*
- *that we see things because light travels from light sources to our eyes or from light sources to objects and then (is reflected) to our eyes*

Common misconceptions – often children will think that:

- *sight is purely an active human process 'I am looking at something, which is why I can see it' or that eyes give out a form of light to enable us to see*
- *reflective surfaces emit light*
- *only shiny surfaces or water reflect light*
- *opaque objects do not reflect light*
- *opaque surfaces give out colour or 'darkness'*

When teaching children about principles of light and how we see, I am guilty of holding back the full truth as a stepping stone to clear scientific understanding. Before you judge me, let me explain!

The principle here is seeing learning as a sequential jigsaw, where each new concept that is learnt is tagged on to prior learning. As the sequence progresses, children will need to 'rethink/redefine' some of their earlier understanding.

For children first learning about the principles of light, understanding that both reflective surfaces and opaque surfaces reflect light can be confusing. In an everyday context, children are familiar with reflection being a sense of mirroring connected with the reflections they see of themselves (or other people/objects). This understanding of reflection as mirroring is then further embedded when learning about reflection in maths. So, and here comes the fib, when first teaching children about principles of light, I have found it useful to create a distinction between the verbs I use. For light reflecting off any reflective surface, I use '**reflect**'; for light reflecting off any opaque surface, I use the term '**bounce**'.

At this stage, I am most concerned with getting on with the business of understanding the abstract concept of how we see, so I wish to avoid confusion.

EXPLORING HOW LIGHT INTERACTS WITH DIFFERENT MATERIALS: TRANSPARENT, TRANSLUCENT, REFLECTIVE, OPAQUE.

Primary school children's initial explorations of materials (typically Years 1 and 2) are from their perceptions of and experiences of materials. A transparent material will be 'a material which **I** can see through'; an opaque material will be 'a material which **I** cannot see through'. In Year 6, children need not only to build on their earlier understanding but also redefine it in terms of how the materials interact with light. This is best done through exploration of materials, to see how light interacts with them.

As a result of these explorations, children create new definitions: a transparent material becomes 'a material which lets most/all light through'; an opaque material becomes or 'a material which most light does not pass through' (and translucent materials allow some light to pass through).

Through their own life experiences and the results of their explorations, reflective surfaces and opaque surfaces appear to interact differently with light (Figure 1). I work with this understanding.

Before moving on, children need to *experience* and *understand* that:

- *light sources emit light*
- *light travels in straight lines*
- *without light, we cannot see*

Figure 1: Children explore how different surfaces interact with light.

UNDERSTANDING HOW WE SEE OBJECTS

For this learning, I like children to work as a group to create a dynamic model which demonstrates how we see objects. A bouncy ball is used to represent how light travels (Figure 2). Using their model, the children role play and explain the process of how we see objects by breaking it into a sequence.

1. *The light source emits light.*
2. *(Some of) the light travels in a straight line towards the opaque object.*
3. *Once the light reaches the opaque object, some of the light* **bounces** *off and travels in a straight line towards the human eye.*
4. *Some of the light enters the human eye; as a result, the object can be seen by the human.*

To use reflect instead of bounce here can potentially confuse children because it may conflict with their own exploration/experience of materials.

"But there's no reflection, so why are you using reflect?"

"But light interacts differently with reflective surfaces and opaque surfaces – we saw that!"

After group work, I will move them on to demonstrating their understanding individually e.g. through the use of a scientific diagram (Figure 3).

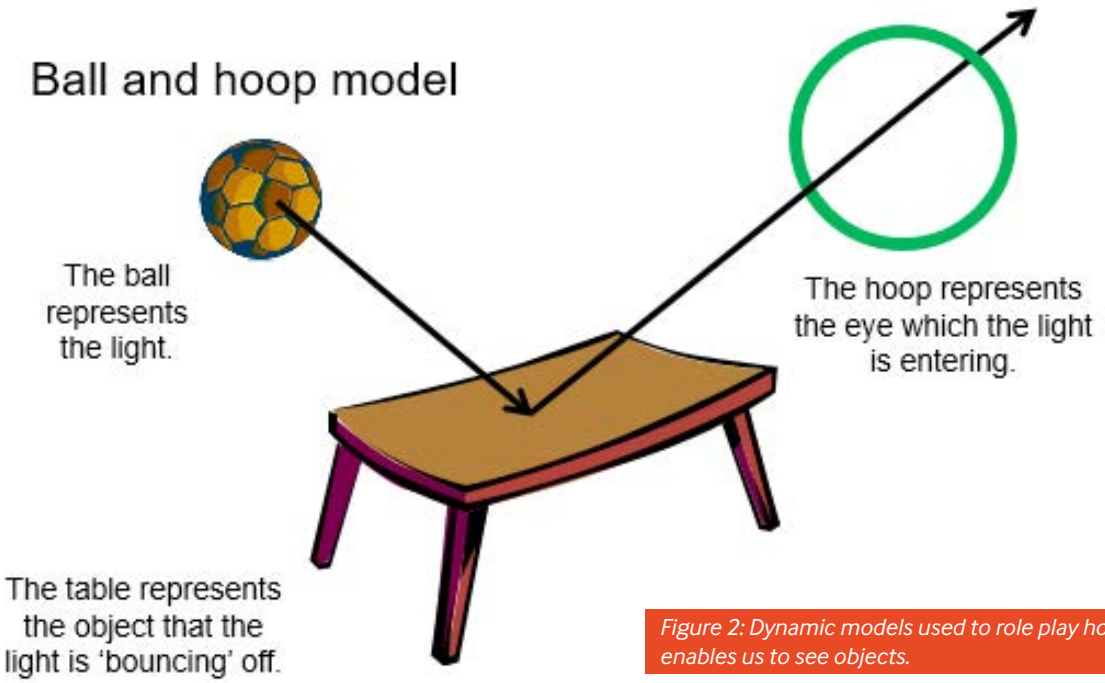

Figure 2: Dynamic models used to role play how light enables us to see objects.

UNDERSTANDING HOW WE SEE OBJECTS (OR ORGANISMS) IN MIRRORS

Once children have fully grasped how we see objects, it is time to introduce a mirror! I will ask children to return to their earlier human model and ask – how do we see using a mirror? Children are challenged to add the mirror into the role play.

After establishing the process, they explain.

- *The light source emits light.*
- *(Some of) the light travels in a straight line towards the opaque object.*
- *Once the light reaches the opaque object, some of the light* **bounces** *off and travels in a straight line towards the mirror.*
- *The light hits the mirror and reflects off travelling in a straight line towards the human eye.*
- *Some of the light enters the human eye; as a result, the object can be seen by the human.*

MOVING LEARNING ON

If children understand how we see an object and how we see using mirrors or other reflective surfaces, then they are able to apply their knowledge to a range of different contexts e.g. how we see using a periscope. Once their understanding is totally secure, it is time for the truth!

Both reflective surfaces and opaque surfaces reflect light but why does it appear to be different?

If a surface is flat and very shiny, almost all of the light will be reflected, which produces clear images of objects (my face reflected in a mirror). Light will strike and reflect off at an equal angle.

Opaque surfaces are 'bumpy' in comparison to reflective surfaces. Light does reflect off such surfaces but it scatters in many directions and cannot create clear images.

The difference can be demonstrated using a bouncy ball and a flat tray (to represent the reflective surface) and an upside down muffin tray (to represent the dull surface). There will be a consistency to the direction in which the bouncy ball bounces off the tray but unpredictable scattering when using the muffin tray.

Would you like write a piece for our section on common misconceptions for a future issue of Why and How?
If you have some good ideas for particular areas of science that you would like to share please contact newsletter@pstt.org.uk

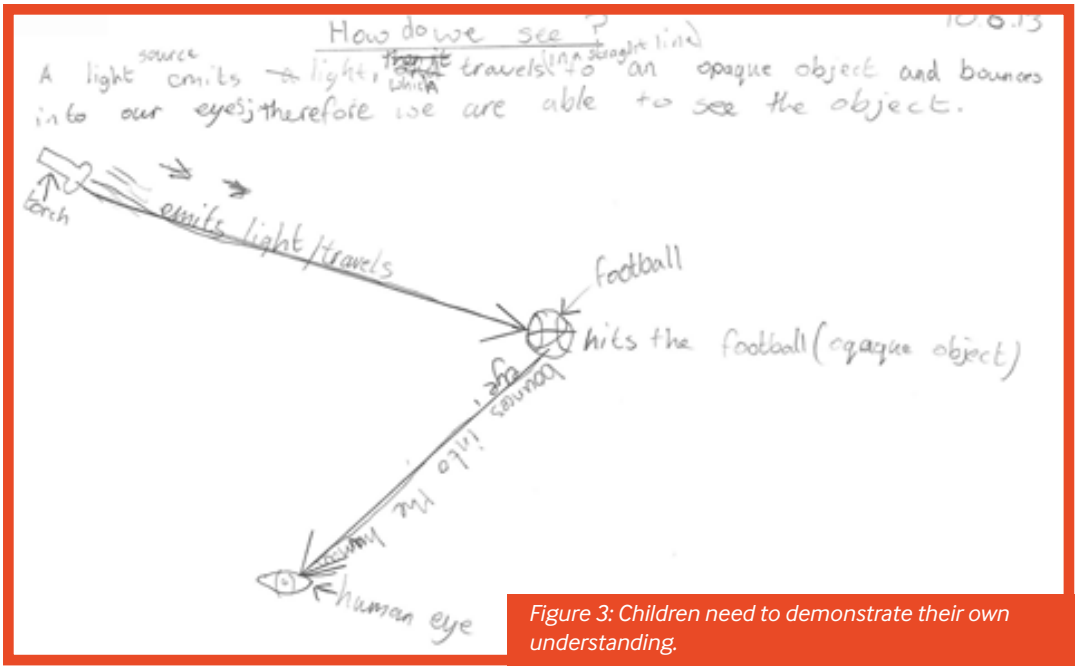

Figure 3: Children need to demonstrate their own understanding.

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This article was developed from work produced by Ruth Shallcross in collaboration with Jason Harding and the London Borough of Enfield's School Improvement Service.

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