**Seeing the light**

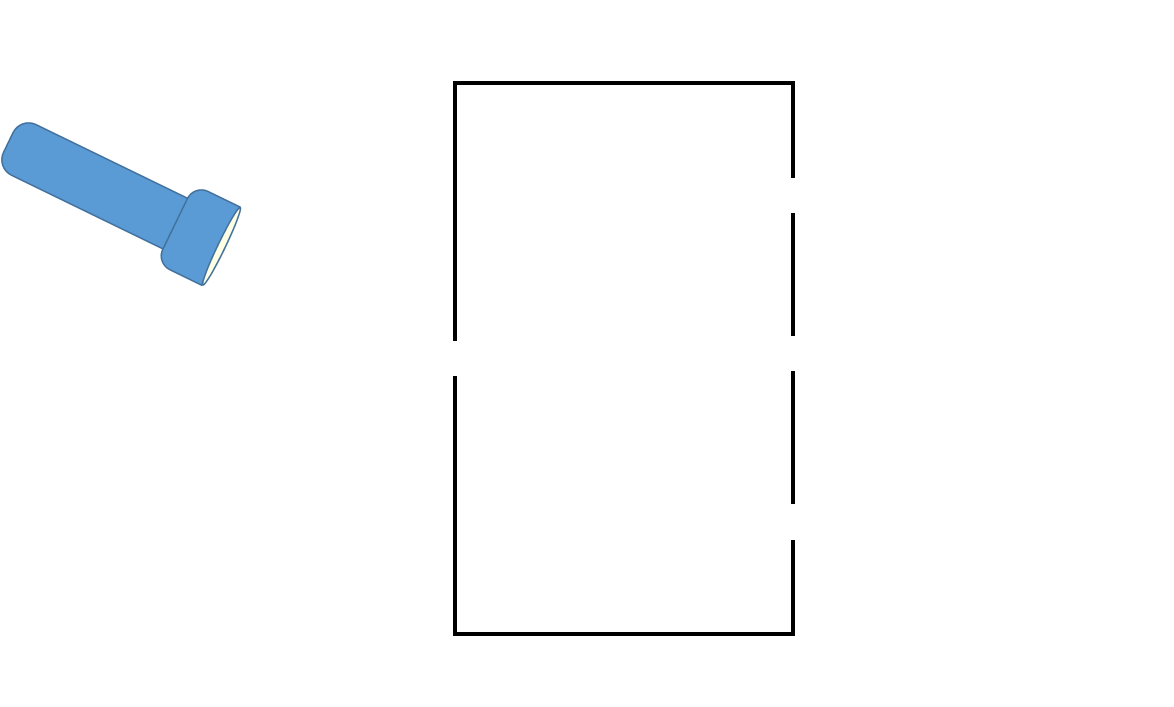
A shoebox has some holes cut in it.

**Predict**

The torch is pointed in the direction shown.

Which hole(s) do you think the torch will light up?

**Explain**

Draw on the diagram to show why you think you will see this

|  |
| --- |
| **Observe the demonstration** |

**Observe**

Record what you see.

**Explain**

Were your prediction and explanation correct?

If not, can you explain what you observed?

*Physics > Big idea PSL: Sound, light and waves > Topic PSL2: How we see > Key concept PSL2.1: The ‘passive eye’ model of vision*

|  |
| --- |
| **Diagnostic question** |
| **Seeing the light** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Objects are seen when light reflects off them into our eyes. |
| Observable learning outcome: | Explain how luminous objects can be seen when light from them enters the eye. |
| Question type: | Predict, explain, observe, explain - practical/demonstration |
| Key words: | Light ray |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught at age 5-11, to aid transition from earlier stages of learning. |

**What does the research say?**

Many studies have explored children’s knowledge of optics and all have identified misunderstandings in optics that are based on ‘common sense’ interpretations and which often suffice to explain everyday observations (Galili and Hazan, 2000). However children commonly use different ideas to explain different optical phenomena and rarely use one model consistently (Andersson and Karrqvist, 1981; Andersson and Karrqvist, 1983).

Guesne found that children often explain how they see luminous objects by describing light coming into their eyes, but then explain how they see non-luminous objects using an ‘active eye’ model, in which something goes out from their eyes (Guesne, 1985; Driver et al., 1994; Hardman and Riordan, 2014).

This question investigates students’ understanding of how they see luminous objects. By describing how luminous objects can only be seen when rays of light from them enter the eye, it also supports the later development of understanding how non-luminous objects are seen.

**Ways to use this question**

Students should complete this activity in pairs or small groups, and the focus should be on the discussions. It is through the discussions that students can check their understanding and rehearse their explanations.

To begin, each group should discuss the activity and use their scientific understanding, firstly to predict *what* they think will happen, and then to explain *why* they think they are going to be right. If students in any group cannot agree, you may be able to direct them with some careful questioning.

Students now watch a demonstration. After the demonstration each group should be given the opportunity to change, or improve their explanation. A good way to review your students’ thinking might be through a structured class discussion. You could ask several groups for their *explanations* and put these on the whiteboard. Then ask other groups to suggest which explanation is the most accurate and the most clearly expressed, and through careful questioning work up a clear ‘class explanation’.

A useful follow up is for individual students to then write down explanations in their own words – without reference to the class explanation on the board (i.e. cover it up).

*Differentiation*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in the each group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

**Equipment**

For demonstration or for each pair/group:

* A torch
* A prepared shoe box, as described in the technician notes

**Technician notes**

Four holes need to be cut out of the shoe box, at the same height as each other, in the positions shown in the diagram. Each hole needs to be approximately 2 cm x 2 cm.

On the inside of the shoe box glue or tape a piece of grease-proof paper over each of the three holes that are along one side of the box. If the torch light illuminates one of these holes, the grease-proof paper will disperse the light so it can be seen from all directions.

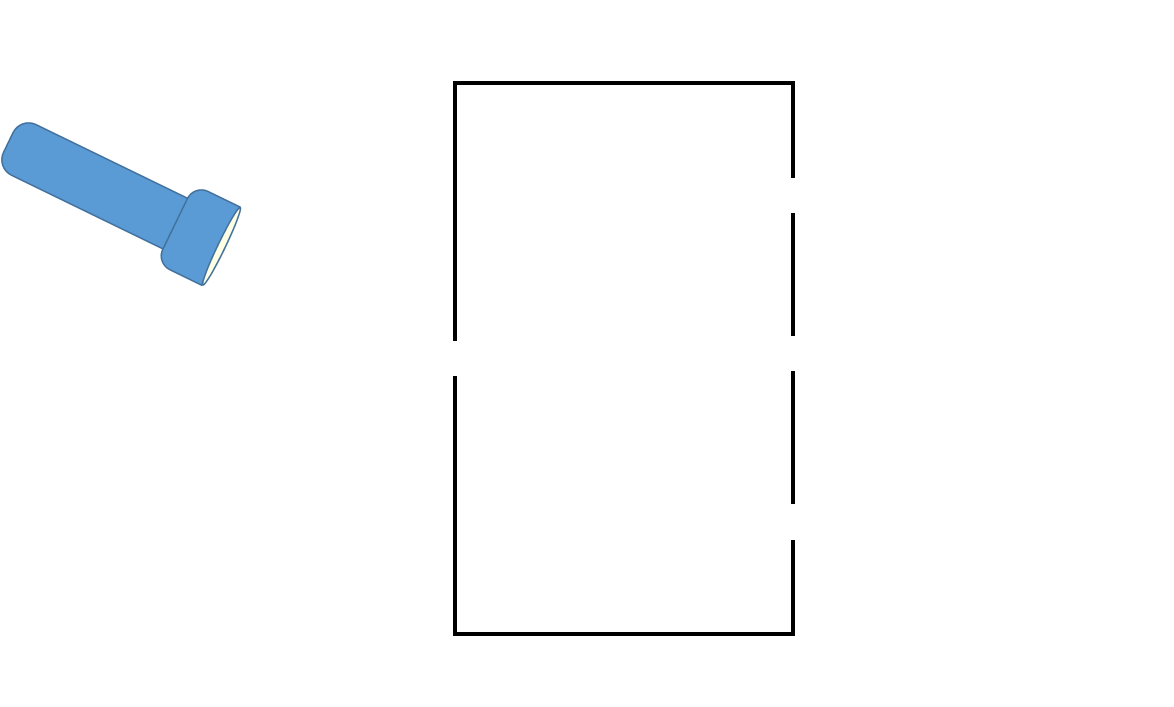
Put the lid back on the box.

**Health and safety**

Practical work should be carried out in accordance with local health and safety requirements, guidance from manufacturers and suppliers, and guidance available from CLEAPSS.

**Expected answers**

Hole 3 will light up and the others will not.



In a study of 36 trainee teachers, 50% wrongly predicted light would be seen through holes 1 and 2 (Viennot, 2004).

The majority of these drew the light spreading out from the first hole in all directions, but only in a half of these cases was the light shown to reach the eye.

**How to respond - what next?**

This question is set up so that those who give the wrong answer will be challenged by the result of the demonstration. It is important to review your students’ thinking, which might be through a structured class discussion as described in *‘Ways to use this question’* above.

If students have drawn the light spreading out at the first hole it can help to ask:

* Which direction did the light travel to get to the first hole? (From the torch in a straight line)
* What is there at the first hole that can make the light spread out or change direction? (Nothing)

The set up can also be demonstrated with a ray-lamp.

**Acknowledgments**

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Images: Peter Fairhurst (UYSEG)

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