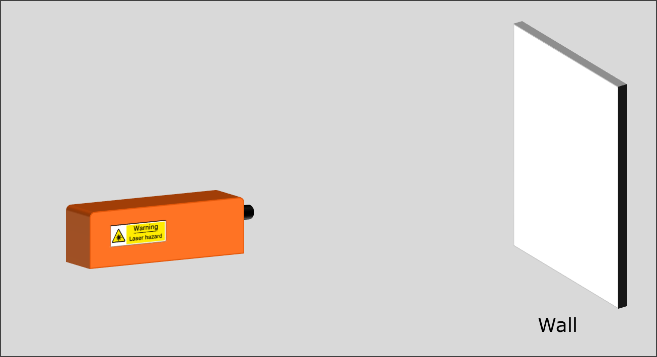
**Laser beam**

When the laser is switched on it emits a beam of light.

This travels across the room and hits the wall.



**Predict**

What will you see when the laser is switched on?

Will you see the light beam?

**Explain**

Why do you think you will see this?

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| **Watch the demonstration** |

**Observe**

What do you see when the laser is switched on?

**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*

|  |
| --- |
| **Response activity** |
| **Laser beam** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Objects are seen when light reflects off them into our eyes. |
| Observable learning outcome: | Apply ideas of how non-luminous objects are seen to interpret new phenomena. |
| Question type: | Predict, explain, observe, explain - practical/demonstration |
| Key words: | Light ray, beam, reflect, scattered |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic questions:

* Diagnostic question: Seeing the light
* Diagnostic question: In the dark
* Diagnostic question: Seeing an explanation

|  |  |
| --- | --- |
| **B** | **BRIDGING**  This diagnostic question probes understanding of ideas that are usually taught at age 14-16, to build a bridge to later 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).



*The progression in conceptions of vision encountered among 13- to 14-year-olds, towards that of a physicist (Guesne, 1985)*

Studies by Ramada and Driver (1989) and Andersson and Karrqvist (1983) found that just 31% of fifteen-year-olds (n=456 and n=166 respectively) described how a girl sees a book using the idea of light going from book to eye. Almost as many either used the non-explanation that ‘light helps us to see’ or gave no explanation at all. Anderson and Smith’s study (1986) showed that 6% of 10- to 11-year olds in their sample held the scientific view of vision, Boyes and Stanisstreet’s study (1991) showed this increases to 10% of 11- to 12-year-olds and 33% of over-14s.

This activity challenges students to apply a scientific understanding of how we see to a new situation.

**Ways to use this activity**

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.

* Arrange the laser so that it will shine across the room, taking care that it points away from the class
* Begin be darkening the room and showing the students the laser, but not yet switched on, and ask them to predict what they think they will see when it is.
* Switch on the laser. If the room is (almost) free of dust the path of light will not be obvious. Ask students to explain what they see.
* Show the students a misting spray and ask them to predict what they will see when it is sprayed in the path of the beam. Ask them to explain their prediction, and then comment on what they do observe.

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 the class:

* Laser
* Matt white screen
* Spray bottle of water to produce a fine mist
* Drying cloth
* Warning sign(s)

**Technician notes**

The laser needs to be set up so that it is pointing at a matt screen, away from all students and with no reflective objects close to its path. If a laser pointer is used it should be clamped so that it does not move.

**Health and safety**

**Full details of health and safety procedures relating to lasers need to be fully understood before carrying out experiments with lasers.**

Water should not be sprayed close to the laser itself and wet floors should be dried immediately.

If there is any chance that someone could enter the room and walk into the beam, then warning signs must be displayed outside the room.

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**

The beam is invisible when the laser is first turned on because there is nothing in the beam for the light to scatter off. No light from the beam is reflected into students’ eyes.

A significant number of students are likely to expect to see a beam across the room. This may be because of their experiences of seeing laser beams in films that are added for artistic effect or made visible using theatrical smoke and fog. The latter are also used in laser light shows.

The mist of water droplets will scatter light that hits them. The concentration of droplets in the laser beam makes its path visible, but only as long as the droplets remain. As the mist sinks to the floor the beam becomes invisible again.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG), from York Science activity PLC3.5a: Dust and mist.

Images: Peter Fairhurst (UYSEG).

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