**Laser shadow**

This demonstration shows students how ordinary light is made up of many rays of light, each moving forwards in a straight line.

**Safety**

Lasers can damage eyesight.

Students should be sat behind the direction in which the laser is pointing. All shiny or reflective surfaces that the laser could be pointed at should be removed.

There should be local rules in place for using lasers and these should be followed.

If a second demonstrator sprays water mist to illuminate the beams, they should stand pointing away from the laser source. This role is best carried out by an experienced adult (teacher or technician) rather than a student.

**Apparatus and materials**

* A laser pointer (or laser)
* Powerful torch
* Fine water spray
* Cut out cardboard penguin (or other object to form a shadow) with a stand or blu-tack
* Clamp and stand to hold the torch in place
* Screen

**Procedure**

1. **Show that light travels, and is present, between the source and the illuminated patch of light**

Shine the powerful torch across the room and illuminate the beam using a fine spray of water. This shows that there is light throughout the beam, and not just at the start and/or end points.

1. **Show that a beam of torch light can be thought of as being made of many rays of light**

With the torch still on, shine a laser pointer along the same beam and illuminate with a fine spray of water. The ray of light from the laser pen can be moved around inside the beam to show how the beam is made from many rays of light. A ray is in fact a very fine beam of light – they are the same thing.

1. **Show that the idea, that light travels in a straight line, can explain the formation of a shadow**

With the torch and a penguin cut-out (or other object) project a shadow onto a screen.

Use the laser pointer inside the beam to demonstrate how each ‘ray’ of light inside the beam travels in a straight line to form the shadow. A fine spray of water can show this more clearly.

Cardboard cut-out (if required to demonstrate)



*Physics > Big idea PSL: Sound, light and waves > Topic PSL1: Sound and light > Key concept PSL1.2: Characteristics of light*

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| **Response activity** |
| **Laser shadow** |

**Overview**

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| Learning focus: | Light travels in straight lines at very high speeds |
| Observable learning outcome: | Describe how light travels in straight lines |
| Activity type: | Clarifying - demonstration/modelling |
| Key words: | Light, travel, straight line, beam, ray |

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

* Diagnostic question: Spotting light
* Diagnostic question: A tree’s shadow

**What does the research say?**

Most 10 and 11 year olds think that light is found only in bright areas and not in the space between, for example, a source of light and the patch of light it makes (Guesne, 1985; Allen, 2014). This may be because when students think of light, they do not necessarily think of it as travelling. They may instead think of rays as like ‘wires of light’ or roads going from A to B (Driver et al., 1994).

In a study of 456 15-year-olds, Ramadas and Driver (1989) found that many students thought light rays were not like ordinary light, but described them variously as long, thin or flashing. These ideas are not helped by the fact that students cannot see the path light takes in normal circumstances.

These misunderstandings are often key stumbling blocks to students’ understanding of light which are rarely considered in teaching schemes and which this activity can help to clarify.

**Ways to use this activity**

This demonstration gives you the opportunity to re-teach a challenging concept, and show your students how it builds up from simpler ideas, using a structured teacher-led discussion.

You should use carefully selected questions to check your students’ understanding of each step, before progressing onto the next one. The activity sheet gives more detailed information about the activity and the set up.

The steps you follow in this demonstration might be:

* Show that light travels, and is present, between the source and the illuminated patch of light
* Show that a beam of torch light can be thought of as being made of many rays of light
* Show that the idea, that light travels in a straight line, can explain the formation of a shadow

*Differentiation*

You could challenge different individuals by asking them follow-up questions to clarify or to extend their original answer. If a student is having difficulty with a particular question, it is often helpful to break it into smaller *chunks*, to lead them to a fuller answer. This technique models more thorough answers, and can be used to support an open classroom culture in which students are encouraged to ‘have a go’.

**Equipment**

For the class:

* A laser pointer (or laser)
* Powerful torch
* Fine water spray
* Cut out cardboard penguin (or other object to form a shadow) with a stand or blu-tack
* Clamp and stand to hold the torch in place
* Screen

**Technician notes**

A darkened room is ideal.

The fine water spray is to be used to spray the beam of light, which will reflect off the droplets to show a clear path of light. Cloths to dry the desk afterwards may be necessary.

A torch or lamp needs to have a beam that is strong enough to be illuminated by the water spray.

The laser needs to be manoeuvrable in order to show paths of light within the torch beam.

**Health and safety**

Lasers can damage eyesight.

Students should be sat behind the direction in which the laser is pointing. All shiny or reflective surfaces that the laser could be pointed at should be removed.

All usual rules for using lasers should be followed.

If a second demonstrator sprays water mist to illuminate the beams, they should stand pointing away from the laser source. This role is best carried out by an experienced adult (teacher or technician) rather than a student.

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

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

**References**

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