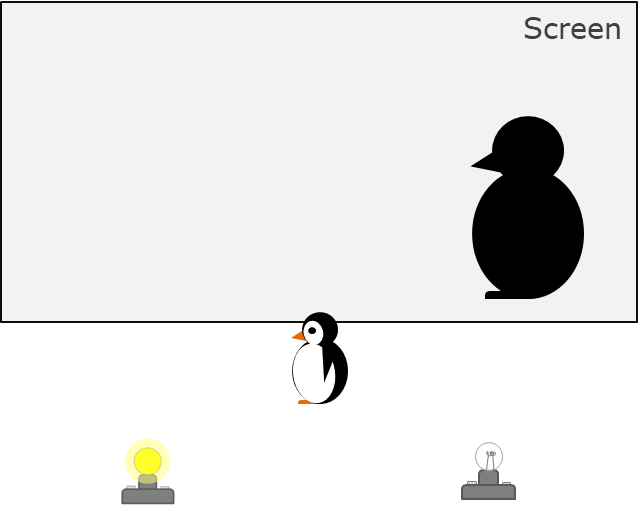
**Extra light shadow**

Light from a small bright lamp is shining on a screen.

A toy penguin makes a shadow on the screen.



**Predict**

What do you think you will see when the second bulb is turned on?

**Explain**

Explain why you think you will see this?

|  |
| --- |
| **Now carry out the investigation** |

**Observe**

Describe what you see when both bulbs are turned on.

**Explain**

Were your prediction and explanation correct?

If not, can you explain what you observed?

Cardboard cut-outs (if required)



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

|  |
| --- |
| **Response activity** |
| **Extra light shadow** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Light travels in straight lines at very high speeds. |
| Observable learning outcome: | Explain how shadows are formed. |
| Activity type: | Predict, explain, observe, explain - practical/demonstration |
| Key words: | Light, travel, straight-line |

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

* Diagnostic question: Making a shadow

**What does the research say?**

To explain how a shadow forms needs an understanding of how light travels in straight lines from a source. This activity challenges students to apply the scientific understanding of light to explain a new situation that cannot be explained with persisting misunderstandings.

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.

Guesne (1985) found many students aged 10-11 viewed shadows as a reproduction of an object’s shape. Young children confuse ‘shadow’ and ‘reflection’ and may draw faces on a shadow. Some may think a shadow is part of an object which is made visible by light. By age 14 Guesne found the majority of students recognised light as an entity and could use this notion to explain shadows in bright light. She also found that many did not think shadows formed when the light was less than bright.

**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 carry out the practical, or watch a demonstration. You will need to decide whether it is better for each group to carry out the practical and risk some unexpected observations, or to demonstrate the activity so that everyone *observes* the same thing.

After the practical 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 each student/pair/group:

* Two ray lamps, or mounted 12V bulbs
* Power pack and wires for the lamps
* Cardboard cut-out of a penguin (or other object) with a stand or blu-tack
* Screen

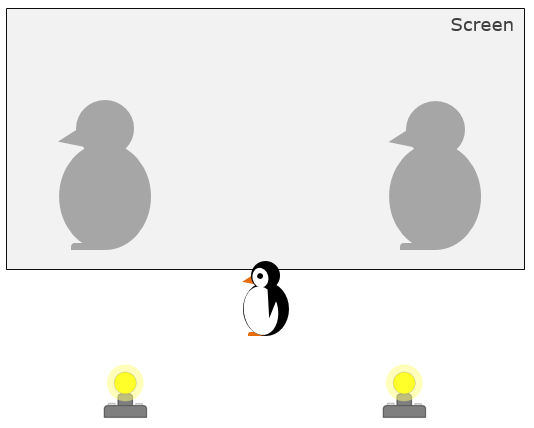
**Technician notes**

Results are usually clear when blinds are closed and the lights are turned off without the need for blackout.

**Health and safety**

Lab packs are heavy and require visual checking for loose wires.

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 answer**

The shadows are not as dark as before (in fact they are as bright as the screen is with one light on). The bright part of the screen receives light from both bulbs and is very bright, the shadow areas receive light from only one bulb and are less bright.

It is an interesting extension to ask students: “what would happen to the shadows if the brightness of the bulbs were reduced?”

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: UYSEG

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