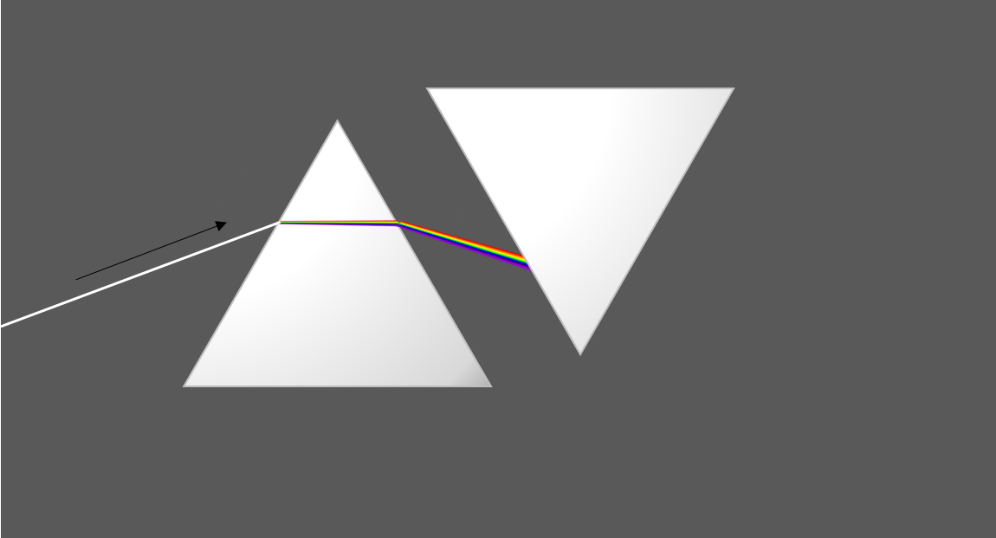
**Newton’s prisms**

A glass prism splits some light into a spectrum.

A second prism is added to bend the light the other way.



**Predict**

What will the second prism do to the spectrum of light?

**Explain**

Why do you think this will happen?

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| **Carry out the investigation** |

**Observe**

Describe what happens to the spectrum of light.

**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 PSL2.2: Seeing in colour*

|  |
| --- |
| **Response activity** |
| **Newton’s prisms** |

**Overview**

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| Learning focus: | Daylight and sunlight are made from all the colours of the spectrum, which together we see as ‘white light’. |
| Observable learning outcome: | Explain how colours of light combine to make light similar to daylight, which is called white light. |
| Activity type: | Predict, explain, observe, explain - practical/demonstration |
| Key words: | White light, spectrum, prism |

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

* Diagnostic question: Three into one

**What does the research say?**

In a study of 13-year-olds (n=150), 72% did not think that white light was a mixture of different colours (Zylbersztajn and Watts, 1982; Driver et al., 1994). In fact, before encountering ‘white light’ in science lessons fewer than 10% of 13- to 15-year-olds (n=22) understood what ‘white light’ was (Haagen-Schutzenhofer, 2017).

For a physicist, sunlight and daylight are both examples of white light. Each consists of all the colours of the spectrum which combine to be seen as white. Students often regard white light as ‘pure light’ that is free of any tinge. More than half of a sample of 13- to 16-year-olds (n=166) considered colour to be different to light and something that is added to light (Galili and Hazan, 2000).

This activity replicates Newton’s classic experiment in which he showed that light is made from the colours of the spectrum of light added together. Students are challenged to use their ideas about white light to explain the results.

**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:

* x2 60o prisms
* lab pack (12V)
* ray lamp
* slit for ray lamp
* white screen

**Health and safety**

A visual check for loose wires and damaged plugs on the lab packs should be carried out.

The main dangers are from the use of mains electricity and the risk of dropping heavy lab packs.

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 colours in the spectrum of light recombines to make white light. This is best seen when the two prisms are fairly close together, as the coloured light then has less distance in which to spread out which makes it easier to recombine.

Each prism ‘bends’ (refracts) light in opposite directions. Light at the blue end of the spectrum is bent the most and light at the red end is bent the least.

This investigation shows that the prism does not add any pigment or react with the light to generate colours, but that the colours are each a part of white light which can be split up and mixed back together to make white.

*The use of the word ‘bend’ needs to be clear. Light changes direction sharply at each surface of the prism; it does not bend in* a curve *through the prism.*

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG), from an idea by Isaac Newton.

Images: Peter Fairhurst (UYSEG).

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