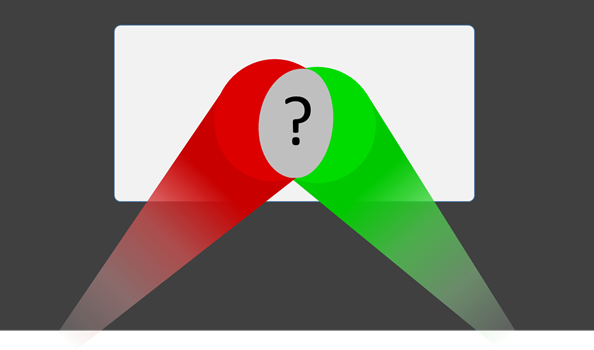
**Bright lights**

Coloured lights can be mixed to make new colours.



Green light is added to red light.

1. How bright is the new colour compared to the red light?

Put a tick (✓) in the box next to the best answer.

|  |  |  |
| --- | --- | --- |
| **A** | Brighter |  |
|  |  |  |
| **B** | Same brightness |  |
|  |  |  |
| **C** | Dimmer |  |

1. What do you think affects the brightness of the new colour compared to the red light?

Which of these statements do you think are right?

For each statement, tick (✓) **one** column to show what you think*.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Statements | | I am **sure** this is right | I think this is right | I think this is wrong | I am **sure** this is wrong |
| **A** | There is now more light |  |  |  |  |
| **B** | There is now more colour |  |  |  |  |

*Physics > Big idea PSL: Sound, light and waves > Topic PSL2: How we see > Key concept PSL2.2: Seeing in colour*

|  |
| --- |
| **Diagnostic question** |
| **Bright lights** |

**Overview**

|  |  |
| --- | --- |
| 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 adding coloured lights together affects brightness. |
| Question type: | Two-tier multiple choice |
| Key words: | Brightness |

**What does the research say?**

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).

Haagen-Schutzenhofer (2017) suggests avoiding the term ‘white light’ in the initial stages of instruction and to develop a scientifically sound concept of white light which is related to everyday experiences. She developed a teaching sequence that starts by showing how coloured lights can be mixed to produce another colour of light. Understanding how coloured lights combine to make new (and brighter) colours of light is necessary in order to understand how white light can be made by combining the colours of the spectrum.

This question investigates students’ understanding of how the brightness of a light increases when extra light is added, no matter what its colour. This idea is often challenging because it can be contradicted by the more common experience of mixing colours of paint.

**Ways to use this question**

Students should complete the questions individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation. The follow on question will give you insights into how they are thinking and highlight specific misconceptions that some may hold.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

1. A, it gets brighter.

2. A, there is more light, is correct and B is wrong.

**How to respond - what next?**

Mixing two colours of light will always result in a brighter light because more light has been added. This means that more light is scattered into a person’s eyes, which they perceive as a brighter light.

Students often confuse mixing colours with mixing paint and imagine that the colour will darken. If students compare different colours on a printed illustration then the colours may all look to be equally bright.

If students have misunderstandings about how adding an extra coloured light increases brightness, then the following BEST ‘response activity’ could be used to investigate how the brightness of a coloured light changes when a second colour is added:

Response activity: Mixing coloured light

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

Galili, I. and Hazan, A. (2000). Learners' knowledge in optics: interpretation, structure and analysis. *International Journal of Science Education,* 22(1)**,** 57-88.

Haagen-Schutzenhofer, C. (2017). Students' conceptions on white light and implications for teaching and learning about colour. *Physics Education,* 52.