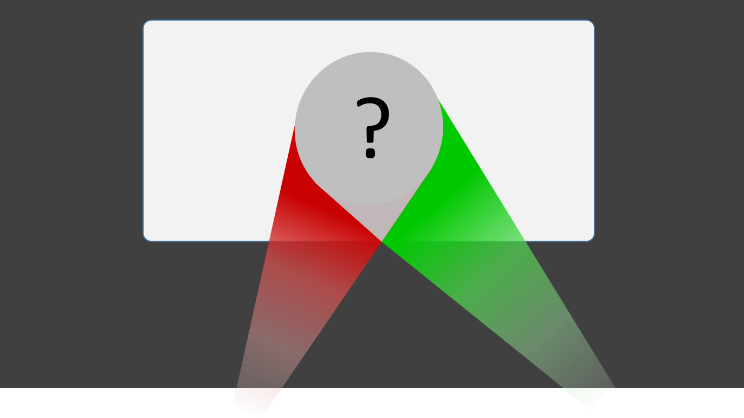
**Mixing coloured light**

Coloured lights can be mixed to make new colours.



**Safety**

Check for loose wires or damaged plugs.

Place the heavy lab pack towards the centre of the table.

**Apparatus and materials**

* lab pack (12V)
* x2 ray lamps
* red, green and blue filters
* white screen

**Procedure**

1. Plug both ray lamps into the lab pack and turn on.
2. Put one coloured filter in each ray lamp.
3. Shine the ray lamps at the screen to add the two colours of light.
4. Write down the new colour in a results table.
5. Write down how the brightness changes when the colours are added.
6. Repeat for different pairs of colours.

**To answer**

1. Did you get the colours that you expected?

*Explain your answer.*

1. What happens to the brightness of red light when a second red light is added?
2. What happens to the brightness of the red light when a different colour is added?

*Why is it harder to judge brightness when the colours are different?*

*Practical skills question:*

1. Why should the ray lamps always be the same distance from the screen?

**Results**

|  |  |  |  |
| --- | --- | --- | --- |
| Colour of light 1 | Colour of light 2 | Colour of mixed light | Change in brightness |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

**Results**

|  |  |  |  |
| --- | --- | --- | --- |
| Colour of light 1 | Colour of light 2 | Colour of mixed light | Change in brightness |
|  |  |  |  |
|  |  |  |  |
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*Physics > Big idea PSL: Sound, light and waves > Topic PSL2: How we see > Key concept PSL2.2: Seeing in colour*

|  |
| --- |
| **Response activity** |
| **Mixing coloured light** |

**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: | Give an example of how coloured lights mix to make light of another colour.  Explain how adding coloured lights together affects brightness. |
| Activity type: | Application and practice – practical |
| Key words: | Brightness, colour |

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

* Diagnostic question: Colour TV
* Diagnostic question: Bright lights

**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 activity gives students the opportunity to investigate the effect of mixing pairs of coloured lights and challenges the misunderstanding that coloured lights mix in the same way as coloured paints.

**Ways to use this activity**

This practical activity gives students the opportunity to practise applying their understanding and to clarify their thinking through discussion. To support this, students should complete the practical in pairs or small groups.

Listening to individual groups as they work often highlights any difficulties they might have. These can often be overcome, through a whole class clarification or redirection part way through the activity.

Asking students to report their findings at end of the practical work is a useful check. After a group has fed back, it might be helpful to model an even better answer. You could do this, for example, by asking another group to add to, or clarify, the first observation. Then ask another group to sum up the important part of the observation, and so on.

*Differentiation*

Providing suitable recording sheets can help some students organise their observations so they can more easily focus on the science. If some students are working with a teaching assistant, then a list of prompt questions for the TA could help to make this activity more purposeful. Some students may benefit from being challenged to plan and organise their own record keeping.

**Equipment**

For each student/pair/group:

* lab pack (12V)
* x2 ray lamps
* red, green and blue filters
* white screen.

**Technician notes**

Students need access to red, green and blue filters that fit into a slot in the ray lamp. The filters should be primary colours. Ideally two of each per group, although these can be shared between groups.

A vertical white screen is used to project the light from the ray lamps onto.

**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**

Red + blue = magenta (dark pink / purple)

Green + blue = cyan (turquoise)

Red + green = yellow

Red + red = red (etc.)

1. The colours are different to those made when paints are mixed.
2. Red + red makes a brighter red light.
3. Red + another colour = a brighter colour. It is harder to tell if this colour is brighter because it is not a like for like comparison. Eyes detect some colours more easily than others.

(The eye is most sensitive to green and then red light and least sensitive to blue. It is particularly sensitive to seeing yellow because yellow triggers both green and red colour receptors.)

1. When the lamps are closer to the screen they are brighter. This changes the brightness of the new colour. It also changes the colour of the mixture if one light is not as close as the other.

**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.