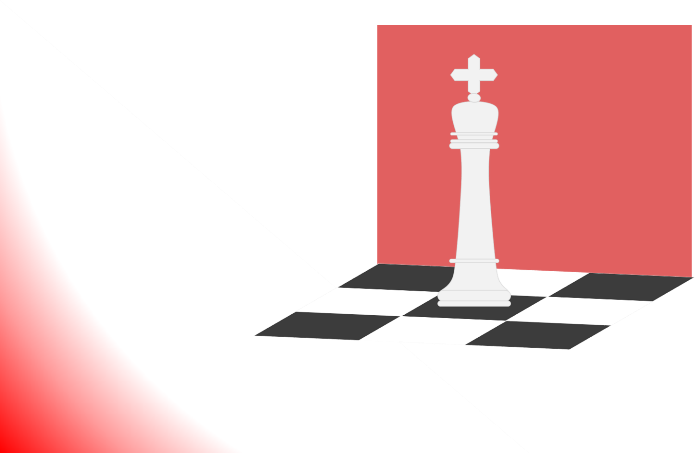
**White king (1)**

Summer is taking a photograph for the cover of her school’s chess magazine.

She is experimenting with different colours.



She starts with a red background.

**Predict**

What will the white king look like in **red** light?

**Explain**

Why do you think it will look like this?

|  |
| --- |
| **Carry out the investigation** |

**Observe**

Describe the colour of the king and of the background.

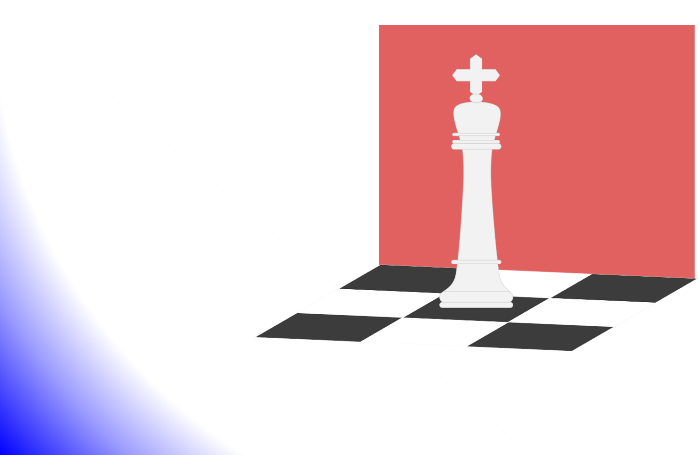
**Explain**

Were your prediction and explanation correct?

If not, can you explain what you observed?

**White king (2)**

Summer is taking a photograph for the cover of her school’s chess magazine.

She is experimenting with different colours.

She keeps a red background and changes

the colour of her light.

**Predict**

What will the white king look like in **blue** light?

**Explain**

Why do you think it will look like this?

|  |
| --- |
| **Carry out the investigation** |

**Observe**

Describe the colour of the king and of the background.

**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** |
| **White king** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Light has colours that are seen when reflected by bodies. |
| Observable learning outcome: | Describe how coloured objects selectively absorb or reflect particular colours of light.  Work out the colour a coloured object looks in light that is a different colour to the object (primary colours). |
| Activity type: | Predict, explain, observe, explain - practical/demonstration |
| Key words: | Absorb, reflect |

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

* Diagnostic question: Blue bottle
* Diagnostic question: TARDIS

**What does the research say?**

Martinez-Borreguero et al. (2013) found that students’ explanations of colour formation were most often of the form: ‘bodies have colours that are seen when they reflect light’. They reformulated this explanation to: ‘light has colours that are seen when it is reflected by bodies’ and asked students to consider which statement they found most useful. They found that a shift in focus to the latter made the origin of misunderstandings more explicit and resulted in a significant improvement in students’ longer term conceptual change.

In a sample of 86 secondary students, over 60% thought the colour perceived was the sum of the colour of light plus the colour of the object. In the same study, over 45% of secondary teachers (n=64), who were mostly science specialists, had the same misunderstanding (Martinez-Borreguero et al., 2013). A further 8% of students thought the colour perceived would always be the same as the colour of the object, and 9% that the colour perceived would be that of the illuminating light. Only one student and eleven teachers in these samples were consistently correct in identifying the perceived colour of a coloured object in different colours of light.

This activity investigates how effectively students can apply their understanding of colour formation to a novel situation. It includes all the different phenomena of colour formation that involve primary colours and challenges all three of the misunderstandings described above.

**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. This can be challenging to do in a typical science laboratory because even small amounts of white light in a dimly lit room can reflect off a coloured object and make it appear a dim version of the colour it looks in white light. A more effective alternative is for students to look through a red filter. Looking through a red filter only allows red light into the eye. What is seen is exactly the same as what would be seen if the room contained only red light. A blue filter can be used to show what the object looks like in blue light.

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:

* Blue filter, red filter
* A picture of a white chess piece stuck onto a sheet of red paper (or a white chess-piece and red screen)

Alternatively, for a demonstration, an intense light with blue and red filters, a white object, a red screen and a very good blackout.

**Expected answers**

In red light the king looks red because white reflects all colours that fall on it and red is the only colour that does. The background looks red because red objects reflect red light and so the red light reflects off it. The king and the background will be hard to tell apart, so the photograph for the school’s chess magazine would be poor.

In blue light the king looks blue because white reflects all colours that fall on it and blue is the only colour that does. The background looks black because red objects reflect red light and absorb all other colours. The blue light will be absorbed and there is no red light to reflect. A blue king on a black background might make a good cover for the chess magazine.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

Martinez-Borreguero, G., et al. (2013). Detection of Misconceptions about Colour and an Experimentally Tested Proposal to Combat them. *International Journal of Science Education,* 35:8**,** 1299-1324.