Light and colour

Television studios, sports stadiums, theatres, roads ... just some of the places that need special lighting. It is the responsibility of lighting engineers and technicians to design, test and develop appropriate lighting systems.

Have you ever been to a theatre or pop concert and noticed the huge number of lights? They come in many different sizes and colours. Some focus light on small areas, some flood a large area with light. Some stay still, others move around. Lighting technicians have to work out how to provide lighting effects for pop concerts and other events. They need to know how lights and colour combine.

Imagine you’re a lighting technician at a theatre. Your favourite band is coming to town. You’ve got to set up the stage lighting and make sure it adds to the atmosphere. You don’t want to make any mistakes!

You need to check how you’ll use your coloured filters.

Your task

You are going to investigate light and how to make different colours.

Read all the instructions carefully before beginning.

What you will need

- light box
- 12 V power supply
- triangular prism
- 3 x primary coloured filters (red, green and blue) in frames
- whiteboard and stand
- coloured pencils or crayons

Safety

Take care – light boxes may get hot.
What you need to do

1. Connect the light box to a power supply and turn it on.
2. Place the prism about 2 cm in front of the light box with one edge facing the box.
3. Place the whiteboard about 20 cm in front of the light box, slightly to one side.
4. If you can’t see a clear spectrum on the whiteboard, move the prism slightly until you can.
5. Identify the seven main colours of the spectrum.
6. Draw this spectrum under ‘results’ below.
7. Colour in the ‘no filter’ row of the results table to show the seven colours – one in each box.
8. Place the red filter in front of the light box. Observe what happens to the spectrum.
9. Colour in the ‘red’ row of the table to show what the spectrum looks like now.
10. Repeat step 6 for the green filter, and then the blue. Colour in the results in the table.
11. Try combining two filters to see what happens to the spectrum. Record the results in the table.
12. Clean the whiteboard.
13. Turn the light box around so that the hinged mirror end is facing the whiteboard.
14. Place each filter in a different slot – one at the front and one either side (you may need to open the hinged mirrors to reveal the side slots).
15. Open the mirrors so that three rectangular, primary-coloured light beams shine onto the whiteboard.
16. Adjust the mirrors so that the pools of light overlap.
17. Place a further filter (or a piece of black card) in the front slot. This will block the central light beam and allow you to observe what happens when only the ‘left’ and ‘right’ pools of light overlap.
18. Use your observations to colour in the overlapping-circles diagram.

Results

1. Draw a spectrum using coloured pencils. Label the seven main colours.
2. Complete this table:

<table>
<thead>
<tr>
<th>colour of filter(s)</th>
<th>spectrum colours visible</th>
</tr>
</thead>
<tbody>
<tr>
<td>no filter</td>
<td></td>
</tr>
<tr>
<td>red</td>
<td></td>
</tr>
<tr>
<td>green</td>
<td></td>
</tr>
<tr>
<td>blue</td>
<td></td>
</tr>
<tr>
<td>red and green</td>
<td></td>
</tr>
<tr>
<td>red and blue</td>
<td></td>
</tr>
<tr>
<td>green and blue</td>
<td></td>
</tr>
</tbody>
</table>

3. Colour this diagram of overlapping primary colour lights:

Questions

- Explain a spectrum using the terms refraction and dispersion.
- How can you remember the colours (and order) in a spectrum?
- There aren’t really any sharp dividing lines between the colours. Describe what the spectrum really looks like.
- Explain how colours can change, using the terms ‘absorb’ and ‘reflect’.
- What are secondary colours and what are their names?
- In terms of coloured light, how can we explain black and white?
- Share your findings with the rest of the class. Are they the same?
- How could you improve your investigation?
- What further investigations about light and colour could you carry out?
- How is mixing light different from your experience of mixing paints in art?

Extension

- Investigate how objects of different colours appear in different coloured lights. The ‘objects’ could simply be pieces of card of different colours.

Engineers

- There are four engineers shown on the poster. What other engineers do you think might be needed to help put on a live music performance?
- As well as working at music concerts, where else might you find a lighting technician? Try to think of at least three areas of work.