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# Colourful Messages

## THE LEARNING CONTEXT

The teacher's intended outcomes were for the students to:

- use scientific ideas to explain how we see coloured light
- use colour filters to explain how we see coloured objects
- investigate to find patterns in order to solve a problem.

The intended outcomes were aligned to the following "big ideas":

- Surfaces and materials can transmit, absorb, or reflect light.
- Visible light is made up of seven colours.
- The colour of objects comes from their reflection and absorption of different parts of the spectrum.
- Coloured light can be produced by selecting and blocking some parts of the spectrum.
- A coloured filter blocks some parts of light and transmits other parts.
- Scientists identify and use patterns and trends.

The teacher took these "big ideas" and most of the activities from *Light and Colour*, Building Science Concepts, Book 10 and *GEMS Colour Analyzers*. The activities were fun and challenging, and they used real contexts. The teacher used them to keep the students focused on the scientific understanding she wanted them to develop.

The teacher introduced the unit with the activity "Decoding Secret Messages" in *GEMS* (pages 5–15). The students wrote their initial explanations of why they could see a secret message in a puzzle when they looked through particular coloured filters. They then used *Light and Colour* to explore activities around the concept of light: letting light in and shutting it out, bouncing and travelling light, and reflection, transmission, and absorption.

They made their second attempts to explain how the filters enabled them to decode the message before exploring colour wheels as mixers of coloured light in *Seeing Colours* (Building Science Concepts, Book 11) and the question "Why does an apple look red?" in *GEMS* (pages 31–36). Finally, the teacher asked the students to create a present for a friend that included a set of "magic glasses", a secret message, instructions on how to use the glasses, and an explanation of how the "magic glasses" work.

## Teacher-student conversation

Discussing Trent's second explanation:

- Teacher: What did you mean when you said, "All the other reflected colours cannot go through the filter and bounce off"?
- Trent: The reflected colours don't bounce off the filter, but they are absorbed by it [the filter]. That's what I really meant.
- Teacher: What did you mean when you wrote "green consists of yellow"?
- Trent: I mean that green includes the colour yellow in its make-up.

Trent went on to create his secret message. You can read his message through a green or red filter (for example, green or red cellophane).

## WHERE TO NEXT?

To move Trent towards the next learning step, the teacher could help him to focus on:

- identifying the strengths and weaknesses of his investigation (investigating in science)
- explaining how colour blindness charts work (developing and communicating scientific understanding).

The teacher could:

- provide a range of optional activities, from open-ended investigations to more structured support, to cater for the range of abilities in the class
- ask Trent to explain, in a structured account, how specific parts of the eye function when light passes through a coloured filter into the eye.



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## Colourful Messages

### CURRICULUM LINKS

*Science in the New Zealand Curriculum*  
Achievement Objectives

#### Level 5: Making Sense of the Nature of Science and Its Relationship to Technology

Students can use their knowledge of a scientific idea to identify and describe examples of technology in which that idea is applied.

*Science in the New Zealand Curriculum*, page 34  
[http://www.tki.org.nz/r/science/curriculum/p34\\_35\\_e.php](http://www.tki.org.nz/r/science/curriculum/p34_35_e.php)

#### Levels 3 and 4: Developing Scientific Skills and Attitudes

**Processing and interpreting:** Students can use organised data and scientific ideas to suggest an answer to their selected questions and problems and make an evaluation of their investigation.

*Science in the New Zealand Curriculum*, page 46  
[http://www.tki.org.nz/r/science/curriculum/p44\\_51\\_e.php](http://www.tki.org.nz/r/science/curriculum/p44_51_e.php)

#### Level 5: Making Sense of the Physical World

Students can:

- carry out simple practical investigations, with control of variables, into common physical phenomena and relate their findings to scientific ideas
- investigate and describe the patterns associated with physical phenomena – some patterns may be expressed in graphical terms.

*Science in the New Zealand Curriculum*, page 80  
[http://www.tki.org.nz/r/science/curriculum/p80\\_81\\_e.php](http://www.tki.org.nz/r/science/curriculum/p80_81_e.php)

#### NCEA (National Certificate for Educational Achievement) Achievement standards

AS90186: Science 1.1 Carry out a practical science investigation with direction

AS90191: Science 1.6 Describe aspects of physics

<http://www.nzqa.govt.nz/ncea/ach/science/index.shtml>

### REFERENCES

Ministry of Education (1993). *Science in the New Zealand Curriculum*. Wellington: Learning Media.

Ministry of Education (2001). *Light and Colour: Our Vision and the World*. Building Science Concepts, Book 10. Wellington: Learning Media.

Ministry of Education (2001). *Seeing Colours: The Spectrum, the Eye, and the Brain*. Building Science Concepts, Book 11. Wellington: Learning Media.

New Zealand Qualifications Authority (2003). Science 1.1 Carry out a practical science investigation with direction. Accessed from <http://www.nzqa.govt.nz/ncea/ach/science/index.shtml>

New Zealand Qualifications Authority (2003). Science 1.6 Describe aspects of physics. Accessed from <http://www.nzqa.govt.nz/ncea/ach/science/index.shtml>

Sneider, C. (1989). *GEMS Color Analyzers: Teachers' Guide*. Lawrence: Hall of Science.



LEVEL 1 2 3 4 **5**

# Colourful Messages

## WHAT THE WORK SHOWS

Trent's work has met level 5 indicators in all but the "reporting" aspect of the "investigating in science" matrix. He comprehends and communicates the key scientific ideas but not very coherently, and he didn't explain how the eye receives messages.



The glasses work by filtering the six different colours on the puzzle. All of the colours of the spectrum come from the appropriate definite light source and reflect off their own colour on the puzzle. All the coloured light rays that reflected are now transmitting towards the magic glasses. If you are looking through the red filter, only red goes through along with orange because it is a shade of red and yellow because red consists of yellow. All the other reflected colours cannot go through the filter and bounce off. If you are looking through the green filter the same occurs except only green goes through along with yellow because green consist of yellow. The clear filter lets all the colours of the spectrum in because it is not a shade of colour - it is plain like a window.

Explanation of how the "magic glasses" work to see the secret message

### Progress Indicator

#### Investigating in Science

##### Exploring a situation

Trent makes increasingly focused and detailed observations relevant to identified scientific patterns and relationships.

##### Processing and interpreting

He reaches relevant conclusions about the effect of viewing colours through coloured filters and discusses how they relate to scientific ideas.

##### Reporting

Trent presents a well-organised report supported by relevant data to explain how the glasses work, but he neglects to explain how the message is received (L 4).

### Progress Indicator

#### Developing and Communicating Scientific Understanding

##### Using scientific ideas in constructing explanations

Trent constructs a well-reasoned and coherent explanation for an experience using significant and appropriate ideas. He connects the key ideas and uses appropriate aids to help communicate them. He does so using an analogy: "like a window".

##### Using scientific vocabulary

Trent uses a range of scientific terms appropriately, with reference to abstract ideas, for example, "filtering", "transmitting", "spectrum", and "reflected".