LEVEL 1 2 **3** 4 5

Periscopes

THE LEARNING CONTEXT

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

- use their data and scientific ideas to suggest an answer to their questions
- reflect on, and make an evaluation of their investigation
- identify possible solutions and explanations
- demonstrate their understanding of the nature of light by designing and constructing a periscope
- share ideas and consider the ideas of others.

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

- Scientists use their observations to identify issues and make the necessary modifications.
- Light travels in straight lines and can be reflected off shiny surfaces.
- Scientists put forward their ideas for others to debate.

The teacher challenged the class to make a periscope that enabled a student to look around the corner of the building to see if the school canteen is open. As a result of a starter activity the teacher realised the students needed further experiences to develop their understandings about light, so he initiated a class discussion on light sources.

He asked the students to differentiate between actual sources of light and reflections of light in a darkened room (such as fire and mirrors). To do this the students used a light source (torch) and simple objects to prove or disprove that light travelled in straight lines. They also explored reflection, refraction, absorption, and the transmission of light.

They used the knowledge gained in the exploratory activities to discuss how a periscope worked, then they made their periscopes. Afterwards they discussed the construction process and formulated a list of questions that would lead to investigating other ways to improve their periscope such as:

- Would the image be clearer if all the inside of the periscope was covered in black paper?
- Would it make the image clearer if you lined the inside of the periscope with mirrors?
- How would the image be affected if the whole periscope was artificially lit?

They discussed these questions and planned improvements to their periscopes.

Teacher-student conversation

During the construction of the periscopes:

Teacher: What are some of the issues that are coming up as you test your periscope?
Nicola: I think we need better mirrors. These plastic ones are too blurry, because they're flexible, with this rough surface. They're not very stable either.
Teacher: Have you thought of some alternatives?
Nicola: We could use glass mirrors – they've got a smooth surface. We'd need to find a better way to fix them in place.

WHERE TO NEXT?

To move Nicola towards the next learning step the teacher could help her focus on:

- continuing to identify the strengths and weaknesses of her own investigations. She could also participate in peer-evaluation of other students' investigations (investigating in science)
- engaging in debate and sharing her understandings with her peers, using the evidence she has collected (thinking in scientific ways).

The teacher could:

- get students to make and trial their new periscope designs (investigating in science)
- provide opportunities, in a future unit, for the students to reflect on the process of investigation and introducing different types of investigations, such as pattern seeking or classifying and identifying (investigating in science)
- encourage the students to evaluate, reflect on, and debate their scientific explanations and understandings (thinking in scientific ways).

CURRICULUM LINKS

Science in the New Zealand Curriculum
Achievement Objectives

Level 3: Making Sense of the Physical World
Students can investigate and describe their ideas about some commonly experienced physical phenomena to develop their understanding of those phenomena.
Science in the New Zealand Curriculum, page 76
http://www.tki.org.nz/r/science/curriculum/p76_77_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

Levels 3 and 4: Making Sense of the Nature of Science and its Relationship to Technology
Students can investigate examples of simple technological devices and link these with some scientific ideas.
Science in the New Zealand Curriculum, page 30
http://www.tki.org.nz/r/science/curriculum/p30_31_e.php

Students can investigate examples of simple technology to clarify some scientific ideas.
Science in the New Zealand Curriculum, page 32
http://www.tki.org.nz/r/science/curriculum/p32_33_e.php

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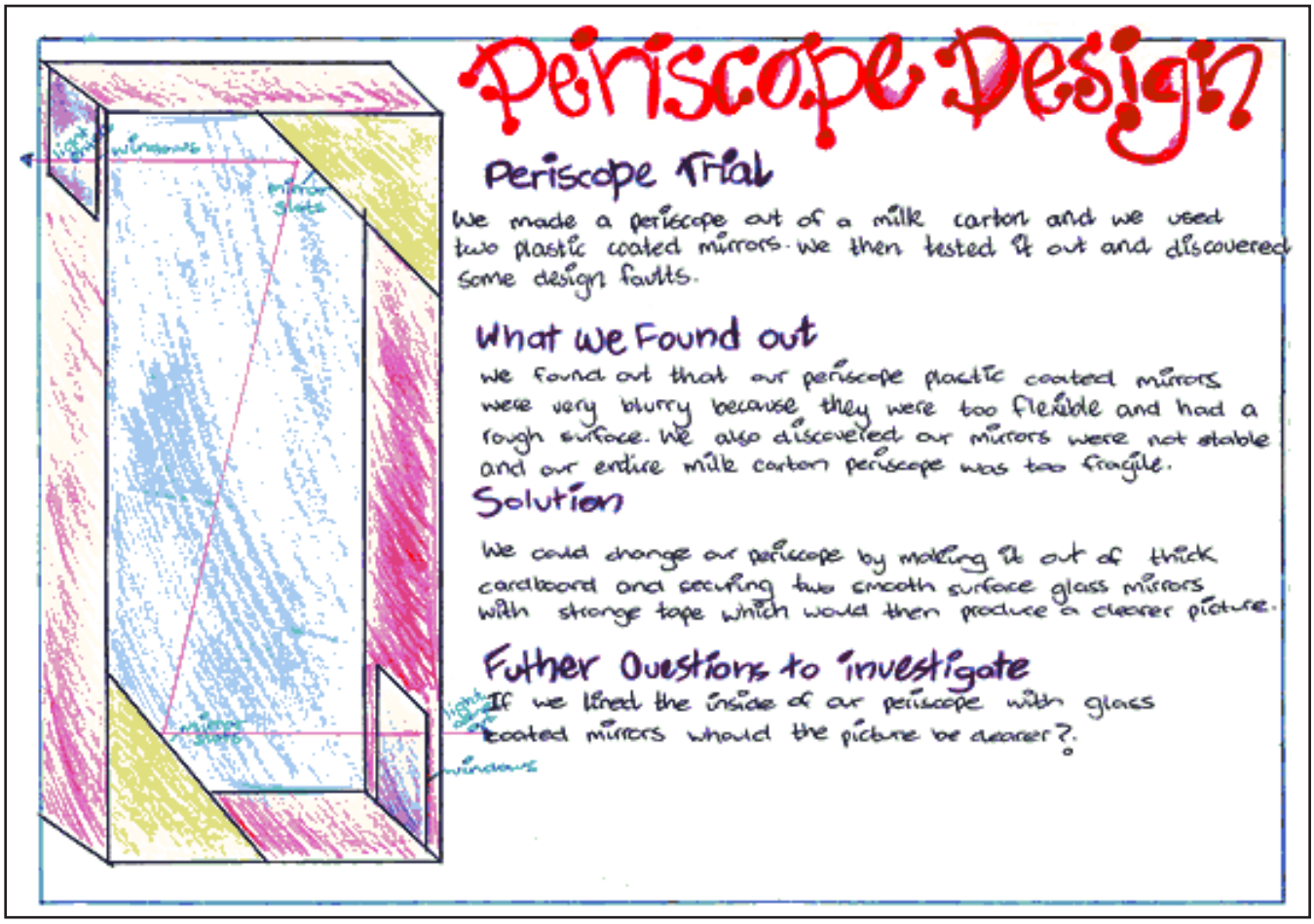
Periscopes

WHAT THE WORK SHOWS

Nicola's periscope design shows how she can apply her knowledge and understanding of light. In discussion with others she recognises the strengths and weaknesses of her investigation and suggests improvements.



Nicola's periscope design

LEVEL 1 2 **3** 4 5

Periscopes

Progress Indicator
Investigating in Science

Exploring a situation
After a *series of observations* Nicola makes her first model based on the following prompts from the teacher:

- How well were you able to see around the corner?
- What were some of the problems you had?
- What changes would you make to your periscope?
- What improvements would you expect these changes to make?

(see "Periscope Trial" in Nicola's periscope design).

Evaluating the investigative process as a continuous activity
Nicola *looks for strengths and weaknesses in her investigation and suggests improvements* in her design by:

- changing the mirrors from plastic to glass
- changing the structure from paper to cardboard
- changing mirrors to glass for a smoother surface and clearer image
- making the mirrors more stable by attaching them more securely.

(see "What we Found out" in Nicola's periscope design).

Reporting
Nicola *presents an organised report linking her findings to her observations* about her periscope (see Nicola's periscope design).

Progress Indicator
Thinking in Scientific Ways

Suggesting explanations
She *suggests explanations supported by some evidence* for changing the construction material of the periscope and securing the mirrors (see "Solution" in Nicola's periscope design).

Comparing and evaluating explanations
In Nicola's report on her periscope she *explains why she changed her ideas referring to the evidence* (see "What we Found out" in Nicola's periscope design).

REFERENCE

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