



## Investigating in Science

## Developing and Communicating Scientific Understanding

ACCESS THE SCIENCE EXEMPLARS ONLINE AT [www.tki.org.nz/r/assessment/exemplars/sci/](http://www.tki.org.nz/r/assessment/exemplars/sci/)

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# Gears

## THE LEARNING CONTEXT

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

- make a working model using the knowledge gained from observation and experimentation
- explain, scientifically, how the model works.

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

- Scientists use their knowledge and understanding to develop practical systems.
- Scientists seek and use evidence to justify their theories to others.

The teacher planned a class unit on gears, with a focus on how an abstract idea can be made meaningful and interesting through careful planning and implementation. He began by getting the class to brainstorm the uses of gears. They created model gears from cardboard, and tried to explain what happens when different size gears connect and movement occurs.

At home they looked carefully at any machines that used toothed wheels, explored how gears worked on bikes, and made models using Lego gears. Then the students created a toy using gears, and wrote instructions for how to use it. They described how the gears in their toy worked so other students could understand how gears operate to make objects move.

## Teacher-student conversation

Laura explains her thinking in this discussion with the teacher:

Teacher: What helped you decide to use gears on this merry-go-round?

Laura: The gears helped it turn smoothly, and make it easier to turn because the operator only has to turn the handle.

Teacher: What are you finding out about gears by making this toy?

Laura: I've found out that you can interlock them vertically and horizontally so that turning the vertical one, with the rotatable handle, will turn something in a horizontal plane, like the base of a pole.

## WHERE TO NEXT?

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

- finding out about making work easier by using other devices such as pulleys (investigating in science)
- seeking further information about gears to understand why she thought it would be better if the teeth were more accurately spaced? (developing and communicating scientific understanding).

The teacher could:

- encourage her to use her developing scientific ideas to make predictions that she could investigate in the next unit (investigating in science)
- encourage Laura to share her ideas with others in order to help her clarify and consolidate her understanding (developing and communicating scientific understanding).

## 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](http://www.tki.org.nz/r/science/curriculum/p76_77_e.php)

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

**Focusing and planning:** Students can use their science ideas and personal observations, and those of others, to make testable predictions or to identify possible solutions for trialling.

*Science in the New Zealand Curriculum*, page 44  
[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 3: Making Sense of the Nature of Science and its Relationship to Technology

Students can investigate examples of simple technological devices and link these to some scientific ideas.

*Science in the New Zealand Curriculum*, page 30  
[http://www.tki.org.nz/r/science/curriculum/p30\\_31\\_e.php](http://www.tki.org.nz/r/science/curriculum/p30_31_e.php)

## REFERENCE

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



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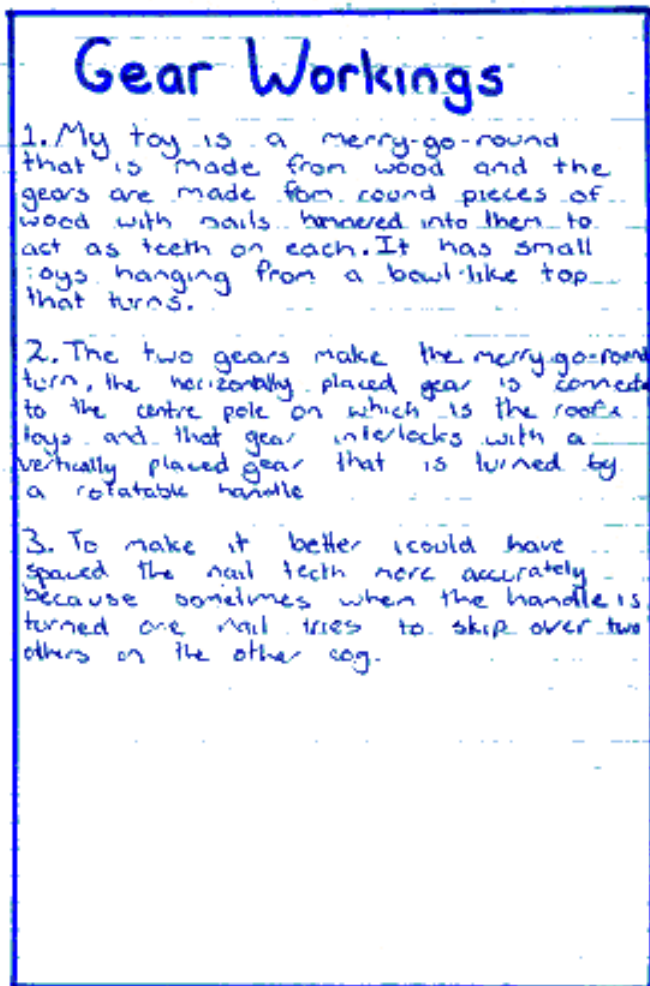
## Gears

### WHAT THE WORK SHOWS

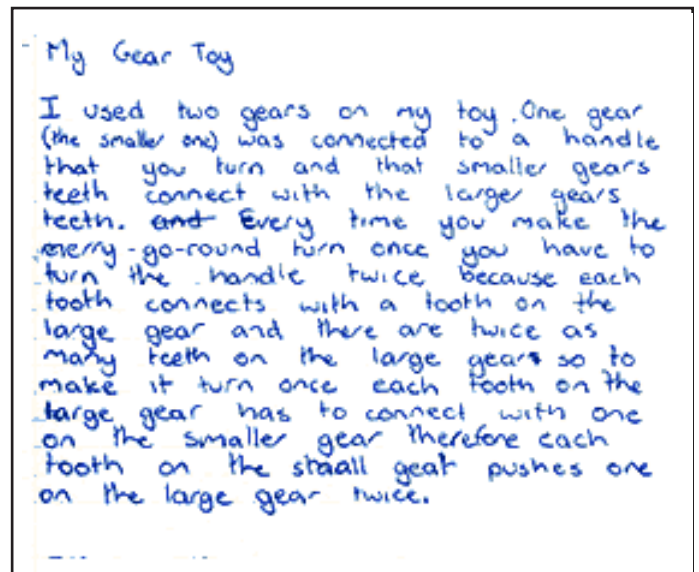
Laura planned and constructed a working model of a gear toy. The two pieces of written work show how she reasoned, planned, and constructed her toy and her detailed explanation of how her toy works.

Focused questions the teacher asked Laura to answer in her reports:

- Describe your toy.
- How does it work?
- How would you improve it?
- Describe how the gears in your toy work.



Laura's description of how her gears work



Laura's description of her toy



Laura's merry-go-round



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## Gears

### Progress Indicator Investigating in Science

#### Exploring a situation

Laura examines the working of her toy closely and *makes a series of observations to look for relationships* between the gears and the movement of her toy and comments realistically on the shortcomings on her construction (see Laura's description of how her gears work).

#### Making predictions

She *uses her own ideas to make testable predictions*.

#### Processing and interpreting

Laura *organises data into obvious trends and patterns and to reach conclusions*.

#### Evaluating the investigative process as a continuous activity

Laura *looks for the strengths and weaknesses in her own investigation and suggests improvements*.

#### Reporting

Laura consolidates her understanding and explains her ideas to others by *presenting an organised report, linking her findings to her observations*.

### Progress Indicator Developing and Communicating Scientific Understanding

#### Using scientific ideas in constructing explanations

Laura *constructs a plausible explanation* for how her gear toy worked and how it could be improved using *some scientific ideas*.

#### Using scientific vocabulary

Laura *develops and uses scientific vocabulary* to describe how the gear toy works and how it could be improved.

#### Reflecting on their understanding

Laura *discusses changes in her own scientific ideas* when she explains her scientific activity in her written reports.