



# Thinking in Scientific Ways

## 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/)

LEVEL 1 2 3 4 5

## Daily Views

### THE LEARNING CONTEXT

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

- explain the causes of day and night and the seasons, using models and evidence
- clarify their scientific ideas.

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

- Day and night are caused by the rotation of Earth on its axis.
- The seasons are caused by the Earth's orbit of the Sun.
- Scientists use evidence to justify their theories to others.

The teachers at this school wanted to teach the students about day and night, the seasons, and the phases of the Moon. They began the unit with a written diagnostic activity. (Some students also had an interview, using models to explain their answers.)

The students' responses indicated that the inclusion of the phases of the Moon in the unit was too much and that they needed to explore:

- the relationship between light and shadows
- models and perspectives of Earth
- scale (distances and sizes).

The teachers decided to use an "investigating with models" approach. Part of this approach was for the students to use *Starry Night*, an astronomy planetarium programme, to collect and record data that they could use to support or refute their explanations. They also worked with globes and models of the Earth, Sun, and Moon in small groups. The investigating with models approach was time-consuming, but it helped the students to understand these difficult concepts.

### Teacher-student conversation

Diagnosing Megan's needs:

- Teacher: Tell me why, in this drawing ["before" view], it's daytime for the top half and night-time for the lower half.
- Megan: Because the top half has the opposite to the lower half. When my family phones England, it's always the opposite time to New Zealand.
- Teacher: So, if you choose two cities in the same longitude on the globe, one in the northern hemisphere [Megan chooses Tokyo] and one in the southern hemisphere [Adelaide], what would you predict about the daytime or night-time in these cities?
- Megan: If Adelaide has daytime, then Tokyo would be night.
- Teacher: How might you test your prediction?
- Megan: I can use *Starry Night* to see what time of day it is in those cities.

The time clock and shadows on *Starry Night* showed that it was the same time in both cities. Megan repeated the test with another pair of cities on the same longitude, helping her to understand that it is the rotation of the Earth that causes day and night and that this supports an east-to-west rather than a north-to-south sunrise to sunset. Her learning was reinforced by an interview with the teacher, in which she used models to explain her ideas (see the video clips).

### WHERE TO NEXT?

To move Megan towards the next learning step, the teacher could help her to focus on:

- using the models to explore why the Sun rises at different times in different places and using her body to model the words "orbit" and "rotation" (thinking in scientific ways)
- finding ways to share her explanations with another group of students who haven't studied the causes of day and night and the seasons (developing and communicating scientific understanding).

The teacher could:

- ask Megan to read a book on a recent discovery and discuss how the scientific community depends on the work of other scientists to make advances in scientific understanding
- encourage Megan to use other aids, such as analogies or role plays, to explain a scientific concept.

### CURRICULUM LINKS

*Science in the New Zealand Curriculum*

#### Achievement Objectives

#### Level 3: Making Sense of the Nature of Science and Its Relationship to Technology

Students can recognise when simple investigations can be classified as a "fair test" and make decisions about the worth of results.

*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)

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

**Processing and interpreting:** Students can identify trends and relationships in recorded observations and measurements by making links within organised data.

*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 3: Making Sense of Planet Earth and Beyond

Students can locate and use information obtained from space exploration to clarify, challenge, and extend their ideas about the general nature and behaviour of the Earth, its moon, and the other planets in our solar system.

*Science in the New Zealand Curriculum*, page 112  
[http://www.tki.org.nz/r/science/curriculum/p112\\_113\\_e.php](http://www.tki.org.nz/r/science/curriculum/p112_113_e.php)

### REFERENCES

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

*Starry Night* CD-ROM. Space Holdings Corp: New York. Available from [www.starrynight.com](http://www.starrynight.com)

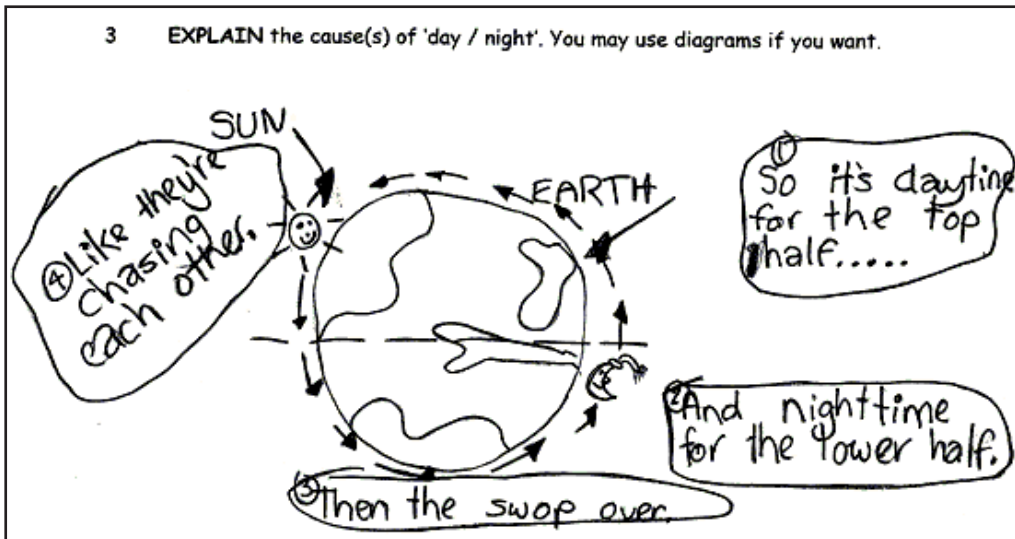


LEVEL	1	2	3	4	5
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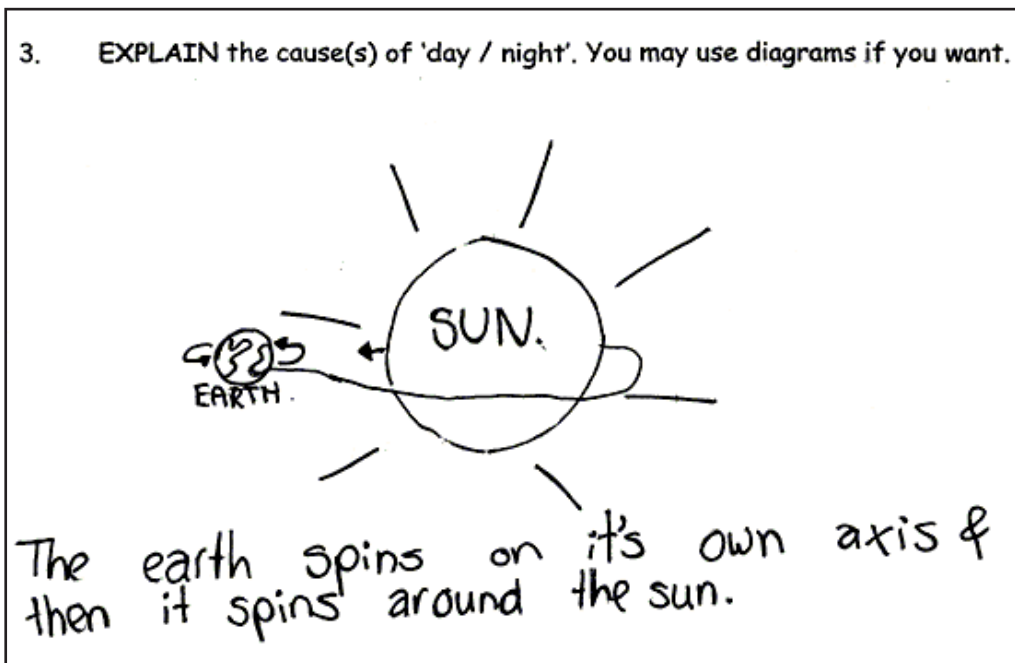
# Daily Views

## WHAT THE WORK SHOWS

This exemplar highlights the importance of finding out students' initial views so that appropriate teaching strategies can be used. Megan's initial explanation for the cause of day and night represents a common misunderstanding in science at this level. The use of appropriate questioning means that the video clip demonstrates a more complete scientific understanding than her written final view.



Megan's "before" view



Megan's "after" view



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### Progress Indicator Thinking in Scientific Ways

#### Suggesting explanations

Megan suggests explanations, supporting her explanation with some evidence (see "before" view). She is able to use simple models to explain her idea (see "after" view).

#### Comparing and evaluating explanations

Megan, with support, changes her idea in the light of the evidence provided by *Starry Night* (see "after" view).



Video of Megan's "before" view

#### Transcript of Megan's before views – day/night

Megan talks to the teacher about her "before" views.

- Teacher: That represents the side.  
 Megan: OK. Well only like the sun, that red line round there.  
 Teacher: Mm, hm.  
 Megan: If the sun was at the top and this was the moon, but this is daylight at the top and this is night-time and when we kind of like swap them around and that way and like in a circle.  
 Teacher: Alright, so your circle, we're sending your circle this way?  
 Megan: Yeah. That way.  
 Teacher: OK. Alright. So I hold this up a little bit would you like then to show us again exactly what you meant by that? OK?  
 Megan: That one. And that one like that.  
 Teacher: OK then, good. Thank you.

### Progress Indicator Developing and Communicating Scientific Understanding

#### Using scientific ideas in constructing explanations

Megan uses her "before" view illustration of a north-to-south sunrise and sunset to offer an explanation for experiences using some scientific ideas (for example, about the Sun, the Earth, and the Moon, and the concept of orbits) related to her experiences (L 2).

Megan attempts to interpret and explain her experiences, using some scientific ideas. By linking those ideas, she offers a more plausible explanation of her observation (see "after" view). In the video clip, Megan shows that she can use an aid – a physical model – to support her explanation.



Video of Megan's "after" view

#### Transcript of Megan's after views – day/night

Megan's talks to the teacher about her "after" views.

- Megan: The earth... the earth spins around on its own axis and while it's doing that it spins round this way and that way.  
 Teacher: OK. Can you show me then which part of earth is day and which is night?  
 Megan: Um, that's day, that's night.  
 Teacher: OK. Why is that night in the back?  
 Megan: Because it's dark and this is sunny. The sun's on that side.