



Thinking in Scientific Ways

Developing and Communicating Scientific Understanding

ACCESS THE SCIENCE EXEMPLARS ONLINE AT www.tki.org.nz/r/assessment/exemplars/sci/

LEVEL 1 2 3 4 5

Reasons for Seasons

THE LEARNING CONTEXT

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

- explain the cause of seasons, using models and evidence
- clarify their own scientific ideas.

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

- The cause of seasons is due to the tilt of Earth remaining the same as it orbits the Sun.
- Scientists use evidence to justify their theories to others.

A team of teachers planned a unit to teach day/night, seasons, and moon phases. They identified several key basic understandings that underpin these concepts and planned an "initial view" diagnostic task to evaluate the students' understandings. Their responses indicated they needed introductory activities on the relationship of light and shade, understanding models and perspectives of Earth, and the notion of scale.

The teachers used an "investigating with models" approach to teach the concepts of day/night and seasons to the students. They found that an explanation of seasons is very difficult to understand and model, so they got the students to work in groups of 5-6 and use models of planet Earth and globes. The groups used an astronomy planetarium, computer program (Starry Night) to collect and record data and the teachers encouraged them to use data to support or refute their explanations for the cause of day/night and seasons.

Teacher-student conversation

Rachel's written explanation shows she needs further supporting evidence, but, in the "modelling" of her written answer, shown in the video clip and in this conversation, Rachel recognises conflicting evidence when clarifying questions are asked.

Teacher: What differences do you notice between the ideas you had at the beginning and the ones you have now (see Rachel's "after" view)?

Rachel: At first I thought it was the moon that caused the seasons, so that first drawing doesn't have the Sun around in it. Also I didn't know the Earth had a tilted axis. It's the tilted axis that gives us seasons.

Teacher: Looking at your final picture, do you think all parts of the Earth have the same seasons?

Rachel: No. The parts in the middle, around the equator, aren't tilted much so they get the same amount as sunlight all the time. The two poles get either lots of sun or hardly any.

WHERE TO NEXT?

To move Rachel to the next learning step the teacher could ask her:

- "Can you use your model to demonstrate what time the sun rises at mid-summer?" (developing and communicating scientific understanding)
- "Can you construct another scientifically acceptable model to provide a fully coherent explanation for the cause of seasons?" (thinking in scientific ways).

The teacher could:

- encourage the class to discuss how useful it is to use models or diagrams in constructing explanations (developing and communicating scientific understanding)
- suggest the class develop models that offer an explanation consistent with the use of evidence in the next science unit (thinking in scientific ways).

CURRICULUM LINKS

Science in the New Zealand Curriculum

Achievement Objectives

Level 4: Making Sense of Planet Earth and Beyond

Students can investigate major factors and patterns associated with the weather, and use given data to predict weather.

Science in the New Zealand Curriculum, page 114
http://www.tki.org.nz/r/science/curriculum/p114_115_e.php

Level 4: Developing Scientific Skills and Attitudes

Processing and interpreting: Students can identify trends and relationships in recorded observations and measurements 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

Level 4: Making Sense of the Nature of Science and its Relationship to Technology

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

REFERENCE

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

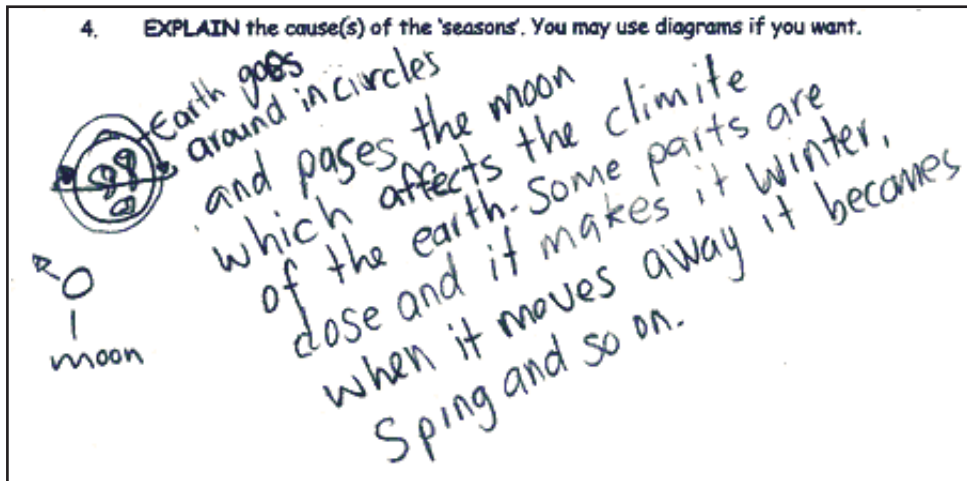


LEVEL	1	2	3	4	5
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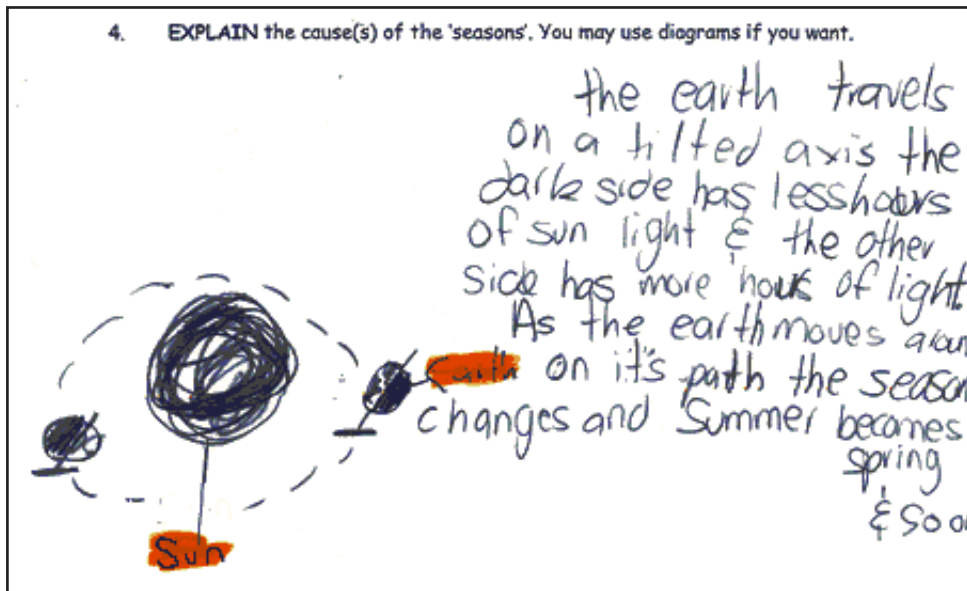
Reasons for Seasons

WHAT THE WORK SHOWS

The two examples of Rachel's work showing her "before" and "after" view demonstrate a change in her understanding about what causes the seasons. Her initial answer shows that she combines a few notions about space objects in her explanation. The final, written answer, and the video clip of the final answer, highlight the teaching and learning that took place.



Rachel's "before" view



Rachel's "after" view



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Progress Indicator

Thinking in Scientific Ways

Suggesting explanations

"Before" view: Rachel suggests cause-effect links for observations or events (L2).

"After" view (written): Rachel suggests an explanation, and considers others linked to the evidence.

Comparing and evaluating explanations

With support, Rachel has changed her ideas in the light of the evidence provided in the activities (L3).

With appropriate questions from the interviewer, she changes her ideas after considering the evidence and argument.

Progress Indicator

Developing and Communicating Scientific Understanding

Using scientific ideas in constructing explanations

"Before" view: Rachel constructs a plausible explanation for an experience of seasons using some scientific ideas (L3).

"After" view [video clip]: Rachel constructs an explanation for an experience using appropriate scientific ideas.

Reflecting on their understanding

"After" view (written): Rachel has relinquished her earlier explanation and discusses the changes in her own scientific ideas (L3).



Video of Rachel's "after" view

Transcript of Rachel – Further questioning

The teacher questions Rachel further to ascertain her understanding of the concepts of day and night and the seasons.

Rachel: The earth is on a tilting axis so that, it spins round to make day and night. It goes around here and this is like spring for this country because it always gets more light and summer over there then autumn going into winter.

Teacher: OK. How do you know that that is winter? What on the model indicates that that's winter?

Rachel: Well this part here is quite dark because it doesn't actually get this sun much when it comes round in a day, gets longer hours if it's round here.

Teacher: But can you show me how it gets longer hours, daylight hours? Can you show me that?

Rachel: Well...

Teacher: [inaudible] 'cause it's shaped.

Rachel: Yeah so it, the sun has longer hours when it's here and when it's round here it has shorter hours round here.

Teacher: Mm, hm, so what season has shorter hours? Shorter daylight hours?

Rachel: Winter.

Teacher: OK, and you just said that this was shorter daylight hours so what's this position here?

Rachel: Well, it would be winter but it gets summer days.

Teacher: And why do you think it's summer?

Rachel: Because it has longer hours of sunlight when it goes round. Like there it goes into day and its long past winter. Goes round here.

Teacher: Is there any other information repetitives (?) that you could use to prove that, one is more [inaudible] on one side.

Rachel: That the north, the pole, the north pole and south pole and Antarctica gets less light – it gets no light in winter and but more light round in summer.

Teacher: OK. So when it's over here in Antarctica is there any light on Antarctica?

Rachel: No.

Teacher: So what could that be then, if there's no light?

Rachel: Winter.

Teacher: OK. And where would summer be? And what do you see there?

Rachel: It gets sun most of the time.

Teacher: Mm, hm, so where is summer then? And using your model, where would summer be Rachel?

Rachel: Over there.

Teacher: OK. And where is, and where would winter be?

Rachel: Over there.

Teacher: And you've got some evidence to support that then don't you. Thank you.