LEVELS 1 AND 2

Science guide for teachers

This guide has been prepared to give teachers some ideas for supporting their students' science learning in school. Students at levels 1 and 2 notice and describe the world around them. Having lots of experiences and talking about the things they notice help them begin to understand about science. They start to use science words to help them explain science ideas.

Student learning in science at levels 1 and 2

Lana is learning at levels 1 to 2 in science. She notices things around her and how they change. She carefully describes the patterns she notices. These include patterns with numbers, measurements, and the order of events.

Lana asks questions about why things happen, and how. She uses what she knows to explain her ideas but does not always use examples to support her explanations. She can use some science words.

Lana works with others to build on her ideas and make them better.

Why are *noticing* and *describing* important in science?

In science careful observation (noticing) helps build evidence. Scientists use observations to look for patterns that help to understand how things work in the world.

Working with students

Notice things with your students. Ask them questions such as:

- What is different about ...?
- What is the same about ...?
- What did you notice when ...?

Model words that help them to describe what they notice. Try new words that:

- describe precisely (hairy, enormous, sharp, breezy)
- compare (brighter, longer, smaller, steeper)
- are words that have a precise science meaning (melt, freeze, eruptions, beak)

Practise **describing things in more detail**, for example:

- When they describe something as small, medium or large ask them what they are comparing these sizes to.
- If they measure something, where on the object would they measure? Help them to practise measuring.

Help them to **explain what they notice**. Ask them questions such as:

- Why do you think that happened?
- Have you seen something like this before?

Help them to **use what they notice** as evidence. Ask them questions such as:

- What did you notice that makes you think that?
- What other things do you notice that make you sure that your thinking is correct?
- Where else might you have seen this?

Examples

Looking at leaves

What do you notice about this leaf?

The leaf is green. It has lines. It is smooth around the edge.

Simple answer

One main line runs from the top to the bottom. There are four other lines [veins] that come off the main line [vein].

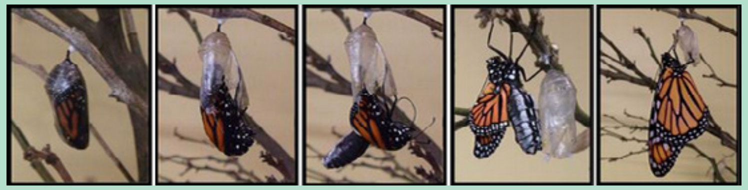
More detailed answer

With help, the students could also give the measurements of the leaf.

This example is about students describing the patterns they notice. To complete this task, the student has to notice details and describe them accurately.

Monarch butterfly

The class has been watching a monarch butterfly emerge from a chrysalis. The teacher asked students to put photographs of the event in order. The student in the example has put the pictures in the correct order.



This example is about ordering events. The student needs to notice what is different in each photograph and decide what happens first.

This guide draws on findings from National Monitoring Study of Student Achievement, Science 2017

LEVEL 3

Science guide for teachers

This guide has been prepared to give teachers some ideas for supporting their students' science learning in school. Students at level 3 are beginning to understand that science ideas are based on evidence. They can ask questions that can be tested. They can carefully plan and carry out investigations, record data, and think about what their results mean. They are beginning to record results and interpret findings using some scientific ways of recording.

Student learning in science at level 3

Sione is learning at level 3 in science. He notices details in things around him, and in how they change. He compares patterns to look for differences. The patterns include patterns with numbers, measurements, and the order of events.

Sione is beginning to read and make meaning from photographs and simple diagrams. He explains his ideas using simple words. His explanations show his growing understanding of basic science ideas.

Sione understands and uses simple graphs, diagrams, food chains, and life cycles. He can make simple graphs and tables.

Sione uses simple science practices, like *fair tests* in his investigations. He can spot major problems in the design of basic science investigations.

Sione uses evidence to back up his explanations. This evidence could be from his own investigations or from someone else's. He transfers what he learns to different contexts.

Definitions

***Fair test:* In a fair test, only one thing changes. Everything else stays the same.**

Why is knowing about *science investigations* important?

Scientists test their ideas about things they have noticed, in an orderly way. They do this to build evidence to help answer their questions. Fair testing is one of the ways scientists investigate. The more we know about investigating the better we can identify problems in investigation design and data.

Working with students

Support students to **design fair tests**. First decide together on a question to investigate. Then ask:

- To answer this question, what will you need to change each time?
- What will you need to keep the same?

Model ways of **recording data**. Ask:

- How will you record your results?
- What is a good way to show others what you have found out?
- Is your graph/table/diagram giving a clear picture of your results?

Have conversations about **graphs or diagrams** in the newspaper, at the supermarket, on packaging, or at the service station. Ask:

- What does this graph or diagram tell us?
- What does it not tell us?
- What symbols are used?
- What could make the graph or diagram better?

Provide opportunities to discuss **claims**, e.g., in advertising or environmental issues. Ask:

- Do you believe the claim? Why? Why not?
- What evidence has been given to support the claim?
- What could you do to check the claim?
- What other tests could be done that would give a different way of thinking about the claim?

Examples

Down the ramp

William wants to find out whether the height of a ramp makes a car go faster.

1. He releases a small toy car down a flat ramp.
2. He releases a large toy car down a steep ramp.

Is this a fair test?

It is not a fair test. The cars are not the same.

It is not a fair test because two things change each time – the size of the toy and the height of the ramp. This means you cannot be sure if it is the toy or the height that makes the car go faster.

This example is about identifying a problem in the design of an investigation. Students have to recognise that only the height of the ramps changes; the cars should be the same.

Sugar in drinks

Moana is investigating sugar in drinks. Here is her data table.

Sugar in some drinks

Bottle of drink	Bottle size	Sugar per bottle
Pure orange drink	100 ml	10.7 g
Diet fizzy	100 ml	0 g
Full cream milk	100 ml	4.8 g
Cola	200 ml	21.2 g

Moana looked at the table and said, "Cola has more sugar than orange juice."

For which drink do you need to do some maths to check if she is right? Explain why.

This example is about identifying a problem in a claim. To answer this question, students need to check that all the bottles are the same size.

This guide draws on findings from National Monitoring Study of Student Achievement, Science 2017

Science guide for teachers

This guide has been prepared to give teachers some ideas for supporting their students' science learning in school. Students at level 4 are continuing to develop their science understandings through investigations and reading about science. They are learning more about the special ways scientists communicate their ideas. Their investigations and science explanations are more detailed. They can judge claims made by others and make some suggestions.

Student learning in science at level 4

Marie is learning at level 4 in science. She notices important details and asks questions about them that lead to understanding a science idea. These details might be similarities and differences or changes in objects, events, ideas, and people's points of view. She uses science words and her observations to describe and explain science ideas.

Marie understands a wide range of complex *science texts,* such as photographs, pictures, drawings, simple *science models,* and diagrams. She understands and uses some *science conventions* such as classification keys, Venn diagrams, and science models.

Marie tests ideas in many ways. She plans and carries out fair tests. She knows when to repeat a test. She understands how to organise information into a table, a graph, or a diagram. She spots differences in results and explanations.

Marie can discuss a science problem, identifying one side of an argument.

Definitions

Science texts: Science texts present facts and explanations about science. Some are written (for example, reports) and some are visual (for example, graphs). They use science words and clear language.

Science models: Science models are a way of representing ideas. They take away a lot of detail so just the important parts are left. They are used to explain things and to predict what might happen. (For example, models are used to predict earthquakes and the weather.) Models can change over time with new information.

Science conventions: Scientists have a set of conventions for how they share information (see "Using arrows").

Why is knowing about *science representations* important?

Agreed ways of representing science ideas in graphs, tables, diagrams, and models (conventions) mean people around the world can understand each other's work. When science ideas are too big or too small to see, scientists explain the idea using a model or diagram.

Working with students

Look for opportunities to **compare different types** of graphs, diagrams, reports, etc. Ask:
- Which most effectively communicates the science information?
- What features of the representation make the science more easily understood?

Discuss the **purpose** of different representations. Ask:
- Do you think it would be better to use a graph or a diagram to show this bit of information? Why?

Compare **two different representations of the same thing**, e.g.,
- What does each representation highlight?

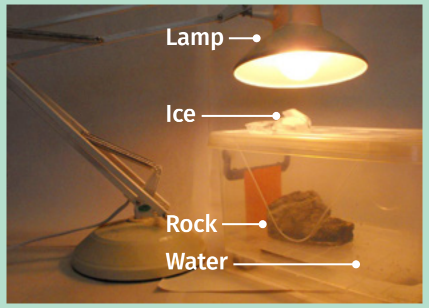
Explore models. Ask:
- What does the model show?
- What doesn't it show?
- How is it different from the real thing?

Examples

Model of the water cycle

Ana made a model to show how water on Earth is constantly recycled. She set it up like this.

Fill in the table to show what each part of Ana's model represents.



The model		Water cycle
The fish tank	represents	Planet Earth including its atmosphere
The rock	represents	.... *(The land)*
The water in the tank	represents	.... *(The oceans)*
The lamp	represents	.... *(The sun)*

This example is about identifying what the elements of a model represent. To make sense of the model, students must understand what each part of the model represents in reality.

Using arrows

1. Arrows in food chains

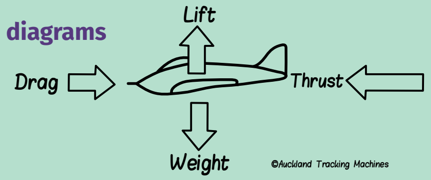
Write 2 things this food chain tells you about rabbits.

grass ⟶ rabbit ⟶ hawk

The rabbit eats grass and is eaten by hawks.

The arrows in this food chain show the movement of *energy*. Grass is a plant. It gains its energy from the sun. The rabbit gains its energy when it eats the grass. The hawk gains its energy when it eats the rabbit. Scientists have agreed that arrows should point in the direction of the flow of the energy.

2. Arrows in force diagrams



What direction is the plane going? Explain why.

The plane is moving forward.

The arrows in the diagram represent the direction of each force acting on the plane. The length of the arrow represents the relative size of the force. Three of the forces are the same size. The thrust force is larger than the others, so the plane is moving forward.

This example is about recognising that in science, arrows can have different meanings depending on the context in which they are used. To complete the tasks students must know the conventions for using arrows in science diagrams.

This guide draws on findings from National Monitoring Study of Student Achievement, Science 2017

ABOVE
LEVEL 4

Science guide for teachers

This guide has been prepared to give teachers some ideas for supporting their students' science learning in school. Above level 4, students are working with more complex science investigations. They are drawing on evidence to argue for or against science claims. They are using more specialised science vocabulary, diagrams, symbols, and models. They may be interested in science issues and begin to contribute their own ideas.

Student learning in science above level 4

Niko is working above level 4 in science. He notices many important details in things around him. He explores things from beyond his everyday world. These can be things like fossils, the universe, or microscopic organisms.

Niko understands more complex science texts like detailed models and diagrams. He can draw many different types of diagrams and models from information he is given. He uses a wide range of science words to help describe and explain science ideas. He uses the correct units of measurement.

Niko plans and carries out science tests that have a range of *variables*. He checks for errors in results and explanations. He will not accept an explanation if there is data or an example that doesn't fit the pattern. Instead, he will ask for more tests or evidence.

Niko can *critique* investigations. For example, he can identify which results are useful and what is missing in a science investigation.

Niko can explain what needs be done to solve a science problem and identifies both sides of the argument.

Definitions

Critique: When we critique something, we evaluate it in a very detailed way.

Variables: The things that might change or stay the same in an investigation are called variables.

Why is *critiquing* science processes and decisions important?

Scientists accept ideas as provisionally correct when their robust testing does not lead to any further questions or differences. However, if more evidence is discovered, their ideas may change. Problems can be complex, and students need to know about science concepts and processes to understand questions and issues, and suggest actions that will help solve them.

Working with students

Talk to your students about a **current science issue** in the media. Ask:

- What are the different ways people think about an issue?
- What is the difference between beliefs and evidence?
- What actions are different groups likely to take?
- How can science help predict the possible impact of different actions?
- Which actions might have the most merit for good outcomes?

Examples

Fruit fly

Question 1. What is the best thing **you** can do to keep Queensland fruit flies out of New Zealand?

A. Be friendly to the sniffer dogs that are looking for fruit in your luggage.

B. Don't bring any fruit from other countries into New Zealand.

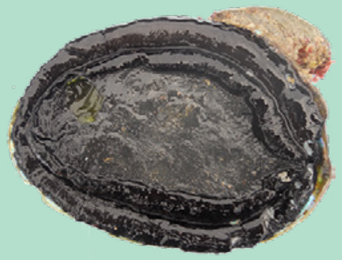
C. Don't buy any fruit that is grown in other countries.

D. Wash all fruit before eating it to get rid of any fruit flies.

Question 2. Why did you choose this statement?

This example asks students to decide which action will have the best outcome and why they think this. To answer this question, students need to know how organisms become established in new habitats.

Kaimoana



Different people have different ideas about what size kaimoana (seafood) to gather to make sure there will be kaimoana for people in the future. Some groups think it's better to put the small ones back while other groups think it is better to put the big ones back.

Question 1. Give a reason that supports the view
It is better to take the small ones and put the big ones back.

Question 2. Give a reason that supports the view
It is better to take the big ones and put the small ones back.

This example asks students to consider both sides of an argument. To answer the questions, students need to know about reproduction cycles.

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