Science 3–4

Chapter 1 — Working scientifically: asking, planning and measuring

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Contents

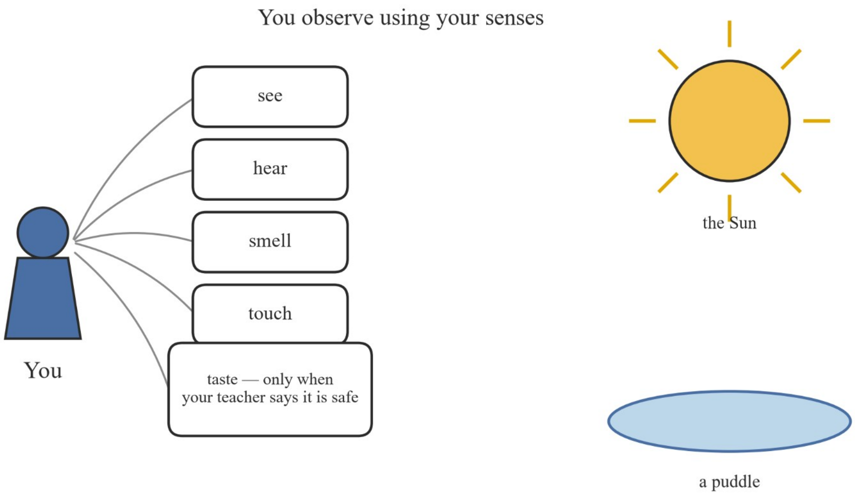
1A — Observing, questioning and predicting

What we teach here — `VC2S4I01` (Victorian Curriculum F–10 Version 2.0, Science, Levels 3 and 4): "observations can be used as a basis for posing questions to identify patterns and relationships, and to predict the outcomes of investigations". **In our words:** what you notice can help you ask good questions, and it can help you say what you think will happen — and why.

Theory

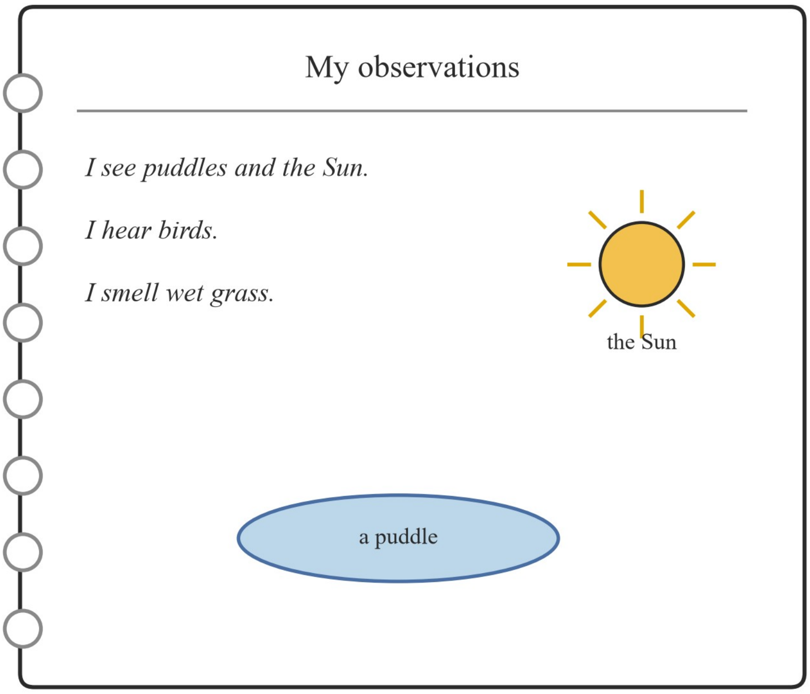
Observing

Science starts with noticing. To **observe** means to look, listen, smell and touch carefully — to use your senses to find out about the world. Scientists observe with all of their senses, and so can you.



It rained last night. This morning you stand in the schoolyard. You **see** puddles and the Sun. You **hear** birds. You **smell** wet grass. You **touch** a cold seat. Each of these is an observation. (You do not taste things in science unless your teacher says it is safe.)

An observation is what you actually noticed — not what you think should happen, and not what you hope will happen. Scientists also **record** their observations: they write them down or draw them, so they remember exactly what happened.



You record an observation by writing it down or drawing it.

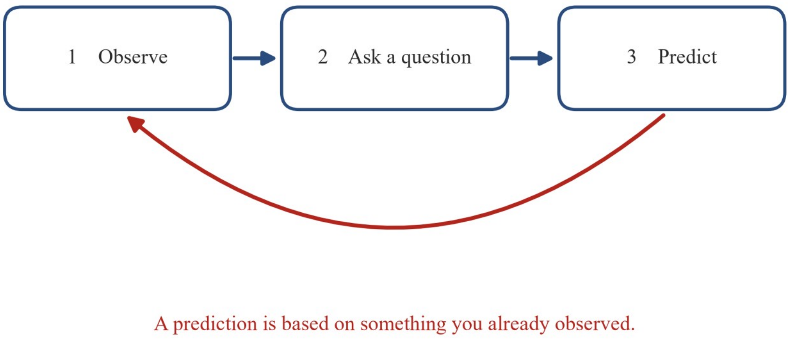
A student's notebook page with three observation sentences and a small drawing of the Sun and a puddle.

Asking questions

Noticing things makes you wonder. Every observation can grow into a question.

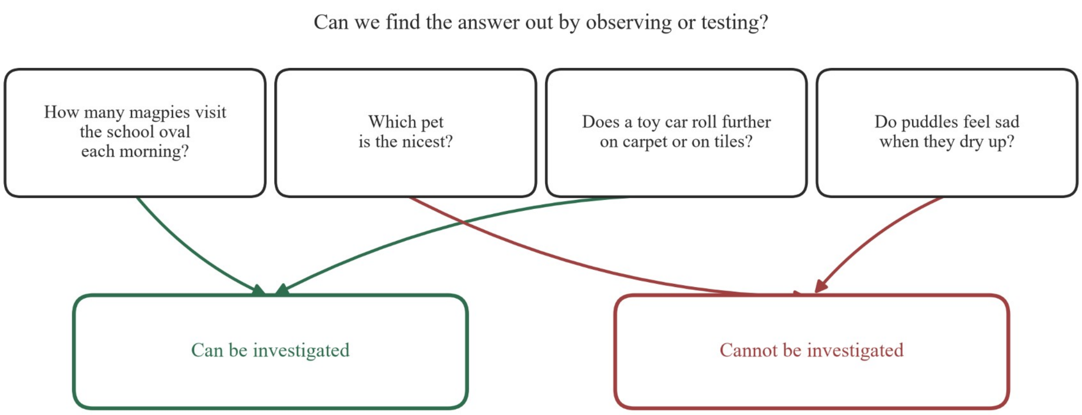
You observe: *the puddle on the oval is gone by lunchtime, but the puddle under the tree is still there.* That observation can grow into the question: *does being in the Sun change how fast a puddle dries?*

The whole move looks like this:



Can we find it out? (Investigating)

To **investigate** means to find out about something carefully. In this subtopic, a question **can be investigated** if we can answer it by watching carefully, by testing, or by looking things up. That is the test we use. Questions about what someone likes, feels or thinks *should* happen cannot be answered that way — so in science they cannot be investigated. They are still questions! They just are not science questions.



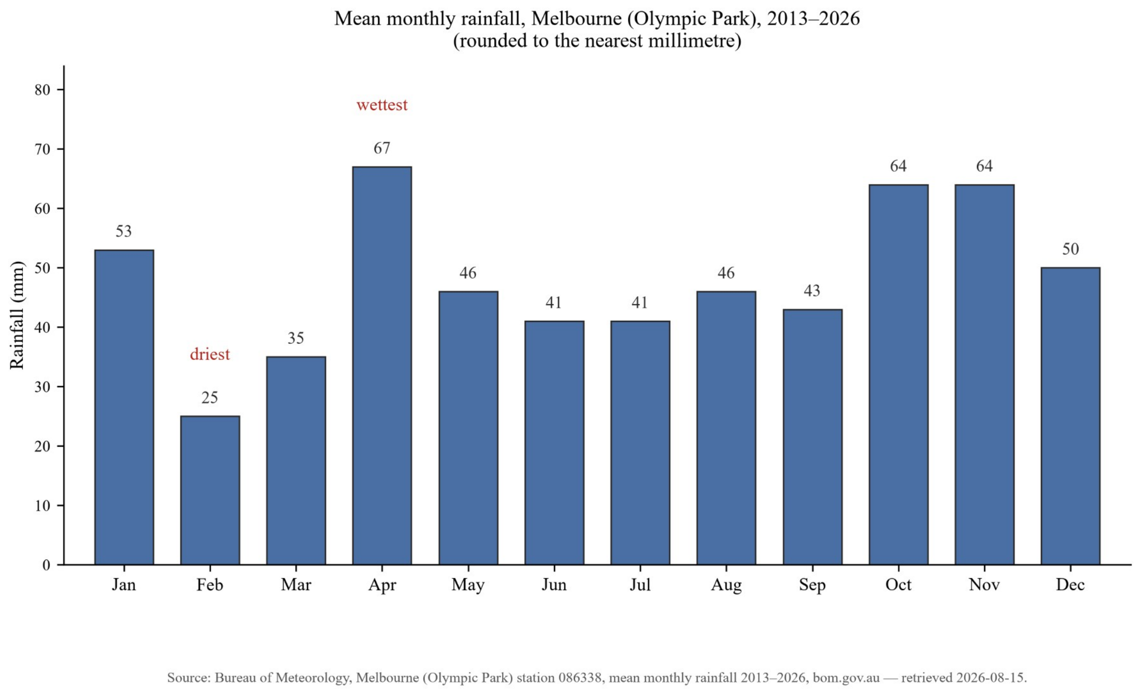
Look at the diagram. *How many magpies visit the school oval each morning?* We can answer that by watching and counting, so it **can be investigated**. *Does a toy car roll further on carpet or on tiles?* We can test that, so it **can be investigated** too. But *which pet is the nicest?* is about what people like — two people can give different answers and both be happy with them. *Do puddles feel sad when they dry up?* is about how a puddle feels, and we can never find that out by watching or testing. That one cannot be investigated either.

The sorting test is one question you ask yourself: *can we find the answer out by observing or testing?*

Patterns and relationships

When you observe again and again, you can start to see a **pattern**. A pattern is something that repeats in your observations, or a change you can describe.

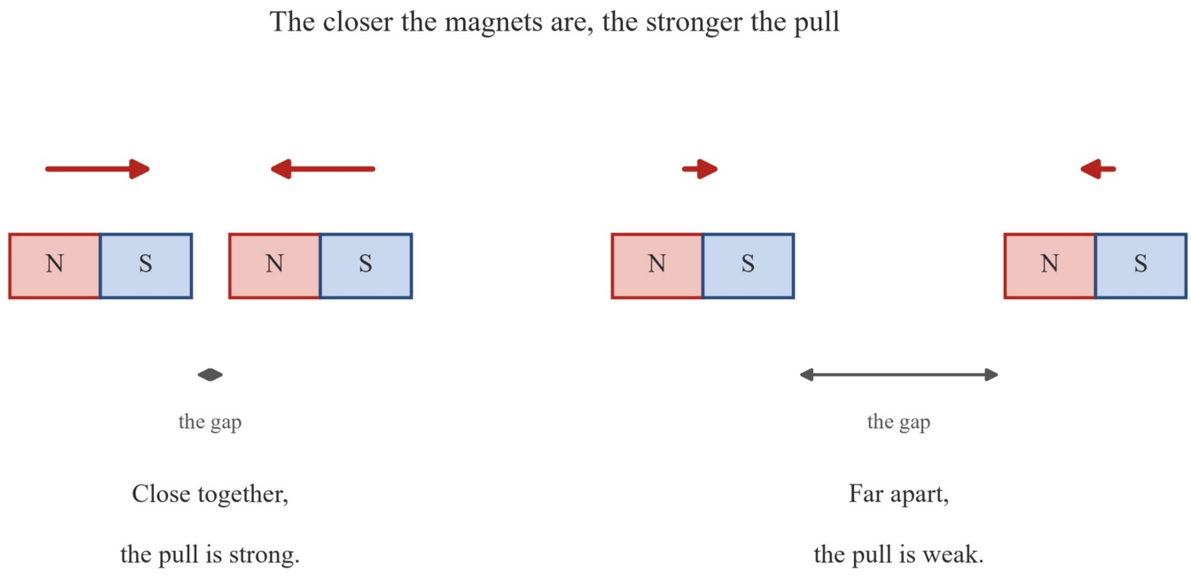
Every sunny day this week, the puddle on the oval was gone by lunchtime. That is a pattern — the same thing kept happening. Scientists call the things they observe and write down **data**. They also find patterns in data. Here is real data about rain in Melbourne:



Look at the bars. The pattern is that the rain is **not** spread evenly through the year. April is the wettest month (about 67 mm), February is the driest (about 25 mm), and autumn and spring are wetter than summer. A **pattern question** asks *what repeats?* or *what stays the same?* For this data: *which months are usually the wettest and the driest?*

Source: Bureau of Meteorology, Melbourne (Olympic Park) station 086338, mean monthly rainfall 2013–2026 (rounded to the nearest millimetre), bom.gov.au — retrieved 2026-08-15.

A **relationship** is when one thing changes and another thing changes with it. Hold two magnets near each other: close together they pull hard; further apart the pull feels weaker. The distance changed, and the pull changed with it. That is a relationship. A **relationship question** asks *when this changes, does that change too?* For the magnets: *how does the distance between two magnets change how strongly they pull?*



Two bar magnets close together pulling strongly, and the same two magnets far apart pulling weakly.

Pattern questions and relationship questions are both science questions. Both of them can usually be investigated.

Predictions

A **prediction** is what you say will happen, **based on** something you observed before. Every prediction has a base — the observation it stands on. A good way to check a prediction is to finish the sentence: *I predict … because I observed …*

Here are two predictions and the observations they stand on.

- Observation: *ice left on the windowsill melted faster than ice left in the cupboard.* Prediction: *I predict ice left in a warm spot will melt faster than ice left in a cool spot.*
- Observation: *on a hot day, the black car in the car park felt hotter than the white car.* Prediction: *I predict a black jumper left in the Sun will feel warmer than a white one.*

If a prediction turns out to be wrong, that is useful. You go back to the observation it was based on, look again, and make a better prediction. Scientists do this all the time.

A prediction is not a guess

A **guess** is saying what might happen with no observation to stand on. A prediction can say where it comes from; a guess cannot.

Amara predicts — she can say why

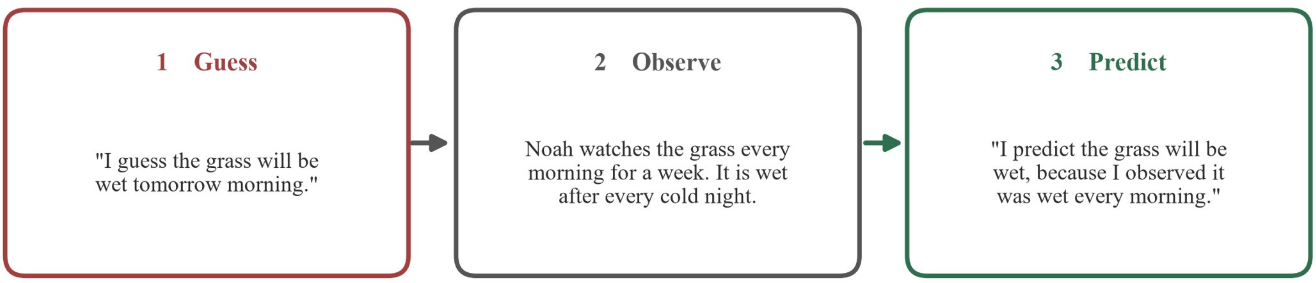
Noah guesses — he cannot say why

Look at the diagram. Amara and Noah both say the grass will be wet tomorrow morning. Amara's sentence is a **prediction**, because it is based on what she observed — the grass was wet every morning this week after a cold night. Noah's sentence is a **guess**, because he cannot say why. He might still be right! But if he is wrong, there is nothing to look back on and fix.

This is the difference that scientists never stop using: *a prediction is based on an earlier observation, and a guess is not.*

You can always upgrade a guess into a prediction. First observe. Then say what you expect to happen, based on what you observed. That is exactly what Noah can do: watch the grass for a week, then say *I predict … because …*

You can always upgrade a guess into a prediction



Now Noah can say where his prediction comes from — so it is a prediction, not a guess.

Three steps to upgrade a guess into a prediction: first Noah guesses, then he observes the grass each morning, then he predicts and can say why.

Words to know in 1A

Word	What it means here
observe	to use your senses to find out about something, carefully
record	to write down or draw what you observed

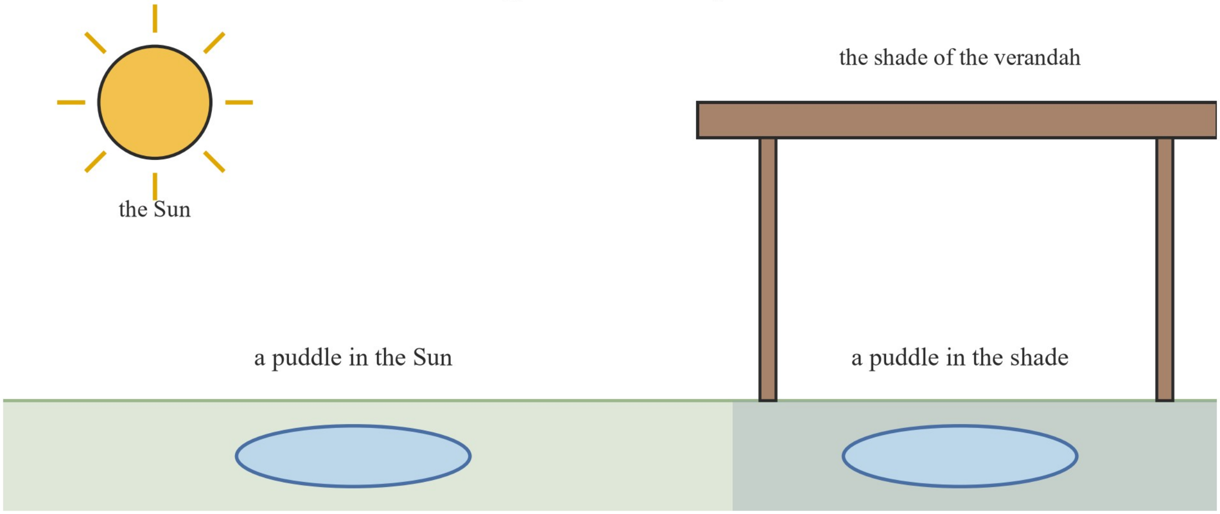
Word	What it means here
investigate	to find out about something carefully, by watching, testing or looking things up
question	what an observation makes you wonder; a science question can be investigated
pattern	something that repeats in your observations, or a change you can describe
relationship	when one thing changes and another thing changes with it
predict / prediction	to say what you think will happen, based on something you observed before
guess	saying what might happen, with no observation to stand on

Worked examples

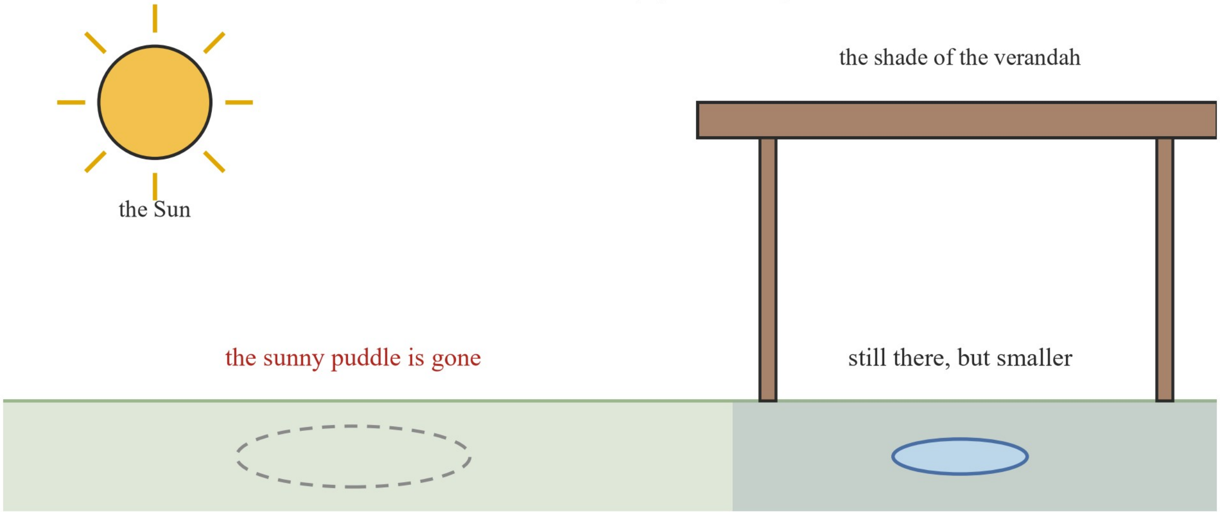
Example 1 — scaffolded

Mia notices two puddles after rain: one on the sunny side of the oval, and one in the shade of the verandah. By lunchtime the sunny puddle is gone, and the shady puddle is still there but smaller. Turn Mia's observation into a question and a prediction.

Morning, after rain: two puddles



Lunchtime: the sunny puddle is gone



Two scenes of the schoolyard after rain: in the morning there is a puddle in the Sun and a puddle in the shade; by lunchtime the sunny puddle is gone and the shady one is smaller.

Working	Comment
Observe: after rain there was a puddle in the Sun and a puddle in the shade. By lunchtime the sunny puddle was gone. The shady puddle was still there, but smaller.	Mia looked carefully, twice — in the morning and at lunch — and she says what she saw, not what she thinks should happen.
Question: does being in the Sun change how fast a puddle dries?	Mia's question grew out of her observation. It can be investigated: she can watch sunny and shady puddles after more rainy days.
Pattern or relationship? This is a relationship question: one thing (Sun or shade) changes, and another thing (how fast the puddle dries) changes with it.	Relationship questions ask *when this changes, does that change too?* Pattern questions ask *what repeats?*
Predict: I predict a puddle in the Sun will dry faster than a puddle in the shade.	The prediction says what Mia thinks will happen next time.
Based on: I observed the sunny puddle gone by lunchtime, with the shady puddle still there.	Every prediction needs a base. This one stands on Mia's own observation — so it is a prediction, not a guess.

Example 2 — scaffolded

Leo holds two bar magnets from the class kit near each other. Close together, they snap together in his hands. Further apart, he feels no pull at all. Turn Leo's observation into a question and a prediction.

Working	Comment
Observe: the magnets pulled strongly when they were close. When Leo moved them further apart, the pull felt much weaker.	Leo used his hands as well as his eyes. Touching is one way to observe.
Question: how does the distance between two magnets change how strongly they pull?	This question is about the pull, and it can be investigated with the class magnets — by trying different distances and watching (and feeling) what happens.
Pattern or relationship? A relationship: the distance changes, and the strength of the pull changes with it.	You do not need to know *why* magnets pull to ask this. The observation is enough.
Predict: I predict the closer the magnets are, the stronger the pull.	The prediction says how the two changes go together.
Based on: I observed the magnets snapping together when close, and not pulling when far apart.	Again the prediction stands on the observation. If Leo is surprised later, he goes back and looks again.

Example 3 — unscaffolded

On Monday, Jay says, "I guess tomorrow afternoon will be warmer than tomorrow morning." His teacher asks him what he has observed. Jay thinks, and says, "Every day this week, the morning was cold and the afternoon was warm." He then says, "I predict tomorrow afternoon will be warmer than tomorrow morning, because every day this week the morning was cold and the afternoon was warm."

Jay's first sentence is a **guess**: it says what might happen, with no observation to stand on. His second sentence is a **prediction**: it says the same thing, but now it is based on what Jay observed all week. Jay upgraded his guess by looking back at his observations and saying them out loud.

∴ Jay's second sentence is a prediction, not a guess, because it is based on what he observed — and if it turns out wrong, Jay knows exactly which observation to look at again.

Example 4 — unscaffolded

Ava's class looks at the rainfall diagram in the Theory. They observe: April is the wettest month (about 67 mm) and February is the driest (about 25 mm), and autumn and spring are wetter than summer.

The pattern: Melbourne's rain is not spread evenly through the year. Autumn (especially April) and spring (October and November) are the wetter months, and summer (especially February) is the drier time.

A question about the pattern: which months are usually the wettest and the driest in Melbourne? The diagram answers it: April the wettest, February the driest.

A prediction: I predict that next year, Melbourne will get more rain in April than in February. It is based on the pattern — over the 13 years of record, April was much wetter than February.

∴ the pattern in the data supports a prediction about next year, and the prediction can say what it is based on — the same move Amara made in the diagram, made with data instead of one week of mornings.

Practice questions

Scaffolded

Q1. Last night it rained. This morning there were puddles all over the oval. By lunchtime the puddles on the oval were gone, but the puddle under the big tree was still there. (a) Write down one observation from this story. (b) Ask one question the observation makes you wonder. (c) Can your question be answered by watching, testing or looking things up? Say how.

Q2. Here are four questions. 1. Do sunflowers like music? 2. How many bees visit the lavender bush each morning? 3. Is blue the nicest colour? 4. Does sand get hotter than soil in the Sun? (a) Say the sorting test you use to decide if a question can be investigated. (b) Sort the four questions into *can be investigated* and *cannot be investigated*, and say why for each.

Q3. Match each prediction to the observation it is based on. The first one is done for you.

Observations: **A.** The ice on the windowsill melted faster than the ice in the cupboard. **B.** Two magnets snapped together when they were close, but did not pull when they were far apart. **C.** The black car in the car park felt hotter than the white car. **D.** Every autumn, the leaves on the elm tree by the gate turn yellow and fall.

Predictions: **1.** I predict the magnets will pull more strongly if I move them closer. (matches B) **2.** I predict the ice in the Sun will melt first. **3.** I predict a black jumper left in the Sun will feel warmer than a white one. **4.** I predict the elm will drop its leaves again next April.

(a) Match predictions 2, 3 and 4 to the observations they are based on.
(b) Choose one of your matches and say what the prediction is based on.

Q4. The table shows real data for Melbourne (Olympic Park): the mean number of days of rain (1 mm or more) in each month, 2013–2026, rounded to the nearest whole day.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5	4	5	8	9	9	9	9	8	9	8	6

(a) Which month has the most days of rain?
(b) Which month has the fewest?
(c) Complete the pattern: "In Melbourne there are ______ days of rain in winter (June to August) than in summer (December to February)." (more / fewer)

Source: Bureau of Meteorology, Melbourne (Olympic Park) station 086338, mean number of rain days 2013–2026, rounded to the nearest whole day, bom.gov.au — retrieved 2026-08-15.

Q5. Tom says, "I guess it will rain on sports day." (a) Why is Tom's sentence a guess and not a prediction? (b) Tom watches the sky before school for two weeks. He notices: every time the sky was dark grey before school, it rained before lunch. Use that observation to rewrite Tom's sentence as a prediction.

Q6. Your class keeps a bird log. Every Monday morning this term, you counted more magpies on the oval than you counted on the Friday before. (a) Ask one pattern question about the log. (b) Predict what the log will show next Monday morning. (c) What is your prediction based on?

Unscaffolded

Q7. Sort these six questions into *can be investigated* and *cannot be investigated*, and say why for each. 1. How many minibeasts live under the log near our garden? 2. Do minibeasts like living under logs? 3. Which lunchbox is the best? 4. Does bread go mouldy faster in a warm spot or in a cool spot? 5. Is it fair that wet days are short? 6. Do I swing higher if I pump my legs on the swing?

Q8. Say whether each question is a **pattern** question or a **relationship** question, and give a reason. 1. What happens to the shadow of the flagpole during the day? 2. Do more worms come to the surface when the soil is wetter? 3. In which months does the elm tree by the gate drop its leaves? 4. Does ice melt faster when the room is warmer?

Q9. Match each prediction to the observation it is based on.

Observations: **A.** Every sunny day this week, the puddle on the oval was gone by lunchtime. **B.** Every very cold morning this month, the grass was covered in frost. **C.** The jelly dissolved faster in hot water than in cold water. (Dissolved means it broke up and disappeared into the water.) **D.** When the wind blew harder, the flag pointed straighter.

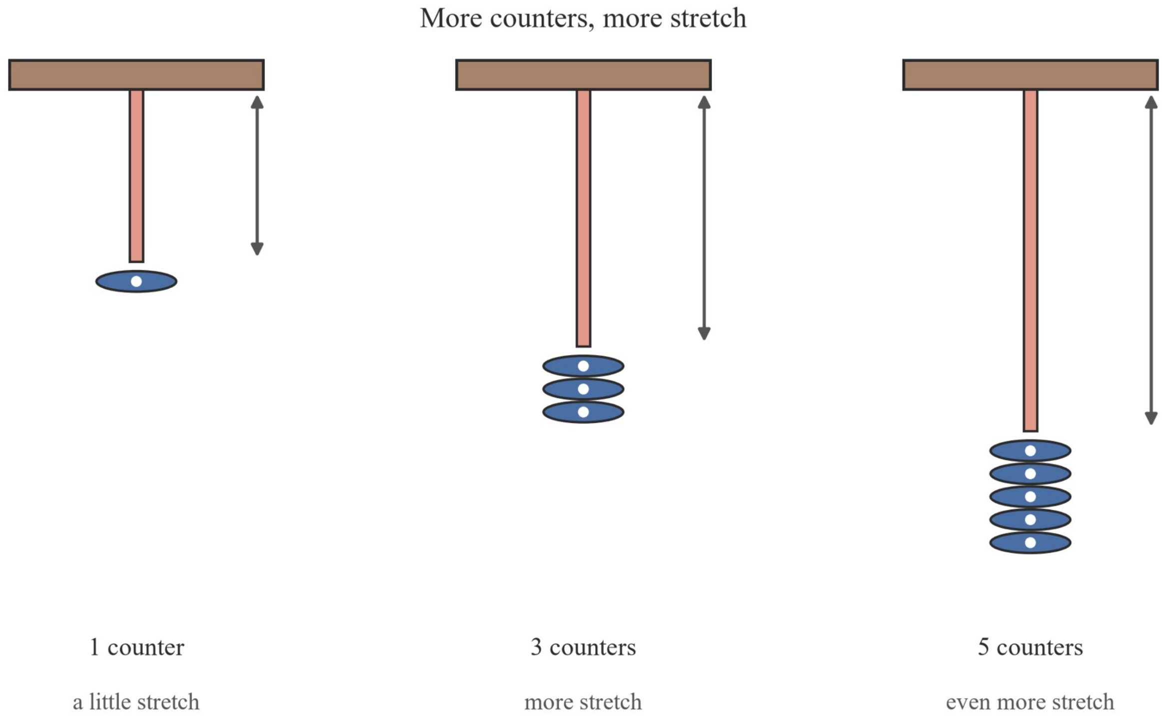
Predictions: **1.** I predict that if tomorrow is very cold, the grass will be covered in frost. **2.** I predict the puddle will be gone by lunchtime tomorrow, if it is sunny. **3.** I predict that on a windier day, the flag will point straight out. **4.** I predict the jelly will dissolve fastest in the hottest water.

Q10. Two students look at the sandpit after a night of rain. Zali says, "I think the sandpit will be wet tomorrow." Ben says, "I predict the sandpit will be wet tomorrow, because every morning this week it was wet after it rained in the night." Which sentence is a prediction and which is a guess? How do you know?

Q11. Priya says, "I guess the butterflies will land on the pink flowers." (a) Why is Priya's sentence a guess? (b) Priya watches the garden for a week. She sees butterflies land on the pink flowers 8 times and on the white flowers 2 times. Use that observation to rewrite Priya's sentence as a prediction.

Q12. Look at the rainfall diagram in the Theory. (a) Describe one pattern you can see in the data. (b) Predict: next year, will Melbourne get more rain in April or in February? (c) What is your prediction based on?

Q13. Jonty hangs counting counters on a rubber band. With 1 counter, the rubber band stretches a little. With 3 counters, it stretches more. With 5 counters, it stretches even more.



A rubber band hanging from a hook stretches more as counting counters are added: one counter, three counters, five counters.

(a) Describe the relationship Jonty observed.
(b) Predict what will happen with 7 counters.
(c) What is your prediction based on?

Q14. Your class looks at its lunchboxes. (a) Write one question about lunchboxes that **can** be investigated. (b) Write one question about lunchboxes that **cannot** be investigated. (c) Say why your question in (b) cannot be investigated.

Q15. Your class looks at its lunchboxes and notices: most of them are made of plastic, and none of them are made of glass. (a) Ask one question about why plastic is used more often than glass for lunchboxes. (b) Can your question be investigated? Say how you would find out.

Q16. The class makes slime. It runs out of the cup like a liquid, but you can pick it up and roll it in your hands like a solid. (a) Ask one question about whether slime is a solid or a liquid. (b) Is your question investigable? Say what you would observe to find out.

Q17. Your class has a pond. You observe: water plants grow in the pond, snails eat the plants, and ducks eat the snails. (a) Predict what will happen to the water plants if all the snails move away. (b) What is your prediction based on?

Q18. Every morning on her way to school, Zia hangs her jumper on the line. She notices: on windy days her jumper is dry when she gets home, and on still days it is still damp. (a) Write two observations from Zia's story. (b) Ask one investigable question about it, and say whether it is a pattern question or a relationship question. (c) Make one prediction. (d) Say what your prediction is based on, and why it is not a guess.

Answers

Q1. (a) e.g. by lunchtime the puddles on the oval were gone but the puddle under the tree was still there; (b) e.g. does being in the shade change how fast a puddle dries?; (c) yes — by watching puddles in the Sun and in the shade after more rainy days (any reasonable question and way of finding out). **Q2.** (a) can we find the answer out by observing or testing?; (b) can be investigated: 2 (watch and count the bees), 4 (test sand and soil in the Sun); cannot: 1 (what a sunflower *likes* can never be found out that way), 3 (what people like is not a science question). **Q3.** (a) 2–A, 3–C, 4–D; (b) e.g. prediction 4 is based on the observation that the elm has dropped its yellow leaves every autumn so far. **Q4.** (a) May, June, July, August and October (9 days each); (b) February (4 days); (c) more. **Q5.** (a) a guess says what might happen with no observation to stand on; (b) I predict it will rain on sports day, because every time the sky was dark grey before school, it rained before lunch. **Q6.** (a) e.g. does the log always show more magpies on Monday than on Friday?; (b) more magpies on Monday morning than on the Friday before; (c) the pattern in the log — it happened every week this term. **Q7.** Can be investigated: 1 (look and count), 4 (watch bread in a warm and a cool spot), 6 (try it on the swing and watch). Cannot: 2 (what minibeasts *like* cannot be found out by observing or testing), 3 (which is *best* is what people think), 5 (asks what should happen, not what does). **Q8.** Pattern: 1 (one thing — the shadow — changing in a way you can describe through the day), 3 (what repeats each year). Relationship: 2 (soil wetness changes and worm numbers change with it), 4 (room warmth changes and melting speed changes with it). **Q9.** 1–B, 2–A, 3–D, 4–C. **Q10.** Ben's is the prediction (it says what it is based on); Zali's is the guess (it cannot say why). **Q11.** (a) it says what might happen with no observation behind it; (b) I predict the butterflies will land on the pink flowers, because in one week I saw them land there 8 times and on the white flowers only 2 times. **Q12.** (a) e.g. autumn and spring are wetter than summer; April is the wettest month and February the driest; (b) more rain in April; (c) the pattern in the data — over the 13 years of record, April was much wetter than February (about 67 mm against about 25 mm). **Q13.** (a) the more counters, the more the rubber band stretches; (b) it will stretch even more than with 5 counters; (c) the relationship observed — every time the number of counters went up, the stretch went up too. **Q14.** e.g. (a) which lunchbox keeps an ice block frozen the longest?; (b) which lunchbox is the coolest-looking?; (c) "coolest-looking" is what people like, so no observation or test can answer it. (Any reasonable pair.) **Q15.** (a) e.g. why is plastic used more often than glass for lunchboxes?; (b) yes — by looking up information and by testing properties such as how heavy, strong or breakable each material is (the testing comes later in the year; asking the question is the skill here). **Q16.** (a) e.g. is slime a solid or a liquid?; (b) yes — observe what slime does: does it keep its own shape like a solid, or take the shape of its container like a liquid? (Deciding the answer is a later topic; the question and the observation are this one.) **Q17.** (a) the water plants will grow more (there will be more of them); (b) the observation that snails eat the plants — with the snails gone, fewer plants get eaten. **Q18.** e.g. (a) on windy days the jumper is dry by home time; on still days it is still damp; (b) does wind change how fast the jumper dries? — a relationship question (wind changes, drying speed changes with it); (c) I predict the jumper will dry faster on a windy day than on a still day; (d) it is based on what Zia observed every morning this term, so it is a prediction, not a guess.

Fully-worked solutions

Q1. (a) An observation is what the story says someone noticed: *by lunchtime the puddles on the oval were gone, but the puddle under the big tree was still there.* (b) A good question grows out of the observation, for example: *does being in the shade change how fast a puddle dries?* (c) The sorting test: can we find it out by watching, testing or looking things up? Yes — watch puddles in the Sun and in the shade after more rainy days, and record what happens to each. A question that passes the sorting test is one we can investigate.

Q2. (a) The sorting test from the Theory: *can we find the answer out by observing or testing?* (b) Question 2 — watch the bush each morning and count the bees: that is observing, so it **can be investigated**. Question 4 — put sand and soil in the Sun and feel or check which gets hotter: a test, so it **can be investigated**. Question 1 — what a sunflower *likes* is not something we can watch, test or look up, so it **cannot be investigated**. Question 3 — which colour is *nicest* is about what people like, so it **cannot be investigated**; two people can give different answers and both be fine with them.

Q3. (a) Work through each prediction and ask *which observation would make me say that?* Prediction 2 is about ice, and observation A is about ice melting faster in a warm place: **2–A**. Prediction 3 is about a black jumper in the Sun, and observation C is about the black car feeling hotter: **3–C**. Prediction 4 is about the elm next April, and observation D is the elm dropping its leaves every autumn: **4–D**. (b) For 4–D: the prediction "the elm will drop its leaves again next April" is based on the observation that it has done the same thing every autumn so far — a pattern is the base of the prediction.

Q4. (a) Read across the table for the biggest number: 9, in May, June, July, August and October — those months share the most days of rain. (b) The smallest number is 4, in February. (c) Winter months (June, July, August: 9, 9, 9) against summer months (December, January, February: 6, 5, 4): the pattern is that there are **more** days of rain in winter than in summer. The *rain* diagram in the Theory shows a different pattern (amount against days) — two patterns can live in the same weather.

Q5. (a) Tom's sentence cannot say what it is based on. A guess says what might happen with no observation to stand on; that is exactly what "I guess" with no reason is. (b) Tom now has an observation — dark grey sky before school went with rain before lunch, every time — so his sentence can become: *I predict it will rain on sports day, because every time the sky was dark grey before school, it rained before lunch.* The new sentence can say where it comes from, so it is a prediction.

Q6. (a) A pattern question asks what repeats: *does the log always show more magpies on Monday than on Friday?* (b) The pattern has held every week this term, so predict the same thing again: *the log will show more magpies on Monday morning than on the Friday before.* (c) The prediction is based on the pattern in the log itself. Because it can say that, it is a prediction and not a guess.

Q7. Apply the sorting test to each. 1 — look under the log and count: observing, so it **can be investigated**. 4 — put one piece of bread in a warm spot and one in a cool spot and watch: a test, so it **can be investigated**. 6 — swing with and without pumping your legs and watch what happens: a test, so it **can be investigated**. 2 — what minibeasts *like* is not something we can watch, test or look up: **cannot**. 3 — which lunchbox is *best* is what people think: **cannot**. 5 — *is it fair* asks what should happen, not what does happen: **cannot**.

Q8. Ask of each question: is it about *one thing changing in a describable way* (pattern), or *one thing changing while another changes with it* (relationship)? 1 — the shadow changes through the day, and we describe how: **pattern**. 3 — the same thing (leaf drop) repeats in the same months each year: **pattern**. 2 — two things change together (wetter soil, more worms at the surface): **relationship**. 4 — two things change together (warmer room, faster melting): **relationship**.

Q9. Match by asking which observation each prediction stands on. 1 is about frost after cold nights — observation B: **1–B**. 2 is about the puddle gone by lunch on sunny days — observation A: **2–A**. 3 is about the flag and the wind — observation D: **3–D**. 4 is about jelly and hot water — observation C: **4–C**. Each match is a prediction pointing back at the observation that is its base, exactly like the red arrow in the chain diagram.

Q10. Ben's sentence says what it is based on — *because every morning this week it was wet after it rained in the night* — so it is a **prediction**. Zali's sentence says what she thinks will happen but gives no observation to stand on, so it is a **guess**. They might both be right about the sandpit! The difference is not who is right; it is whether the sentence can say where it comes from.

Q11. (a) "I guess" with nothing behind it: no observation is named, so it is a guess. (b) After a week of watching, Priya has an observation — 8 landings on pink flowers against 2 on white — so her sentence can become: *I predict the butterflies will land on the pink flowers, because in one week I saw them land there 8 times and on the white flowers only 2 times.* The guess has been upgraded into a prediction by giving it a base.

Q12. (a) Read the bars: April is the tallest (about 67 mm) and February the shortest (about 25 mm); autumn and spring stand taller than summer. That is the pattern: the rain is not spread evenly through the year. (b) If the pattern holds, **April** will get more rain than February next year. (c) The base is the pattern in the data: over the 13 years of record, April was much wetter than February (about 67 mm against about 25 mm). A prediction based on a pattern is stronger than a guess — and if next year surprises us, we look at the pattern again.

Q13. (a) Two things changed together: the number of counters went up, and the stretch went up. That is a relationship: *the more counters, the more the rubber band stretches.* (b) If the relationship keeps holding, 7 counters will stretch the rubber band **even more than 5 counters did**. (c) The base is what Jonty observed at 1, 3 and 5 counters — every step up in counters was a step up in stretch.

Q14. A question that can be investigated must pass the sorting test. Example pair: (a) *which lunchbox keeps an ice block frozen the longest?* — we can test that and watch what happens, so it can be investigated; (b) *which lunchbox is the coolest-looking?* — that is about what people like, so it cannot be investigated; (c) no observation or test can settle what looks coolest, because two people can give different answers and both be honest. Any pair that passes and fails the sorting test for these reasons is right.

Q15. (a) The observation is *most lunchboxes are plastic and none are glass*, so a good question is: *why is plastic used more often than glass for lunchboxes?* (b) Yes, it can be investigated — by looking up information and by observing the materials: how heavy they are, and what happens when they are dropped. Asking the question is the skill in this subtopic; the testing of materials is a later one.

Q16. (a) The observation is that slime behaves like a liquid *and* like a solid, so a good question is: *is slime a solid or a liquid?* (b) Yes, it is investigable by observation: record what slime does — a solid keeps its own shape, and a liquid takes the shape of its container, so watch which of those the slime does, and when. Slime is one of those substances that makes the question interesting; deciding its answer belongs to a later topic, but posing the question belongs here.

Q17. (a) The snails eat the water plants. If all the snails move away, fewer plants get eaten, so predict: *the water plants will grow more — there will be more of them.* (b) The prediction is based on what the class observed: snails eat the plants, and ducks eat the snails. With the snails gone, nothing eats the plants. It is the same move as every other prediction in this subtopic, made about living things.

Q18. (a) Two observations from the story: *on windy days the jumper is dry by home time*, and *on still days it is still damp.* (b) A question that grows from them: *does wind change how fast the jumper dries?* It is a **relationship** question — one thing (the wind) changes, and another (drying speed) changes with it. It passes the sorting test: Zia can keep watching the line on windy and still days. (c) *I predict the jumper will dry faster on a windy day than on a still day.* (d) The base is the pattern Zia observed every morning this term — windy went with dry, still went with damp. Because the sentence can say that, it is a prediction; a guess is the same sentence with the *because* taken away.

Planning a fair test, and working safely

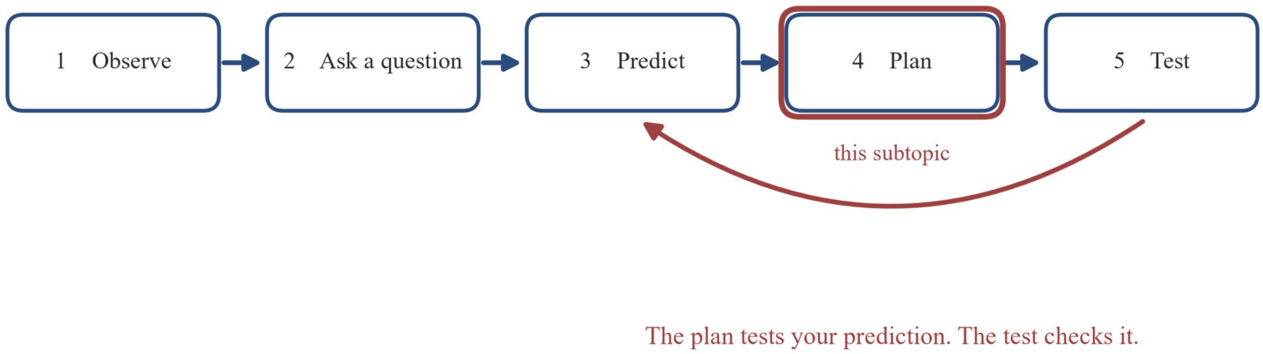
> **What we teach here** — `VC2S4I02` (Victorian Curriculum F–10 Version 2.0, Science, Levels 3 and 4): "scientific investigations to answer questions or test predictions can be planned and conducted using provided scaffolds, including identifying the attributes of fair tests, and considering the safe use of materials and equipment". **In our words:** before you test something, you plan it — and a good plan makes the test fair and keeps everyone safe. The planning contexts come from the elaborations of `VC2S4I02` (`.E01–.E04` and `.E06`). `VC2S4I02.E05` is reserved under the ICIP decision and is not taught here.

Theory

From question to plan

In 1A you learned the first steps of investigating: you **observe**, you **ask a question**, and you **predict** — you say what you think will happen, based on what you observed. Then comes the test. This subtopic adds the step in the middle: the **plan**.

A **plan** is what you write down *before* you do the test. It says what you will change, what you will keep the same, what you will look for, what you will use, the steps in order, how you will work safely, and how many times you will do the test. A **planning scaffold** is a starting frame your teacher gives you — a form with those parts ready for you to fill in. You do not have to think up the parts from nothing; the scaffold holds them for you.



A five-step chain: observe, ask a question, predict, plan, test, with the plan step highlighted and an arrow showing the test checks the prediction

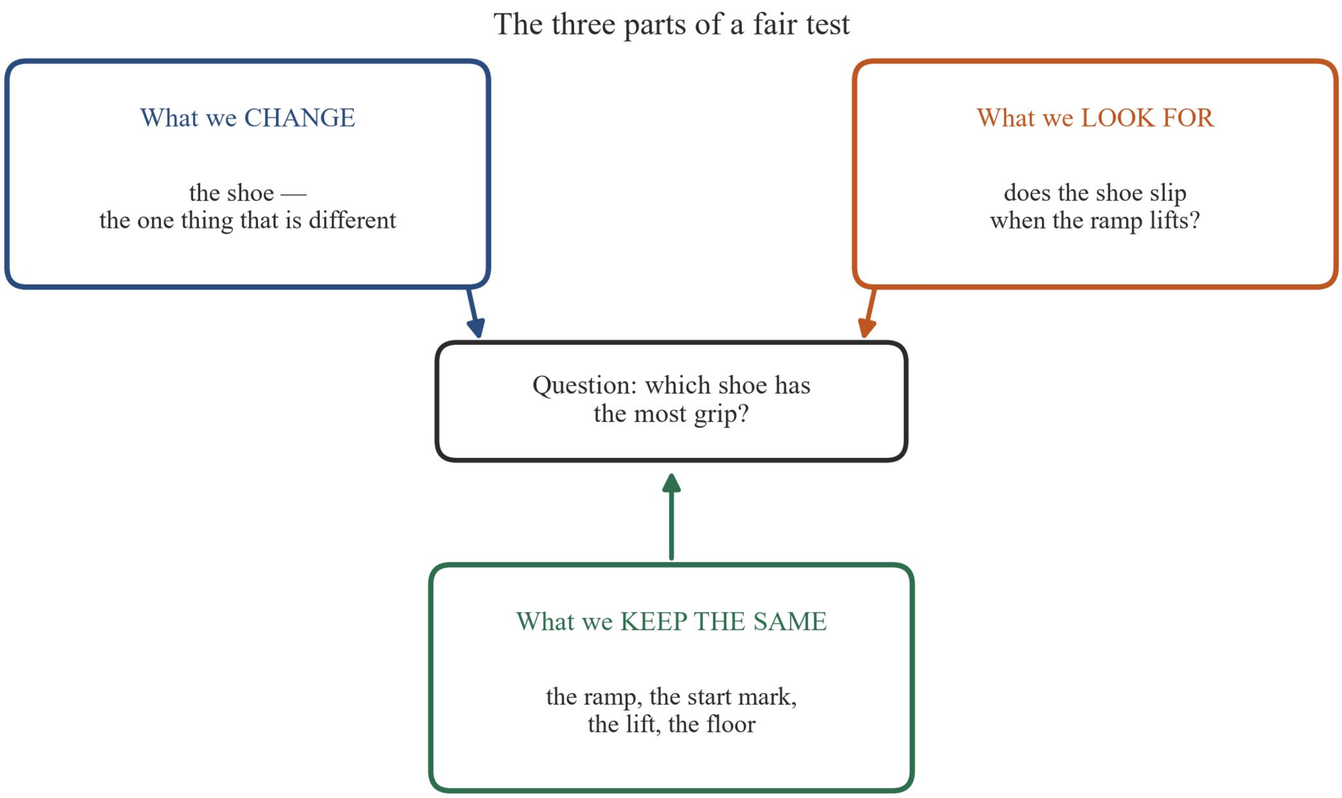
The plan tests your prediction, and the test checks it. If the test surprises you, you go back, look again, and make a better prediction — just like in 1A.

Fair tests

A **fair test** is a test where only **one** thing changes, and everything else stays the same. (This is not the same "fair" as taking turns in a game. It is fair in the sense that the test gives you an answer you can trust.)

Every fair test has three parts:

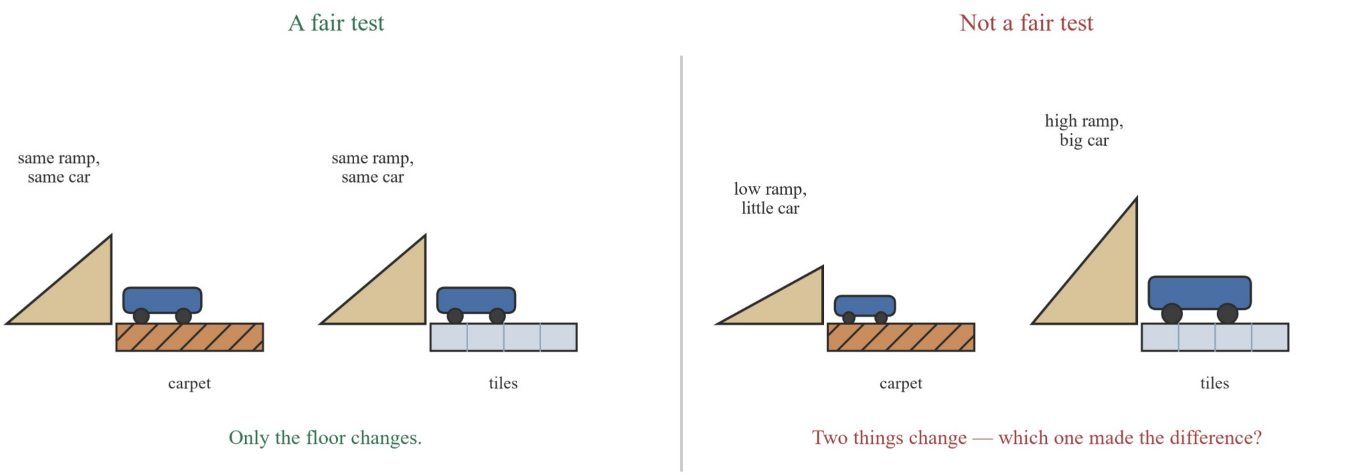
- **what we change** — the one thing that is different each time;
- **what we keep the same** — everything else, so it cannot spoil the answer;
- **what we look for** — what we watch or count to get the answer.



In a fair test, only ONE thing changes. Everything else stays the same.

Three boxes around one question box: what we change, what we keep the same, and what we look for, with the rule that only one thing changes

Why does it matter? Look at the two panels below.

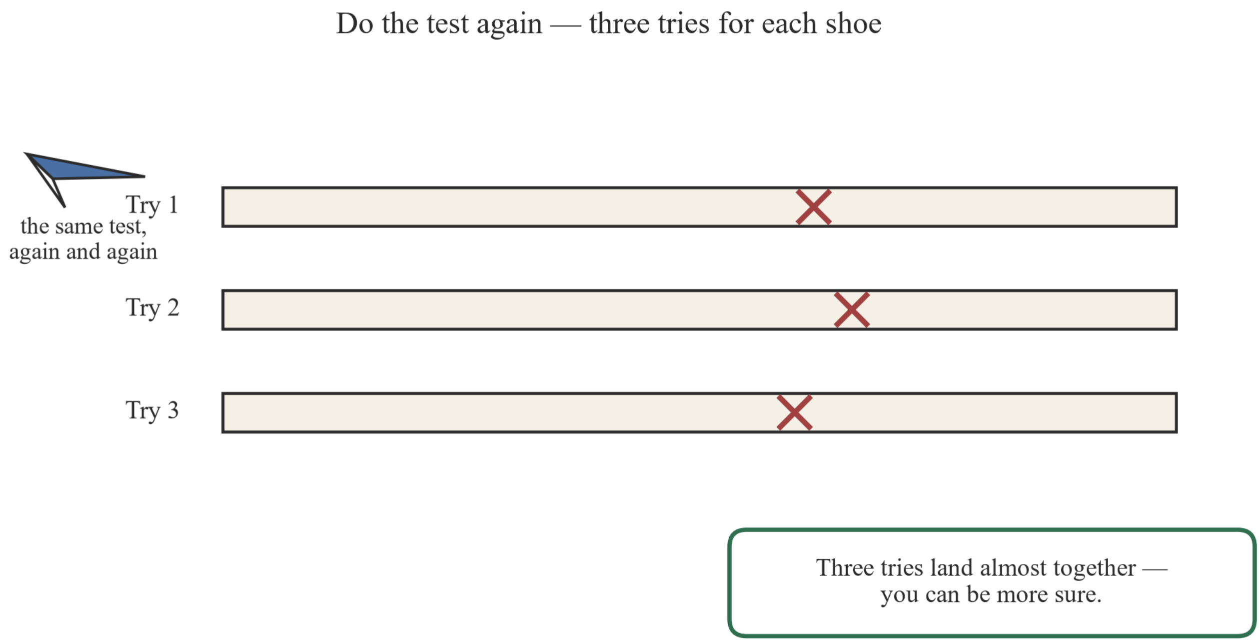


Two panels: a fair test where only the floor changes, and an unfair test where the ramp height and the car size change at the same time

On the left, the ramp is the same and the car is the same; only the floor changes. If the car rolls a different way on the two floors, you know the floor made the difference. That is a fair test. On the right, two things change — the ramp and the car. If the big car on the tiles rolls the longest way, was it the ramp? The car? The floor? Nobody can say. When two things change, the test cannot point at the cause, so it is not fair.

Doing the test again

One try can be luck. Maybe the car bumped the strip. Maybe the shoe started off the mark. That is why a plan says how many times the test will be done. Do the same test again, and again, and look at the tries together.



Three tries of the same test marked on three strips, landing almost together, so you can be more sure

Three tries that land almost together let you be more sure than one try can. If one try lands a long way from the others, that is the one to check — maybe something went wrong on that try. The same rule works when your class runs a **simulation** — a role-play that stands in for the real thing, like a producers and consumers game: run it several times before you trust what it shows.

The planning scaffold

Here is the scaffold filled in for a shoe-grip test. **Grip** means how well the underneath of a shoe holds on without slipping.

Planning scaffold — filled in for the shoe-grip test

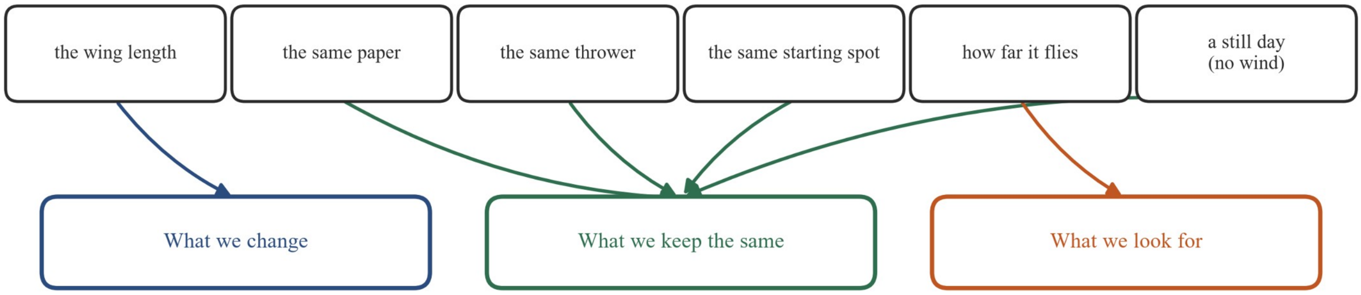
Question	Which shoe has the most grip — the runner, the thong or the football boot?
My prediction (and what it is based on)	I predict the football boot, because I observed it did not slip on the wet grass.
What we will CHANGE	the shoe — only this
What we will KEEP THE SAME	the ramp, the start mark, the lift, the floor
What we will LOOK FOR	does the shoe slip when we lift the ramp?
What we will USE	three shoes, a ramp, a block, chalk
Our STEPS	1 Put one shoe on the ramp at the start mark. 2 Lift one end of the ramp slowly. 3 Watch the shoe. Record: did it slip? 4 Do this three times for each shoe.
How we will work SAFELY	Stand beside the ramp, not under it. If a shoe slides off, nobody is in its way.
We will do the test ... times	three times for each shoe

The planning scaffold filled in for the shoe-grip test: question, prediction and its base, change, keep the same, look for, use, steps, safely, and how many times

Notice the colours. The **change** row is blue, the **keep the same** row is green, and the **look for** row is orange — the same colours as the three parts of a fair test. The scaffold also has a prediction with its base (from 1A), a **use** row for the equipment, a **steps** row for the order, a **safely** row, and a row for how many times.

You can sort any plan's cards into the three fair-test groups. Try it with Ruby's paper-plane question: *does wing length change how far a paper plane flies?*

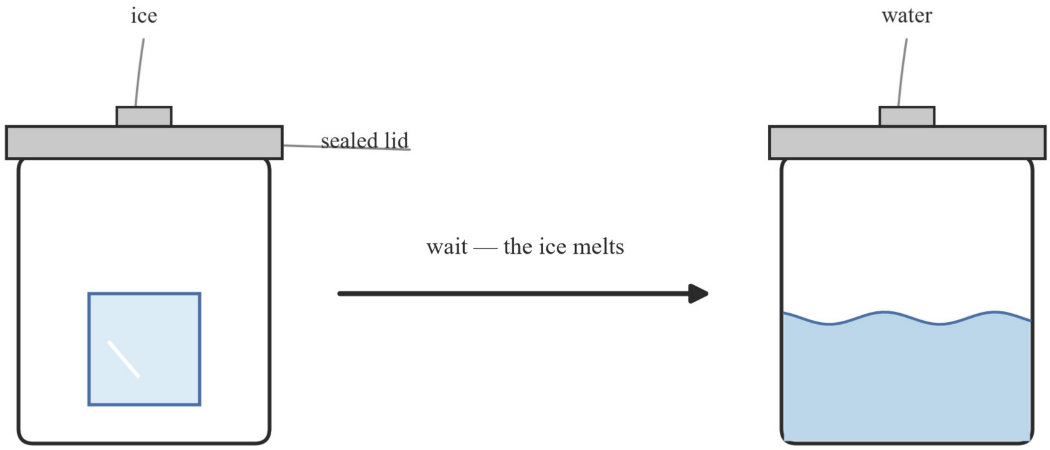
Ruby's paper-plane test — where does each card go?



Six plan cards sorted into three groups: the wing length is what we change; the same paper, the same thrower, the same starting spot and a still day are what we keep the same; how far it flies is what we look for

The same sort works for the melting-ice test: two identical **sealed** containers — lids shut, so nothing gets in and nothing gets out — each with one ice cube of the same size. One jar waits in a warm spot and one in a cool spot. The warm-or-cool spot is the change; the jars, lids and ice size are kept the same; the amount of melted water is what we look for.

The melting-ice test — the lid stays on tight



Same container, same lid. Nothing gets in, nothing gets out — so the test is fair.

The same sealed jar before and after waiting: an ice cube becomes a pool of water, with the lid kept shut so nothing gets in or out

Because the lid stays shut, no water can get in and no water can get out. The only thing that can change the water in the jar is the melting itself — that is what makes the test fair.

Working safely

A plan always thinks about safety. Two words do the work:

- A **hazard** is anything that could hurt someone.
- A **control** is what you do to stop the hurt.

A good plan names both, every time, and says who is keeping an eye on things — in our class, the teacher.

Name the hazard — then match its control

HAZARD — could hurt someone		CONTROL — stops the hurt
Water spilt on the floor	→	Wipe it up at once
Broken glass on the bench	→	Do not touch it — tell the teacher
Sharp sticks in the soil	→	Wear gloves when you dig
Hot water for the test	→	The teacher pours; you stand back

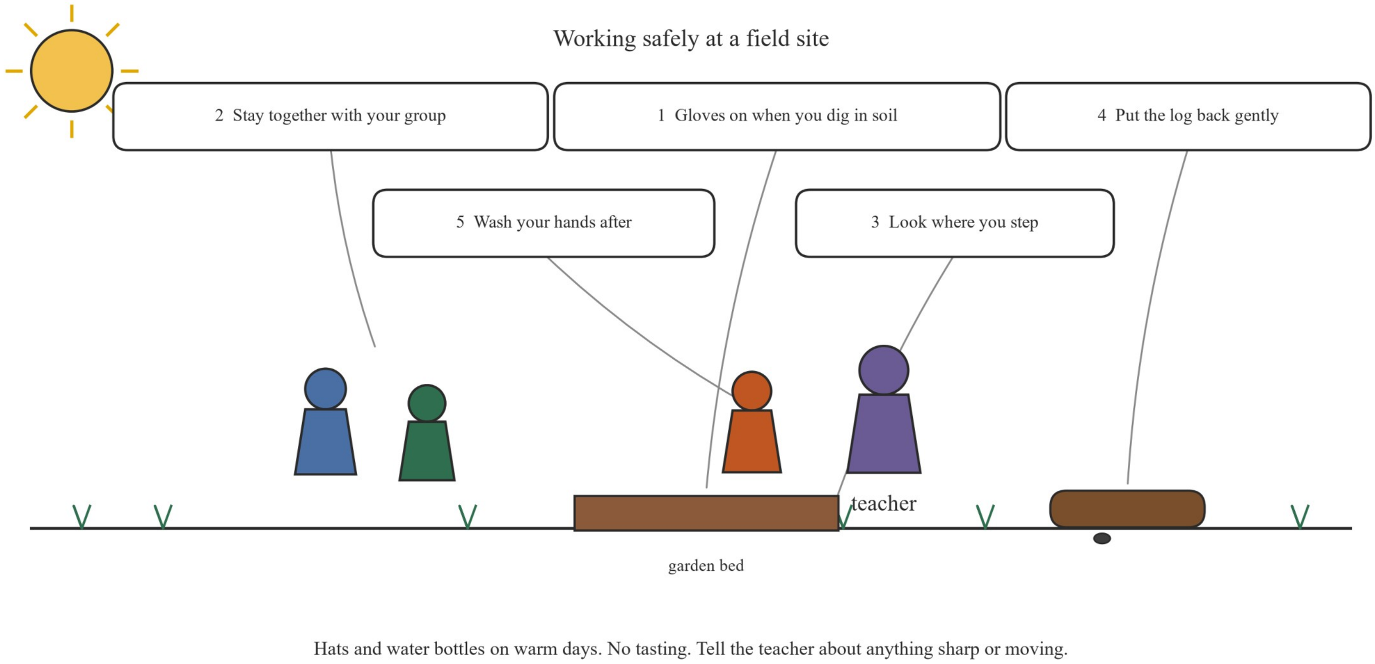
A good plan always names both: the hazard and its control.

Four matched pairs: water spilt on the floor is wiped up at once; broken glass is not touched and the teacher is told; sharp sticks in the soil mean gloves; hot water means the teacher pours while you stand back

Every hands-on activity in this book names its hazard, its control, and the teacher's part. Nothing we do in class uses an open flame. If a test needs hot water, it comes from a kettle that the teacher uses — never from something you heat yourself.

Safe at a field site

Sometimes the test is outside, at a **field site** — a place like the garden bed, where you work carefully and leave things as you found them. The field-site rules give the picture: gloves on when you dig in soil, washing your hands after, staying with your group, looking where you step, and putting logs back gently, because animals live under them. The teacher sets and checks any **pitfall trap** — a cup sunk into the ground that small animals like beetles walk into — and you look on without touching. With the teacher's help you can also learn to identify what animals leave behind: their calls, their tracks and their scats (their droppings).



A field site scene with five safety callouts: gloves on when you dig in soil, stay together with your group, look where you step, put the log back gently, and wash your hands after

Hats and water bottles on warm days. No tasting, ever. And anything sharp or moving gets reported to the teacher, not poked.

Words to know in 1B

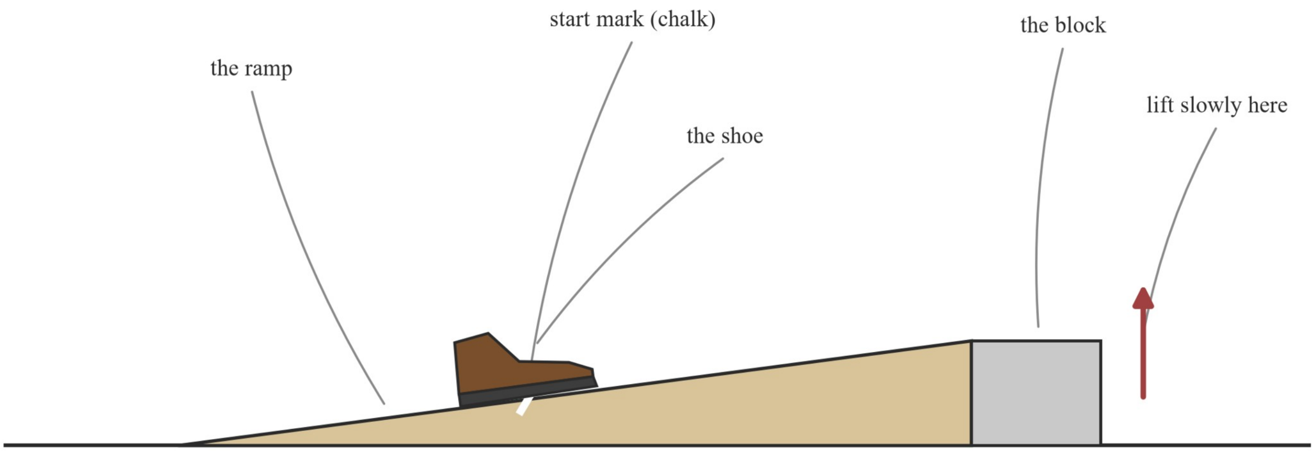
Word	What it means here
plan	what you write down before the test: the change, the keep-the-same, the look-for, the use, the steps, the safely, and how many times
planning scaffold	a starting frame the teacher gives you, with the parts of a plan ready to fill in
fair test	a test where only one thing changes and everything else stays the same, so the answer can be trusted
what we change / keep the same / look for	the three parts of a fair test
try	one time the test is done; a plan says how many tries there are
grip	how well the underneath of a shoe holds on without slipping
sealed	shut all the way, so nothing gets in and nothing gets out
hazard	anything that could hurt someone
control	what you do to stop the hurt
field site	a place outside, like the garden bed, where the class works carefully
pitfall trap	a cup sunk into the ground that small animals walk into; the teacher sets and checks it

Worked examples

Example 1 — scaffolded

Mia wants to know which shoe has the most grip: her runner, her thong or her football boot. She has a ramp, a block to lift one end onto, and chalk for a start mark. The equipment looks like this.

The shoe-grip test — lifting the ramp slowly



Lift the ramp slowly. The shoe with the most grip slips last.

A shoe sitting on a ramp at a chalk start mark, with one end of the ramp resting on a block and an arrow showing where to lift slowly

Fill in the planning scaffold for Mia's test.

Working	Comment
Question: which shoe has the most grip — the runner, the thong or the football boot?	The question came from Mia wondering about her own shoes. It can be tested.
Prediction: I predict the football boot, because I observed it did not slip on the wet grass.	A prediction with its base, the 1A way.
Change: the shoe — only this.	One thing changes, so the test can be fair.
Keep the same: the ramp, the start mark, the lift, the floor.	Every shoe starts at the same mark on the same ramp, and the ramp is lifted the same slow way each time.
Look for: does the shoe slip when the ramp lifts?	The shoe that slips last has the most grip.
Use: three shoes, a ramp, a block, chalk.	The equipment, listed so nothing is forgotten.
Steps: 1 Put one shoe on the ramp at the start mark. 2 Lift one end of the ramp slowly. 3 Watch the shoe. Record: did it slip? 4 Do this three times for each shoe.	Steps in order, so anyone could do the test the same way.
Safely: stand beside the ramp, not under it; if a shoe slides off, nobody is in its way; the teacher watches the lifting.	Hazard: a shoe sliding off the ramp. Control: nobody stands in its path. The teacher keeps an eye on it.
Times: three tries for each shoe.	Three tries that land together beat one lucky try.

Example 2 — scaffolded

Leo reads the melting-ice plan above and checks it against the scaffold, row by row.

Working	Comment
Question: does ice melt faster in a warm spot than in a	One question, testable with two jars.

Working	Comment
cool spot?	
Prediction: I predict the ice in the warm spot will melt faster, because I observed ice on the windowsill melt before ice in the cupboard.	The base is an observation from 1A's examples.
Change: the spot — warm or cool.	The one thing that is different.
Keep the same: the same jars, lids shut, the same size ice cube, the same wait.	Same containers, sealed, so only the spot differs.
Look for: how much water is in each jar after the wait.	Melted ice becomes water you can see and compare.
Use: two identical jars with lids, two same-size ice cubes, a tray under each jar.	Trays catch any water on the outside of the jars.
Steps: 1 Put one ice cube in each jar. 2 Put the lids on and shut them. 3 One jar to the warm spot, one to the cool spot. 4 Wait one hour. 5 Look at the water in each jar.	In order, so the tries match.
Safely: wipe up any spilt water at once; do not touch anything hot; the teacher checks the warm spot first.	Hazard: water on the floor makes a slip; a warm spot can hold hot things. Controls: wipe up, do not touch, teacher checks.
Times: three tries on three days.	Repeats again — one day can be luck.

Example 3 — unscaffolded

Jay tests how far a toy car rolls on carpet and on tiles. On the carpet he uses a low ramp and his little car. On the tiles he uses a high ramp and his big car. The big car rolls the longest way on the tiles, so Jay says, "Cars roll further on tiles than on carpet."

A fair test changes only one thing. Jay changed two: the ramp *and* the car. The floor changed too, which was the one thing he meant to change — so in his test, three things were different at once. When the big car rolled the longest way, it might have been the high ramp, it might have been the big car, and it might have been the tiles. The test cannot point at the cause. To fix it, Jay keeps the ramp the same and the car the same, and changes only the floor.

∴ Jay's test is not fair, because more than one thing changed — and his fix is to keep the ramp and the car the same and change only the floor.

Example 4 — unscaffolded

At the garden bed, the class looks for minibeasts — small animals like insects, worms and beetles. Ruby digs with her bare hands "to feel the worms better". Leo turns a log over, looks under it, and leaves it turned over because "it was heavy". Tom runs ahead to the next bed while the group is still at the first one.

Name the problem in each choice, and the control that fixes it.

Ruby's bare hands are the first problem: soil holds sharp sticks and things that can hurt, so the control is gloves on when you dig, and washing hands after. Leo's turned-over log is the second: animals live under that log, and a turned-over log loses its home — the control is to put the log back gently, the way it was. Tom running ahead is the third: someone out of sight of the group is someone the teacher cannot keep safe — the control is to stay together with your group, and to look where you step while you move.

∴ each unsafe choice has a control the class already knows — gloves and washing hands, put the log back gently, stay together — so the field site stays safe and the minibeasts keep their home.

Practice questions

Scaffolded

Q1. Finish the two sentences that say what a fair test is. (a) In a fair test, only ______ thing changes. (b) Everything else ______ the same.

Q2. Look at the shoe-grip equipment in Example 1. (a) What do you lift slowly during the test? (b) What is the chalk start mark for? (c) How do you tell which shoe has the most grip?

Q3. Match each hazard to its control.

Hazards: **1.** Hot water is needed for the test. **2.** Water spilt on the floor. **3.** Sharp sticks in the soil. **4.** Broken glass on the bench.

Controls: **A.** Wear gloves when you dig. **B.** The teacher pours it from the kettle; you stand back. **C.** Do not touch it — tell the teacher. **D.** Wipe it up at once.

Q4. Ruby's paper-plane test is sorted in the diagram above. Use it to fill in three scaffold rows. (a) What we change: ______ (b) What we keep the same: name two cards. (c) What we look for: ______

Q5. Which of these are safe ways to work at the field site? For each one that is not safe, give the control that fixes it. (a) Gloves on when you dig in soil. (b) Running ahead of your group. (c) Putting the log back gently after you look under it. (d) Tasting a berry to see if it is nice.

Q6. In the melting-ice test, the lids stay shut. Why does that make the test fairer?

Unscaffolded

Q7. In Ruby's paper-plane test, where does the card "the same thrower" go — change, keep the same, or look for? Say why.

Q8. Tom blows bubbles with two different wands to see which makes big bubbles. He blows one wand inside the room and the other outside, where the wind is blowing. Is his test fair? Say why, and fix it.

Q9. A class tests how far cars roll on carpet and on tiles. They use the same ramp and the same car — but on the carpet they lift the ramp a little, and on the tiles they lift the ramp a lot. Which fair-test rule is broken? Say what "keep the same" should hold.

Q10. A plan says "we will do the test three times." Why not just once?

Q11. Zara makes a **prototype** — a first version to test and improve — of a toy: a paper spinner with two wings. She predicts the spinner with longer wings will spin for longer. Fill in the three fair-test rows (change, keep the same, look for) for her test.

Q12. The bench after science: a puddle of water by the sink, a broken jar by the tray, and a bag on the floor where people walk. Name each hazard and give its control.

Q13. The class works at the creek edge for the morning. From everything in this subtopic, list four safe ways to work there.

Q14. Ava tests which cup keeps ice solid the longest. She uses two cups of the same size — but one cup has a lid and the other does not, and she puts three ice cubes in one cup and one in the other. Name two things Ava must keep the same to make her test fair.

Q15. A test needs warm water. Write the **safely** row of the scaffold for it: name the hazard, the control, and the teacher's part.

Q16. Here is a filled scaffold for a ball-roll test.

Row	Filled in
Question	Does a ball roll the longest way on carpet, on tiles or on grass?

Row	Filled in
Change	the floor — carpet, tiles, grass
Keep the same	the same ball, the same ramp, the same lift
Look for	how far the ball rolls
Times	three tries on each floor

(a) What is the one thing that changes?
(b) Name two things kept the same.
(c) What will the class look for?
(d) How many tries in all?

Q17. Zara’s spinner test (Q11) is nearly ready, but her friend wants to change the paper colour too, “to know which spinner is which”. Why should the paper stay the same colour and kind — or should it? Say what the fair rule tells you.

Q18. Zali tests two shoes on the ramp. For the second shoe she also lifts the ramp higher, “to make it more fun”. Her second shoe slips sooner. Can she say which shoe has less grip? Say why, using the fair-test rule.

Answers

Q1. (a) one; (b) stays. **Q2.** (a) one end of the ramp; (b) every shoe starts at the same place, so that part stays the same; (c) the shoe that slips last, as the ramp lifts, has the most grip. **Q3.** 1–B, 2–D, 3–A, 4–C. **Q4.** (a) the wing length; (b) any two of: the same paper, the same thrower, the same starting spot, a still day; (c) how far it flies. **Q5.** Safe: (a) and (c). Not safe: (b) — control: stay together with your group; (d) — control: no tasting; tell the teacher about it instead. **Q6.** With the lid shut, nothing gets in and nothing gets out, so the water in the jar can only come from the melting ice — the two jars differ only in their spot. **Q7.** Keep the same. A different thrower might throw harder or softer, and then the thrower — not the wing length — could cause any difference. **Q8.** Not fair: two things change (the wand and the wind). Fix: blow both wands in the same place, on a still day, changing only the wand. **Q9.** The lift of the ramp must stay the same; lifting the ramp more on the tiles breaks the keep-the-same rule. **Q10.** One try can be luck; three tries that land almost together let you be more sure. **Q11.** Change: the wing length. Keep the same: the same paper, the same thrower (same twist), the same starting spot, a still day. Look for: how long the spinner spins. **Q12.** Puddle → wipe it up at once. Broken jar → do not touch it, tell the teacher. Bag on the walk → move it out of the way so nobody trips. **Q13.** Any four of: stay together with your group; look where you step; gloves on if you dig in soil; wash your hands after; put logs and rocks back gently; no tasting; tell the teacher about anything sharp or moving; hats and water on warm days. **Q14.** Any two of: the same lid on both cups (or no lid on either); the same number and size of ice cubes; the same spot for both cups; the same wait. **Q15.** Hazard: hot water can burn. Control: the teacher pours it from the kettle; you stand back; cups sit on a tray. Teacher's part: the teacher does the pouring and stays while the test runs. **Q16.** (a) the floor; (b) any two of: the same ball, the same ramp, the same lift; (c) how far the ball rolls; (d) nine (three tries on each of three floors). **Q17.** The paper must stay the same kind; colour is part of "the same paper". If the paper differs, two things change and the test is not fair. (If the colour were the only difference and the paper kind stayed the same, that would be a *different* fair test — with colour as the change.) **Q18.** No. Two things changed (the shoe and the lift), so the earlier slip might be the shoe or might be the higher lift; the test cannot point at the cause.

Fully-worked solutions

Q1. A fair test changes one thing and keeps everything else the same, so (a) **one** and (b) **stays**. Those two words are the whole rule: one thing changes, everything else stays the same.

Q2. (a) The steps row says *lift one end of the ramp slowly* — you lift the ramp, not the shoe. (b) The start mark keeps the starting place the same for every shoe; without it, the starting place would be another hidden change. (c) You watch as the ramp lifts: the shoe that holds on the longest — that slips last — has the most grip.

Q3. Hot water is poured by the teacher from the kettle while you stand back: **1–B**. Spilt water is a slip, wiped up at once: **2–D**. Sharp sticks in the soil meet gloves: **3–A**. Broken glass is never touched — the teacher is told: **4–C**.

Q4. Read the sorting diagram. (a) The blue change card is *the wing length*. (b) The green keep-the-same cards are *the same paper, the same thrower, the same starting spot* and *a still day* — any two. (c) The orange look-for card is *how far it flies*.

Q5. (a) gloves for digging and (c) putting the log back gently are both on the safe list from the field-site diagram. (b) Running ahead leaves the group, and the teacher cannot keep an eye on someone out of sight — the control is to stay together. (d) Tasting is never done in science — the control is no tasting, and the teacher is told about the berry instead.

Q6. Fair means the two jars differ only in the one thing you change (the spot). An open jar could lose water to the air or catch drops from outside; a shut lid stops both, so the water you see at the end came only from the ice that melted. That is what "sealed" is doing in the plan.

Q7. Ask of each card: is it the one thing we change, a thing we keep the same, or the thing we look for? The thrower is not what Ruby is testing (that is the wing length) and it is not what she measures (that is the flight). It is something that could cause a difference if it changed — a stronger throw flies further — so it goes in **keep the same**.

Q8. Tom meant to change the wand, but the wind changed as well: one wand was tested in still air and one in moving air. Two things changed, so if one wand makes big bubbles and the other does not, Tom cannot say it was the wand. The fix: test both wands in the same place at the same time — a still spot — so only the wand differs.

Q9. The one thing that should change is the floor. The lift of the ramp is a keep-the-same: a car lifted more starts with more push, so on the tiles the ramp would be helping the car. The rule broken is *everything else stays the same* — the lift must be the same on every floor.

Q10. A single try can be spoilt by luck — a bump, a slip, a throw that went wrong. Doing the test three times and looking at the tries together shows whether the first try was real or luck: tries that land almost together let you be more sure.

Q11. Change: the wing length — the one thing Zara is testing. Keep the same: the same paper, the same thrower giving the same twist, the same starting spot, and a still day so the wind cannot sneak in as a second change. Look for: how long each spinner spins — the thing she watches and compares.

Q12. Work through the bench naming hazard then control. The puddle by the sink is a slip → wipe it up at once. The broken jar can cut → do not touch it; tell the teacher. The bag on the walking path can trip someone → move it out of the way. Each pair is the same shape as the hazard–control diagram: name the hurt, then stop the hurt.

Q13. The field-site rules travel to any site, creek included: stay together with your group; look where you step; gloves on when you dig in soil; wash your hands after; put logs and rocks back gently; no tasting; tell the teacher about anything sharp or moving; hats and water on warm days. Any four of these is a correct list.

Q14. Ava meant to change the cup. But the lid and the ice also differ, so any difference at the end might be the lid's work or the ice's work, not the cup's. To make it fair she keeps the lid the same on both cups and the ice the same (same number, same size) — and the same spot and the same wait — changing only the cup.

Q15. The safely row names hazard, control and the teacher's part. Hazard: hot water can burn skin. Control: the teacher pours it from the kettle, you stand back, and the cups sit on a tray so drips do not spread. Teacher's part: the teacher does all the pouring and stays with the class while the test runs. No student heats anything; the teacher does.

Q16. (a) The change row says the floor — carpet, tiles or grass. (b) The keep-the-same row lists the same ball, the same ramp and the same lift — any two. (c) The look-for row says how far the ball rolls. (d) Three tries on each of three floors: 3 + 3 + 3 = 9 tries in all — repeats on every change, so each floor gets three tries to be sure.

Q17. The fair rule says one thing changes and everything else stays the same. Zara's test changes the wing length, so the paper — its kind *and* its colour — belongs in keep-the-same: different paper could fly or spin a different way, and then two things would change. The friend's idea only works as a different test, where colour is the one change and the wings stay the same.

Q18. Apply the rule: one thing changes, everything else stays the same. Zali changed the shoe *and* the lift. A higher lift makes any shoe slip sooner, so the earlier slip might belong to the lift, not the shoe. The test cannot point at the cause — which is exactly what an unfair test cannot do. Her fix: same lift for both shoes, three tries each.

Measuring and recording with scaled instruments

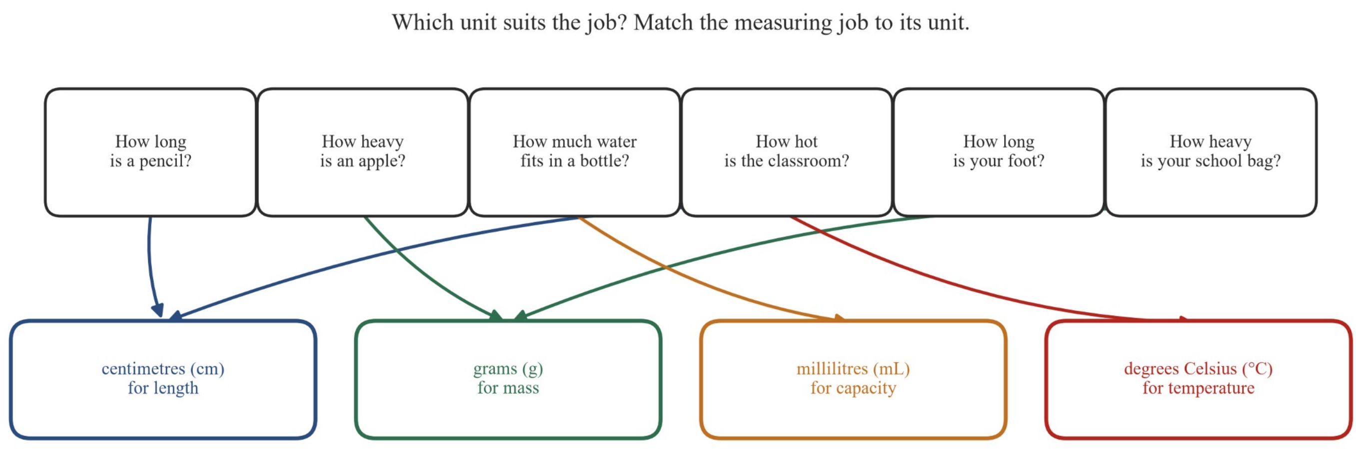
What we teach here — `VC2S4I03` (Victorian Curriculum F–10 Version 2.0, Science, Levels 3 and 4): "observations, including formal measurements, can be made and recorded by following procedures to use familiar scaled instruments and digital tools as appropriate". **In our words:** we follow the steps, read our class tools carefully — even the little marks with no number on them — and write down what we see, number and unit together, in a table we planned before the numbers arrived.

What we learn

What measuring means

When we **measure**, we compare something with a **unit** — a fixed amount that everyone agrees on. A **unit** is why measuring is better than guessing with our eyes. If you say "my pencil is 7 long", nobody knows what you mean. If you say "my pencil is 7 cm long", everyone can check it, because everyone's centimetre is the same size.

A tool with marks on it that we measure with is called an **instrument**. Rulers, measuring cups, scales and thermometers are all instruments. The marks on an instrument are called a **scale**, and one small step on the scale is one **unit** of that scale.



Six measuring jobs sorted into four unit boxes: cm for length, g for mass, mL for how much a cup holds, and °C for temperature.

The unit first, then the number

Every measurement is two things: a **number** and a **unit**. The unit is not a small extra — it is half of the answer. Before you read any number, ask *which unit?*

- **Length** — how long something is. We measure it in centimetres (cm) or metres (m).
- **Mass** — how heavy something is, really how much matter is in it. We measure it in grams (g).
- How much a cup or bottle holds is called its **capacity**. We measure it in millilitres (mL).
- **Temperature** — how hot or cold something is. We measure it in degrees Celsius (°C).

Capacity, millilitres and degrees Celsius are our new science words for this subtopic; the short forms mL and °C travel with the numbers in our tables.

Estimate first, then measure

An **estimate** is a sensible guess at the size of something, made *before* measuring, using what you already know. A pencil is about 15 cm long — you know that from your pencil case, so it is a sensible estimate. Saying "a pencil is 100 m long" is not an estimate; it is not sensible.

1 Estimate → 2 Measure → 3 Record the number and its unit → 4 Compare: was your estimate close?

If your measure is very different from your estimate, measure again.

A four-box loop: estimate, then measure, then compare, then measure again if the two do not match.

The estimate is a check on the measuring. If your measure lands far from your estimate, something went wrong — maybe you read the wrong mark, or the tool was not at zero — so you measure again.

Following the steps

A **procedure** is the steps we follow, in order. Measuring has a short set of steps that works for every instrument with a scale.

Reading any scaled instrument — the same four steps, in order

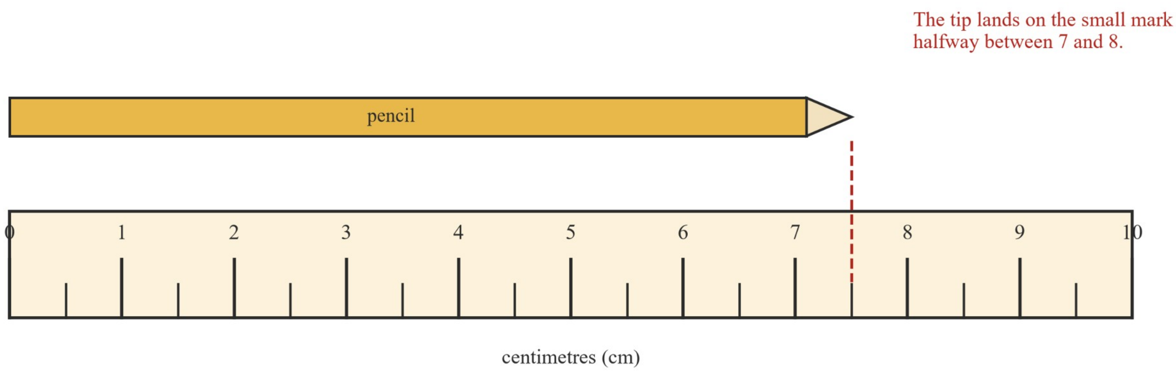
1 Find the zero: where the measuring starts → 2 Work out what each small mark is worth → 3 Look straight on at the mark, at eye level → 4 Write the number and its unit

Four steps for reading any instrument with a scale: find zero, work out what each small mark means, look straight on at eye level, and write the number with its unit.

Step 2 is the secret of this whole subtopic: on many instruments, **not every mark has a number**. You have to work out what the little marks mean before you read.

Length — reading a ruler

On our ruler, the big numbered marks are whole centimetres. Between them there is one small mark with no number. That small mark is half a centimetre — the middle of the step from one whole number to the next.



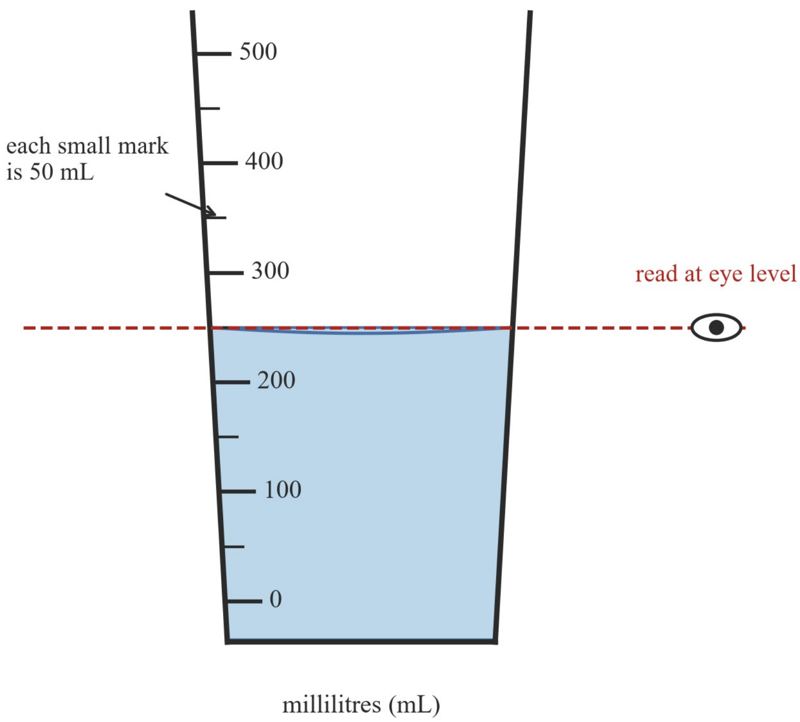
That is 7 whole centimetres and a half more — seven and a half centimetres, written 7.5 cm.

A ruler from 0 to 10 cm with numbered centimetre marks and small half-centimetre marks; a pencil tip stops at the small mark between 7 and 8, so the pencil is 7.5 cm long.

The pencil tip stops at the small mark between 7 and 8. So the pencil is 7 whole centimetres and a half more. We write that as 7.5 cm — the point means "and a half more" when the small mark is a half. Say it out loud as "seven point five centimetres", and always say the unit too.

Capacity — reading a measuring cup

On our cup, the numbered marks count by hundreds of mL. Between them there is one small mark with no number — the middle, 50 mL.



The water sits on the small mark halfway between 200 and 300: 250 mL.

A measuring cup from 0 to 500 mL with numbered marks every 100 mL and small marks every 50 mL; the water sits at the small mark between 200 and 300, so it is 250 mL, and a dashed eye-level line shows where to look.

The water sits at the small mark between 200 and 300, so the capacity of the water is 250 mL. Look straight on, at eye level, when you read — from above, the water looks higher than it is. And notice the water dips a little in the middle; read the bottom of the dip.

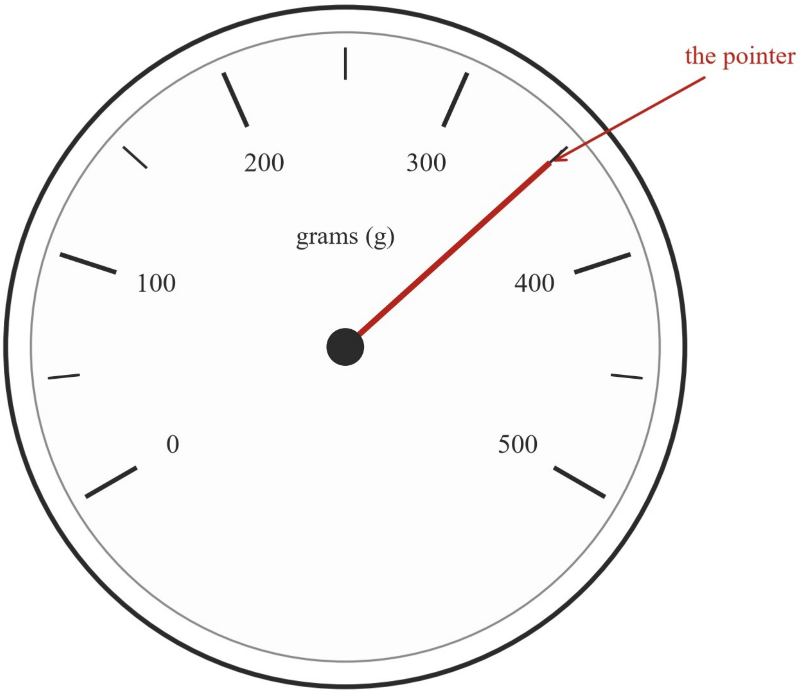
Try it — read a temperature

1. Put some ice and water into a cup.
2. Put the thermometer in and wait. The red line moves, then it stops.
3. Look straight on, at eye level.
4. Read the number the red line stops at, and write it with °C in your table.

Safe work: water on the floor makes slips — wipe spills up straight away. Ice held on your skin for a long time can hurt — move the ice with a spoon, not your fingers. Glass thermometers can break — carry them gently, sitting down, and tell your teacher straight away if one breaks. Your teacher works with you on this one.

Mass — reading a dial scale

On our dial, the numbers count by hundreds of grams, and each small mark between them is 50 g. The pointer moves around the dial as more mass is put on the scale.



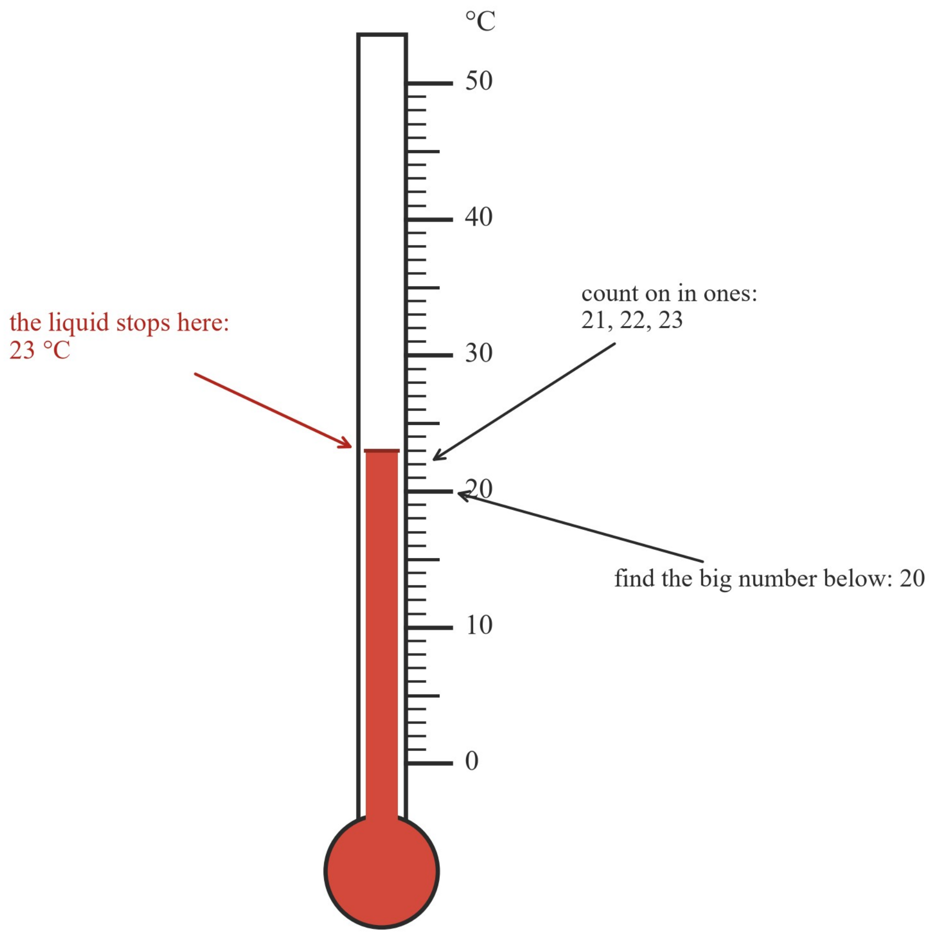
The pointer sits on the small mark between 300 and 400: 350 g.
Each small mark is 50 g.

A dial scale from 0 to 500 g with numbers every 100 g and small marks every 50 g; the pointer sits at the small mark between 300 and 400, so the reading is 350 g.

The pointer sits at the small mark between 300 and 400, so the mass on the scale is 350 g.

Temperature — reading a thermometer

On our thermometer, the numbers count by tens of degrees, and each tiny mark between them is one degree. When the red line stops between two numbered marks, count on in ones from the lower number.



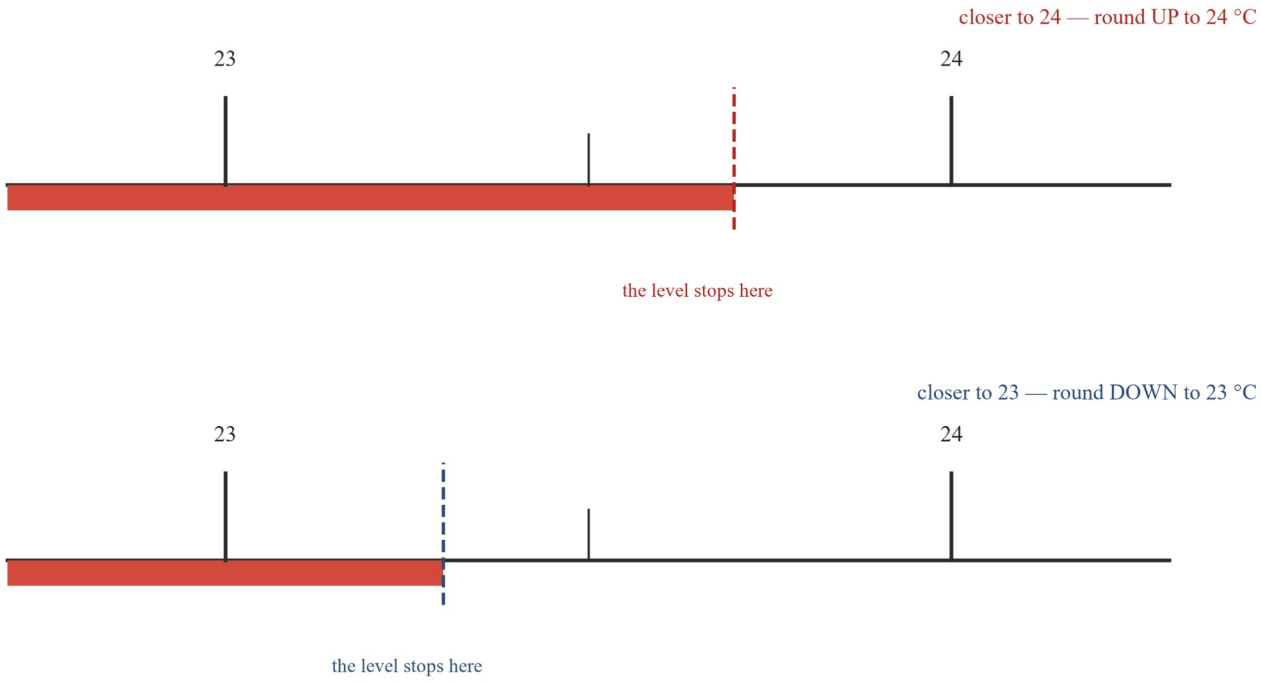
The warmer it gets, the higher the red liquid climbs.

A thermometer from 0 to 50 °C with numbers every 10 and a tiny mark for every degree; the red line stops three tiny marks past 20, so the reading is 23 °C.

The red line stops three tiny marks past 20, so the temperature is 23 °C. Say it as “twenty-three degrees Celsius”.

Between two marks — round up or round down

Sometimes the red line, or the water, or the pointer stops *between* two of the marks we read by. Then we **round**: we write the nearer mark.



Right in the middle between two marks? We round up, so everyone in the class records the same way.

Two close-up scales between 23 and 24. Top: the level stops near 24, so it is closer to 24 and we round up to 24. Bottom: the level stops near 23, so it is closer to 23 and we round down to 23.

- Closer to the higher mark → **round up**: 23.7 is nearer to 24, so we record 24 °C.
- Closer to the lower mark → **round down**: 23.3 is nearer to 23, so we record 23 °C.
- Right in the middle → we **round up**, so everyone in the class records the same way.

Rounding is not making up a number. It is choosing the mark the reading is nearest to, and it is part of reading the instrument carefully.

Plan the table before the numbers arrive

Scientists **record** their measurements in a **table** — rows and columns of boxes — and they plan the table *before* they measure, together as a group. A good table has:

- a box for **what** you measured (the object, or the month, or the day);
- a box for the **estimate** and a box for the **measure**;
- the **unit written in the top box**, so nobody can forget it.

Our measuring plan — drawn before we measure

Object	Estimate (cm)	Measure (cm)
pencil		
glue stick		
spoon		
book		

The unit (cm) sits in each heading, so nobody forgets it. The cells stay empty until the measuring starts.

A blank table planned before measuring: the top boxes say Object, Estimate (cm) and Measure (cm), and the rows are pencil, glue stick, spoon and book. The cells are empty until the measuring starts.

The empty boxes are the point. When the table is planned first, everyone records the same things in the same order, and nobody has to ask "wait, where do I write this?" halfway through.

Record what you saw

When the numbers arrive, write what you saw — not what you thought you would see, and not what the group next to you got. If you read 120 mL, you write 120 mL, even if you estimated 100 mL. The estimate was your check; the measure is your record.

Here is a finished record of real temperatures. Every top box carries its unit, and every number was read from a real record, not made up.

A finished record — real temperatures for Melbourne (Olympic Park), 2013–2026

Month	Mean maximum temperature (°C)	Mean minimum temperature (°C)
January	26.8	16.5
February	25.9	16.0
July	14.5	7.5
December	24.7	14.4

Every heading carries its unit, and every number was read, not made up.

Source: Bureau of Meteorology, Melbourne (Olympic Park) station 086338, mean monthly temperatures 2013–2026, bom.gov.au, archived at _build3_4/_sources/bom086338.html — retrieved 2026-08-15.

A finished table of real temperatures for Melbourne: January 26.8 and 16.5, February 25.9 and 16.0, July 14.5 and 7.5, December 24.7 and 14.4, with the unit °C in each top box and a source line under the table.

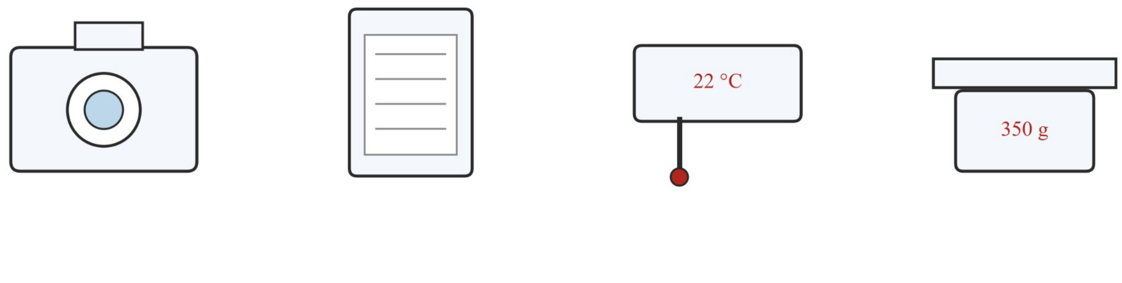
Source: Bureau of Meteorology, Melbourne (Olympic Park) station 086338, mean monthly temperatures 2013–2026, bom.gov.au, copy kept at _build3_4/_sources/bom086338 (saved page) — retrieved 2026-08-15.

The long names in the table's top boxes: the mean maximum temperature is the usual hottest reading for a month, and the mean minimum is the usual coldest — each worked out over the 13 years. Maximum means highest; minimum means lowest.

Digital tools

Digital tools can measure and record with you, when they help. A digital thermometer or a digital scale finds the number for you — there are no marks to read. A camera or a tablet can record what you see, again and again, so you can look back.

Digital tools can record with you



digital camera — take photos of what you see, again and again

tablet — type your table where your group can see it

digital thermometer — the number shows on a screen

digital scale — no marks to read, but still write the unit

The tool finds the number for you. You still write the number and its unit in your own table.

Four digital tools: a digital camera, a tablet, a digital thermometer showing 22 °C on a screen, and a digital scale showing 350 g on a screen.

But the unit rule never changes. The screen says 350 — you still write **350 g** in your own table. A number without its unit is only half a measurement, whoever found the number.

Words to know in 1C

Word	What it means here
measure / measurement	comparing something with a unit everyone agrees on; the number and unit you get
instrument	a tool with a scale that we measure with, like a ruler, cup, scale or thermometer
scale	the marks on an instrument
unit	the fixed amount everyone agrees on, like cm, g, mL or °C
length	how long something is (cm, m)
mass	how much matter is in something (g)
capacity	how much a cup or bottle holds (mL)
temperature	how hot or cold something is (°C)
estimate	a sensible guess at a size, made before measuring, using what you know
procedure	the steps we follow, in order
round up / round down	write the nearer mark; right in the middle, we round up
record	to write down what you saw, number and unit together
digital tool	a tool that finds the number for you and shows it on a screen

Worked examples

Example 1 — with help

Nina reads a measuring cup of water. The water sits one small mark above the 400 line. On this cup the numbered marks count by hundreds of mL, and there is one small mark between them. Read the cup for Nina, using the four steps.

Working	Comment
Step 1 — find zero: the 0 line is at the bottom of the cup, and the water is well above it.	Every reading starts at zero.
Step 2 — work out the small marks: numbered marks count by 100, with one small mark between, so each small mark is 50 mL.	Not every mark has a number. The small mark is the middle of the step.
Step 3 — look straight on: Nina puts the cup on the desk and her eyes level with the water.	From above, the water looks higher than it is.
Step 4 — number and unit: the water is one small mark above 400, so 400 + 50 = 450, written **450 mL**.	The unit travels with the number. Nina says “four hundred and fifty millilitres” out loud.

Example 2 — with help

Tom measures a glue stick with the ruler above. Before he starts: *which unit?* Length is measured in centimetres, so cm. His estimate: a glue stick is a bit shorter than a new pencil (about 15 cm), so about 10 cm. The glue stick’s end stops at the small mark between 8 and 9.

Working	Comment
Unit: cm, because it is a length.	The unit is chosen *before* the number.
Estimate: about 10 cm.	A sensible guess from what Tom knows — a new pencil is about 15 cm.
Read: 8 whole centimetres and a half more, written **8.5**	The small mark between 8 and 9 is the half.

Working	Comment
cm.	
Check against the estimate: 8.5 is near 10, so the measure makes sense. Record 8.5 cm.	If the ruler had said 85 cm, Tom would measure again — far from the estimate means check.

Example 3 — on your own

Look at the finished record of real Melbourne temperatures above. Round each of these readings to the nearer whole degree: the January mean maximum (26.8 °C), the February mean maximum (25.9 °C), and the July mean minimum (7.5 °C).

26.8 is between 26 and 27, and closer to 27, so it rounds up to 27. 25.9 is between 25 and 26, and closer to 26, so it rounds up to 26. 7.5 is right in the middle between 7 and 8 — and right in the middle, we round up, so it rounds to 8.

∴ the rounded readings are: January mean maximum about 27 °C, February mean maximum about 26 °C, and July mean minimum about 8 °C — the middle one rounding up by our class rule, so everyone records it the same way.

Source: Bureau of Meteorology, Melbourne (Olympic Park) station 086338, mean monthly temperatures 2013–2026, bom.gov.au, copy kept at _build3_4/_sources/bom086338 (saved page) — retrieved 2026-08-15.

Example 4 — on your own

Your group wants to find out which of two sponges holds more water. Plan the table you will record it in, *before* any water is poured.

The thing we change is the sponge, so the first column names the sponge: Sponge A and Sponge B. We measure how much water each holds — that is a capacity, so the unit is mL, and it goes in the top boxes. We also estimate first, so there is a box for the estimate. The planned table is:

Sponge	Estimate (mL)	Measure (mL)
Sponge A		
Sponge B		

∴ the table is planned before the water is poured, the unit (mL) sits in the top boxes, and there is a box for the estimate and a box for the measure — so when the numbers arrive, everyone records them in the same places.

Practice questions

With help

Q1. Match each job to the unit we would use. (a) the length of a pencil (b) the mass of an apple (c) how much a water bottle holds (d) the temperature of the cup in the Try it

Q2. Why do we estimate before we measure? Give two reasons.

Q3. A pencil tip stops at the small mark between 4 and 5 on our ruler. (a) Say the length in words. (b) Write it as a number with its unit.

Q4. Look at the measuring cup diagram above. (a) Read the amount of water. (b) How did you know what each small mark means?

Q5. Look at the thermometer diagram above. (a) Read the temperature. (b) How did you count on from 20?

Q6. Round each reading to the nearer whole degree. (a) 23.7 °C (b) 23.2 °C (c) 23.5 °C

On your own

Q7. Plan a table for measuring the pencil, the spoon and the book in centimetres, with an estimate and a measure for each. Draw the top boxes and the row boxes. Where does the unit sit?

Q8. These four steps for reading an instrument are in the wrong order. Put them in the right order. **A.** Write the number with its unit. **B.** Find zero. **C.** Look straight on, at eye level. **D.** Work out what each small mark means.

Q9. Use the finished record of real Melbourne temperatures above. (a) Which month has the highest mean maximum temperature, and what is it? (b) Round the December mean maximum (24.7 °C) to the nearer whole degree. (c) Round the July mean minimum (7.5 °C) to the nearer whole degree. (d) After rounding, why do we say "about"?

Q10. (a) Name two digital tools that can record with you. (b) A digital scale shows 350. What must you still add when you write it in your table, and why?

Q11. Sam recorded the mass of the flour as "350". What is wrong with Sam's record, and how do you fix it?

Q12. On the dial scale above, the pointer sits at the small mark between 200 and 300. Read the mass, with its unit.

Q13. You estimate a book at about 30 cm long. You measure it and read 95 cm. What do you do next, and why?

Q14. Mia estimated the cup would show 100 mL. It shows 120 mL. What number does Mia write in her table, and why?

Q15. A thermometer's red line stops between 6 and 7. (a) It is closer to 7. What do you record? (b) It is closer to 6. What do you record? (c) It is right in the middle. What do you record, and why?

Q16. Which is longer — the spoon or the glue stick? Write your full plan: the unit, your estimates, the table you will use, the steps you will follow, and what you will record.

Q17. Two groups read the temperature of the same cup of water. Group 1 writes 23 °C and Group 2 writes 25 °C. Give two reasons the readings could be different.

Q18. Match each job to the best tool: ruler, measuring cup, dial scale, thermometer, camera. (a) a photo of the class plant, once a week, to see how it grows (b) the mass of a lunchbox (c) the length of the desk (d) the temperature of a cup of water (e) how much water a bottle holds

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Answers

Q1. (a) cm; (b) g; (c) mL; (d) °C. **Q2.** It is a check on the measuring — if the measure lands far from the estimate, you measure again; and it helps you catch reading the wrong mark or a tool not at zero. **Q3.** (a) 4 whole centimetres and a half more; (b) 4.5 cm. **Q4.** (a) 250 mL; (b) the numbered marks count by 100 and there is one small mark between them, so each small mark is the middle, 50 mL. **Q5.** (a) 23 °C; (b) each tiny mark is one degree, so count on 3 marks past 20: 21, 22, 23. **Q6.** (a) 24 °C (closer to 24, round up); (b) 23 °C (closer to 23, round down); (c) 24 °C (right in the middle, we round up). **Q7.** Top boxes: Object, Estimate (cm), Measure (cm); rows: pencil, spoon, book. The unit (cm) sits in the top boxes, so nobody forgets it. **Q8.** B, D, C, A. **Q9.** (a) January, 26.8 °C; (b) 25 °C; (c) 8 °C (right in the middle, we round up); (d) because the true reading was between whole degrees — rounding chose the nearer mark. **Q10.** (a) any two of: digital camera, tablet, digital thermometer, digital scale; (b) the unit (g) — a number without its unit is only half a measurement. **Q11.** The unit is missing; write 350 g. **Q12.** 250 g (the small mark between 200 and 300 is 50 g past 200). **Q13.** Measure again and check the estimate — 95 cm is far from 30 cm, so something needs checking (maybe the wrong mark, or the ruler not at zero). **Q14.** 120 mL — you record what you saw, not what you thought you would see. **Q15.** (a) 7; (b) 6; (c) 7 — right in the middle, we round up, so everyone records the same way. **Q16.** e.g. unit: cm; estimates: spoon about 12 cm, glue stick about 10 cm; table with top boxes Object, Estimate (cm), Measure (cm) and rows spoon, glue stick; steps: find zero, work out the small marks, look straight on, write number and unit; record the measure next to the estimate. **Q17.** e.g. one group read from above instead of at eye level; one group read before the red line stopped moving; the groups read different marks (one rounded up, one rounded down). **Q18.** (a) camera; (b) dial scale; (c) ruler; (d) thermometer; (e) measuring cup.

Worked answers

Q1. Length is measured in centimetres, so the pencil is **(a) cm**. Mass is measured in grams, so the apple is **(b) g**. How much a bottle holds is a capacity, measured in millilitres, so **(c) mL**. How hot the water is, is a temperature, measured in degrees Celsius, so **(d) °C**. The unit is chosen from *what* we are measuring, before any number is read.

Q2. First reason: the estimate is a check. If the measure lands far from the estimate, something went wrong, so you measure again. Second reason: it makes you look at the tool first — which unit, and what the small marks mean — before the numbers arrive.

Q3. (a) The small mark between 4 and 5 is the half, so in words: *4 whole centimetres and a half more.* (b) With the point for “and a half”: **4.5 cm**. The unit travels with the number.

Q4. (a) The water sits at the small mark between 200 and 300, so **250 mL**. (b) The numbered marks count by 100 mL and there is one small mark between them, so the small mark is the middle of the step: 50 mL. That is Step 2 — work out the small marks before you read.

Q5. (a) The red line stops three tiny marks past 20, so **23 °C**. (b) Each tiny mark is one degree, so count on in ones from 20: 21, 22, 23. Say it as “twenty-three degrees Celsius”.

Q6. (a) 23.7 is between 23 and 24 and closer to 24, so **24 °C** — round up. (b) 23.2 is closer to 23, so **23 °C** — round down. (c) 23.5 is right in the middle; right in the middle we round up, so **24 °C**.

Q7. The table is planned before measuring. Top boxes: *Object*, *Estimate (cm)*, *Measure (cm)* — the unit sits in the top boxes. Row boxes: pencil, spoon, book. With the unit in the top boxes and the estimate next to the measure, nobody forgets either one.

Q8. The steps run in this order: **B** find zero → **D** work out what each small mark means → **C** look straight on, at eye level → **A** write the number with its unit. You cannot read the small marks before you know what they mean, and you write nothing down until you have read carefully.

Q9. (a) Reading down the mean maximum column, the highest number is 26.8, in **January**. (b) 24.7 is between 24 and 25 and closer to 25, so **25 °C**. (c) 7.5 is right in the middle between 7 and 8; we round up, so **8 °C**. (d) Because the true reading sat between whole degrees — rounding chose the nearer mark, so the whole number is *about* right, not exact.

Q10. (a) Any two of: a digital camera, a tablet, a digital thermometer, a digital scale. (b) The unit — **g**. The screen finds the number, but a number without its unit is only half a measurement, so you write 350 g in your own table.

Q11. “350” has no unit, so nobody knows if it is 350 g, 350 mL or 350 of something else. Fix it by writing the unit: **350 g**. The unit is half of the answer.

Q12. The numbers count by 100 g and each small mark is 50 g. The small mark between 200 and 300 is 50 g past 200, so the mass is **250 g**.

Q13. 95 cm is far from the estimate of 30 cm, so something needs checking. Measure again, look at zero, and check you read the right mark. A book about 30 cm long should not measure 95 cm — a measure far from the estimate means measure again, not just write it down.

Q14. Mia writes **120 mL**. The record is what she saw, not what she thought she would see. Her estimate (100 mL) did its job — it was the check — and the measure (120 mL) is the record.

Q15. (a) Closer to 7, so record **7** — round up. (b) Closer to 6, so record **6** — round down. (c) Right in the middle we round up, so record **7** — the class rule means everyone records the same reading the same way.

Q16. A full plan names the unit first: length, so **cm**. Estimates come next: the spoon about 12 cm, the glue stick about 10 cm (any sensible estimates). The table is planned before measuring, with the unit in the top boxes:

Object	Estimate (cm)	Measure (cm)
spoon		
glue stick		

Then follow the steps — find zero, work out the small marks, look straight on at eye level, write the number with its unit — and record each measure next to its estimate. The longer one is the one that measures more.

Q17. Any two of: one group looked from above instead of straight on at eye level (from above, the line looks higher); one group read before the red line stopped moving; the line sat between two marks and one group rounded up while the other rounded down; the thermometers were not at zero to start.

Q18. (a) **camera** — it records what you see, again and again, so you can look back. (b) **dial scale** — mass is what the dial scale reads, in g. (c) **ruler** — length, in cm. (d) **thermometer** — temperature, in °C. (e) **measuring cup** — capacity, in mL. Each tool matches the unit the job needs.

Chapter 1 check-up — Working scientifically: asking, planning and measuring

This check-up is a piece of class work from your workbook. It is a school instrument, not a VCAA exam — Science Levels 3 and 4 has no outside exam. There is no time to beat. Take as long as you need. If you want, your teacher will read any question out to you.

> **Chapter 1 check-up · Codes `VC2S4I01` (1A), `VC2S4I02` (1B), `VC2S4I03` (1C)**
>
> **Total: 15 marks** · Part A — Questions A1 to A8 · 8 marks · Part B — Questions B1 to B3 · 7 marks
>
> Part A questions are worth 1 mark each. Part B questions are worth 2 or 3 marks, and the marks for each part are written with the question.

Every question in this check-up points to a part of the Levels 3 and 4 achievement standard that Chapter 1 teaches. The extracts, word for word:

> *Students pose questions to identify patterns and relationships, and make predictions based on observations.* — `VC2S4I01` (1A)
>
> *They plan investigations using planning scaffolds, identify key components of fair tests and describe how they conduct investigations safely.* — `VC2S4I02` (1B)
>
> *They use familiar classroom instruments and simple procedures to record observations and results, including formal measurements.* — `VC2S4I03` (1C)

The words in this check-up are the words you learned in Chapter 1. If you need them, the word lists are at the end of 1A, 1B and 1C.

In this check-up you will:

- sort two questions, and say pattern or relationship (A1, A2)
- finish a sentence about predictions (A3)
- find the change and the look-for in a fair test (A4, A5)
- match hazards to their controls (A6)
- match measuring jobs to their units (A7)
- read a thermometer (A8)
- compare a guess with a prediction, and explain the difference (B1)
- say whether a test is fair, and how to make it fair (B2)
- make a table before the numbers arrive (B3)

Part A — 8 marks

Eight questions, each worth 1 mark. A question gets its mark, or no mark.

A1. *(1 mark · `VC2S4I01`)* Sort these two questions into *can be investigated* and *cannot be investigated*.

1. Do more magpies visit the oval in the morning or in the afternoon?
2. Which bedtime story is the best?

A2. *(1 mark · `VC2S4I01`)* Look at this question: *Does sugar dissolve faster in hot water than in cold water?* (To dissolve means to break up and disappear into the water.) Is it a **pattern** question or a **relationship** question?

A3. *(1 mark · `VC2S4I01`)* Finish the sentence: *A prediction is based on something you ______ before.*

A4. *(1 mark · `VC2S4I02`)* Noah wants to know which ball bounces higher: the tennis ball or the rubber ball. He drops each ball from the same height, onto the same floor, and watches how high it bounces. In Noah's fair test, what is the one thing he changes?

A5. *(1 mark · `VC2S4I02`)* In Noah's test from A4, what does he look for?

A6. *(1 mark · `VC2S4I02`)* Match each hazard to its control. Draw a line from each hazard to the right control.

Hazards: **1.** Water spilt on the floor. **2.** Sharp sticks in the soil. **3.** Broken glass on the bench. **4.** The test needs hot water.

Controls: **A.** Wear gloves when you dig. **B.** The teacher pours it from the kettle, and you stand back. **C.** Wipe it up at once. **D.** Do not touch it — tell the teacher.

A7. *(1 mark · `VC2S4I03`)* Match each measuring job to its unit. The units are **cm**, **g**, **mL** and **°C**.

- (a) the length of a glue stick
- (b) the mass of a book
- (c) how much a bottle holds
- (d) the temperature of a cup of cold water

A8. *(1 mark · `VC2S4I03`)* A thermometer has a number every ten degrees, and each tiny mark between the numbers is one degree. The red line stops four tiny marks past 30. Write down the temperature. Give the number **and** its unit.

Part B — 7 marks

Three questions. B1 is worth 2 marks, B2 is worth 3 marks, and B3 is worth 2 marks. Write your answers in your own words.

B1. *(2 marks · `VC2S4I01`)* Mia says, "I guess the soil in the garden bed will be dry tomorrow." Leo says, "I predict the soil in the garden bed will be dry tomorrow, because it has not rained for five days, and the soil was dry this morning."

- (a) Which sentence is the **guess**, and which is the **prediction**? (1 mark)
- (b) Explain your answer. What does a prediction have that a guess does not? (1 mark)

B2. *(3 marks · `VC2S4I02`)* Priya wants to find out whether plants grow taller with more water. She puts one plant on the sunny window bench and gives it a lot of water. She puts the other plant in the shady corner and gives it only a little water. After two weeks, the plant on the window bench is taller. Priya says, "Plants grow taller with more water."

- (a) Is Priya's test fair? Say why. (1 mark)
- (b) Name two things Priya should keep the same, so that only one thing changes. (2 marks)

B3. *(2 marks · `VC2S4I03`)* Your group will measure the **mass** of three objects: a pencil, a spoon and a glue stick. Before you measure, make the table you will record your numbers in. Your table needs:

- a place for each object;
- a box for the **estimate** and a box for the **measure**;
- the unit in the right place.

Mark record

Question	Code	Worth	Given
A1 — sort the questions	`VC2S4I01`	1	
A2 — pattern or relationship	`VC2S4I01`	1	
A3 — what a prediction stands on	`VC2S4I01`	1	
A4 — the one thing that changes	`VC2S4I02`	1	
A5 — what to look for	`VC2S4I02`	1	
A6 — match the hazards to the	`VC2S4I02`	1	

Question	Code	Worth	Given
controls			
A7 — match the jobs to the units	VC2S4I03	1	
A8 — read the thermometer	VC2S4I03	1	
B1 — guess or prediction, and why	VC2S4I01	2	
B2 — is the test fair, and how to fix it	VC2S4I02	3	
B3 — make the table	VC2S4I03	2	
Total		**15**	

Marking guide

Teacher guidance — Chapter 1 check-up · 15 marks. This guide is written so a teacher without a science background can mark the check-up. Every acceptable answer is written out below, and every mark is allocated per response.

About this instrument

- The check-up is a **school instrument**, not a VCAA exam. Science Levels 3 and 4 has no external examination and no external assessment.
- Completion is **untimed** — a student may take as long as they need.
- **Reading support** is permitted: the teacher may read any question aloud on request. Reading is not being assessed.
- A mark is a record that the evidence was seen. Marks are for reporting against the achievement standard, not for ranking students.

The extracts evidenced

Each question is tagged with the code it traces to. The three extracts from the Levels 3 and 4 achievement standard, quoted at the head of the check-up:

- `VC2S4I01` (1A): "Students pose questions to identify patterns and relationships, and make predictions based on observations."
- `VC2S4I02` (1B): "They plan investigations using planning scaffolds, identify key components of fair tests and describe how they conduct investigations safely."
- `VC2S4I03` (1C): "They use familiar classroom instruments and simple procedures to record observations and results, including formal measurements."

Marks at a glance

Part	Questions	Code	Marks
Part A	A1–A3	`VC2S4I01`	3
Part A	A4–A6	`VC2S4I02`	3
Part A	A7–A8	`VC2S4I03`	2
Part B	B1	`VC2S4I01`	2
Part B	B2	`VC2S4I02`	3
Part B	B3	`VC2S4I03`	2
		Total	**15**

General marking rules

- Accept answers in the student's own words. The acceptable answers below are wide by design — if the response shows the understanding, give the mark.
- Spelling does not lose marks.
- Part A items are marked all-or-nothing: each gets its 1 mark, or 0.
- Part B items are part-marked exactly as shown with each question.
- If an answer is right but the reason is unclear, ask the student to say more — once. If the follow-up shows the understanding, give the mark. If it shows a guess with nothing behind it, record 0 and move on without comment.

Part A — answers

A1 · `VC2S4I01` · 1 mark

- **Accept:** question 1 in *can be investigated* — you can watch the oval and count the magpies; question 2 in *cannot be investigated* — which story is "the best" is what people like, and two people can give different answers.

- **Marks:** 1 for both sorted correctly; 0 otherwise.
- **Evidences:** "pose questions …" — the sorting test taught in 1A: *can we find the answer out by observing or testing?*

A2 · `VC2S4I01` · 1 mark

- **Accept:** a **relationship** question. (No reason is needed for the mark. If one is given: the warmth of the water changes, and how fast the sugar dissolves changes with it.)
- **Marks:** 1 for *relationship*; 0 for *pattern*.
- **Evidences:** "pose questions to identify patterns and relationships" — relationship questions ask *when this changes, does that change too?*

A3 · `VC2S4I01` · 1 mark

- **Accept:** *observed*. Also accept *observation*, or the student's own wording of the same idea — *saw*, *noticed*, *found out by looking*.
- **Marks:** 1 for any of these; 0 for a word that does not point at an earlier observation (for example, *thought* or *guessed*).
- **Evidences:** "make predictions based on observations" — the 1A rule: a prediction is based on an earlier observation, and a guess is not.

A4 · `VC2S4I02` · 1 mark

- **Accept:** the ball — which ball it is (the tennis ball or the rubber ball).
- **Marks:** 1 for the ball; 0 for anything else (for example, the height or the floor, which are kept the same).
- **Evidences:** "identify key components of fair tests" — the part of the fair test that 1B calls *what we change*.

A5 · `VC2S4I02` · 1 mark

- **Accept:** how high the ball bounces.
- **Marks:** 1 for the bounce height; 0 otherwise.
- **Evidences:** "identify key components of fair tests" — the part of the fair test that 1B calls *what we look for*.

A6 · `VC2S4I02` · 1 mark

- **Accept:** 1–C (spilt water → wipe it up at once), 2–A (sharp sticks → gloves when you dig), 3–D (broken glass → do not touch it, tell the teacher), 4–B (hot water → the teacher pours it from the kettle, you stand back).
- **Marks:** 1 for all four matched; 0 otherwise.
- **Evidences:** "describe how they conduct investigations safely" — the hazard-and-control pairs taught in 1B.

A7 · `VC2S4I03` · 1 mark

- **Accept:** (a) cm, (b) g, (c) mL, (d) °C.
- **Marks:** 1 for all four matched; 0 otherwise. Accept the unit written in words (centimetres, grams, millilitres, degrees Celsius).
- **Evidences:** "use familiar classroom instruments … including formal measurements" — choosing the unit before the number, the 1C rule.

A8 · `VC2S4I03` · 1 mark

- **Accept: 34 °C** — the number and the unit together. Accept "34 degrees" or "thirty-four degrees Celsius" as the unit said aloud or written in words.
- **Marks:** 1 for 34 with its unit; 0 for 34 with no unit, and 0 for a wrong count on the tiny marks (for example, 32 °C or 40 °C).
- **Evidences:** "use familiar classroom instruments … including formal measurements" — counting on in ones past the numbered mark, and keeping the unit with the number.

Part B — answers

B1 · `VC2S4I01` · 2 marks

- **(a) — 1 mark.** Accept: Mia's sentence is the **guess**; Leo's sentence is the **prediction**. Both must be named correctly for the mark.
- **(b) — 1 mark.** Accept any wording that gives the prediction a base the guess does not have. Examples: *a prediction is based on something you observed before, and a guess is not*; *Leo can say where his sentence comes from — five days with no rain, and dry soil this morning — and Mia cannot*; *Leo looked back at what he observed first*. The response must say, in some words, that the prediction stands on an earlier observation.
- **Evidences:** "make predictions based on observations" — the difference between a prediction and a guess is the difference 1A teaches and never stops using.

B2 · `VC2S4I02` · 3 marks

- **(a) — 1 mark.** Accept: **no** (not fair), with any wording that says more than one thing changed — the water *and* the spot (sunny or shady). Example: *two things are different, so Priya cannot say which one made the plant grow taller*. "No" with no reason gets 0.
- **(b) — 2 marks, one per valid thing kept the same.** Accept any two that hold everything the same except the water. Examples: both plants in the same spot (the same light); the same kind of plant; the same kind of pot and the same soil; watering at the same time and the same way. Do **not** accept "the amount of water" — that is the one thing Priya changes. One thing named = 1 mark; two things named = 2 marks.
- **Evidences:** "identify key components of fair tests" — one thing changes, everything else stays the same, so the test can point at the cause.

B3 · `VC2S4I03` · 2 marks

- **Structure — 1 mark.** Accept any table with a place for each of the three objects (pencil, spoon, glue stick) and separate boxes for the **estimate** and the **measure**. The objects may run down the rows or across the top; either way is right, because the table is planned before the measuring starts.
- **Unit — 1 mark.** Accept the unit **g** (or *grams*) written in the top boxes of the number columns — for example, *Estimate (g)* and *Measure (g)*. The unit must sit in the heading, not be added beside each number later.
- **Evidences:** "use familiar classroom instruments and simple procedures to record observations and results, including formal measurements" — planning the table first is the procedure, and the unit in the top boxes is the 1C rule.

Total

Part A: 8 marks. Part B: 7 marks (2 + 3 + 2). **Total: 15 marks.**