Science 9–10

Chapter 16 — Use and influence of science

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Contents

Socio-scientific issues: projected outcomes, and why individuals, communities and industries adopt or resist a scientific practice

Chapter 16 — Use and influence of science (Science, Levels 9 and 10)

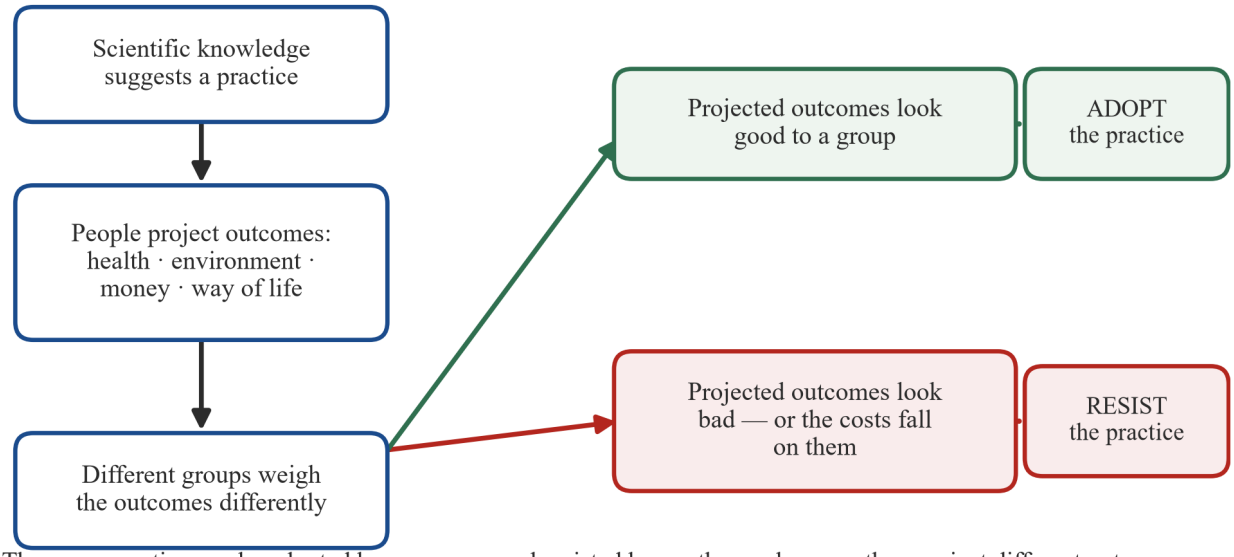
Subtopic 16A · VC2 Science as a human endeavour — Use and influence of science

CD code: `VC2S10H03` (16A owns this content description in full — no partner) **Content description (verbatim):** "the use of scientific knowledge to address socio-scientific issues and shape a more sustainable future for humans and the environment may have diverse projected outcomes that affect the extent to which scientific knowledge and practices are adopted more broadly by society" **Elaboration ids drawn on:** `VC2S10H03.E01` · `VC2S10H03.E02` · `VC2S10H03.E03` · `VC2S10H03.E04` · `VC2S10H03.E05` (`VC2S10H03.E06` is reserved under the TOC's D10(b) ICIP decision and is not taught here.) **Achievement standard (extract served):** "They examine how different projected outcomes of the application of scientific knowledge to a selected socio-scientific issue may lead to varied support from individuals and groups in society." **Maths interlock (D11):** `VC2M10ST04` — reading statistics: always ask what the denominator is and who was counted; re-used from 5B.

Theory

What makes an issue socio-scientific? Science is very good at telling us what is likely to happen if we do something. On its own, it is not enough to tell us what we *should* do. A **socio-scientific issue** — in this section, a question about what people should do, where scientific knowledge matters but people's values matter too — reaches beyond the laboratory: who gains, who pays, and what a community wants to protect are all part of it. Whether riders must wear helmets, whether a farmer plants a genetically engineered crop, whether a street of homes adds solar panels: each of these rests on scientific evidence, and each is also a decision about what people value. On such issues, sensible people who agree about the facts can still disagree about what to do — and that disagreement is part of the issue, not a failure to understand the science.

The content description for this subtopic makes one big claim about these issues: the same science can lead to **diverse projected outcomes**. A **projected outcome** is a result a person or group expects when they picture a practice being adopted — for their health, their environment, their money, or their way of life. And how widely a practice is adopted follows those projections. The figure below is the shape of every case study in this section.

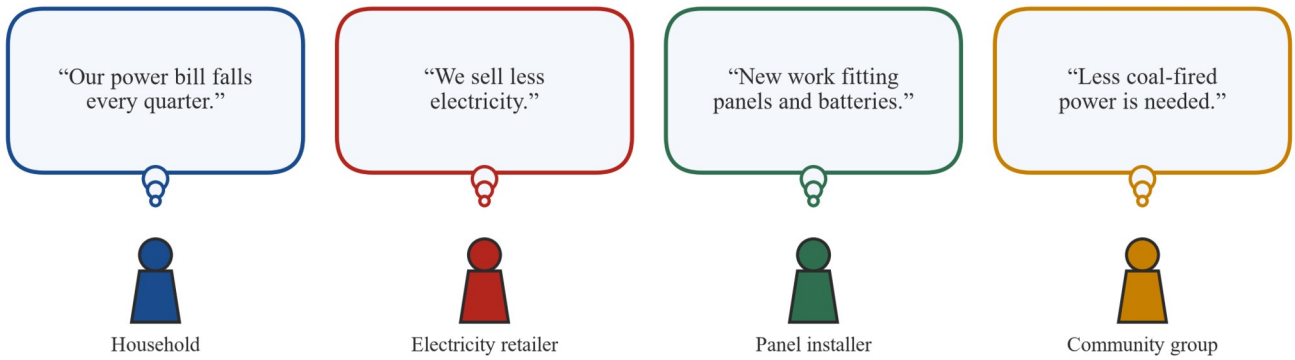


The same practice can be adopted by one group and resisted by another — because they project different outcomes.

Flow diagram: scientific knowledge suggests a practice; people project outcomes for health, environment, money and way of life; different groups weigh those outcomes differently; where the projected outcomes look good to a group

they adopt the practice, and where they look bad — or the costs fall on them — they resist it. Caption: the same practice can be adopted by one group and resisted by another, because they project different outcomes.

Four groups, one practice. The same point in close-up. Four groups look at the one practice — rooftop solar — and each projects a different outcome. The household projects smaller bills; the electricity retailer projects selling less power; the panel installer projects new work; the community group projects less coal-fired power. Nobody is wrong about whose outcomes they care about. The figure draws all four views the same size on purpose: a bigger bubble would not make a view more correct.



The same practice — rooftop solar — seen from four positions. Each view is drawn the same size: a bigger bubble would not make it more correct.

Four figures with equal-sized thought bubbles looking at the same practice, rooftop solar: a household — "Our power bill falls every quarter"; an electricity retailer — "We sell less electricity"; a panel installer — "New work fitting panels and batteries"; a community group — "Less coal-fired power is needed." Caption: the same practice seen from four positions, each view drawn the same size.

Empirical claims and value claims. Every socio-scientific debate mixes two kinds of claim, and the first skill in this section is telling them apart. An **empirical claim** is a claim about what is true or what will happen — it can be checked against evidence, at least in principle. A **value claim** is a claim about what matters or what ought to happen — evidence can inform it, but evidence alone cannot settle it. Neither kind is silly. The skill is to label which is which, so that empirical claims get tested against evidence and value claims get discussed openly, instead of a values disagreement hiding inside a facts disagreement.

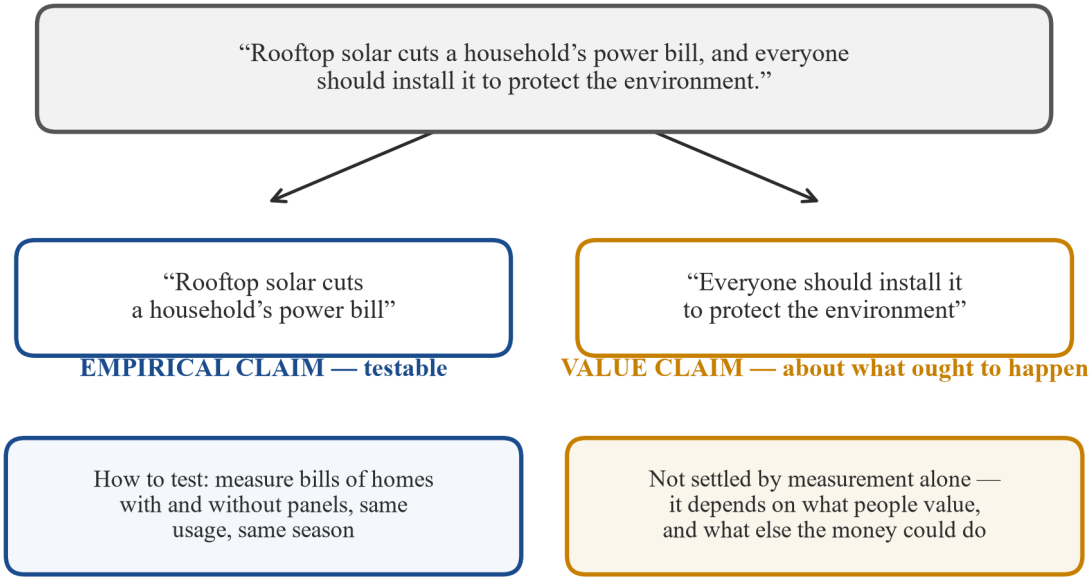


Diagram splitting one sentence — "Rooftop solar cuts a household's power bill, and everyone should install it to protect the environment" — into two halves: "Rooftop solar cuts a household's power bill", labelled EMPIRICAL CLAIM, testable, with the test "measure bills of homes with and without panels, same usage, same season"; and "Everyone should install it to protect the environment", labelled VALUE CLAIM, about what ought to happen, noted as not settled by measurement alone.

Why groups adopt, and why groups resist. The reasons on each side fall into a small number of families, and — this is the heart of the subtopic — both columns can hold reasonable positions at the same time.

Why a group might ADOPT a practice	Why a group might RESIST it
The evidence shows a real benefit	They judge the risks or uncertainty to be real
The cost is low, or there is money helping them change	The cost falls on them, and the benefit goes elsewhere
A law or rule requires it	It clashes with what they value (choice, tradition, livelihood)
People around them are doing it (social norms)	They do not trust the institutions behind it
Support, advice or equipment is provided	They cannot access it, or lack the information to judge it

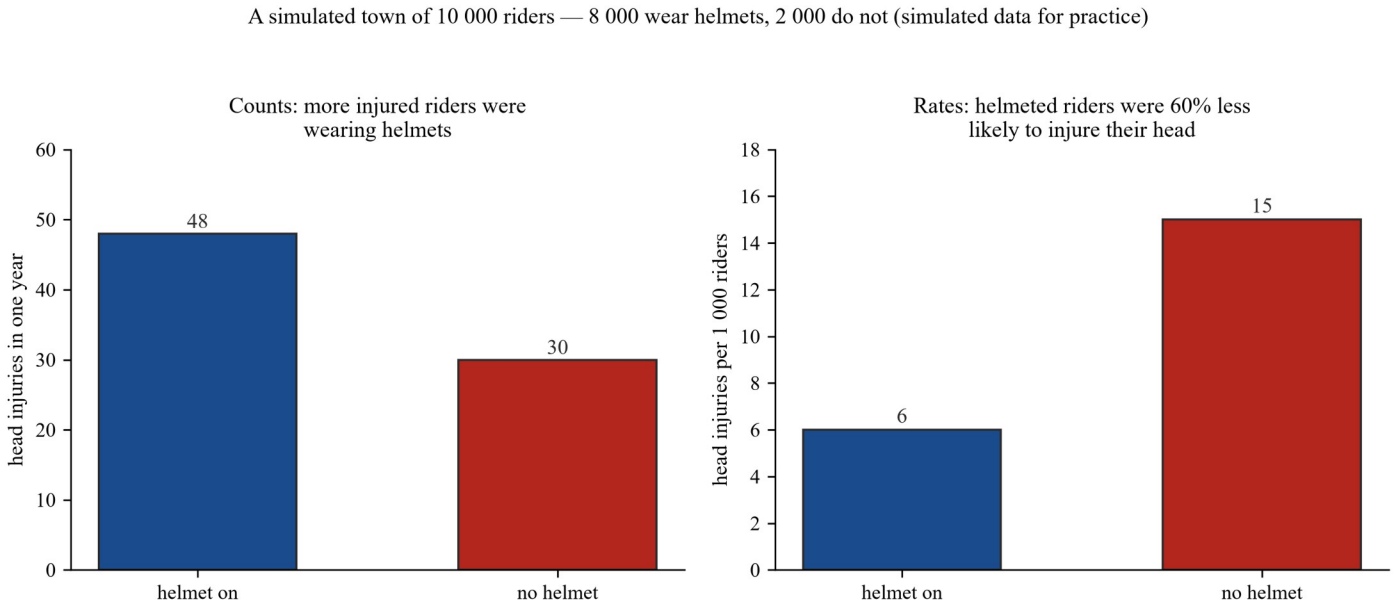
Both columns can hold reasonable positions at once. The job is to examine each reason, not to assume one side is ignorant.

Two equal columns. Why a group might ADOPT a practice: the evidence shows a real benefit; the cost is low, or there is money helping them change; a law or rule requires it; people around them are doing it (social norms); support, advice or equipment is provided. Why a group might RESIST it: they judge the risks or uncertainty to be real; the cost falls on them, and the benefit goes to other people; it clashes with what they value (choice, tradition, livelihood); they

do not trust the institutions behind it; they cannot access it, or lack the information to judge it. Caption: both columns can hold reasonable positions at once; the job is to examine each reason, not to assume one side is ignorant.

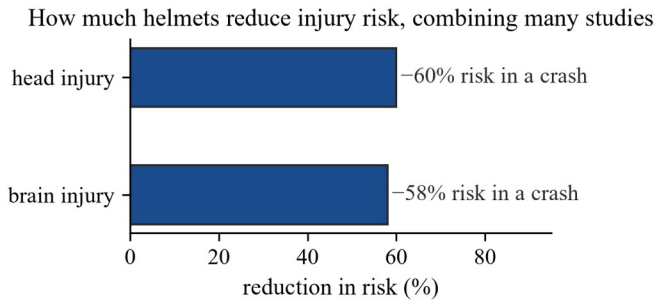
When you examine a debate, put each side's case in its strongest form before you judge it. If you can write down the best version of the view you disagree with, then your own view has been properly tested. And when a group resists a practice, the useful question is never "what is wrong with them?" but "which projected outcome — which cost, risk or value — makes this reasonable from where they stand?"

Reading statistics: counts are not rates. One statistical habit guards every case study in this section (`VC2M10ST04`, re-used from 5B): when someone gives you a number, ask *out of how many?* and *who was counted?* A count on its own can reverse the truth. Picture a simulated town of 10 000 riders (simulated data for practice): 8 000 of them wear helmets and 2 000 do not. Over a year, 48 riders wearing helmets end up with a head injury, and 30 riders without helmets do. The raw counts say "more injured riders wore helmets" — as if helmets were useless. But the two groups are not the same size. Per 1 000 riders, the helmeted group suffers 48 ÷ 8 = 6.0 head injuries and the unhelmeted group 30 ÷ 2 = 15. The rate for helmeted riders is 60% lower. Same town, same numbers, opposite story — the denominator is the whole difference.



Two bar charts of the same simulated town of 10 000 riders, 8 000 wearing helmets and 2 000 not. Left, counts: 48 head injuries with helmets, 30 without, titled "Counts: more injured riders were wearing helmets." Right, rates per 1 000 riders: 6 with helmets, 15 without, titled "Rates: helmeted riders were 60% less likely to injure their head." Labelled simulated data for practice.

Case study 1 — bicycle and e-scooter helmets. On 1 July 1990, Victoria became the first place in the world to require every bicycle rider to wear a helmet (Source: Victorian Government, bicycle helmet law, 1990 — retrieved 2026-08-21). The science behind the law is strong: a **meta-analysis** — a study that combines the results of many earlier studies — by Attewell, Glase and McFadden found that wearing a helmet cuts the risk of head injury in a crash by about 60%, and of brain injury by about 58% (Source: Attewell, Glase & McFadden, Accident Analysis & Prevention, 2001 — retrieved 2026-08-21).

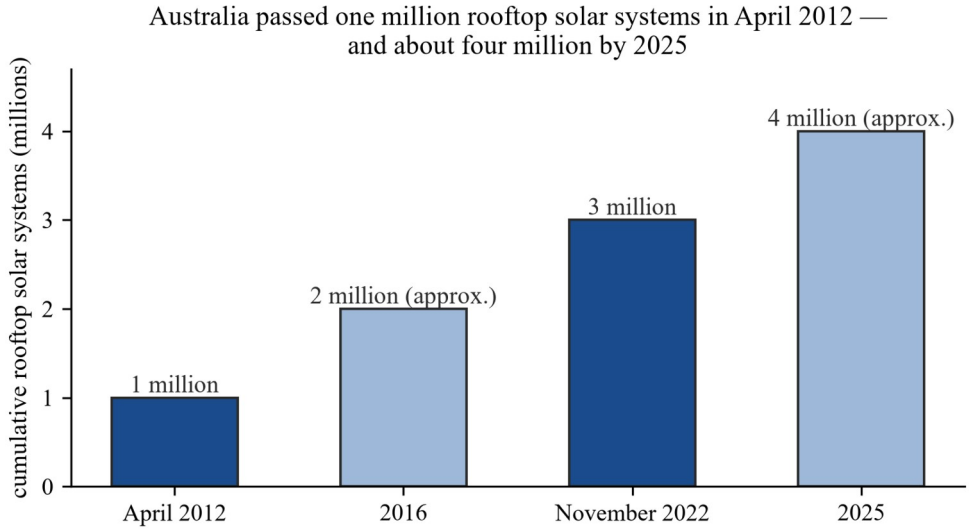


Source: Attewell, Glase & McFadden, "Bicycle helmet efficacy: a meta-analysis", Accident Analysis & Prevention, 2001 — retrieved 2026-08-21.

Bar chart combining many studies: wearing a helmet cuts the risk of head injury in a crash by about 60% and of brain injury by about 58%. Source line: Attewell, Glase & McFadden, Accident Analysis & Prevention, 2001, retrieved 2026-08-21.

Most riders adopted the practice: the law requires it, the evidence shows a real benefit, and people around them do it. Yet resistance has never disappeared, and its strongest forms are worth examining. Some riders judge the risk on their short, familiar trips to be tiny — an empirical claim, testable, and partly fair for them, though crashes are rare events that do not announce themselves in advance. Some hold a value claim: the choice about their own body is theirs. Some project an outcome about health of a different kind — that a helmet rule makes riding look dangerous and puts people off a cheap, healthy, clean form of transport. When e-scooters arrived, the same statistics and the same arguments restarted for a new machine: same science, new projected outcomes, fresh debate about whether the same rule should apply.

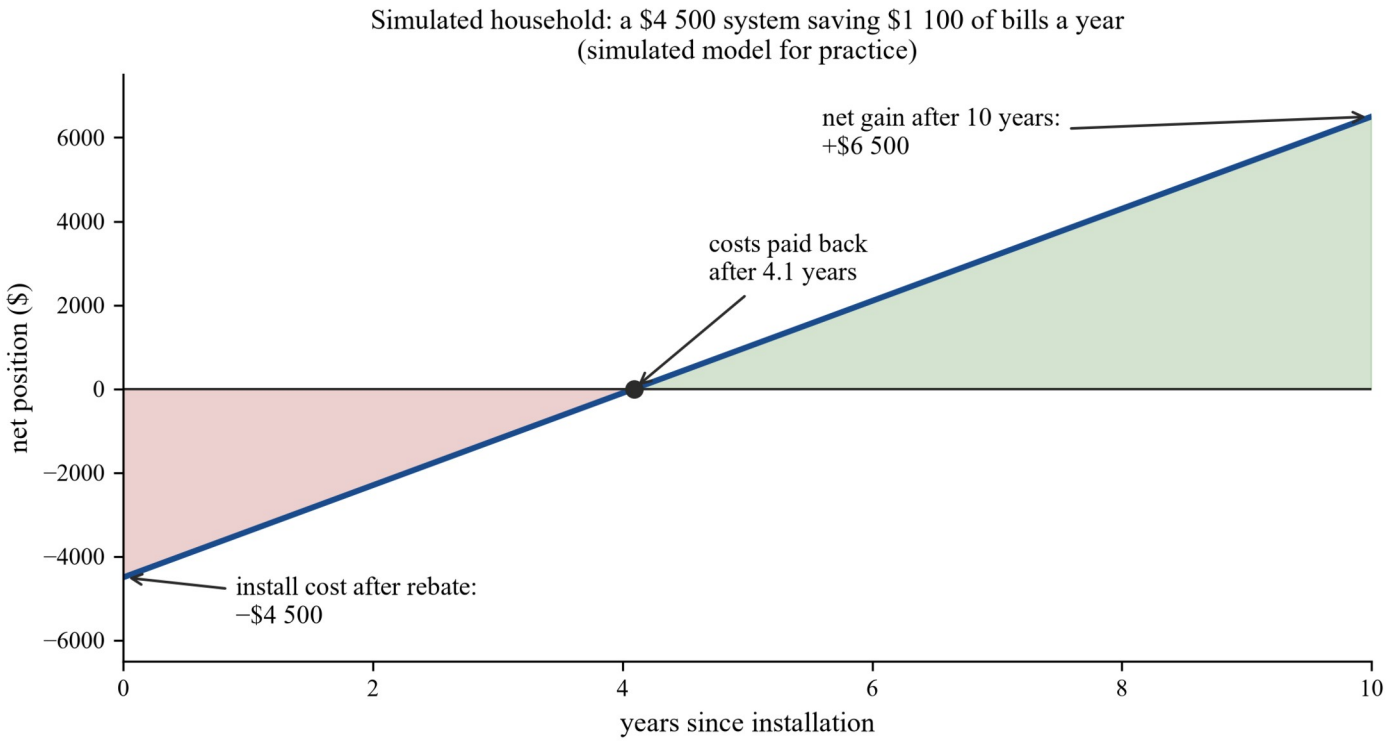
Case study 2 — rooftop solar and battery storage. Australia has one of the highest rates of rooftop solar in the world. The total number of small systems passed one million in April 2012, reached about two million by 2016, three million in November 2022 and about four million by 2025 (Source: Australian Government Clean Energy Regulator, small-scale solar statistics — retrieved 2026-08-21).



Source: Australian Government Clean Energy Regulator, small-scale solar statistics — retrieved 2026-08-21.

Bar chart of the total number of rooftop solar systems in Australia at four dates: 1 million in April 2012, about 2 million by 2016, 3 million in November 2022, about 4 million by 2025. Source line: Australian Government Clean Energy Regulator, retrieved 2026-08-21.

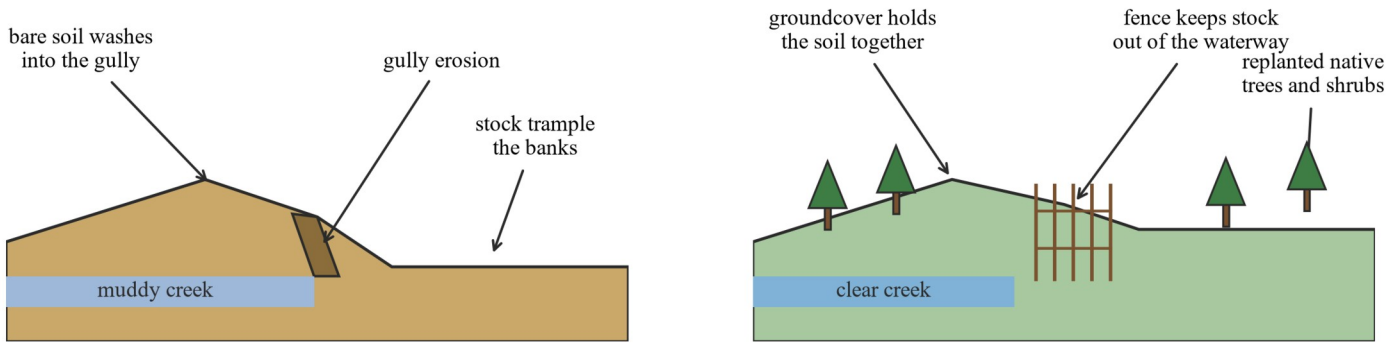
Why did so many households adopt? The money story is the clearest reason. Picture a simulated household (simulated model for practice) that pays $4 500 for a system after a rebate and saves $1 100 a year on bills. Its net position starts at −$4 500, climbs by $1 100 each year, and crosses zero — the system has paid for itself — after about 4.1 years; by year 10 the household is $6 500 ahead. Add the other adopt reasons from the figure above — falling prices, money helping them change, neighbours doing it — and the growth in the milestones chart is no mystery.



Line graph of a simulated household's net position over 10 years: starting at −$4 500 (install cost after rebate), rising $1 100 a year, costs paid back after 4.1 years, net gain after 10 years of +$6 500. The losing years are shaded red and the gaining years green. Labelled simulated model for practice.

Resistance is just as reasonable from where it stands. A renter cannot put panels on a roof they do not own: the cost would fall on the landlord while the savings go to the tenant — the second resist reason in the figure, exactly. Some households face a large upfront cost even when the payback is good. Some do not trust the numbers they are sold, because payments for power sent back to the grid have changed over the years. And battery storage — storing daytime generation to use at night — repeats the same pattern one step on: households that value independence from the grid adopt, while households that see a costly device with a fast-changing technology wait.

Case study 3 — Landcare and carbon in the soil. In 1986 the first Landcare group formed in western Victoria — farmers and neighbours working together on local land. The movement spread across the country and is supported today by the Australian Government's National Landcare Program (Source: Australian Government, National Landcare Program; first Landcare group, western Victoria, 1986 — retrieved 2026-08-21). The practices are practical: replanting native trees and shrubs, fencing stock out of creeks, keeping groundcover so soil stops washing away, and disturbing the soil less. Healthy soil also stores carbon — **carbon sequestration**, the locking of carbon in soil and plants instead of leaving it in the air as carbon dioxide.



Soil quality improves when erosion stops: roots hold soil, plant litter feeds it, and carbon is stored in it

Before-and-after cross-sections of a paddock. Before: bare soil washing into a gully, stock trampling the banks, a muddy creek. After: groundcover holding the soil together, a fence keeping stock out of the waterway, replanted native trees and shrubs, a clear creek. Caption: soil quality improves when erosion stops — roots hold soil, plant litter feeds it, and carbon is stored in it.

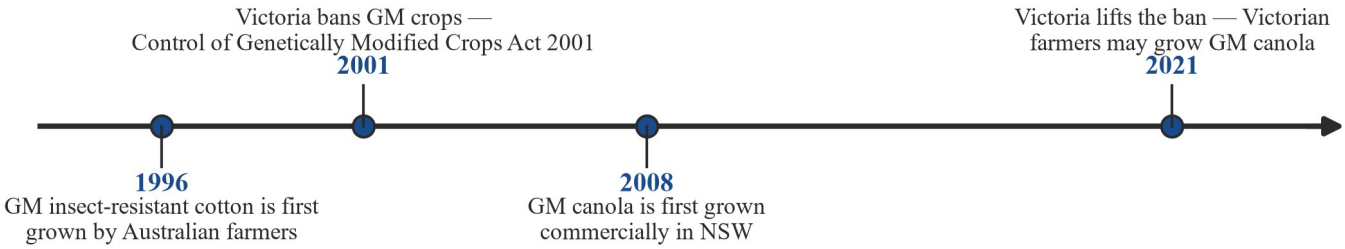
Adoption here is driven by outcomes the farmer can see on their own land: better pasture, shade for stock, a creek that runs clear instead of carrying the topsoil away — plus community belonging, and funding and advice that lower the cost of changing. Resistance is driven by the shape of the costs and benefits: the work and the money fall on one farm today, while the carbon benefit is shared by everyone, everywhere, for decades. Results also take years to show, and a practice that works on one farm may fail in the next valley. So even people who fully agree with the science can reasonably resist carrying the cost alone — the second resist reason again.

Case study 4 — citizen science in public health. Citizen science is scientific work that members of the public take part in. One Australian example is FluTracking: volunteers across the country answer a two-minute survey each week — do you have a fever or a cough? — and researchers combine the reports to map flu-like illness in close to real time, as an early warning alongside hospital and laboratory data (Source: FluTracking, weekly online health survey, flutracking.net — retrieved 2026-08-21).

Five-stage cycle: volunteers answer a weekly survey (fever? cough?); reports are combined from thousands of households; researchers map flu-like illness across Australia; health services get an early warning before hospital data show it; results go back to the public, so volunteers see what their reports built. Centre label: FluTracking, citizen science for public health.

People adopt citizen science for the reasons in the figure: it costs two minutes a week, they want to help, and the results come back to them. But notice the statistical catch, the same habit as before: volunteers choose themselves, so they are not a random slice of the population. Treated carelessly, the weekly totals could mislead about everyone. Researchers therefore interpret the data knowing exactly *who was counted* — which is also why citizen science is used **alongside** hospital and laboratory data, not instead of it.

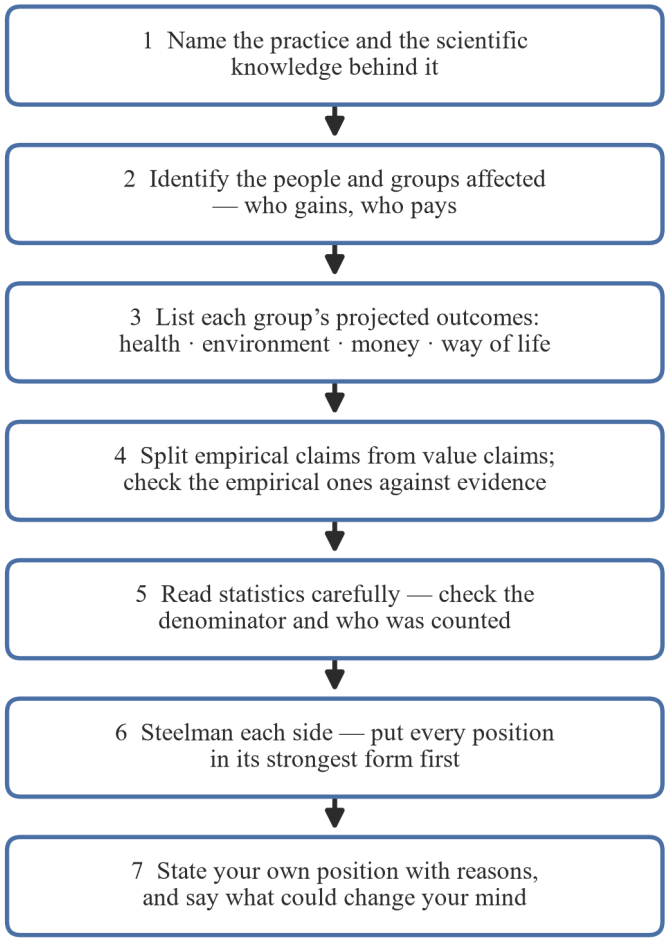
Case study 5 — genetically engineered crops. A crop is **genetically engineered** (also called genetically modified, GM) when scientists have changed its DNA to give it a trait it did not have — for example cotton that carries its own protection against insect pests, or canola that tolerates a particular herbicide (a chemical that kills weeds), so weeds can be controlled without killing the crop. Australia's story with these crops is a clean example of adoption and resistance changing places over time.



Timeline: 1996, GM insect-resistant cotton is first grown by Australian farmers; 2001, Victoria bans GM crops — Control of Genetically Modified Crops Act 2001; 2008, GM canola is first grown commercially in NSW; 2021, Victoria lifts the ban — Victorian farmers may grow GM canola.

Growers adopted GM cotton from 1996 for projected outcomes they could bank: fewer spray passes, less insect damage, more reliable harvests. Resistance came from other projected outcomes: some buyers paid extra for produce grown without engineered DNA, so several states, Victoria among them, chose to protect that market; some people hold the value claim that food should be produced without engineered DNA; some judged the long-term effects uncertain — an empirical claim, which the following decades of growing experience were exactly the test of. In 2001 Victoria banned GM food crops by law; in 2021 it lifted the ban, after years of evidence from neighbouring states that the projected harms had not arrived and the projected benefits had. Read against the content description, that is the whole lesson in one paragraph: the science did not change minds by itself — the projected outcomes did.

A method for examining an issue. The seven steps below are the method this section teaches, and the method the activities, worked examples and the big issue-analysis question at the end all use.



Seven-step flow: 1 name the practice and the scientific knowledge behind it; 2 identify the people and groups affected — who gains, who pays; 3 list each group's projected outcomes: health, environment, money, way of life; 4 split empirical claims from value claims, and check the empirical ones against evidence; 5 read statistics carefully —

check the denominator and who was counted; 6 steelman each side — put every position in its strongest form first; 7 state your own position with reasons, and say what could change your mind.

Activities

Activity 1 — Two columns, one street. Take rooftop solar and three positions: a family who own their home, a renter, and the home's landlord. For each position, fill in the two columns of the adopt/resist figure with at least one reason, using the figure's reason families as a prompt. Label every reason you write as empirical or value. Then find one fact about solar — for example, that panels cut the home's power bills — that appears as an adopt reason for one of your three positions and a resist reason for another, and explain in one sentence why the same fact points in opposite directions for them.

Activity 2 — Denominator detective. Using the simulated helmet town (8 000 helmeted riders with 48 head injuries; 2 000 unhelmeted riders with 30 head injuries), calculate the head-injury rate per 1 000 riders for each group, and check that the helmeted rate is 60% lower. Then take the headline "More injured riders were wearing helmets" and rewrite it as an accurate one-sentence headline that uses the rates, and add a second sentence saying what the original headline left out.

Activity 3 — Who gains, who pays? Choose one Landcare practice from the paddock figure (fencing the creek, replanting, keeping groundcover). List the projected outcomes of adopting it for (i) the farmer and (ii) the wider community, under the four headings health, environment, money, way of life. Mark who gains and who pays for each outcome. Then propose one change — for example, shared cost, free advice, loaned equipment — that could move a resister towards adopting, and name the projected outcome your change alters.

Worked examples

Examples in this section are reasoning examples. Where numbers appear they come from the figures and tables above; simulated data is labelled as such.

Example 1 — scaffolded

Apply method steps 1–4 to Victoria's helmet law.

Step	Reasoning
1 — name the practice and the science	The practice: every bicycle rider wears a helmet. The science: a helmet absorbs impact in a crash, and combined studies find about 60% less head injury and about 58% less brain injury when a helmeted rider crashes.
2 — who is affected	Riders (choice, comfort, safety); families (medical costs, care); hospitals and ambulance services (serious head injuries); governments (laws, health budgets); bicycle sellers and makers (sales).
3 — projected outcomes	Riders who adopt: fewer serious head injuries (health), a small cost and some lost comfort (money, way of life). Riders who resist: keep their freedom to choose (way of life), judge their own risk as tiny (health). Governments: fewer serious injuries and smaller hospital bills (health, money), but a rule some voters dislike (way of life).
4 — split empirical from value	Empirical: "helmets cut head-injury risk in a crash by about 60%" — testable, and tested by the combined studies. Value: "the choice about my own body is mine" — not settled by any measurement. Both appear in the real debate; labelling them keeps the argument honest.

Example 2 — scaffolded

Use the simulated helmet town to show why the raw counts mislead.

Working	Comment
Helmeted: 48 injuries among 8 000 riders	The count alone.
48 ÷ 8 = 6.0 injuries per 1 000 riders	Divide by the group's size: the denominator.
Unhelmeted: 30 ÷ 2 = 15 per 1 000 riders	Same calculation for the smaller group.
(15 − 6) ÷ 15 = 0.60 → 60% lower	The helmeted rate is 60% below the unhelmeted rate.

The counts (48 vs 30) suggest helmets fail; the rates (6 vs 15 per 1 000) show the opposite. The simulated town was built to reproduce the real combined-studies result — about 60% — so the habit and the evidence agree: always ask *out of how many?*

Example 3 — unscaffolded

A simulated household pays $4 500 for rooftop solar after a rebate. (a) If the system saves $1 100 a year, confirm the payback time of about 4.1 years and the net position at year 10. (b) A second simulated household saves only $900 a year. Find its payback time and its net position at year 10. (c) Explain why a renter with the same $900-a-year bills would still not install solar, even though the payback in (b) looks good.

(a) $4 500 ÷ $1 100 a year ≈ 4.1 years; at year 10 the net position is 10 × $1 100 − $4 500 = +$6 500, matching the payback figure.

(b) $4 500 ÷ $900 a year = 5.0 years; at year 10 the net position is 10 × $900 − $4 500 = +$4 500.

(c) The payback only works for whoever pays the $4 500. A renter does not own the roof: the cost would fall on the landlord while the bill savings go to the tenant. The cost falls on one person and the benefit goes to another — the second resist reason in the figure — so the same good numbers produce a different projected outcome and a different decision.

Example 4 — unscaffolded

Victoria banned GM food crops in 2001 and lifted the ban in 2021. Steelman both decisions, then say which projected outcomes changed in between.

The 2001 ban, in its strongest form: buyers were paying extra for non-GM produce, so the state protected a market its farmers already had; the long-term effects of the new crops were still an open empirical question; and part of the community held the value claim that food should be grown without engineered DNA. Banning bought time to test the empirical claim while keeping the value-based market. The 2021 lifting, in its strongest form: neighbouring states had grown GM canola for over a decade with the projected harms not arriving and the projected benefits — fewer spray passes, reliable harvests — arriving; the open empirical question had largely been answered; and the extra payment for non-GM produce had shrunk, so the ban's benefit no longer outweighed its cost to farmers. What changed between the two dates was not the science of the crops so much as the projected outcomes: once the projected harms failed to appear and the projected benefits showed up next door, the same community weighed the outcomes differently and adoption followed.

Practice questions

Scaffolded questions

Question 1 Label each claim as empirical or value, using the definitions from the theory. (a) "Wearing a helmet cuts the risk of head injury in a crash by about 60%." (b) "Riders should be free to choose whether to wear a helmet." (c) "A rooftop solar system can pay for itself in about four years." (d) "A garden grown without engineered DNA is worth paying extra for."

Question 2 Use the simulated helmet town (8 000 helmeted riders, 48 head injuries; 2 000 unhelmeted riders, 30 head injuries). (a) Which group had more head injuries in total? (b) Calculate the head-injury rate per 1 000 riders for each group. (c) Which group was safer per rider, and how many times lower was its rate?

Question 3 Use the adopt/resist figure. (a) Give two adopt reasons that fit a family who own their home and are thinking about solar. (b) Give two resist reasons that fit a renter. (c) Which of the two is a value claim: "the evidence shows a real benefit", or "it clashes with what they value"?

Question 4 Use the rooftop solar milestones chart. (a) About how many years passed between one million systems (April 2012) and three million (November 2022)? (b) Which gap between neighbouring milestones was the shortest? (c) Give one adopt reason from the theory that could help explain that fast gap.

Question 5 Use the citizen science cycle and the seven-step method. (a) Name the stage of the cycle in which volunteers report their own symptoms. (b) Which step of the seven-step method is the warning "volunteers are not a random slice of the population" part of?

Question 6 Match each helmet-debate action to the method step it is (steps 4, 5 or 6). (a) Testing the "60% less head injury" claim against the combined studies. (b) Writing the freedom-of-choice view in its strongest form before answering it. (c) Asking how many riders there were in each group before comparing injury counts.

Unscaffolded questions

Question 7 Two neighbours read the same solar figures; one installs panels and one does not. Using the idea of projected outcomes, explain how both decisions can be reasonable.

Question 8 A rider says: "I only ride 500 m to the station, so my risk is tiny — and the law should not care what I do." (a) Identify the empirical claim and name the evidence that would test it. (b) Identify the value claim. (c) Steelman the view: write its strongest form in one sentence.

Question 9 A social-media post says: "Most riders in hospital after bike crashes were wearing helmets, so helmets don't work." Use the denominator habit to explain what the post leaves out, and why its counts are exactly what the simulated town shows even though helmets work.

Question 10 A simulated household pays $4 500 for solar after a rebate, but its bill savings are only $550 a year. (a) How many years until the system has paid for itself? (b) What is the household's net position at year 10? (c) Is this household more or less likely to adopt than the $1 100-a-year household? Link your answer to one adopt reason in the figure.

Question 11 In the Landcare case study, the cost of storing carbon in soil falls on one farm while the benefit is shared by everyone. (a) Explain why this shape produces resistance even where everyone agrees with the science. (b) Name one change that shifts who pays, and say which projected outcome it alters.

Question 12 FluTracking volunteers choose themselves. Give one way the weekly totals could mislead if they were treated as if the whole population had been asked, and name the method step that catches the problem.

Question 13 For the GM-crop debate, give one empirical claim and one value claim used by (a) growers who adopted GM canola, and (b) people who resisted it.

Question 14 A household with rooftop solar is deciding whether to add a battery. List two projected outcomes that push towards adding one and two that push towards waiting, and label each of the four as empirical or value.

Question 15 In one of the case studies, find a single fact that appears as an adopt reason for one group and a resist reason for another. Name the fact and the two groups, and say which projected outcome each group is weighing.

Question 16 (8 marks) Issue analysis. Choose **either** rooftop solar **or** bicycle/e-scooter helmets, and examine it with the seven-step method, showing how different projected outcomes of the practice lead to varied support from individuals and groups. Your answer must: name the practice and the scientific knowledge behind it; identify at least two groups with different projected outcomes; split one empirical claim from one value claim in the debate; steelman the resisting view; and state your own position with reasons, including what evidence or outcome would change your mind.

Answers

Question 1 (a) empirical; (b) value; (c) empirical; (d) value. **Question 2** (a) the helmeted group, 48 vs 30; (b) 6.0 and 15 per 1 000 riders; (c) the helmeted group, 2.5 times lower (15 ÷ 6). **Question 3** (a) e.g. the evidence shows a real benefit (falling bills); the cost is low or money helps them change; people around them are doing it. (b) e.g. they cannot access it — the roof is not theirs; the cost falls on them (the landlord) while the benefit goes to someone else (the tenant). (c) "it clashes with what they value". **Question 4** (a) about 10 years; (b) 2022 to 2025, about 3 years; (c) e.g. people around them are doing it, or falling costs and money helping them change. **Question 5** (a) stage 1, the weekly survey; (b) step 5 — check the denominator and who was counted. **Question 6** (a) step 4; (b) step 6; (c) step 5. **Question 7** see solution. **Question 8** (a) "my risk on my short trip is tiny" — tested by crash and injury data for short, familiar trips; (b) the law should not control this choice; (c) see solution. **Question 9** see solution. **Question 10** (a) about 8.2 years; (b) +$1 000; (c) less likely — see solution. **Question 11** (a) see solution; (b) e.g. a shared-cost scheme — see solution. **Question 12** see solution. **Question 13** see solution. **Question 14** see solution. **Question 15** see solution. **Question 16** see solution for marking points.

Fully-worked solutions

Question 1 (a) Empirical — it says what will happen in crashes, and the combined studies test it. (b) Value — about who should decide; no measurement settles it. (c) Empirical — bills can be measured with and without panels. (d) Value — about what the buyer values; "worth paying extra" is not testable.

Question 2 (a) The helmeted group: 48 injuries against 30. (b) Helmeted: 48 ÷ 8 = 6.0 per 1 000 riders; unhelmeted: 30 ÷ 2 = 15 per 1 000 riders. (c) The helmeted group was safer per rider: 15 ÷ 6 = 2.5, so the unhelmeted rate is 2.5 times higher (the helmeted rate is 60% lower).

Question 3 (a) Any two that fit an owning family: the evidence shows a real benefit (their bills fall); the cost is low or money helps them change; people around them are doing it. (b) Any two that fit a renter: they cannot access it (the roof is not theirs); the cost falls on them and the benefit goes to other people; they lack the information to judge it. (c) "It clashes with what they value" — it says what ought to matter, so it is a value claim; "the evidence shows a real benefit" is testable, so empirical.

Question 4 (a) April 2012 to November 2022 is about 10 years. (b) The 3-million to 4-million gap, 2022 to 2025 — about 3 years, shorter than any other gap. (c) Any adopt reason that builds on itself: people around them are doing it (once a street has panels, the next house follows), or falling costs and money helping them change.

Question 5 (a) Stage 1 — volunteers answer the weekly survey (fever? cough?). (b) Step 5: read statistics carefully — check the denominator and who was counted. The volunteers are the sample, and they chose themselves.

Question 6 (a) Step 4 — check the empirical claims against evidence. (b) Step 6 — steelman each side. (c) Step 5 — check the denominator and who was counted.

Question 7 The figures are the same for both neighbours, but the projected outcomes are not. The neighbour who installs projects bill savings, a rising home value and a cleaner grid; the other neighbour projects a large upfront cost they would rather spend on other things, uncertainty about future payments for power sent back, or a roof they plan to replace soon. Each weighs the same facts against their own money, their own plans and their own values — so the same science supports two reasonable, opposite decisions. That is exactly the content description: diverse projected outcomes, varied support.

Question 8 (a) The empirical claim is "my risk on my short trip is tiny". It is tested by crash and injury data for short, familiar trips — which is where many urban crashes actually happen, so the claim is only partly fair. (b) The value claim is "the law should not care what I do" — a claim about who decides, not about risk. (c) A strong form: "For a low-speed, two-minute trip I have made safely for years, a legal penalty buys almost no safety and takes a small freedom — the rule should fit the risk." A good answer to it then notes that crashes are rare, unwarned events, that head injuries fall on families and hospitals as well as riders, and that a simple uniform rule is cheap to follow and hard to replace with case-by-case judgement.

Question 9 The post compares counts (how many injured riders wore helmets) and leaves out the denominator: how many riders of each kind there are. In the simulated town, most riders wear helmets (8 000 of 10 000), so even though

helmets cut the per-rider risk by 60%, the raw count of injured helmeted riders (48) is still higher than the unhelmeted count (30). The post's count is therefore exactly what a working helmet plus a mostly helmeted town looks like. The rates — 6 vs 15 per 1 000 — are the comparison that answers "do helmets work?", and they say yes.

Question 10 (a) \$4 500 ÷ \$550 a year ≈ 8.2 years. (b) 10 × \$550 − \$4 500 = +\$1 000. (c) Less likely. The benefit is still positive but the payback is slow, so "the evidence shows a real benefit" is weaker for this household, and any change — moving house, a repair bill, falling payments for exported power — can erase the small gain. Compare the \$1 100 household, whose system is \$6 500 ahead by year 10: the adopt column gets weaker as the projected money benefit shrinks.

Question 11 (a) Agreement with the science settles the empirical claim (healthy soil stores carbon) but not who carries the cost. The farmer projects years of work and money on their side of the ledger and a benefit they will never be paid for on the other; the wider community projects a benefit with almost no cost to itself. A practice whose cost and benefit fall on different people produces resistance from the payer even when everybody agrees about the facts. (b) Example: a shared-cost scheme that pays farmers for measured soil carbon. It moves part of the cost from the farm to the community that shares the benefit, and it changes the farmer's projected money outcome from "I pay, they gain" to "we both gain" — the second resist reason stops applying.

Question 12 People who already worry about flu, or who spend their days online, may join more than others, so the weekly totals could overstate (or understate) how much flu is really circulating if read as if everyone had been asked. Step 5 catches it: check the denominator and who was counted. Researchers therefore treat the totals as an early warning and check them against hospital and laboratory data.

Question 13 (a) Growers: empirical — GM canola needs fewer spray passes and gives more reliable harvests (measured on farms); value — a farmer should be free to choose the seed that suits their farm. (b) Resisters: empirical — long-term effects were uncertain when the crops were new (testable over time); value — food should be produced without engineered DNA, or buyers' willingness to pay extra for non-GM produce should be protected (a money outcome resting on a value claim).

Question 14 Towards adding: empirical — the battery stores cheap daytime generation for the evening, cutting bills further (measurable); value — the household values being independent of the grid, including during blackouts. Towards waiting: empirical — battery prices have been falling, so waiting may buy a better device (a testable projection); value or empirical mix — the household sees the upfront cost as money that could do more good spent another way (a weighing of outcomes). Any four reasons correctly labelled score; the mark is for keeping the testable claims and the values claims in separate columns.

Question 15 Example from the GM case study: the fact "GM canola tolerates a particular herbicide". Growers read it as an adopt reason — weeds controlled without killing the crop, fewer spray passes (money, environment). Some resisters read the same fact as a resist reason — a crop built to be sprayed with a herbicide clashes with the farming they value and with the market for produce grown without it (way of life, money). The fact is one; the projected outcomes weighed against it are different. (The solar case works too: "panels cut the home's power bills" is an adopt reason for the household and a resist reason for the electricity retailer.)

Question 16 A strong answer (helmets chosen here) moves through the method. Step 1: the practice is that every rider wears a helmet; the science is that a helmet absorbs impact, and combined studies find about 60% less head injury and about 58% less brain injury in a crash. Steps 2–3: riders project safety or lost choice; families and hospitals project fewer serious head injuries; governments project smaller health bills and a rule some voters dislike. Step 4: "helmets cut head-injury risk by about 60%" is empirical and tested; "the choice about my body is mine" is a value claim that no study settles. Step 5: injury statistics must be read as rates per rider, not counts — the "most injured riders wore helmets" count is what a mostly helmeted town produces anyway. Step 6: the resisting view in its strongest form — for short, slow, familiar trips the absolute risk is small, the rule buys little safety there, and it takes a freedom; and a helmet rule that makes riding look dangerous may put people off a healthy, clean transport. Step 7: a position with reasons — for example, that the rule should stay, because head injuries are rare, unwarned and costly to people besides the rider, and the rule is cheap to follow — together with what would change the mind: good evidence that the rule itself greatly reduces riding and harms health overall, or injury data showing the per-rider benefit is far smaller than the combined studies say. Marks are awarded for using the method and the evidence honestly on both sides, not for which position is chosen.

Where this leads: the skill this subtopic teaches — taking a socio-scientific issue, mapping the groups and their projected outcomes, and justifying a position — is exactly what VCE Biology Unit 2, Area of Study 3 ("How do humans use science to explore and communicate contemporary bioethical issues?") grades as a whole outcome, with Environmental Science Unit 2 Area of Study 3 ("How do scientific endeavours contribute to minimising human impacts on Earth's systems?"), Physics Unit 2 Area of Study 2 and Chemistry Unit 1 Area of Study 3 taking the same examination into their own content; all reference-only for this book (TOC D9, D12). The two habits this section builds — splitting empirical claims from value claims, and reading a statistic for its denominator and who was counted — are the prerequisites those VCE studies assume and do not re-teach.

Interpretation, misinformation and the values that set research priorities

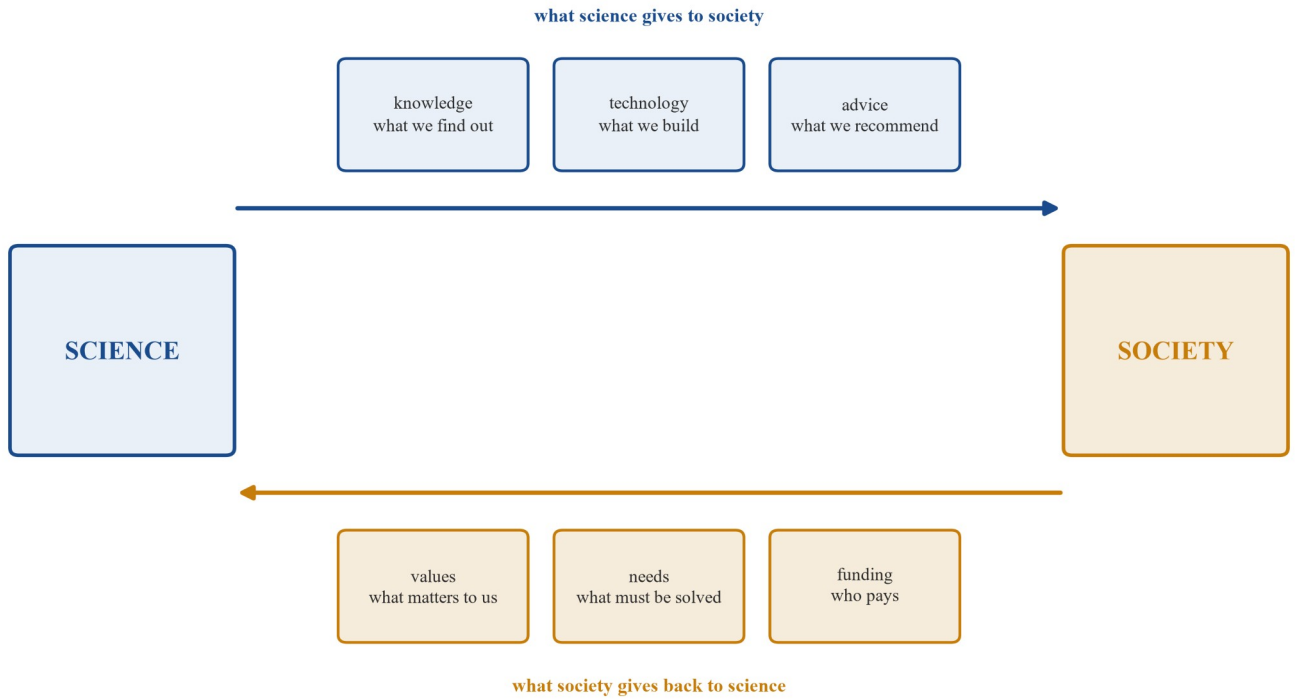
Chapter 16 — Use and influence of science (Science, Levels 9 and 10)

> **Subtopic 16B** · VC2 Use and influence of science
>
> **CD code:** `VC2S10H04` (delivered whole by this subtopic) **Content description (verbatim):** "scientific knowledge may be interpreted in different ways by individuals and groups in society; the values and needs of society can influence the focus of scientific research" **Elaboration ids drawn on:** `VC2S10H04.E01` · `VC2S10H04.E02` · `VC2S10H04.E03` · `VC2S10H04.E04` · `VC2S10H04.E05` · `VC2S10H04.E07` (id `VC2S10H04.E06` is not authored, under the TOC's D10 ICIP decision) **Achievement standard (verbatim):** "They discuss how scientific information and misinformation may inform personal and social decision-making and influence priorities for scientific research." **Maths interlocks (D11):** `VC2M10ST04` — analyse claims, inferences and conclusions of statistical reports in the media and other places, by linking claims to displays, statistics and representative data, including ethical considerations and identification of potential sources of bias (taught in Subtopic 5B; this subtopic reuses it on trend graphs and risk numbers).

The datasets in the figures are simulated data for practice; the real-world records carry source lines.

Theory

Subtopic 5B gave you the checks. This one asks the bigger question. Subtopic 5B taught you to assess a claim: what was measured, how big the sample was, whether the headline matched the study, who paid. This subtopic zooms out from the single claim to the whole of science and society, and it has two halves. First: once scientific knowledge is out in the world, *different people read it in different ways* — some readings are fair, some bend the data, and some are **misinformation** (information that is false or misleading, whether by accident or on purpose), and all of these feed the decisions you and your society make. Second: science does not study everything at once — *what it studies next is chosen*, and the choosing is driven by the values and needs of society and by whoever pays. The two halves meet in one picture.

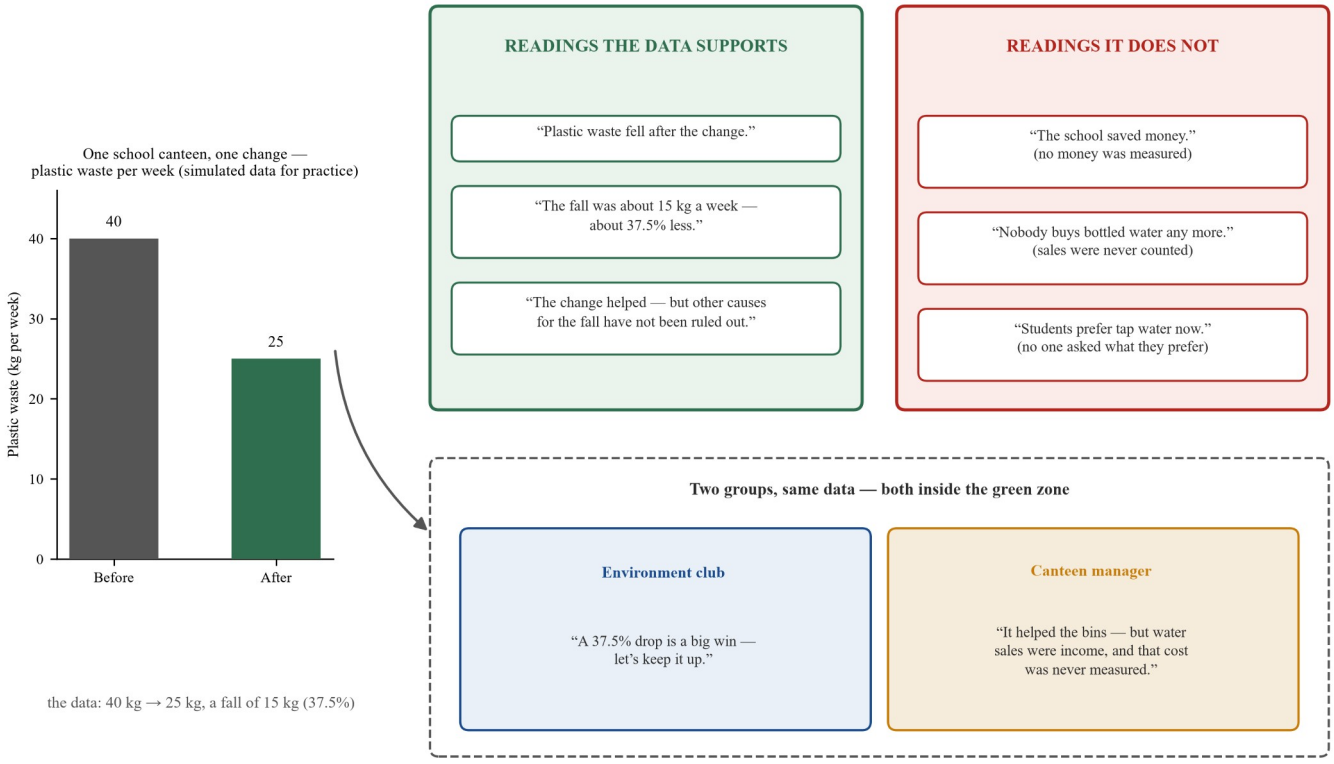


A two-lane diagram between a blue SCIENCE box on the left and an amber SOCIETY box on the right. The top lane, arrowed science to society and labelled "what science gives to society", carries three blue cards: knowledge (what we find out), technology (what we build), advice (what we recommend). The bottom lane, arrowed society to science and labelled "what society gives back to science", carries three amber cards: values (what matters to us), needs (what

must be solved), funding (who pays). Caption: science and society is a two-way street — this subtopic is about the bottom lane as much as the top

You have already spent this book on the top lane — knowledge, technology and advice are what the other fifteen chapters hand over. This subtopic lives on the bottom lane. Values, needs and funding flow *into* science, and they shape both how its knowledge is read and what it studies next. That is the content description in one picture.

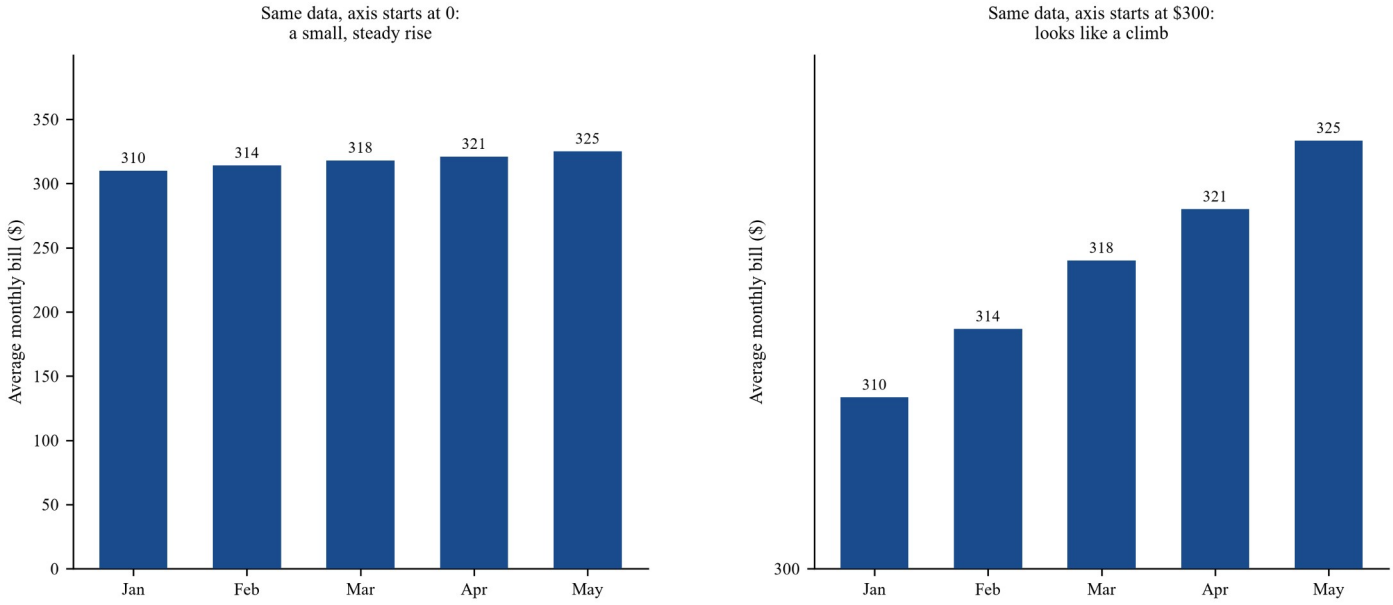
One dataset, different fair readings. The first limb of the content description says scientific knowledge *may be interpreted in different ways by individuals and groups in society*. An **interpretation** is a reading of what the knowledge means for you — and the same finding can genuinely mean different things to different groups, because the groups care about different things. Look at one small dataset read by two groups.



Left: a two-bar chart of simulated canteen data for practice, plastic waste per week 40 kg before and 25 kg after a change, labelled "the data: 40 kg to 25 kg, a fall of 15 kg (37.5%)". Top right: a green zone titled READINGS THE DATA SUPPORTS with three cards — "Plastic waste fell after the change", "The fall was about 15 kg a week — about 37.5% less", "The change helped — but other causes for the fall have not been ruled out"; and a red zone titled READINGS IT DOES NOT with three cards — "The school saved money (no money was measured)", "Nobody buys bottled water any more (sales were never counted)", "Students prefer tap water now (no one asked what they prefer)". Bottom: a dashed box titled "Two groups, same data — both inside the green zone" holding a blue Environment club card ("A 37.5% drop is a big win — let's keep it up") and an amber Canteen manager card ("It helped the bins — but water sales were income, and that cost was never measured")

Both groups are reading the *same* numbers, and neither is wrong. The environment club cares about waste, so to them the fall is a win worth keeping. The canteen manager cares about the budget, so she reads the same fall as a trade — the bottled water was also income, and nobody measured that side. Two different interpretations, both inside the green zone: both stay inside what was measured. That is the honest form of the content description's first limb. Different groups may weigh the same knowledge differently, because different things matter to them — and science still holds, because every fair reading sits inside the data. The red zone is the warning: interpretations that step *outside* what was measured — money saved, habits changed, preferences — are not interpretations of the data at all. They are new claims wearing the data's clothes.

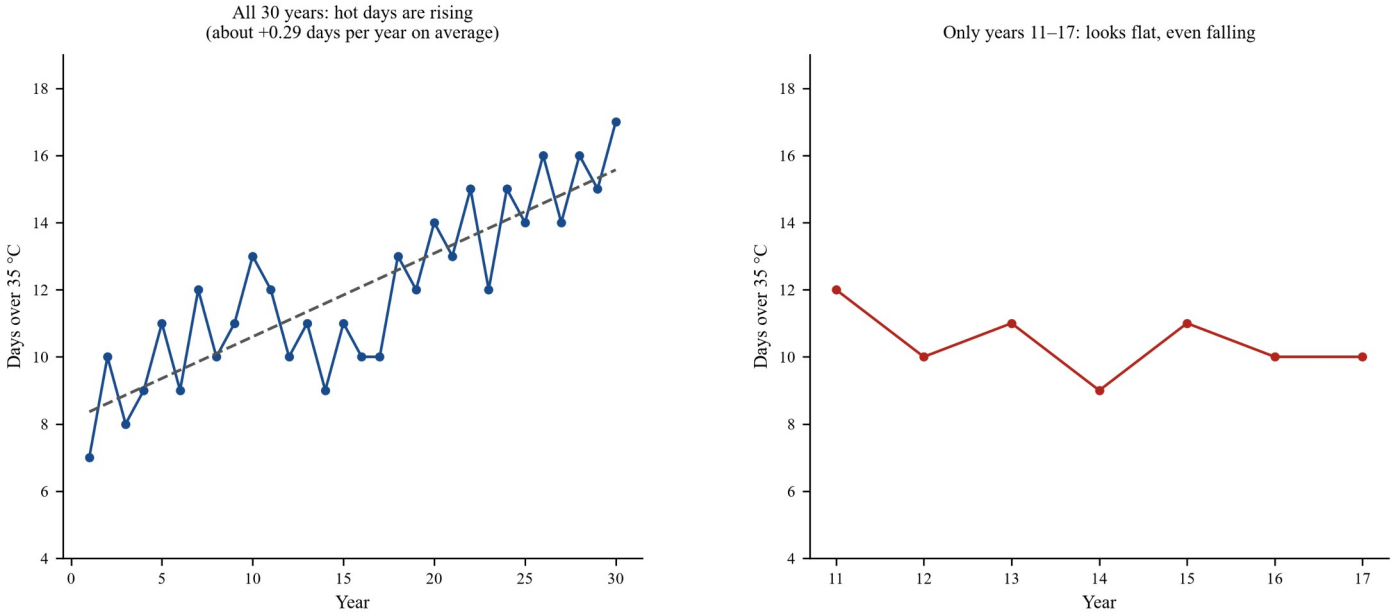
When the reading bends the data (elaboration `VC2S10H04.E04`). Between the green zone and the red zone sits the danger the elaboration names: *how data is analysed and interpreted can bias results to align with specific viewpoints.* A **bias** is a tilt in how data is handled that pushes the reading one way. Three tricks do most of the bending, and all three are matters of presentation — the numbers never change, only what you are shown of them. The first is the **truncated axis**: the same school electricity bills, drawn twice.



Simulated data for practice. The bills rose $310 → $325, a rise of $15 — about 4.8%. Nothing changed but the axis.

Two bar charts of the same simulated data for practice: an average monthly electricity bill of $310, $314, $318, $321 and $325 from January to May. Left panel, axis from 0 to 400, titled "Same data, axis starts at 0: a small, steady rise", the bars look almost level. Right panel, axis from 300 to 330, titled "Same data, axis starts at $300: looks like a climb", the same bars look steeply rising. Caption: the bills rose $310 to $325, a rise of $15, about 4.8% — nothing changed but the axis

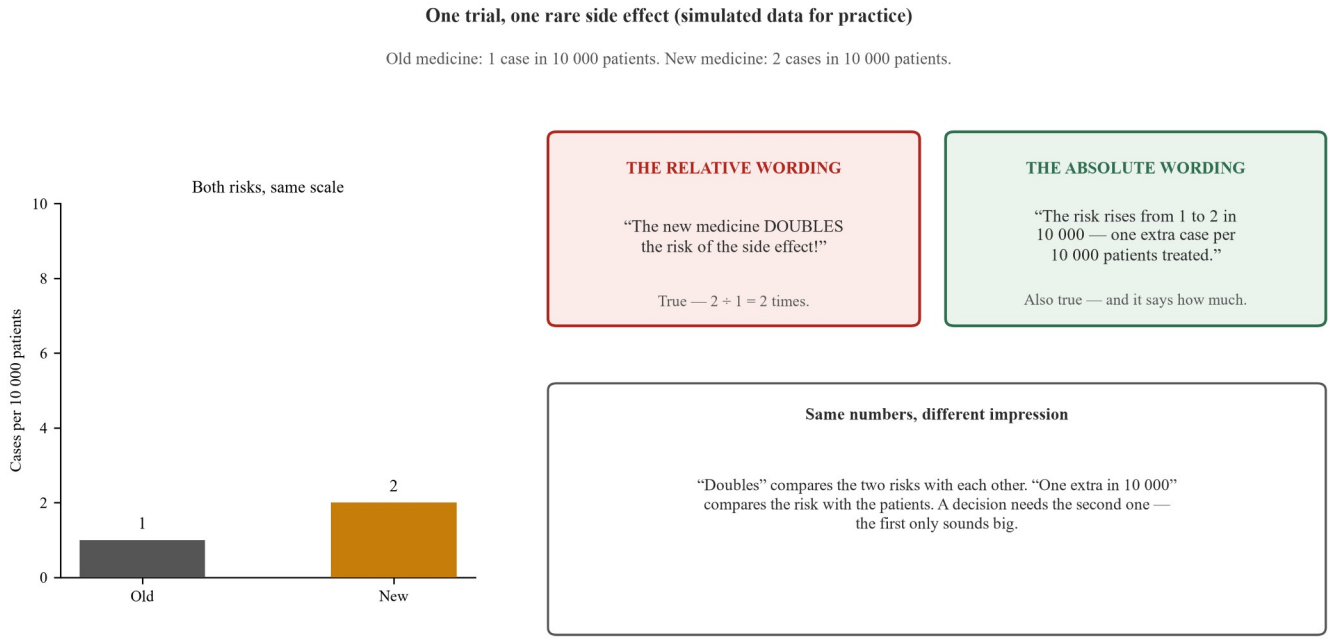
Nothing about the bills is different between the panels — $310 to $325 is a rise of $15, about 4.8%, in both. What changed is the axis, and with it the story your eye tells you: a quiet rise on the left, an alarming climb on the right. A truncated axis is not always a lie — zooming in is honest if the caption says so — but it is the classic way to make a small change look like a big one, and it is exactly "analysis or interpretation biasing results to align with a viewpoint". This is where the maths interlock `VC2M10ST04` bites: link the claim to the *display* before you believe the shape. The second trick is the **cherry-picked window** — the same series, shown twice, with the right-hand panel starting and stopping where the noise happens to dip.



Simulated data for practice. Same series both times — the right panel just starts and stops where the noise dips.

Two line graphs of the same simulated 30-year series of days over 35 degrees Celsius for practice. Left panel, titled "All 30 years: hot days are rising (about +0.29 days per year on average)", shows a noisy rising line with a dashed upward trend line. Right panel, titled "Only years 11 to 17: looks flat, even falling", shows just the seven points where the noise dips. Caption: same series both times — the right panel just starts and stops where the noise dips

You met cherry-picking in Subtopic 5A as a honesty failure in arguments; here it is the same failure wearing a graph. Over all 30 years the series rises at about 0.29 days per year on average — the first five years average 9 hot days, the last five average 15.6. Yet the seven-year window a sceptical reader might quote (years 11–17) genuinely slopes *down*, because those years happen to run 12 down to 10. Neither panel invents a number; the bias is in the frame. The check is the one from `VC2M10ST04`: *how much of the picture am I being shown, and who chose the edges?* The third trick is the **relative-versus-absolute switch** — one risk, told two true ways that feel nothing alike.

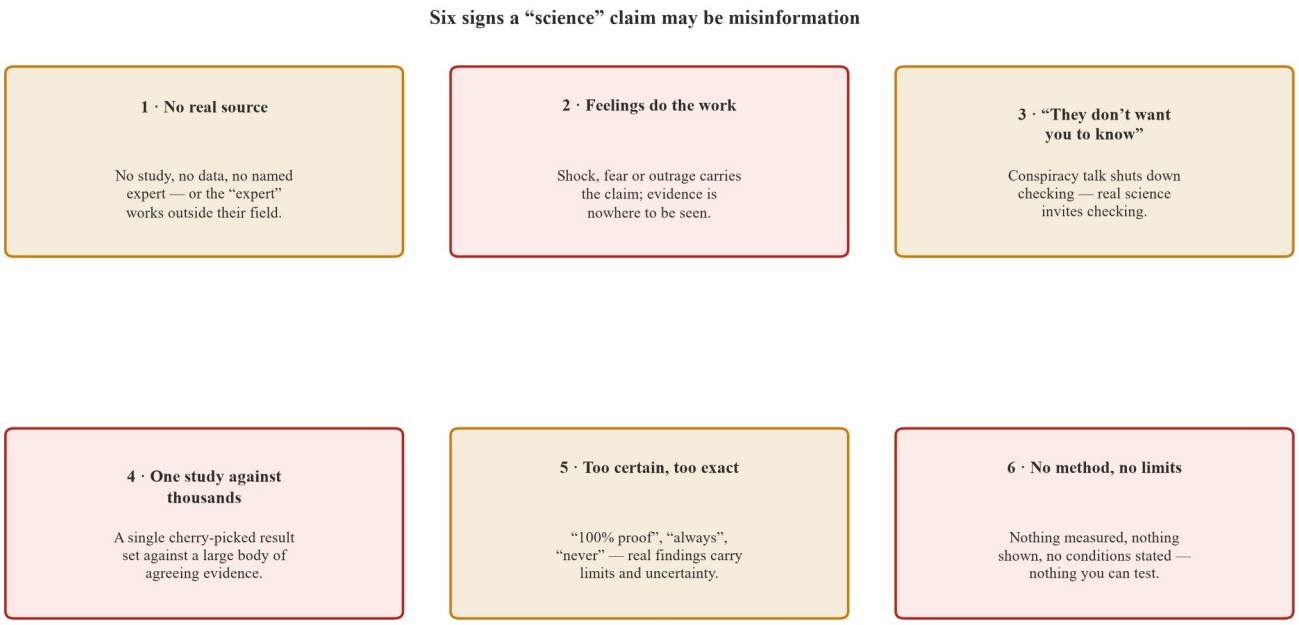


Top line: one trial, one rare side effect (simulated data for practice) — old medicine 1 case in 10 000 patients, new medicine 2 cases in 10 000 patients. Left: a small bar chart on one honest scale showing 1 and 2 cases per 10 000. Middle: a red card, THE RELATIVE WORDING — "The new medicine doubles the risk of the side effect!" (true — 2 divided by 1 is 2 times). Right: a green card, THE ABSOLUTE WORDING — "The risk rises from 1 to 2 in 10 000 — one extra case per 10 000 patients treated" (also true — and it says how much). Bottom box, "Same numbers,

different impression": "doubles" compares the two risks with each other; "one extra in 10 000" compares the risk with the patients — a decision needs the second one

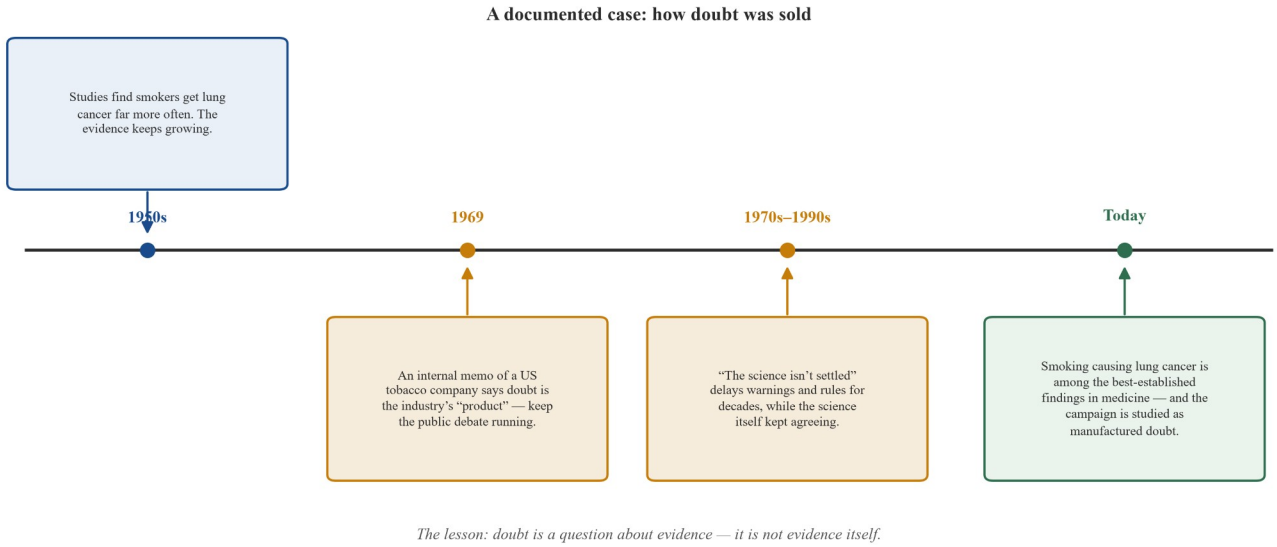
Both wordings are arithmetically true, and that is what makes this trick dangerous: nobody has lied. "Doubles" is a **relative** statement — it compares the new risk with the old one. "One extra case per 10 000" is an **absolute** statement — it compares the risk with the people taking it. A person deciding whether to take the medicine needs the absolute number; the relative number only tells them how the two risks compare. Whenever a claim hands you a percentage or a "times more", ask *more than what, and how big was the starting amount?* — that single question is `VC2M10ST04` doing its job.

Misinformation — a claim with no evidence behind it. The achievement standard for this subtopic pairs *information* with *misinformation*, because the two travel the same roads and must be told apart. Misinformation is not the same as the bent interpretations above: a bent reading starts from real data and leans on it, while misinformation has no data leaning behind it at all. Six signs catch most of it.



Six cards, numbered. 1, No real source — no study, no data, no named expert, or the "expert" works outside their field. 2, Feelings do the work — shock, fear or outrage carries the claim and evidence is nowhere to be seen. 3, "They don't want you to know" — secret-plot talk shuts down checking, while real science invites checking. 4, One study against thousands — a single cherry-picked result set against a large body of agreeing evidence. 5, Too certain, too exact — "100% proof", "always", "never", when real findings carry limits and uncertainty. 6, No method, no limits — nothing measured, nothing shown, no conditions stated, nothing you can test

Notice what the signs have in common: every one of them is a missing *check* — the checks Subtopic 5B taught you to run. That is the point. Misinformation survives only where checking stops, which is why sign 3 is the tell of tells: real science publishes its method so that strangers can try to prove it wrong, while a claim that pre-excuses every check ("they don't want you to know") is protecting itself from exactly the thing that would make it trustworthy. And misinformation is not a new trick. The best-documented case in history ran for decades and is still studied today.

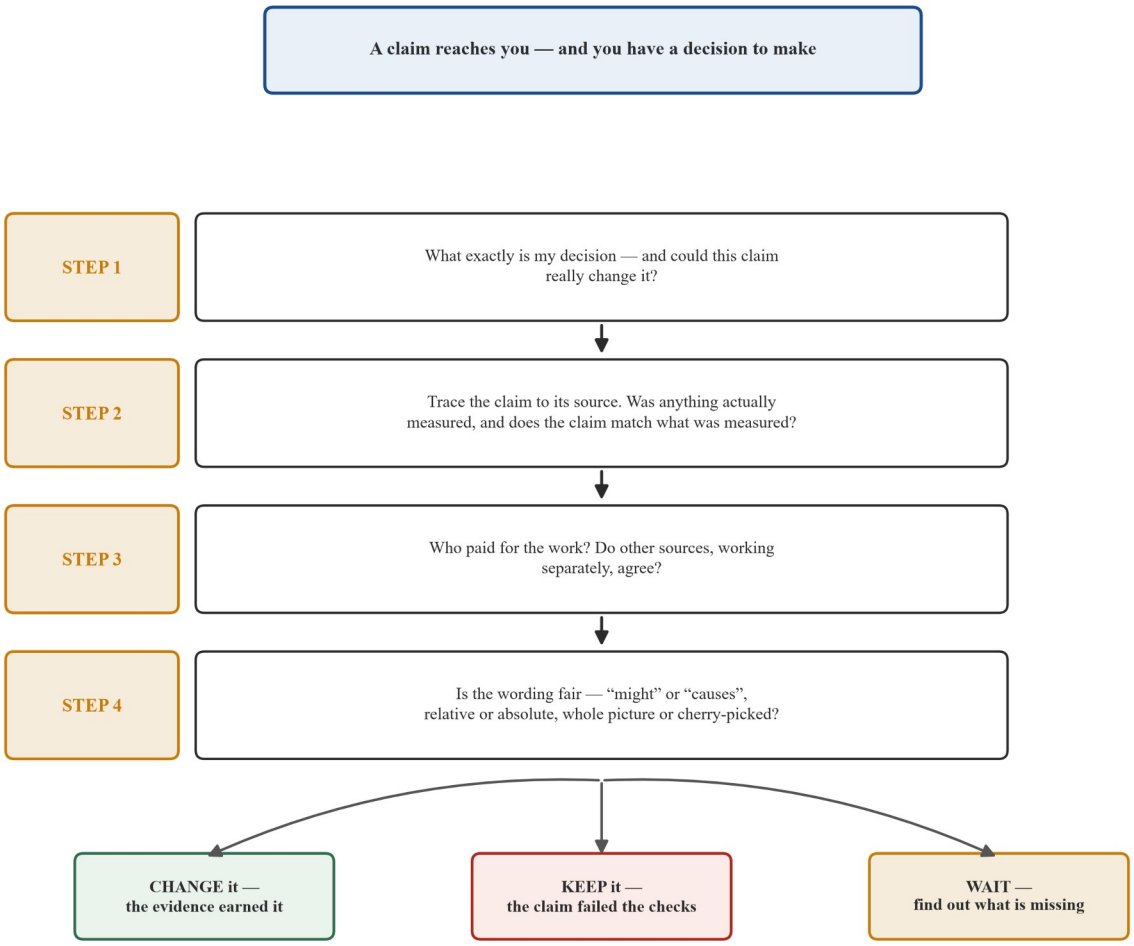


A four-stop timeline titled "A documented case: how doubt was sold". 1950s: studies find smokers get lung cancer far more often, and the evidence keeps growing. 1969: an internal memo of a US tobacco company says doubt is the industry's "product" — keep the public debate running. 1970s to 1990s: "The science isn't settled" delays warnings and rules for decades, while the science itself kept agreeing. Today: smoking causing lung cancer is among the best-established findings in medicine, and the campaign is studied as manufactured doubt. Caption line: doubt is a question about evidence — it is not evidence itself

Read the timeline slowly, because it is the whole subtopic in one case. By the 1950s the medical evidence on smoking and lung cancer was strong and only getting stronger. The industry's answer, in its own 1969 words, was that *doubt* was its product: not better science, but a louder debate, so that "the science isn't settled" could delay warnings and rules for decades. The public heard two "sides" and concluded the question was open — while among the people who had actually measured, it never was. The lesson is precise: genuine doubt is a question about evidence (*how strong is it, what would change it?*), and it is healthy — manufactured doubt is a strategy, and it is the oldest form of misinformation on record.

Truth Tobacco Industry Documents (UCSF Library), "Smoking and Health Proposal", 1969. industrydocuments.ucsf.edu — retrieved 21 August 2026.

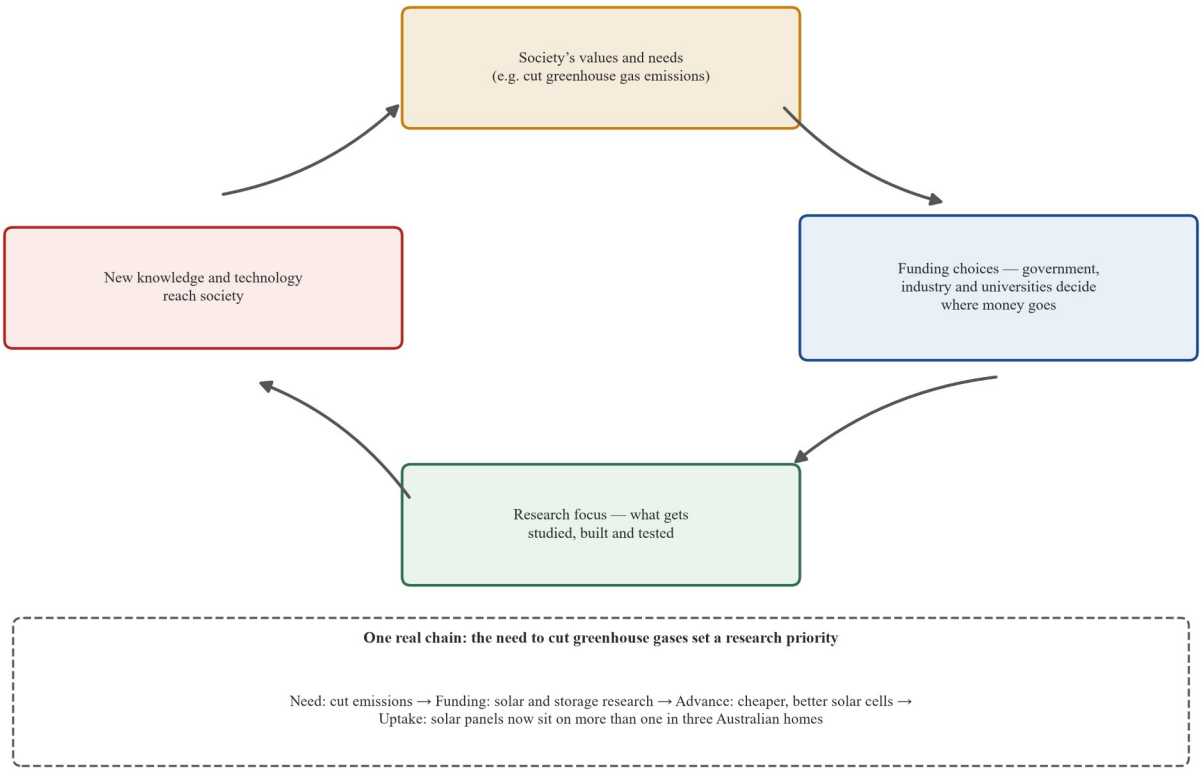
From a claim to a decision. The achievement standard says scientific information and misinformation *inform personal and social decision-making* — so the skill ends not in a verdict on the claim but in a decision of your own. Four steps carry any claim from your feed to your choice.



A four-step ladder under the heading "A claim reaches you — and you have a decision to make". Step 1: what exactly is my decision — and could this claim really change it? Step 2: trace the claim to its source — was anything actually measured, and does the claim match what was measured? Step 3: who paid for the work — do other sources, working separately, agree? Step 4: is the wording fair — "might" or "causes", relative or absolute, whole picture or cherry-picked? Three verdict boxes below the ladder: CHANGE it — the evidence earned it; KEEP it — the claim failed the checks; WAIT — find out what is missing

Step 1 is the one everyone skips and the one that matters most: a claim only deserves checking if it could actually change something you are deciding. Steps 2 to 4 are the checks you now know — source and measurement, funding and agreement, fairness of wording — and the three verdicts are honest endings, including WAIT: *find out what is missing* is a decision, not a failure. The ladder works the same way for a social decision — a council weighing a health claim, a government weighing a climate one — as for a personal one. The standard's two words, *personal and social*, are doing exactly that work.

Values and needs set the research focus (elaboration `VC2S10H04.E07`). Turn now to the second limb of the content description. The top lane of the two-way street is not a tap science turns on wherever it likes: *the values and needs of society influence the focus of scientific research*, and the mechanism is the one the elaboration names — **financial support from governments or commercial organisations is needed for scientific developments, and it can determine what research is undertaken.** Money is finite; every funded project is a thousand unfunded ones; so the question a society answers with its budget is *what do we need enough to pay someone to find out?*



A four-stage loop: Society's values and needs (example given: cut greenhouse gas emissions) leads to Funding choices — government, industry and universities decide where money goes; that leads to Research focus — what gets studied, built and tested; that leads to New knowledge and technology reach society; and that feeds back into society's values and needs. Below, a dashed box titled "One real chain: the need to cut greenhouse gases set a research priority": Need — cut emissions, then Funding — solar and storage research, then Advance — cheaper, better solar cells, then Uptake — solar panels now sit on more than one in three Australian homes

Follow the loop once with the real chain in the box. The *need* — cutting greenhouse gas emissions — made governments and industry *fund* solar and storage research; that funding set the *focus* — cells, batteries, inverters; the *advance* that came back was cheaper, better solar technology; and the *uptake* is visible on Australian roofs, where more than one in three homes now has solar panels. Nothing in the loop is a weakness. The loop is how a society points its science at its problems — the elaboration says this determines what research is undertaken, and that is a fact to understand, not a scandal. The skill the standard asks for is seeing the loop running: when you read what research is happening, ask *whose value, whose need, whose money?*

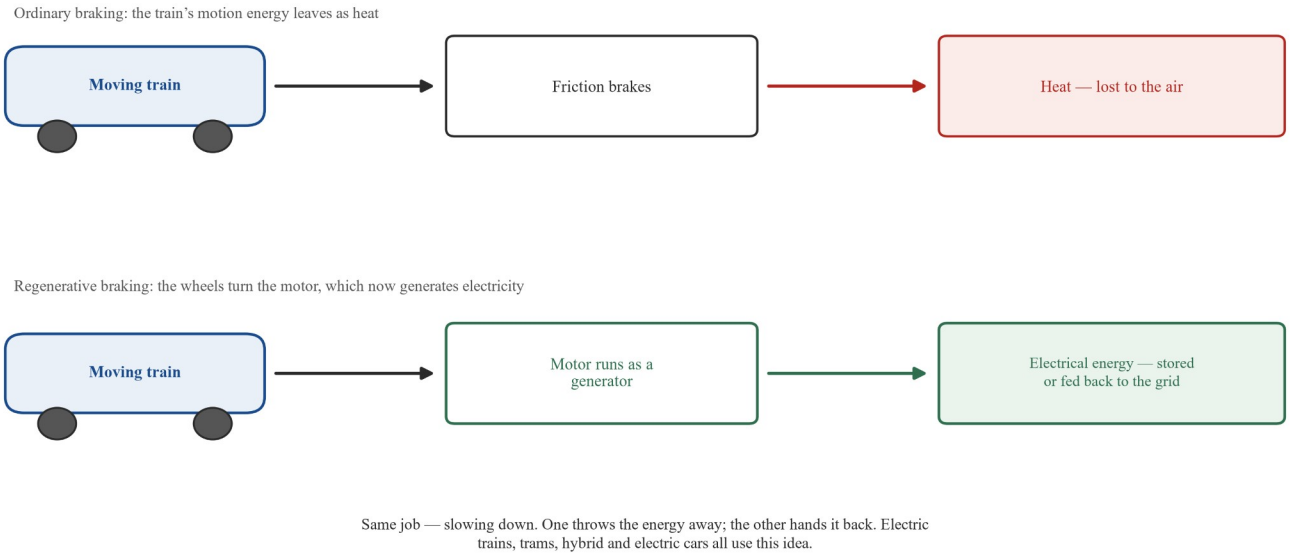
Four windows on values setting direction. The elaborations give four concrete windows onto the loop, and each one is a place where a societal value or need pulled research in a direction it would not otherwise have gone.

Window 1 — the need to cut greenhouse gases (elaboration `VC2S10H04.E01`). The same need behind the solar chain above has driven scientific and technological advances right across energy: better cells, bigger batteries, smarter grids. One finding shows the loop working today: CSIRO's annual GenCost comparison of new electricity generation finds new large-scale solar and wind the cheapest new-build options — a result that itself steers where the next research dollar goes, because the need that funded the research now meets the economics the research produced.

CSIRO, "GenCost 2024-25", 2025. csiro.au — retrieved 21 August 2026. Clean Energy Council, "Clean Energy Australia", 2026. cleanenergycouncil.com.au — retrieved 21 August 2026.

Window 2 — innovative energy-transfer devices (elaboration `VC2S10H04.E02`). The need to waste less energy produced a class of devices that catch energy mid-transfer and hand it back. The cleanest example is **regenerative braking**: the trick of making a vehicle's motor run backwards as a generator whenever it slows.

An energy-transfer device: regenerative braking (E02)

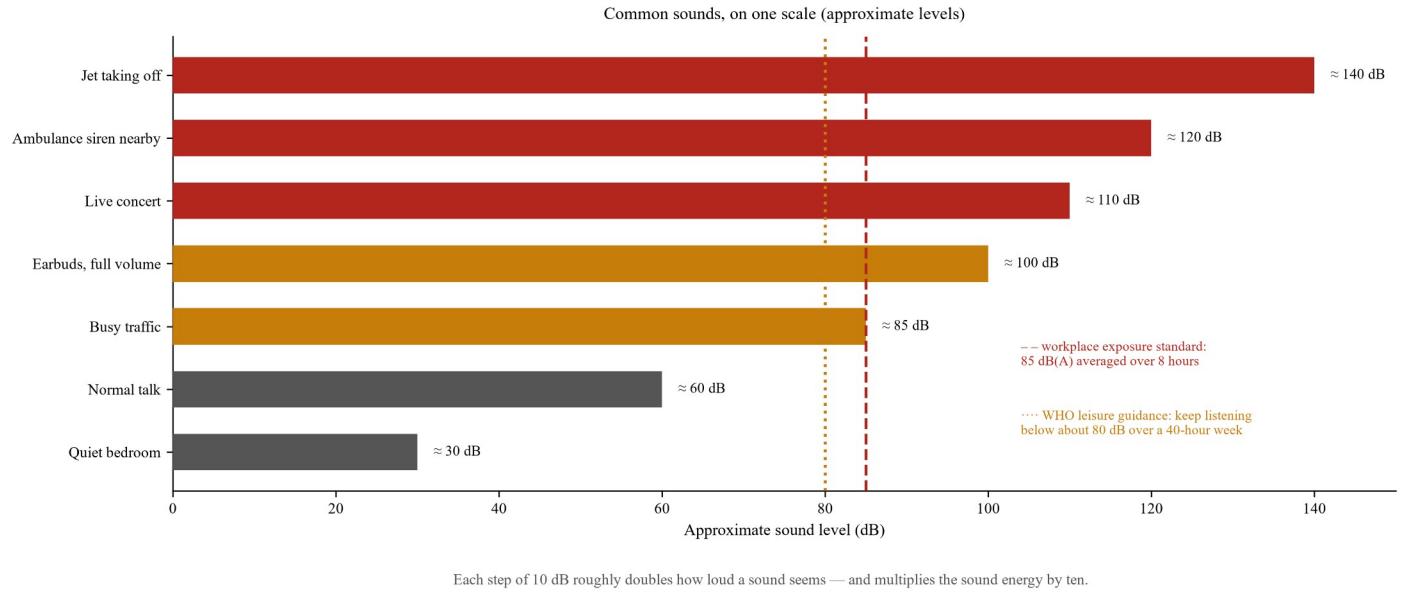


Same job — slowing down. One throws the energy away; the other hands it back. Electric trains, trams, hybrid and electric cars all use this idea.

Two horizontal lanes. Top lane, ordinary braking: a moving train leads to friction brakes, which lead to a red box, heat — lost to the air. Bottom lane, regenerative braking: a moving train leads to the motor running as a generator, which leads to a green box, electrical energy — stored or fed back to the grid. Caption: same job — slowing down; one throws the energy away, the other hands it back; electric trains, trams, hybrid and electric cars all use this idea

Ordinary friction braking turns a vehicle's motion energy into heat and loses it to the air — every stop throws the energy away. Regenerative braking turns the same slowing into electrical energy, stored on board or fed back to the grid, so a train that stops at every station recovers a share of the energy it spent getting there. Trams, electric trains, and hybrid and electric cars all use the idea, and several of the devices that carry it — the power electronics, the battery chemistry, the control systems — exist because the need to cut emissions and fuel use paid for the research. Communication runs the same window: the demand for faster, smaller, cooler devices drove the research behind the optical fibres and chips your phone already uses.

Window 3 — safe sound levels (elaboration `VC2S10H04.E03`*).* The value here is a health one: hearing, once damaged, does not grow back. New materials and procedures — better ear protection, noise-cancelling earphones that let you turn the volume down, quieter tools, roster rules that rest your ears — exist because workplaces and leisure industries were given levels to meet. Two numbers set the frame.

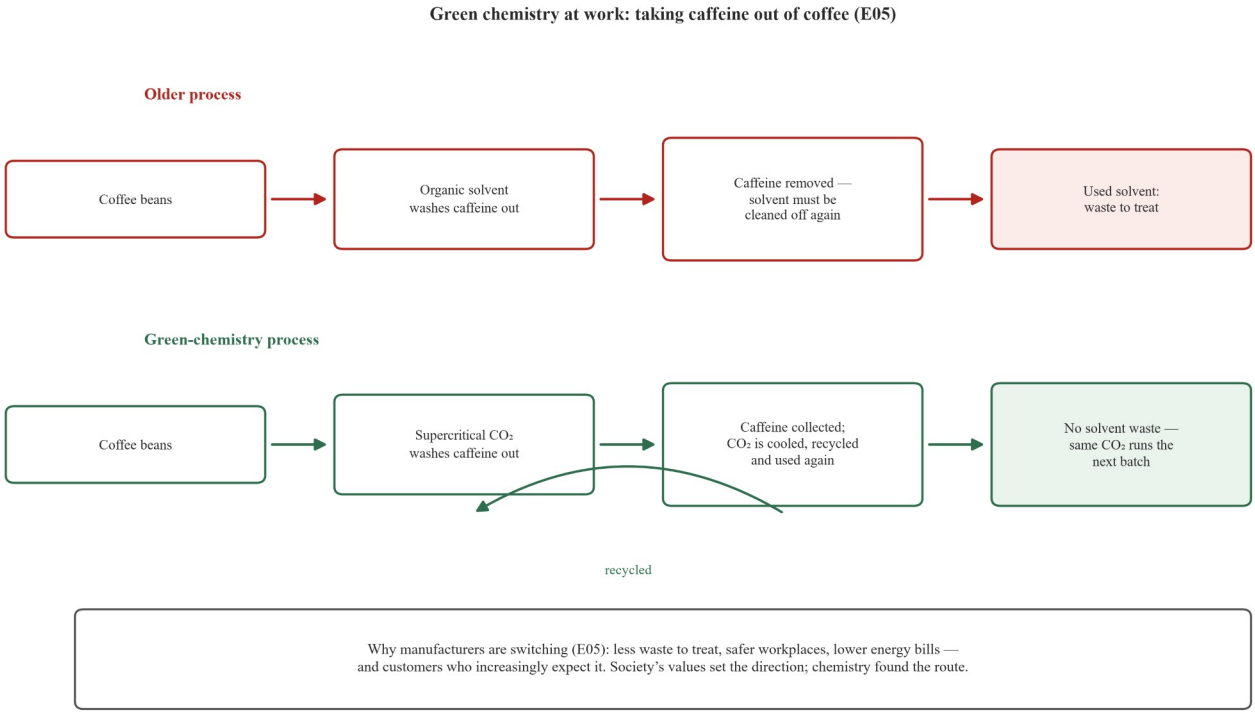


A horizontal bar chart of approximate sound levels on one scale: quiet bedroom about 30 dB, normal talk about 60 dB, busy traffic about 85 dB, earbuds at full volume about 100 dB, live concert about 110 dB, ambulance siren nearby about 120 dB, jet taking off about 140 dB. A red dashed vertical line marks the workplace exposure standard, 85 dB(A) averaged over 8 hours; an amber dotted line marks the WHO leisure guidance, keep listening below about 80 dB over a 40-hour week. Caption: each step of 10 dB roughly doubles how loud a sound seems and multiplies the sound energy by ten

In Australian workplaces, the exposure standard for noise is 85 dB(A) averaged over an 8-hour day — above it, the employer must act. For leisure listening, the World Health Organization's guidance is to keep it below about 80 dB over a 40-hour week. Read the chart against those two lines: busy traffic sits *at* the workplace standard, while earbuds at full volume (about 100 dB) sit two 10-dB steps above the leisure guidance — and because each 10 dB multiplies the sound energy by ten, that is about 100 times the energy of the guided level, seeming roughly four times as loud. This is the elaboration in one picture: the *need* (hearing loss in workplaces and in young listeners) set the *focus* (materials and procedures that hold levels safe), and the advances — from foams and muffs to cancelling circuitry — are the loop's return.

Safe Work Australia, "Managing noise and preventing hearing loss at work", 2026. safeworkaustralia.gov.au — retrieved 21 August 2026. World Health Organization, "Make Listening Safe", 2026. who.int — retrieved 21 August 2026.

Window 4 — green chemistry (elaboration `VC2S10H04.E05`). The last window is the one where the value has moved inside the factory: many manufacturers are adopting **green chemistry** — designing chemical processes so they make less hazardous waste, use less energy, and recycle what they use. The everyday case is decaffeinated coffee.



Two process lanes for taking caffeine out of coffee. Top lane, older process (red): coffee beans lead to an organic solvent washing the caffeine out, which leads to caffeine removed but the solvent needing to be cleaned off again, which leads to a shaded red box, used solvent — waste to treat. Bottom lane, green-chemistry process (green): coffee beans lead to supercritical carbon dioxide washing the caffeine out, which leads to caffeine collected while the carbon dioxide is cooled, recycled and used again, which leads to a shaded green box, no solvent waste — the same carbon dioxide runs the next batch; a curved recycle arrow runs back from the collecting stage to the washing stage. Caption: why manufacturers are switching — less waste to treat, safer workplaces, lower energy bills, and customers who increasingly expect it

The older route washed caffeine out of beans with organic solvents, leaving spent solvent to clean up and treat as waste at every batch. The green route uses carbon dioxide held under high pressure — **supercritical** carbon dioxide, a state between gas and liquid that dissolves caffeine well — which is then cooled, freed of caffeine, and run through the next batch: the solvent never becomes waste because it never leaves the loop. Manufacturers adopt it for the reasons in the caption — less waste to treat, safer workplaces, lower energy bills — and underneath those reasons sits the value the elaboration points at: a society that increasingly expects its goods made cleanly is a market that pays for clean making. The values set the direction; chemistry found the route.

When values disagree. The loop's first stage is *society's values and needs* — but societies contain more than one value, and they can rank differently. Suppose a government holds one large research fund and two strong applications: a vaccine for a rare disease that affects a small number of Australians, and a cheaper, cleaner way to make steel, which would cut emissions on a national scale. Two fair views of the same money:

- **Fund the vaccine.** A society is judged by how it treats its most vulnerable. The rare-disease patients have no commercial funder at all — no company will recover the cost from so few buyers — so public money is the *only* money that will ever do this research. The steel work, by contrast, has an industry with a profit motive behind it; if government does not fund it, firms may still.
- **Fund the steel.** Cleaner steelmaking cuts emissions at national scale and lowers costs across the economy, helping millions — including the most vulnerable — and the planet's emissions window does not wait. Rare-disease treatments developed overseas can be bought in later; a missed emissions cut cannot be bought back.

Neither view misreads the science; they rank the *values* differently — care for a few now against benefit for many over time — and both rankings are defensible. That is the second limb of the content description at full strength: values and needs do not whisper behind the research, they *are* the first stage of the loop, and a society can honestly disagree about them. The discipline the subtopic asks for is the same one the funding elaboration asks for: make the

value visible. A funding choice stated as "this is what we need, this is why we pay for it" is science and society working in the open — which is exactly where the standard's discussion begins.

Activities

Activity 1 — Two fair readings, one unfair one. Work in pairs with the canteen dataset of the interpretation-space figure (40 kg to 25 kg of plastic waste per week). (1) Choose two groups in your school with different jobs or cares (for example, the principal and the waste-contractor) and write one fair reading of the data for each — each reading must stay inside the green zone. (2) Write a third reading that the data does *not* support, and state exactly which measured quantity it steps outside (like the red-zone cards do). (3) Swap with another pair and sort their three readings into the green and red zones, giving one reason per card.

Activity 2 — The misinformation clinic. Take three short "science" posts your teacher provides (or the simulated posts from the practice questions). For each: (1) run the six signs from the misinformation figure and record which signs appear; (2) state which of Subtopic 5B's five headline checks the post would fail first; (3) rewrite the post so it says only what its evidence supports — or mark it *unsalvageable* if no evidence is offered at all. Then choose one real decision you expect to make this month that a claim might influence, and walk it up the decision ladder, ending in one of the three verdicts.

Activity 3 — Follow the money (elaboration `VC2S10H04.E07`). Using news items or pages your teacher provides, list three real research projects currently funded in Australia. For each, record: who pays (government or commercial), the need or value the funder has in it, and the question the research will answer. Then, as a class, answer the loop's shadow question: name one important question that has *no* funder at present, and discuss — without taking sides — which value a society would be showing if it chose to fund that question next.

Worked examples

Datasets in this section are simulated data for practice.

Example 1 — scaffolded

A report on a school's electricity bills shows the five monthly averages from the axis-trick figure: \$310, \$314, \$318, \$321, \$325 (January to May).

(a) Calculate the rise in the average bill from January to May.

(b) Express that rise as a percentage of the January bill, to one decimal place.

(c) One panel of the figure makes the rise look like a steep climb. Using your answers to (a) and (b), explain which display is the fairer one and why the other biases the reading (elaboration `VC2S10H04.E04`).

Working	Comment
(a) \$325 − \$310 = \$15	The rise is a fact about the numbers, the same in both panels.
(b) 15 ÷ 310 ≈ 0.048, so about 4.8%	A percentage puts the size of the rise in plain sight.
(c) The panel whose axis starts at \$0 is fairer: the bars then show the rise as what it is, about 4.8% on top of a large bill. The truncated panel starts its axis at \$300, so a \$15 rise fills half the picture	The numbers never changed — only the frame did. A frame chosen to make a small rise look large is the bias the elaboration names.

The data supports "the bills rose steadily, by about 4.8% over five months". It does not support "the bills are climbing out of control" — that reading comes from the frame, not from the figures.

Example 2 — scaffolded

A trial of a new medicine finds a rare side effect in 2 of 10 000 patients; the old medicine showed it in 1 of 10 000 (the relative-versus-absolute figure).

(a) Write the **relative** comparison of the two risks.

(b) Write the **absolute** extra risk of the new medicine.

(c) A patient must decide whether to take the new medicine. Which wording should sit in front of them, and why is the other wording true but not enough?

Working	Comment
(a) 2 ÷ 1 = 2 — the risk *doubles* (two times the old risk)	Relative statements compare the two risks with each other.
(b) 2 − 1 = 1 extra case per 10 000 patients treated	Absolute statements compare the risk with the people taking it.
(c) The absolute wording. "Doubles" sounds alarming but hides that both risks are tiny; "one extra case in 10 000" says how much risk is actually being added	A decision needs the size of the thing decided about. The relative number is true — it just is not the number a decision runs on.

Both wordings pass the arithmetic; only one passes the decision. When a claim offers you "doubles", "triples" or "50% more", ask for the starting amount before you feel anything.

Example 3 — unscaffolded

A post quotes the window-trick figure's right panel and claims: *"The last data shows hot days falling — the rising trend is wrong."* Assess the claim as elaboration `VC2S10H04.E04` directs, using the full 30-year series (first five years averaging 9 hot days, last five averaging 15.6, trend about +0.29 days per year).

The claim's numbers are real — years 11–17 do slope down — so the assessment is an assessment of the *frame*, not the figures. Run the checks. Size of picture: the post shows 7 of 30 years, chosen (or received) where the noise dips; the full series rises at about +0.29 days per year. Direction of the edges: the quoted window begins just after a high run (year 10 at 13 days) and ends in a low run (year 17 at 10), the exact shape a falling line needs; first-five versus last-five means (9 against 15.6) show the opposite movement over the whole record. So the claim is a cherry-picked window presented as the whole picture — a reading biased to a viewpoint by the choice of frame, which is precisely the elaboration's warning. The fair statement of the same data is: *hot days vary year to year and rise on average over the full record; the years 11–17 dip is part of that noise, not a trend.*

Example 4 — unscaffolded

Take the green-chemistry figure (decaffeinating coffee). Trace the change from the older solvent process to the supercritical carbon-dioxide process through the four stages of the priority loop, and name the value sitting at the loop's first stage.

Values and needs. A society increasingly expects goods made without hazardous waste; workplaces must keep exposures safe; waste costs money to treat. Those needs are the first stage. **Funding choices.** Manufacturers — and the research bodies they work with — put money behind processes that cut waste and energy, because the needs above make clean processes pay. **Research focus.** Chemists study alternatives to organic solvents; high-pressure carbon dioxide gets the work because it can dissolve caffeine and then be recovered. **Advance reaching society.** The recycled-CO_2 route: no spent solvent to treat, safer workplaces, lower energy bills — and decaffeinated coffee the buyer trusts. The value at the first stage is the whole chain's engine: *waste and hazard should be designed out, not cleaned up* — and the elaboration's observation is that manufacturers adopt green chemistry not despite the market but because the market's values now reward it. A society that had ranked cheapness above all else would have paid for the other route instead.

Practice questions

Scaffolded questions

Question 1 Use the two-way-street figure. (a) Name the three things the figure shows science giving to society. (b) Name the three things the figure shows society giving back to science. (c) Which lane is this subtopic mostly about, and which lane did the rest of the book mostly travel?

Question 2 Use the interpretation-space figure (40 kg to 25 kg of plastic waste per week). (a) State the environment club's reading and the canteen manager's reading. (b) Both readings are fair. What keeps them both inside the green zone? (c) Why does "the school saved money" belong in the red zone?

Question 3 Use the axis-trick figure ($310 to $325, January to May). (a) Calculate the rise and express it as a percentage of the January bill to one decimal place. (b) Which panel biases the reading towards "alarming climb", and by what choice? (c) A truncated axis is not always dishonest. State one honest use of a zoomed axis.

Question 4 Use the relative-versus-absolute figure (1 in 10 000 against 2 in 10 000). (a) State the relative wording and show its arithmetic. (b) State the absolute wording and show its arithmetic. (c) Why does a person deciding whether to take the medicine need the absolute wording?

Question 5 Use the six-signs figure and the tobacco timeline. (a) The tobacco industry's "the science isn't settled" campaign — which two of the six signs does it show, and why? (b) Which sign is about words like "always", "never" and "100% proof"? (c) The timeline's lesson line says doubt is a question about evidence, not evidence itself. Explain the difference in your own words.

Question 6 Use the priority-loop figure and its real chain. (a) Put the four stages of the loop in order, starting from values and needs. (b) In the solar chain, name the need, the funding, the advance and the uptake. (c) Elaboration `VC2S10H04.E07` names two kinds of funder. Name them, and say what their choices can determine.

Unscaffolded questions

Question 7 Use the window-trick figure. A post claims: *"Years 11 to 17 prove the hot-day trend is falling."* Without recalculating anything, give the two checks from `VC2M10ST04` (as used in this subtopic) that catch the problem, and state what the full series shows instead, using the two five-year means (9 and 15.6) and the trend of about +0.29 days per year.

Question 8 A simulated post reads: *"SECRET REPORT they don't want you to see: the new additive in school canteen food is 100% safe — experts agree, always. Share before it's deleted!"* Run the six signs over it, listing each sign the post shows with a phrase from the post as evidence. Then write the one question you would need answered before the claim could be checked at all.

Question 9 A friend says: *"My uncle smoked his whole life and never got lung cancer, so the smoking evidence must be weak."* Using the tobacco timeline and the idea that doubt is a question about evidence, explain (a) why one counter-example does not undo a body of evidence, and (b) what made the smoking-and-lung-cancer finding strong in the first place.

Question 10 Use the sound-levels figure. (a) Which sounds in the figure sit at or above the workplace exposure standard of 85 dB(A)? (b) Earbuds at full volume (about 100 dB) sit two 10-dB steps above the WHO leisure guidance of about 80 dB. Using the figure's caption rule, state how the sound energy compares, and how the seemed loudness compares. (c) Name two advances (materials or procedures, per elaboration `VC2S10H04.E03`) that help keep leisure listening safe, and say which line of the loop each one is.

Question 11 Use the regenerative-braking figure. (a) State the energy transfer in ordinary friction braking and in regenerative braking. (b) Name two kinds of vehicle the figure says use the idea. (c) Explain, in one sentence of the priority loop, why regenerative braking exists as a research direction at all.

Question 12 Use the green-chemistry figure. (a) State the waste difference between the two processes. (b) Give two reasons manufacturers adopt the green route (elaboration `VC2S10H04.E05`). (c) "The values set the direction; chemistry found the route." Apply that sentence to this figure: which value, which direction, which route?

Question 13 A coffee company could fund two different studies: study A, "does our coffee taste better than the rival's?", and study B, "does the caffeine in coffee affect teenage sleep?". Using elaboration `VC2S10H04.E07`, explain which study the company is likely to fund and why, which funder (government or commercial) is more likely to fund the other, and what this shows about "what research is undertaken".

Question 14 A city holds one large research grant. Application 1: a vaccine for a rare disease affecting a small number of residents. Application 2: a cheaper, cleaner way to make steel, cutting emissions city-wide. Write the strongest fair case for each funding view — each view argued at its best, not at its weakest (use the two bulleted views of the theory

if you wish) — then state (a) what the two views disagree about (it is not the science), and (b) what a funder owes the public when it chooses, per the last paragraph of the theory.

Question 15 A simulated headline reads: *"Spray study shock: cleaning spray kills 99.9% of germs — households should switch now."* The study behind it tested the spray on lab dishes, paid for by the spray's maker. Walk the claim up the four steps of the decision ladder for the personal decision *should my household switch sprays?*, stating what each step finds, and end in one of the three verdicts with a reason.

Question 16 The same 30-year hot-day series is read by two groups. Group X: *"We must cut emissions now — the trend is rising."* Group Y: *"The trend is small; the money is better spent protecting homes from the heat we already get."* (a) Show that both readings sit inside the data (use the trend of about +0.29 days per year). (b) Name the value or need behind each group's reading. (c) Explain why this disagreement is the content description's first limb working honestly, not a failure of the science.

Answers

Question 1 (a) knowledge (what we find out), technology (what we build), advice (what we recommend); (b) values (what matters to us), needs (what must be solved), funding (who pays); (c) this subtopic is mostly about the bottom lane (society to science); the rest of the book travelled the top lane (science to society). **Question 2** (a) club: a 37.5% drop is a big win, keep it up; manager: it helped the bins, but water sales were income and that cost was never measured; (b) both stay inside what was measured — neither adds an unmeasured quantity; (c) no money was measured, so "saved money" steps outside the data. **Question 3** (a) \$15; 15 ÷ 310 ≈ 4.8%; (b) the panel whose axis starts at \$300 — the choice of axis zero makes a \$15 rise fill half the picture; (c) e.g. zooming in to show a small but important change *while saying the axis is zoomed* — honesty is in the labelling. **Question 4** (a) "the risk doubles": 2 ÷ 1 = 2; (b) "one extra case per 10 000": 2 − 1 = 1; (c) the absolute wording says how much risk is added against the people taking it; "doubles" only compares the two risks and makes a tiny risk sound large. **Question 5** (a) sign 4 (one line of "debate" set against a large body of agreeing evidence) and sign 5 or the feelings work of sign 2 — "isn't settled" pretends uncertainty the evidence did not have; (b) sign 5, "too certain, too exact" (its mirror image: false certainty in either direction); (c) genuine doubt asks how strong the evidence is and what would change it; manufactured doubt is a claim repeated to delay action, with no question behind it. **Question 6** (a) values and needs → funding choices → research focus → new knowledge and technology reach society (→ back to values and needs); (b) need: cut emissions; funding: solar and storage research; advance: cheaper, better solar cells; uptake: solar on more than one in three Australian homes; (c) governments and commercial organisations; their financial support can determine what research is undertaken. **Question 7** Checks: how much of the picture is shown (7 of 30 years), and who chose the edges (the window starts after a high run and ends in a low one). The full series rises at about +0.29 days per year; first five years average 9, last five 15.6 — the dip is noise inside a rising record. **Question 8** Sign 1 (no study, no data, no named expert), sign 2 (shock and urgency carry it), sign 3 ("they don't want you to see / share before it's deleted" shuts down checking), sign 5 ("100% safe", "always"). First question needed: what was actually measured, by whom, and where is it published? **Question 9** (a) the finding is about groups and probabilities — smokers got lung cancer *far more often*; one person's outcome was always possible inside that pattern, so it questions nothing; (b) many independent studies, over decades, pointing the same way — a body of evidence, not a single result. **Question 10** (a) busy traffic (85), earbuds full volume (100), live concert (110), ambulance siren (120), jet taking off (140); (b) energy about 10 × 10 = 100 times the guided level; seemed loudness about 2 × 2 = 4 times; (c) e.g. noise-cancelling earphones (a procedure/material that lets volume drop) and ear protection/limiter rules at concerts — each is the loop's "advance" line, arriving because the health need set the focus. **Question 11** (a) ordinary: motion energy → heat, lost to the air; regenerative: motion energy → electrical energy, stored or fed back; (b) any two of electric trains, trams, hybrid cars, electric cars; (c) the need to waste less energy (and cut emissions) funded the research that produced the device. **Question 12** (a) older: spent solvent becomes waste each batch; green: the CO_2 is recycled, so no solvent waste; (b) any two of less waste to treat, safer workplaces, lower energy bills, customers who expect it; (c) value: waste and hazard should be designed out; direction: money went to clean processes; route: the recycled supercritical-CO_2 process. **Question 13** The company funds A — it serves the seller, not the buyer; a government (or health funder) is more likely to fund B, a public-health question with no profit in it. What research is undertaken follows who pays — the elaboration's point exactly. **Question 14** (a) they rank values differently — care for a few now versus benefit for many over time; both accept the same science; (b) the value made visible: state what we need and why we pay for it, in the open. **Question 15** Step 1: the decision is real (which spray to buy). Step 2: the study measured germ-kill on lab dishes — the headline's "switch now" sells a home result the study did not measure. Step 3: the maker paid — declared? and do independent sources agree? Step 4: "99.9%" is a lab figure doing home work; relative to what? Verdict: WAIT — find out whether the spray beats what you already use, in homes, in work paid for and checked by someone else. **Question 16** (a) both quote the same rising trend (+0.29/yr); X reads it as a reason to cut emissions, Y as a reason to protect against the heat already arriving — neither denies the numbers; (b) X: the value of preventing harm (cutting the cause); Y: the value of protecting people now (adapting to the effect); (c) different groups weighing the same knowledge by different values is the first limb working as described — the science holds while the readings differ, because both stay inside the data.

Fully-worked solutions

Question 1 (a) Knowledge (what we find out), technology (what we build), and advice (what we recommend). (b) Values (what matters to us), needs (what must be solved), and funding (who pays). (c) This subtopic is mostly about the bottom lane — values, needs and funding flowing from society into science — because that lane is what the

content description describes. The rest of the book travelled the top lane: every earlier chapter was science handing knowledge, technology and advice to society.

Question 2 (a) The environment club reads the fall as "a 37.5% drop is a big win — let's keep it up"; the canteen manager reads it as "it helped the bins — but water sales were income, and that cost was never measured". (b) Both readings stay inside what was measured: the waste fell, and both groups talk about the waste (and about the *absence* of a money measurement, which the manager honestly flags). Neither group invents a quantity. (c) Because no money was ever measured. "Saved money" is a new claim about an unmeasured quantity — red zone, not an interpretation of the data at all.

Question 3 (a) Rise = \$325 − \$310 = \$15. Percentage = 15 ÷ 310 ≈ 0.048 → about 4.8%. (b) The right panel, whose axis starts at \$300 instead of \$0. That single choice makes a \$15 rise on a \$310 bill fill half the picture's height, reading as an alarming climb — the frame doing the arguing. (c) A zoomed axis is honest when the zoom is declared and the point is a small but real change worth seeing closely — for example, plotting 310–325 with a caption stating "axis zoomed; rise is 4.8%". The dishonesty is not the zoom; it is the zoom doing a job the numbers would not do in the open.

Question 4 (a) Relative: new ÷ old = 2 ÷ 1 = 2 — "the new medicine doubles the risk". (b) Absolute: new − old = 2 − 1 = 1 extra case per 10 000 patients treated. (c) Because a decision runs on the size of what is being risked. "Doubles" compares two tiny risks with each other and sounds large; "one extra case in 10 000" compares the risk with the people taking it and says the added risk is very small. Both are true; only the second is the number a decision needs.

Question 5 (a) Sign 4 — one manufactured "debate" set against a large body of agreeing evidence — and sign 5's mirror image, false uncertainty: "isn't settled" claimed a doubt the evidence did not contain. (Sign 2 also fits: the campaign ran on fear of being "duped" by health authorities, feelings doing the work.) (b) Sign 5 — "too certain, too exact": real findings carry limits and uncertainty, so "always", "never" and "100% proof" are tells. (c) Genuine doubt is a question *about* evidence — how strong is it, what would change it — and it gets resolved by measuring. Manufactured doubt is the word "doubt" used as a shield, repeated to keep a debate running after the evidence already answered the question. One is a stage of science; the other is a strategy against it.

Question 6 (a) Society's values and needs → funding choices → research focus → new knowledge and technology reach society, feeding back into values and needs. (b) Need: cut greenhouse gas emissions. Funding: solar and storage research. Advance: cheaper, better solar cells. Uptake: solar panels on more than one in three Australian homes. (c) Governments and commercial organisations. Because financial support from them is needed for scientific developments, their choices can determine what research is undertaken.

Question 7 Check one — how much of the picture is shown: the post quotes 7 of the 30 years, so the claim rests on a quarter of the record presented as the record. Check two — who chose the edges: years 11–17 begin just after a high run and end in a low one, the exact edges a falling line needs; a window chosen (or received) at the noise dip is the cherry-picking Subtopic 5A named. The full series shows the opposite: first five years average 9 hot days, last five average 15.6, and the trend line over all 30 years rises at about +0.29 days per year. Fair statement: the series rises on average with year-to-year noise; years 11–17 are a dip inside that rise, not a trend.

Question 8 Sign 1 — no study, no data, no named expert: "experts agree" names nobody and shows nothing. Sign 2 — feelings do the work: "shock", "share before it's deleted" is urgency, not evidence. Sign 3 — checking is shut down in advance: "they don't want you to see" pre-excuses every check a reader might run. Sign 5 — too certain, too exact: "100% safe" and "always" are wording real findings never use. (Signs 4 and 6 fold into the same absences: no body of evidence shown, no method, no limits.) The one question the claim needs before it can be checked at all: *what was actually measured, by whom, and where is it published?* — without a method and a source, there is nothing to run the checks on.

Question 9 (a) The smoking finding was never "every smoker gets lung cancer". It was that smokers get lung cancer *far more often* — a statement about groups and chances. One uncle's outcome was always possible inside that pattern, so it is noise of exactly the kind the window-trick figure warns about: one hand-picked point standing in for the series. (b) Many independent lines of evidence — large studies, over decades, in different countries, by teams with nothing to do with each other — all pointing the same way. That convergence is what made the finding strong, and it is why a manufactured "debate" could delay rules without ever touching the evidence.

Question 10 (a) Busy traffic (about 85 dB, at the standard), earbuds at full volume (about 100 dB), live concert (about 110 dB), ambulance siren nearby (about 120 dB), jet taking off (about 140 dB). (b) Two 10-dB steps above the guidance: energy 10 × 10 = about 100 times the sound energy of the 80 dB guided level; seemed loudness about 2 × 2 = about four times as loud. (c) Any two, placed on the loop's advance line: noise-cancelling earphones (a material/procedure that lets the listener drop the volume, because the outside noise is cancelled); better ear protection and limiter or roster procedures at concerts and worksites. Each exists because the health need (hearing does not grow back) set the research focus — the loop's first two stages.

Question 11 (a) Ordinary friction braking: the train's motion energy becomes heat, lost to the air. Regenerative braking: the wheels turn the motor as a generator, and the motion energy becomes electrical energy, stored on board or fed back to the grid. (b) Any two of: electric trains, trams, hybrid cars, electric cars. (c) The need to waste less energy and cut emissions funded the research whose advance is the device — values and needs on the loop's first stage, a money-saving, emissions-cutting technology on its last.

Question 12 (a) The older process ends every batch with used solvent to treat as waste; the green process recycles its carbon dioxide, so the solvent never becomes waste at all. (b) Any two of: less waste to treat (a direct cost saving), safer workplaces (no organic solvent exposure), lower energy bills, and customers who increasingly expect clean-made goods. (c) The value: waste and hazard should be designed out of a process, not cleaned up afterwards. The direction: research and investment money went towards clean processes because society's expectations made them pay. The route: supercritical carbon dioxide, recycled batch to batch — chemistry's answer to the direction the value set.

Question 13 The company is likely to fund study A: it serves the seller — a taste result it can advertise — and a taste test is exactly the research a commercial funder's values point at. Study B, a public-health question with no profit in the answer, is more likely funded by a government or health body, whose need is the public's health rather than a brand's sales. That contrast is the elaboration in miniature: financial support is needed for scientific developments, and *who* supplies it can determine what research is undertaken — the same question, funded or not, depending on whose values it serves.

Question 14 The strongest fair case for each view, as in the theory: the vaccine view — a society is judged by how it treats its most vulnerable, and these patients have no commercial funder at all, so public money is the only money that will ever do this work; the steel view — cleaner steelmaking cuts emissions at national scale and lowers costs across the economy, helping millions now and later, and a missed emissions cut cannot be bought back. (a) The views disagree about the ranking of values — care for a few now against benefit for many over time — not about any scientific fact; both accept the same evidence about the vaccine and the steel. (b) The value made visible: the funder owes the public a stated reason — "this is what we need, this is why we pay for it" — because values driving the focus is normal; values driving it in the dark is not.

Question 15 Step 1 — the decision is real and the claim could change it: which spray the household buys. Step 2 — trace the claim: the study measured germ-kill on lab dishes; "households should switch" sells a home result that was never measured, so the headline fails the match check. Step 3 — funding and agreement: the maker paid, so the funding should be declared and independent sources should be sought before the claim carries weight. Step 4 — wording: "99.9%" is a lab-dish figure doing home work, and "kills germs" says nothing compared with the spray you already own. Verdict: WAIT — find out what is missing: does the spray beat your current one, in homes, in work whose funding and method survive someone else's checking? Until then the claim has not earned a change of habit.

Question 16 (a) Both groups quote the same trend — about +0.29 hot days per year over the full series, first five years averaging 9 and last five 15.6 — and neither denies it; the numbers sit inside both readings. (b) Group X's value: preventing harm at the cause — cutting emissions now so the trend does not grow. Group Y's value: protecting people now — the heat already arriving needs homes ready for it, and the trend's present size makes adaptation urgent. (c) Because the first limb says scientific knowledge *may be interpreted in different ways by individuals and groups in society* — and here both interpretations stay inside the data while ranking different needs. The science holds; the readings differ honestly. It would only be a failure if one group bent the frame (a cherry-picked window, a truncated axis) or stepped outside the data — the red-zone moves this subtopic exists to catch.

Where this leads: the VCE pathways that assume this subtopic — **Biology** Units 1–2 Area of Study 3 and **Environmental Science** Units 1–2 Area of Study 3 both grade the skill this subtopic builds: taking scientific information as it appears in the world, separating the claim about the evidence from the claim about the values in it, and discussing how society's needs set the research agenda; **Physics** Unit 2 Area of Study 2 and **Chemistry** Unit 1 Area of Study 3 pick up the devices and processes (regenerative braking, green chemistry) as society-facing options and applications. Within this book, Subtopic 16A carries the other half of the chapter — how individuals, communities and industries adopt or resist a scientific practice — and the inquiry sequence's reporting steps (Subtopics 6A and 6B) are where your own arguments show the checks you learned here.

Test A

Topic test 7 — Science in society

Use and influence of science · Chapter 16 · Subtopics 16A and 16B · Codes VC2S10H03 and VC2S10H04

Total: 30 marks · Section A (multiple choice): 5 marks · Section B (short/structured response): 25 marks

7 of the 30 marks are science inquiry marks, attached to the inquiry skills Chapter 16 re-uses from Chapters 2–6 — the statistics checks of Subtopic 5B and the claim-and-bias checks of Subtopics 5A and 5B (Section B, Q7 and Q8).

Planned for about 40 minutes. This paper is untimed — there is no time to beat.

This is a school-designed paper. It is not a VCAA instrument. Achievement at Levels 9 and 10 is reported against the Victorian Curriculum achievement standard on teacher judgement; the marks here are one source of evidence towards that judgement.

Conditions

- Completion is **untimed**. The 40 minutes is planning guidance only; take as long as you need.
- **Reading support** is permitted. Your teacher may read any question out to you if you need it. Reading is not what is being looked at, and your teacher will not help with the answer.
- **No calculator is required.** The only arithmetic on this paper is the division in Q7, and it can be done by hand. No formula sheet. No reading time.
- Answer every question. For multiple-choice questions, circle the letter of the best answer. There is only one best answer for each question.

In this test you will:

- show how different groups project different outcomes for the one practice, and how those projected outcomes drive adoption and resistance (Q5, Q6, Q11)
- separate an empirical claim — a claim about what is true — from a value claim — a claim about what ought to happen (Q6)
- read a statistic by asking for the denominator and who was counted (Q3, Q7)
- identify how the presentation of data can bias its interpretation (Q4, Q8)
- identify the signs of misinformation, and the first question a claim needs before it can be checked (Q9)
- describe how society's values, needs and funding set the focus of research (Q2, Q10)
- examine one socio-scientific issue end to end with the seven-step method (Q11)

Section A — Multiple choice (5 marks)

Each question is worth 1 mark. Circle the letter of the best answer.

Q1 *(1 mark · VC2S10H03)* Citizen science means:

A. Government scientists conducting research for national security B. Research that can only be carried out by people holding a PhD C. Members of the public contributing data or analysis to scientific projects D. Professional scientists working only with other professionals in their field

Q2 *(1 mark · VC2S10H04)* Why has solar PV research grown rapidly in the last 20 years?

A. Photovoltaic cells were only invented within the last two decades B. Policy support and investment driven by climate goals C. Sunlight reaching Earth has become significantly stronger recently D. Other forms of electricity generation have stopped functioning

Q3 *(1 mark · VC2S10H03)* In a simulated town of 10 000 riders, 8 000 wear helmets and 2 000 do not. Over a year, 48 riders wearing helmets and 30 riders without helmets end up with a head injury. A social-media post reads: "More injured riders were wearing helmets, so helmets don't work." What does the post leave out?

A. How many riders there were in each group — the denominator B. Whether the helmets met a safety standard C. How fast each rider was travelling in the crash D. The cost of each helmet

Q4 *(1 mark · VC2S10H04)* A club's electricity bills rise gently from $240 to $250 over five months. Drawn on an axis that starts at $0, the rise looks small. Drawn on an axis that starts at $235, the same rise looks like a steep climb. What is the name of the technique where the axis is made to start part-way up, so that a small change looks large?

A. Cherry-picking the window B. Switching the relative and absolute risk C. Repeating the measurement D. Truncating the axis

Q5 *(1 mark · VC2S10H03)* Four groups look at the one practice — rooftop solar. The household projects smaller bills; the electricity retailer projects selling less power; the panel installer projects new work; the community group projects less coal-fired power. What does this best show?

A. The group with the most evidence always adopts the practice B. Whether a group adopts the practice follows the projected outcomes it weighs C. A practice that meets any resistance is never adopted D. Projected outcomes matter only to governments

Section B — Short/structured response (25 marks)

Q6 *(4 marks · VC2S10H03)* Subtopic 16A draws four groups looking at the one practice: rooftop solar.

(a) State the projected outcome the household weighs, and the projected outcome the electricity retailer weighs. *(2 marks)*
(b) Label each claim as empirical or value, and give the reason for each label in one sentence.
(c) "Rooftop solar cuts a household's power bill."
(ii) "Everyone should install it to protect the environment." *(2 marks)*

Q7 *(3 marks · VC2S10H03 · inquiry)* E-scooters have arrived in a simulated town *(simulated data for practice)*. Of its 10 000 e-scooter riders, 6 000 wear helmets and 4 000 do not. Over a year, 42 riders wearing helmets and 40 riders without helmets end up with a head injury.

(a) Calculate the head-injury rate per 1 000 riders for each group. Show your working. *(2 marks)*
(b) A post reads: "More injured riders were wearing helmets, so helmets don't work." State what the post leaves out. *(1 mark)*

Q8 *(4 marks · VC2S10H04 · inquiry)* A sports club's average monthly electricity bills over five months are $240, $243, $245, $248 and $250 *(simulated data for practice)*. A post shows a graph of the bills whose vertical axis starts at $235, and writes: "Club power bills are climbing out of control!"

(a) Name the technique the graph uses, and state what has changed between the honest display and this display — and what has not changed. *(2 marks)*
(b) Explain why the display biases the reading. *(1 mark)*
(c) The same post quotes only the middle years of a 30-year series of hot days, where the noise happens to dip, and writes: "The rising trend has stopped." Name that second technique. *(1 mark)*

Q9 *(3 marks · VC2S10H04)* A simulated post reads *(simulated post for practice)*:

"URGENT: leaked report they don't want you to see — the new sports drink improves sprint times by 300%! Scientists agree: always. Share before it's deleted!"

(a) Identify two of the six signs of misinformation the post shows, giving a phrase from the post as the evidence for each. *(2 marks)*
(b) State the one question that must be answered before the claim can be checked at all. *(1 mark)*

Q10 *(3 marks · VC2S10H04)* Subtopic 16B traces one real chain: the need to cut greenhouse gas emissions set a research priority, and solar panels now sit on more than one in three Australian homes.

(a) In that chain, name (i) the funding and (ii) the advance. *(1 mark)*

(b) Name the two kinds of funder whose financial support is needed for scientific developments, and state what their choices can determine. *(2 marks)*

Q11 *(8 marks · VC2S10H03)* Issue analysis. On 1 July 1990, Victoria became the first place in the world to require every bicycle rider to wear a helmet. When e-scooters arrived, the same statistics and the same arguments restarted for a new machine.

Examine the question "Should e-scooter riders be required to wear helmets, the same way bicycle riders are?" Use the seven-step method of Subtopic 16A, and show how different projected outcomes of the practice lead to varied support from individuals and groups. Your answer must:

- name the practice and the scientific knowledge behind it;
- identify at least two groups with different projected outcomes;
- split one empirical claim from one value claim in the debate;
- steelman the resisting view — write its strongest form; and
- state your own position with reasons, including what evidence or outcome would change your mind.

(1 mark for the practice and its science; 2 marks for two groups and their projected outcomes; 1 mark for each claim correctly split; 1 mark for the steelman; 2 marks for your position, reasons and what would change your mind.)

Test B

Topic test 7 — Science in society

Use and influence of science · Chapter 16 · Subtopics 16A and 16B · Codes VC2S10H03 and VC2S10H04

> **Total: 30 marks** · Section A (multiple choice): 5 marks · Section B (short/structured response): 25 marks
>
> **7 of the 30 marks are science inquiry marks**, attached to the inquiry skills Chapter 16 re-uses from Chapters 2–6 — the statistics checks of Subtopic 5B and the claim-and-bias checks of Subtopics 5A and 5B (Section B, Q7 and Q8).
>
> **Planned for about 40 minutes. This paper is untimed — there is no time to beat.**
>
> This is a school-designed paper. It is not a VCAA instrument. Achievement at Levels 9 and 10 is reported against the Victorian Curriculum achievement standard on teacher judgement; the marks here are one source of evidence towards that judgement.

Conditions

- Completion is **untimed**. The 40 minutes is planning guidance only; take as long as you need.
- **Reading support** is permitted. Your teacher may read any question out to you if you need it. Reading is not what is being looked at, and your teacher will not help with the answer.
- **No calculator is required.** The only arithmetic on this paper is the division and subtraction in Q7 and Q8, and it can be done by hand. No formula sheet. No reading time.
- Answer every question. For multiple-choice questions, circle the letter of the best answer. There is only one best answer for each question.

In this test you will:

- identify a practice Landcare supports (Q1)
- describe how society's values and needs set the focus of research, and who pays for it (Q2, Q4, Q10)
- examine how the projected outcomes of a practice changed between 2001 and 2021 (Q3)
- read a statistic by asking for the denominator and who was counted (Q7)
- separate a relative risk from an absolute risk, and identify a biased display (Q5, Q8)
- identify the signs of misinformation, and the first question a claim needs before it can be checked (Q9)
- show how different groups project different outcomes for the one practice (Q6)
- examine one socio-scientific issue end to end with the seven-step method (Q11)

Section A — Multiple choice (5 marks)

Each question is worth 1 mark. Circle the letter of the best answer.

Q1 *(1 mark · VC2S10H03)* Which practice would Landcare typically support?

A. Land clearing B. Wetland draining C. Soil compaction D. Native revegetation and erosion control

Q2 *(1 mark · VC2S10H04)* Public concern about climate change has accelerated research into:

A. Renewable energy and carbon capture technologies B. New methods to expand coal mining output C. Improving petrol engine efficiency as the main solution D. Reducing the need for large-scale energy storage

Q3 *(1 mark · VC2S10H03)* Victoria banned genetically modified (GM) food crops in 2001 and lifted the ban in 2021. What changed most in between?

A. The science of genetic engineering was shown to be wrong B. Food crops stopped containing DNA C. The projected outcomes — the projected harms did not arrive, and the projected benefits showed up in neighbouring states D. There was no longer enough evidence to act on

Q4 *(1 mark · VC2S10H04)* Financial support from governments or commercial organisations is needed for scientific developments. This support can determine:

A. The laws of nature that scientists discover B. What research is undertaken C. How fast scientific instruments travel D. The number of students who study science

Q5 *(1 mark · VC2S10H04)* In a trial, a rare side effect appears in 2 of 10 000 patients taking an old medicine and 6 of 10 000 patients taking a new medicine *(simulated data for practice)*. A headline reads: "New medicine triples the risk!" A patient deciding whether to take the new medicine needs most:

A. The relative wording, because it sounds like the larger number B. Neither wording, because both are false C. The relative wording, because it compares the two risks with each other D. The absolute wording — 4 extra cases per 10 000 patients — because it says how much risk is added

Section B — Short/structured response (25 marks)

Q6 *(4 marks · VC2S10H03)* A household with rooftop solar is deciding whether to add a battery.

(a) Give one projected outcome that pushes towards adding a battery, and one projected outcome that pushes towards waiting. *(2 marks)*
(b) Label each claim as empirical or value, and give the reason for each label in one sentence.
(c) "A battery stores daytime generation for use at night."
(ii) "Households should be free to choose their own energy." *(2 marks)*

Q7 *(3 marks · VC2S10H03 · inquiry)* In a simulated town *(simulated data for practice)*, 7 500 bicycle riders wear helmets and 2 500 do not. Over a year, 45 riders wearing helmets and 25 riders without helmets end up with a head injury.

(a) Calculate the head-injury rate per 1 000 riders for each group. Show your working. *(2 marks)*
(b) A post reads: "More injured riders were wearing helmets, so helmets don't work." State what the post leaves out. *(1 mark)*

Q8 *(4 marks · VC2S10H04 · inquiry)* In a trial, a rare side effect appears in 2 of 10 000 patients taking an old medicine and 6 of 10 000 patients taking a new medicine *(simulated data for practice)*.

(a) Write the relative comparison of the two risks, and show its arithmetic. *(1 mark)*
(b) Write the absolute extra risk of the new medicine, and show its arithmetic. *(1 mark)*
(c) State which wording a person deciding whether to take the medicine needs, and why the other wording is true but not enough. *(1 mark)*
(d) A second post quotes only the years where the noise dips in a 30-year series of hot days, and claims the rising trend has stopped. Name the technique the post uses. *(1 mark)*

Q9 *(3 marks · VC2S10H04)* A simulated post reads *(simulated post for practice)*:

"SHOCK: doctors don't want you to know — this supplement cures a cold overnight! One study proves it: 100% guaranteed, never fails. Share before it's deleted!"

(a) Identify two of the six signs of misinformation the post shows, giving a phrase from the post as the evidence for each. *(2 marks)*
(b) State the one question that must be answered before the claim can be checked at all. *(1 mark)*

Q10 *(3 marks · VC2S10H04)*

(a) Put the four stages of the priority loop in order, starting from society's values and needs. *(1 mark)*
(b) In the regenerative-braking chain, name (i) the need and (ii) the advance. *(1 mark)*
(c) A coffee company could fund study A, "does our coffee taste better than the rival's?", or study B, "does the caffeine in coffee affect teenage sleep?". State which study a commercial funder is likely to fund and why, using the idea that who pays can determine what research is undertaken. *(1 mark)*

Q11 *(8 marks · VC2S10H03)* Issue analysis. A Victorian council is debating whether to require rooftop solar on every new home. *(The debate is hypothetical; no real council's position is quoted.)*

Examine the question “Should new homes be required to have rooftop solar?” Use the seven-step method of Subtopic 16A, and show how different projected outcomes of the practice lead to varied support from individuals and groups. Your answer must:

- name the practice and the scientific knowledge behind it;
- identify at least two groups with different projected outcomes;
- split one empirical claim from one value claim in the debate;
- steelman the resisting view — write its strongest form; and
- state your own position with reasons, including what evidence or outcome would change your mind.

(1 mark for the practice and its science; 2 marks for two groups and their projected outcomes; 1 mark for each claim correctly split; 1 mark for the steelman; 2 marks for your position, reasons and what would change your mind.)

Marking guide

This guide is written for a teacher marker — no specialist science background beyond Chapter 16 of this book is needed. Award a mark when the student's answer matches an acceptable response below or says the same idea in other words. Do not award half marks. The marks are a record that evidence was seen; they are not used to rank students.

Test A — Section A — Multiple choice

Q	Answer	Code	Source
Q1	**C**	VC2S10H03	bank item VC2S10H03.E01.S01.D1.V01
Q2	**B**	VC2S10H04	bank item VC2S10H04.E01.S01.D2.V01
Q3	**A**	VC2S10H03	new item authored against VC2S10H03.E05
Q4	**D**	VC2S10H04	new item authored against VC2S10H04.E04
Q5	**B**	VC2S10H03	new item authored against VC2S10H03 (content description — projected outcomes)

Two of the five items are drawn from the MCQ bank under the codes assessed on this paper; none is drawn from a neighbouring code. Three are newly authored against the same codes: the bank's VC2S10H03 items cover only citizen science (.E01) and Landcare (.E02), and cannot supply an item on helmet statistics (the statistics limb is elaboration VC2S10H03.E05) or on the projected-outcome reasoning at the heart of the content description, at any difficulty. The bank's VC2S10H04 items cover only the direction of research (.E01) and energy-transfer devices (.E02), and cannot supply an item on bias in the presentation of data (the interpretation limb is elaboration VC2S10H04.E04). Items mix easy (D1), medium (D2) and hard (D3) difficulties. Bank items are printed with their stem and options word for word; only the positions of the options have changed for this paper, so that the correct answers are spread across A, B, C and D (the printed positions are A × 1, B × 2, C × 1, D × 1).

Why each answer is correct, in brief:

- **Q1 C** — citizen science is members of the public contributing data or analysis to scientific projects; the other options describe professional-only research.
- **Q2 B** — the need to cut greenhouse gas emissions set the value, and policy support and investment followed it into solar research; the other options are false (photovoltaic cells are older than two decades, and neither the sun nor the rest of the grid changed in those ways).
- **Q3 A** — the denominator: the two groups are not the same size (48 out of 8 000 against 30 out of 2 000). As rates, the helmeted group is the safer one, so the raw counts alone mislead.
- **Q4 D** — truncating the axis changes only the frame, never the numbers; cherry-picking selects the years shown, and the relative-versus-absolute switch changes the wording of a risk.
- **Q5 B** — this is the content description itself: diverse projected outcomes affect how broadly a practice is adopted. The figure does not show evidence "winning", and some resistance does not stop adoption.

Test A — Section B — Short/structured response

Q6 *(4 marks · VC2S10H03)* (a) the household — smaller power bills. *1 mark* The electricity retailer — selling less power. *1 mark* Accept any wording of the same projections. (b) (i) empirical — a claim about what happens, checkable by measuring bills with and without panels. *1 mark* (ii) value — a claim about what ought to happen, which no measurement can settle. *1 mark* The label and a matching reason must both be there. Marker note: this item assesses the projected-outcome and empirical/value-claim limbs taught in Subtopic 16A (the "Four groups, one practice" figure), under the VC2S10H03 content description.

Q7 *(3 marks · VC2S10H03 · inquiry)* (a) helmeted: 42 ÷ 6 = 7.0 head injuries per 1 000 riders. *1 mark* Unhelmeted: 40 ÷ 4 = 10 head injuries per 1 000 riders. *1 mark* Accept working that shows division by each group's size in thousands. (b) the denominator — how many riders there were in each group. *1 mark* Accept "they are not compared as rates" or "the helmeted group was much larger". Marker note: the inquiry marks attach to the statistics checks of Subtopic 5B (the VC2M10ST04 habit of asking *out of how many?* and *who was counted?*), re-used in Subtopic 16A (elaboration VC2S10H03.E05). The data are simulated data for practice, newly built for this paper so the raw count misleads in the same shape as the town taught in 16A (42 > 40, while the rate says the opposite).

Q8 *(4 marks · VC2S10H04 · inquiry)* (a) truncating the axis. *1 mark* Changed: where the vertical axis starts ($235 instead of $0); not changed: the bills themselves, $240 to $250 (a rise of $10, about 4.2%). *1 mark* (b) the chosen frame makes a small rise fill most of the picture's height, so the eye reads a gentle rise as a steep climb — the frame does the arguing, not the numbers. *1 mark* (c) cherry-picking the window. *1 mark* Marker note: this item assesses bias in the presentation of data (elaboration VC2S10H04.E04), taught in Subtopic 16B with the axis-trick and window-trick figures. The inquiry marks attach to the claim checks of Subtopic 5B and the honesty-in-argument checks of Subtopic 5A (cherry-picking), which Subtopic 16B re-uses.

Q9 *(3 marks · VC2S10H04)* (a) any two signs with a matching phrase, for example: no real source — "Scientists agree" names nobody; feelings do the work — "URGENT … Share before it's deleted!"; "they don't want you to know" — "they don't want you to see"; too certain, too exact — "300%" and "always". *1 mark* for each sign-with-evidence pair. (b) what was actually measured, by whom, and where is it published? *1 mark* Accept any wording that asks for the method and the source. Marker note: the six signs and the first question are taught in Subtopic 16B (the misinformation-signs figure and the decision ladder). The post is a simulated post for practice.

Q10 *(3 marks · VC2S10H04)* (a) (i) solar and storage research; (ii) cheaper, better solar cells. *1 mark* Both needed. (b) governments, and commercial organisations. *1 mark* Their choices can determine what research is undertaken. *1 mark* Marker note: the chain is the priority loop of Subtopic 16B (elaboration VC2S10H04.E07): society's values and needs → funding choices → research focus → new knowledge and technology reach society.

Q11 *(8 marks · VC2S10H03)* Award as follows. Marks are awarded for using the method and the evidence honestly on both sides, not for which position is chosen. - The practice — e-scooter riders wear helmets; the science — a helmet absorbs impact in a crash, and combined studies find about 60% less head injury and about 58% less brain injury when a helmeted rider crashes. *1 mark* - Two groups with different projected outcomes, for example: riders who resist project keeping their freedom to choose and judge their own risk on short trips as tiny; families and hospitals project fewer serious head injuries; governments project smaller health bills and a rule some voters dislike; e-scooter sellers project a rule that makes the machine look dangerous. *2 marks* — 1 mark per group-with-outcome pair. - One empirical claim correctly identified, for example "my risk on short, familiar trips is tiny" — testable against crash and injury data. *1 mark* - One value claim correctly identified, for example "the choice about my own body is mine". *1 mark* - The resisting view steelmanned — written in its strongest form, not a weak version. *1 mark* - The student's own position with reasons, and what evidence or outcome would change their mind. *2 marks* — 1 mark for the position with reasons, 1 mark for what would change the mind. Marker note: this is the 8-mark issue analysis §7 requires on this paper, assessed against the VC2S10H03 achievement-standard extract with the seven-step method of Subtopic 16A. The e-scooter restart is taught in 16A case study 1, whose source lines are the Victorian Government bicycle helmet law, 1990, and Attewell, Glase & McFadden, Accident Analysis & Prevention, 2001 (both retrieved 2026-08-21); students quoting the 60% and 58% figures from that case study are quoting taught content.

Test B — Section A — Multiple choice

Q	Answer	Code	Source
Q1	**D**	VC2S10H03	bank item VC2S10H03.E02.S01.D2.V01
Q2	**A**	VC2S10H04	bank item VC2S10H04.E01.S01.D1.V01
Q3	**C**	VC2S10H03	new item authored against VC2S10H03.E04
Q4	**B**	VC2S10H04	new item authored against VC2S10H04.E07
Q5	**D**	VC2S10H04	new item authored against VC2S10H04.E04

Two of the five items are drawn from the MCQ bank under the codes assessed on this paper; none is drawn from a neighbouring code. Three are newly authored against the same codes, for the same reason as Test A: the bank's VC2S10H03 items cover only citizen science (.E01) and Landcare (.E02), and cannot supply an item on the adoption of genetically engineered crops (elaboration VC2S10H03.E04) at any difficulty; the bank's VC2S10H04 items cover only the direction of research (.E01) and energy-transfer devices (.E02), and cannot supply an item on the funding limb (elaboration VC2S10H04.E07) or on the relative-versus-absolute presentation of risk (elaboration VC2S10H04.E04). Items mix easy (D1), medium (D2) and hard (D3) difficulties. Bank items are printed with their stem and options word for word; only the positions of the options have changed for this paper, so that the correct answers are spread across A, B, C and D (the printed positions are A × 1, B × 1, C × 1, D × 2).

Why each answer is correct, in brief:

- **Q1 D** — Landcare supports restoration: native revegetation and erosion control. The other options are the practices restoration works against.
- **Q2 A** — the concern about climate change is the need, and funding followed it into renewable energy and carbon capture.
- **Q3 C** — Subtopic 16A case study 5: in neighbouring states the projected harms did not arrive and the projected benefits did; the science did not change minds by itself — the projected outcomes did.
- **Q4 B** — elaboration VC2S10H04.E07: financial support is needed for scientific developments, and it can determine what research is undertaken. Funding sets the focus; it does not set the laws of nature.
- **Q5 D** — both wordings are arithmetically true (6 ÷ 2 = 3; 6 − 2 = 4), but a decision runs on the size of what is risked: "4 extra cases per 10 000" says how much risk is added, while "triples" only compares two tiny risks with each other.

Test B — Section B — Short/structured response

Q6 *(4 marks · VC2S10H03)* (a) Towards adding, for example: the battery stores cheap daytime generation for the evening, cutting bills further; or the household values independence from the grid, including during blackouts. *1 mark* Towards waiting, for example: battery prices have been falling, so waiting may buy a better device; or the upfront cost is money that could do more good spent another way. *1 mark* One projected outcome each way; labels are not required in (a). (b) (i) empirical — what a battery does with daytime generation can be measured. *1 mark* (ii) value — a claim about what ought to be allowed, which no measurement settles. *1 mark* The label and a matching reason must both be there. Marker note: battery storage is taught in Subtopic 16A case study 2 (elaboration `VC2S10H03.E03`); the battery decision is practice question 14 of the same subtopic.

Q7 *(3 marks · VC2S10H03 · inquiry)* (a) helmeted: 45 ÷ 7.5 = 6.0 head injuries per 1 000 riders. *1 mark* Unhelmeted: 25 ÷ 2.5 = 10 head injuries per 1 000 riders. *1 mark* Accept working that shows division by each group's size in thousands. (b) the denominator — how many riders there were in each group. *1 mark* Accept "they are not compared as rates" or "the helmeted group was much larger". Marker note: as Test A Q7 — the statistics checks of Subtopic 5B re-used in Subtopic 16A (elaboration `VC2S10H03.E05`). Fresh simulated data for practice, built so the raw count misleads in the same shape (45 > 25, while the rate says the opposite).

Q8 *(4 marks · VC2S10H04 · inquiry)* (a) 6 ÷ 2 = 3 — the risk triples (three times the old risk). *1 mark* The arithmetic must be shown. (b) 6 − 2 = 4 extra cases per 10 000 patients treated. *1 mark* The arithmetic must be shown. (c) the absolute wording. *1 mark* "Triples" compares two tiny risks with each other and sounds large; "4 extra cases in 10 000" compares the risk with the people taking it and says how much risk is added — the number the decision runs on. The reason must say why the relative wording is true but not enough. (d) cherry-picking the window. *1 mark* Marker note: parts (a)–(c) are the relative-versus-absolute switch taught in Subtopic 16B (elaboration `VC2S10H04.E04`, worked example 2); part (d) is the window trick of the same elaboration. The inquiry marks attach to the same claim checks as Test A Q8. The trial data are simulated data for practice, newly built for this paper.

Q9 *(3 marks · VC2S10H04)* (a) any two signs with a matching phrase, for example: "they don't want you to know" — "doctors don't want you to know"; too certain, too exact — "100% guaranteed, never fails"; one study against thousands — "One study proves it"; feelings do the work — "SHOCK … Share before it's deleted!". *1 mark* for each sign-with-evidence pair. (b) what was actually measured, by whom, and where is it published? *1 mark* Accept any wording that asks for the method and the source. Marker note: as Test A Q9 — the six signs and the decision ladder of Subtopic 16B. The post is a simulated post for practice.

Q10 *(3 marks · VC2S10H04)* (a) society's values and needs → funding choices → research focus → new knowledge and technology reach society. *1 mark* The order must be right. (b) (i) the need to waste less energy and cut emissions; (ii) regenerative braking — the device that turns a vehicle's slowing into electrical energy, stored or fed back, instead of losing it as heat. *1 mark* Both needed. (c) study A — it serves the seller, and a taste result is a result the company can advertise. *1 mark* The reason must use the idea that who pays can determine what research is undertaken. Accept the converse framing: study B is the public-health question with no profit in it, so a government or health body is the likely funder. Marker note: the loop and its stages are taught in Subtopic 16B (elaboration `VC2S10H04.E07`); regenerative braking is window 2 of the same subtopic (elaboration `VC2S10H04.E02`); the coffee-company contrast is practice question 13 of the same subtopic.

Q11 *(8 marks · VC2S10H03)* Award as for Test A Q11, applied to the issue "Should new homes be required to have rooftop solar?": - The practice — rooftop solar on every new home; the science — panels generate electricity from sunlight, cutting the household's bills and the grid's fossil-fuel generation. *1 mark* - Two groups with different projected outcomes, for example: home buyers project smaller bills but a higher purchase price; builders project extra cost and work; electricity retailers project selling less power; the community projects less coal-fired power; future renters project savings they never paid for. *2 marks* — 1 mark per group-with-outcome pair. - One empirical claim correctly identified, for example "solar cuts the household's power bill" — measurable. *1 mark* - One value claim correctly identified, for example "protecting the environment is worth paying extra for" or "buyers should be free to choose their own energy". *1 mark* - The resisting view steelmanned — for example, an upfront cost that pushes new homes further out of reach for first-home buyers, carrying a benefit that arrives over years the buyer may not stay. *1 mark* - The student's own position with reasons, and what evidence or outcome would change their mind. *2 marks* — 1 mark for the position with reasons, 1 mark for what would change the mind. Marker note: this is the 8-mark issue analysis §7 requires on this paper, assessed against the `VC2S10H03` achievement-standard extract with the seven-step

method of Subtopic 16A, whose own case study 2 supplies the rooftop-solar content (Source: Australian Government Clean Energy Regulator, small-scale solar statistics — retrieved 2026-08-21). The council debate is hypothetical, as the stem states.

Tracing the items to the achievement standard

Every item traces to the achievement-standard extract of the subtopic that owns its code (§4 of the plan of record). Both Chapter 16 codes are delivered whole: `VC2S10H03` by 16A and `VC2S10H04` by 16B — there are no partner subtopics. The extracts are quoted as the authority file gives them.

Code	Subtopic	Achievement-standard extract	Test A items	Test B items
`VC2S10H03`	16A	"They examine how different projected outcomes of the application of scientific knowledge to a selected socio-scientific issue may lead to varied support from individuals and groups in society."	Q1, Q3, Q5, Q6, Q7, Q11	Q1, Q3, Q6, Q7, Q11
`VC2S10H04`	16B	"They discuss how scientific information and misinformation may inform personal and social decision-making and influence priorities for scientific research."	Q2, Q4, Q8, Q9, Q10	Q2, Q4, Q5, Q8, Q9, Q10

Inquiry weighting: 7 of the 30 marks on each paper are inquiry items attached to the inquiry skills Chapter 16 re-uses from Chapters 2–6 (Section B Q7 and Q8) — meeting the required minimum of 6 inquiry-strand marks per topic test (D7). On both papers Q7 reads a statistic for its denominator and who was counted (the `VC2M10ST04` checks taught in Subtopic 5B and re-used in Subtopic 16A, elaboration `VC2S10H03.E05`), and Q8 interprets a presentation and identifies the bias in its frame (the claim checks of Subtopic 5B and the honesty-in-argument checks of Subtopic 5A, re-used in Subtopic 16B, elaboration `VC2S10H04.E04`).

Mark record — Test A

Question	Code	Worth	Given
Q1 — what citizen science means	VC2S10H03	1	
Q2 — why solar research grew	VC2S10H04	1	
Q3 — what the helmet counts leave out	VC2S10H03	1	
Q4 — a steep climb from a gentle rise	VC2S10H04	1	
Q5 — four groups, one practice	VC2S10H03	1	
Q6 — projected outcomes and two kinds of claim	VC2S10H03	4	
Q7 — e-scooter helmets: counts and rates (inquiry)	VC2S10H03	3	
Q8 — two ways a graph can argue (inquiry)	VC2S10H04	4	
Q9 — the signs of misinformation	VC2S10H04	3	
Q10 — who pays sets the focus	VC2S10H04	3	
Q11 — issue analysis: e-scooter helmets	VC2S10H03	8	
Total		**30**	

Mark record — Test B

Question	Code	Worth	Given
Q1 — a practice Landcare supports	VC2S10H03	1	
Q2 — what climate concern accelerated	VC2S10H04	1	
Q3 — what changed between 2001 and 2021	VC2S10H03	1	
Q4 — what funding determines	VC2S10H04	1	
Q5 — “triples the risk”	VC2S10H04	1	
Q6 — the battery: add or wait	VC2S10H03	4	
Q7 — bicycle helmets: counts and rates (inquiry)	VC2S10H03	3	
Q8 — relative and absolute risk (inquiry)	VC2S10H04	4	
Q9 — the signs of misinformation	VC2S10H04	3	
Q10 — the priority loop and who pays	VC2S10H04	3	
Q11 — issue analysis: rooftop solar on new homes	VC2S10H03	8	
Total		**30**	