Year 10 Science Complete Study Guide

Complete study guide · Level 10 · Victorian Curriculum F–10 Version 2.0 · AceGuides

This guide follows the Victorian Curriculum F–10 Version 2.0 (VC2.0) Science curriculum published by the VCAA, which is based on the Australian Curriculum Version 9.0. In VC2.0, Science content is set out in a combined Levels 9 and 10 band; this guide covers the Level 10 content of that band (genetics, evolution, atoms and reactions, the universe, global systems and climate, motion and energy) together with the Science as a human endeavour and Science inquiry strands you are assessed on in Year 10.

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About this guide

How to use this guide

Each topic section is written to be read in order: first the ideas, then worked examples, then a summary table, then practice questions. Every practice question has a full worked solution at the back of the guide, so you can check your own working step by step.

- Read a section once for understanding. Highlight the **bold** terms – these are the words examiners expect to see.
- Cover the worked examples and try them yourself before reading the solution.
- Do the "Check your understanding" questions without notes, then mark them using the Worked solutions section.
- In the final week, sit the Practice exam under timed conditions (70 minutes) and use the One-page summary for last-minute revision.

> **Exam tip:** Blue boxes like this one give advice on how marks are awarded. Amber boxes warn you about mistakes students make every year.

How Year 10 Science is assessed

Year 10 Science is assessed by your school, not by a state-wide exam. Schools choose their own tasks and weightings, so check your school's assessment outline. Most Victorian schools use a mix of:

Task type	What it usually looks like	What it tests
Topic tests	30–60 minute tests at the end of each unit	Knowledge, calculations, explanations
Practical reports	A written report on an experiment you carried out	Planning, data analysis, evaluation
Research tasks	Poster, essay or presentation on a science issue	Science as a human endeavour, communication
End-of-semester exam	60–120 minutes, multiple choice plus short and extended answers	Everything in the semester

The curriculum's achievement standard says that by the end of Level 10 you should be able to explain heredity and genetic diversity, use evidence for evolution by natural selection, describe

the big bang theory and its evidence, explain global climate patterns using energy flow, explain motion using Newton's laws, explain patterns in the periodic table and predict reaction products and rates. You should also be able to plan valid, reproducible investigations, analyse data and evaluate claims, and explain how scientific knowledge is checked through peer review.

Year 10 Science also matters for VCE: Biology, Chemistry, Physics, Psychology and Environmental Science all build directly on these topics.

Eight-week revision plan

Week	Focus	Tasks
1	Science inquiry skills; Science as a human endeavour	Read sections 1–2, do both question sets
2	DNA, genes and inheritance	Section 3; practise 10 Punnett squares
3	Evolution by natural selection	Section 4; write one extended answer
4	Atoms, the periodic table and bonding	Sections 5–6; learn the first 20 elements
5	Chemical reactions and rates	Section 7; balance 15 equations
6	The universe; global systems and climate	Sections 8–9
7	Motion, Newton's laws and energy	Sections 10–11; all calculations twice
8	Whole course	Practice exam (timed), mark it, revise weak areas

Contents

1. Science inquiry skills and the practical report
2. Science as a human endeavour
3. DNA, genes and inheritance
4. Evolution by natural selection
5. Atomic structure and the periodic table
6. Chemical bonding
7. Chemical reactions, equations and reaction rates
8. The universe and the big bang
9. Global systems and climate change
10. Motion and Newton's laws
11. Energy and its conservation
12. Exam technique
13. Practice exam
14. Worked solutions
15. Glossary
16. One-page summary

1. Science inquiry skills and the practical report

Science inquiry is the "how" of science: asking testable questions, designing fair investigations, collecting and processing data, and judging how much the results can be trusted. These skills are tested in every topic, so learn this section well.

Questions, hypotheses and predictions

A **research question** is a question that an investigation can answer, such as "How does the temperature of water affect the time taken for a tablet to dissolve?"

A **hypothesis** is a testable explanation that links the independent and dependent variables and gives a reason. A **prediction** is the specific result you expect if the hypothesis is correct.

A strong hypothesis uses the form: "If [independent variable] is [changed], then [dependent variable] will [change], because [scientific reason]."

Example: "If the temperature of the water is increased, then the time for the tablet to dissolve will decrease, because particles move faster and collide more often with the tablet surface."

> **Common mistake:** Writing "I think it will dissolve faster" is a guess, not a hypothesis. A hypothesis names both variables, states the direction of the change and gives a reason.

Variables

- The **independent variable** (IV) is the one you deliberately change.
- The **dependent variable** (DV) is the one you measure; it depends on the IV.
- **Controlled variables** are kept the same so that only the IV affects the DV. This is what makes a test fair.
- A **control** (or control group) is a set-up where the IV is not applied or is kept at a standard value, so you have something to compare the results against.

Investigation	Independent variable	Dependent variable	Two controlled variables
Effect of ramp height on a trolley's speed	Height of ramp (cm)	Speed at bottom (m s^{-1})	Trolley mass, ramp surface
Effect of acid concentration on	Concentration of HCl (M)	Volume of gas in 60 s (mL)	Mass of magnesium, temperature

reaction rate			
Effect of light colour on plant growth	Colour of light	Height gained in 14 days (mm)	Plant species, volume of water

Exam tip: When asked to identify a controlled variable, name something specific and measurable ("the volume of acid, 50 mL") rather than something vague ("the same equipment").

Validity, reliability, accuracy and precision

These four words are often confused, and examiners reward students who use them correctly.

- **Valid**: the investigation actually tests what it claims to test. Validity depends on controlling variables and measuring the right thing.
- **Reliable** (also called **reproducible** or **repeatable**): the same results are obtained when the investigation is repeated, by you or by someone else. You improve reliability by doing repeat trials and calculating a mean.
- **Accurate**: a measurement is close to the true or accepted value.
- **Precise**: repeated measurements are close to each other (small spread), whether or not they are close to the true value.

Situation	Accurate?	Precise?
Darts clustered tightly at the bullseye	Yes	Yes
Darts clustered tightly in one corner	No	Yes
Darts spread widely but averaging at the bullseye	Yes, on average	No
Darts spread widely and away from the bullseye	No	No

Common mistake: Repeating an experiment does not make it more accurate. Repeats improve reliability and reduce the effect of random errors; they do nothing about a systematic error.

Errors and uncertainty

- **Random errors** cause readings to scatter unpredictably above and below the true value (for example, reaction time when using a stopwatch). They are reduced by repeating and averaging.
- **Systematic errors** shift every reading in the same direction by a similar amount (for example, a scale that reads 2 g too high, or reading a measuring cylinder from above). They are reduced by calibrating equipment and improving technique, not by repeating.
- **Mistakes** (personal errors), such as spilling a sample or misreading a scale, are not "errors" in the scientific sense; the result should be discarded and the trial repeated.
- An **outlier** is a result that does not fit the pattern of the others. Check whether it has an obvious cause; if it does, leave it out of the mean and say so in your report.

The **uncertainty** of a measuring instrument is usually taken as half the smallest division for an analogue scale (a ruler marked in mm has an uncertainty of ±0.5 mm) and one unit of the last digit for a digital display.

Percentage error compares your result to an accepted value:

percentage error = |experimental value − accepted value| ÷ accepted value × 100%

Worked example 1.1: processing results

A student times a ball rolling down a ramp four times: 2.31 s, 2.28 s, 2.35 s and 2.90 s. Calculate a suitable mean.

1. Look for an outlier: 2.90 s is far from the other three (all within 0.07 s of each other), so it is an outlier.
2. Mean of the remaining three = (2.31 + 2.28 + 2.35) ÷ 3 = 6.94 ÷ 3 = 2.313… s.
3. Round to match the data (two decimal places): mean = 2.31 s.

Worked example 1.2: percentage error

A class measures the acceleration due to gravity as 9.6 m s^{-2}. The accepted value is 9.8 m s^{-2}.

percentage error = |9.6 − 9.8| ÷ 9.8 × 100% = 0.2 ÷ 9.8 × 100% = 2.0% (2 significant figures)

Presenting data

- Tables: IV in the first column, DV in the following columns, units in the column headings (not in every cell), and a mean column.
- **Line graphs** are used when both variables are continuous (numbers that can take any value, such as temperature). **Column (bar) graphs** are used when the IV is categorical (such as colour of light or type of metal).
- On a graph the IV goes on the x-axis and the DV on the y-axis. Label both axes with quantity and unit, use an even scale, and draw a line or curve of best fit rather than joining dots.
- A **trend** describes the overall pattern ("as temperature increases, dissolving time decreases"). A **correlation** is a relationship between two variables; it does not prove that

one causes the other.

> **Exam tip:** When describing a graph, give the trend and quote data with units: "As temperature increased from 20 °C to 60 °C, dissolving time decreased from 48 s to 12 s."

Ethics and safety

A **risk assessment** identifies each hazard, the risk it poses and how the risk will be controlled (for example, "1.0 M hydrochloric acid is corrosive: wear safety glasses and gloves, and wipe up spills immediately"). Investigations involving animals or people need ethical consideration: informed consent, privacy, minimising harm and using the smallest number of animals possible.

Writing a practical report

Section	What to include
Title	A short description of the investigation
Aim	What you are trying to find out ("To investigate the effect of … on …")
Hypothesis	If … then … because …
Variables	IV, DV and at least three controlled variables
Materials	A list of equipment with sizes and quantities
Method	Numbered steps in past or imperative tense, precise enough for someone else to repeat; include repeats and safety
Results	Tables of raw and processed data, a correctly drawn graph, any observations
Discussion	Describe the trend; explain it using science; compare with the hypothesis; identify errors and outliers; evaluate validity and reliability; suggest specific improvements
Conclusion	One to three sentences that answer the aim, state whether the hypothesis was supported and quote key data
References	Sources used, in a consistent style

Common mistake: "The hypothesis was proven" is wrong. Experiments support or do not support a hypothesis; they never prove it.

Exam tip: Improvements must be specific. "Be more careful" scores nothing; "use a light gate instead of a hand-held stopwatch to remove reaction-time error" scores the mark.

Check your understanding: section 1

1. A student investigates how the mass of sugar dissolved in 100 mL of water affects its boiling point. Identify the IV, the DV and two controlled variables. (3 marks)
2. Write a hypothesis for the investigation in question 1. (2 marks)
3. A digital balance always reads 0.5 g even when nothing is on it. Name the type of error and explain how to correct it. (2 marks)
4. Five trials of the time for 10 swings of a pendulum gave 14.2 s, 14.4 s, 14.3 s, 16.9 s and 14.1 s. Calculate a suitable mean. (2 marks)
5. A student measures the density of aluminium as 2.81 g cm^{-3}. The accepted value is 2.70 g cm^{-3}. Calculate the percentage error. (2 marks)
6. Explain the difference between precision and accuracy, using an example. (3 marks)

2. Science as a human endeavour

This strand is about how scientific knowledge is produced, checked and used by people and society. Questions usually ask you to explain, using an example, how ideas change, how technology and science drive each other, or how society influences research.

How scientific knowledge is validated: publication and peer review

Scientists communicate results by publishing in **scientific journals**. Before a paper is accepted it goes through **peer review**: independent experts in the same field check the methods, data, analysis and conclusions, and recommend acceptance, changes or rejection.

Peer review helps to:

- detect errors in method, calculation or reasoning
- check that conclusions are supported by the data
- prevent fraud and unsupported claims from entering the scientific record
- allow other scientists to **replicate** (repeat) the work, which is the strongest test of a result

A claim gains acceptance when it has been published, replicated by independent groups and is consistent with other evidence. A single study, a media report or a social-media post is not enough.

Models and theories are contestable and refined over time

A **scientific theory** is a well-tested explanation supported by a large body of evidence (for example, the theory of evolution or the big bang theory). It is not a guess. A **model** is a simplified representation (physical, diagrammatic or mathematical) that helps explain or predict.

Theories and models can be revised when new evidence appears. The history of the atomic model is the classic example:

Year	Scientist	Model or discovery	Evidence
1803	John Dalton	Atoms are tiny indivisible spheres	Fixed mass ratios in compounds
1897	J. J. Thomson	Discovered the electron; "plum pudding" model	Cathode rays bent by electric and magnetic fields

End of free sample

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