

Science 5–6

Chapter 8 — Earth and space sciences

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Weathering, erosion, transportation and deposition

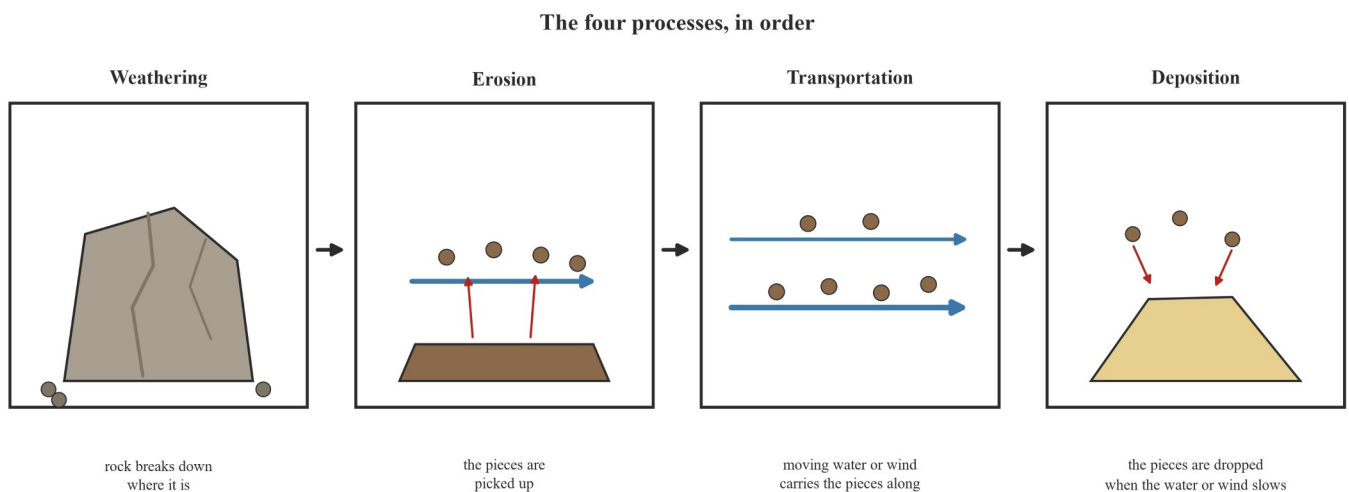
geological processes including weathering, erosion, transportation and deposition can cause slow or rapid changes to Earth's surface — VC2S6U05

Words to know — **weathering**: the breaking-down of rock where it sits; **erosion**: the picking-up and moving of broken pieces by moving water or moving air; **transportation**: the carrying of those pieces along by moving water or moving air; **deposition**: the dropping of the pieces when the water or air slows down; **mechanical weathering**: breaking caused by non-living things, such as wind-blown sand, heating and cooling, and ice; **biological weathering**: breaking caused by living things, such as tree roots; **frost wedging**: water freezing in a crack and forcing it wider; **abrasion**: the rubbing and wearing-away of rock by wind-blown sand; **run-off**: water that runs off the ground instead of sinking in; **simulated slope**: a model slope built in the classroom to stand in for a real hillside.

Rock looks strong, yet every hillside, cliff and riverbank on Earth is slowly being broken down and moved. Four processes do this work, and they always act in the same order. This section looks at each one, at the difference between them, at how fast or slow they can be, and at how the things humans do can speed them up or slow them down.

Theory

The four processes, in order



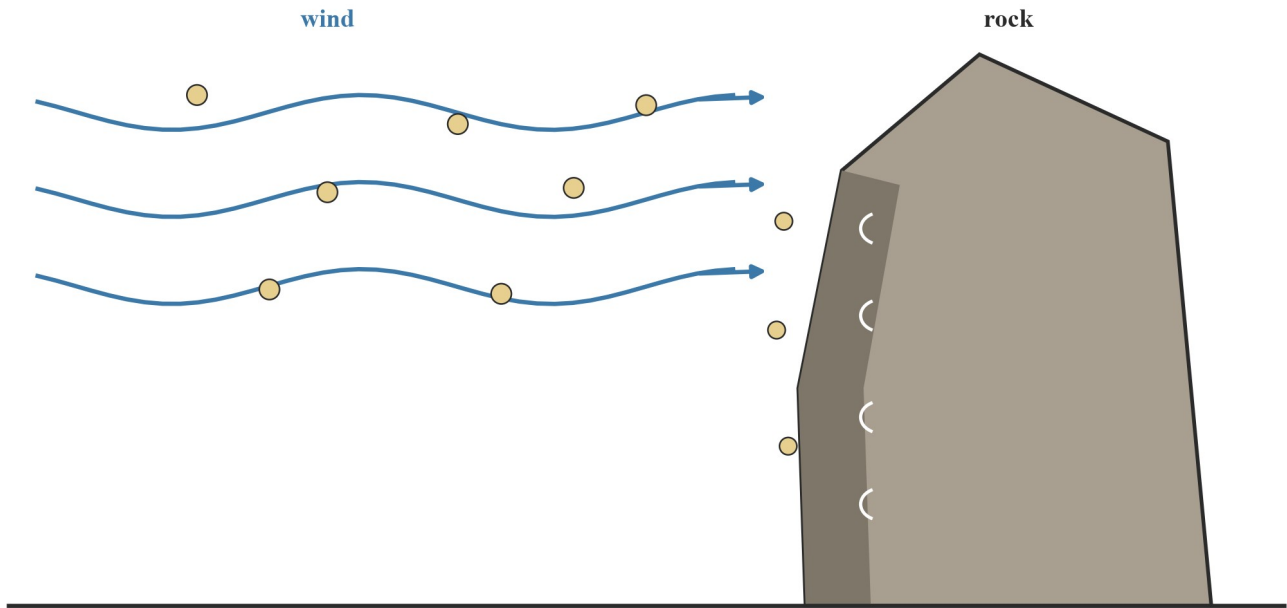
Four labelled panels in a row joined by arrows: weathering shows a cracked rock with loose pieces at its base; erosion shows pieces lifted into a moving stream; transportation shows pieces carried along in the flow; deposition shows pieces dropped in a mound where the water slows.

The four processes form a team that works in order:

1. **Weathering** breaks rock down where it is. The rock does not move; it just gets broken into little pieces.
2. **Erosion** picks those pieces up. Moving water or moving air lifts the pieces and takes them away from where they were.
3. **Transportation** carries the pieces along. The moving water or air keeps the pieces going, sometimes for a very long way.
4. **Deposition** drops the pieces. When the water or air slows down, it can no longer carry its load, and the pieces settle and build up.

The order matters. Rock has to be broken before the pieces can be picked up, and the pieces have to be carried before they can be dropped. You will use these four words a lot in this section, so learn them in order: **weathering** → **erosion** → **transportation** → **deposition**.

Mechanical weathering: wind abrasion



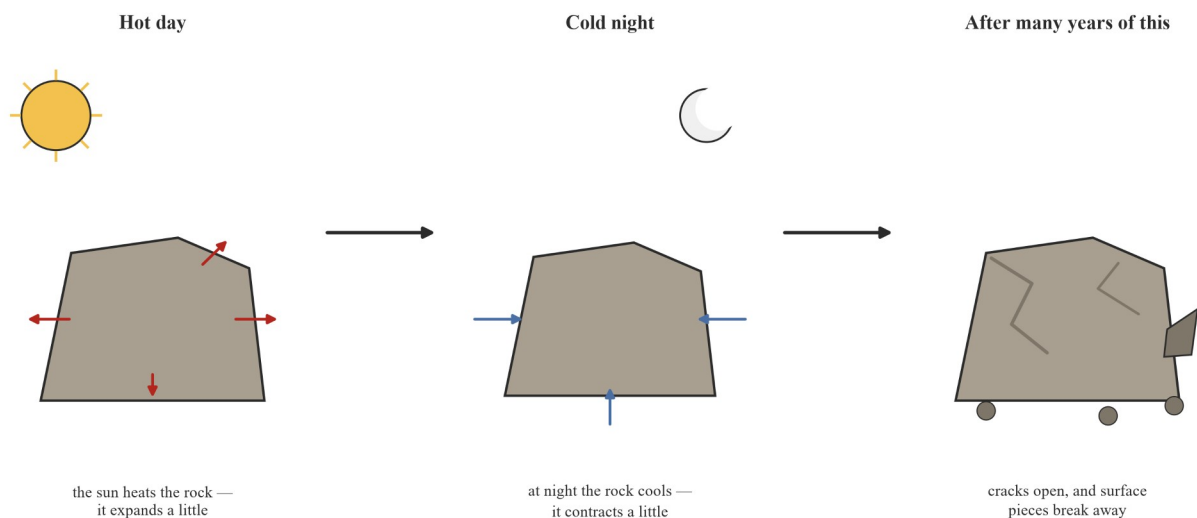
Wind-blown sand hits the rock and rubs it, wearing it away

Side view of wind streamlines carrying sand grains towards a tall rock; the face of the rock that the wind hits is darker, worn smooth, and pitted with small hollows.

In dry, windy places, the wind picks up grains of sand and throws them at rock. Every grain that hits rubs a tiny bit of rock away, like sandpaper rubbed over wood. This rubbing is called **abrasion**, and it is mechanical weathering: the rock is broken down where it stands, by a non-living thing. Over many years the face of the rock that faces the wind is worn smooth and pitted, and the rock slowly wears away.

Mechanical weathering: heating and cooling

Heating and cooling, over and over, cracks rock apart

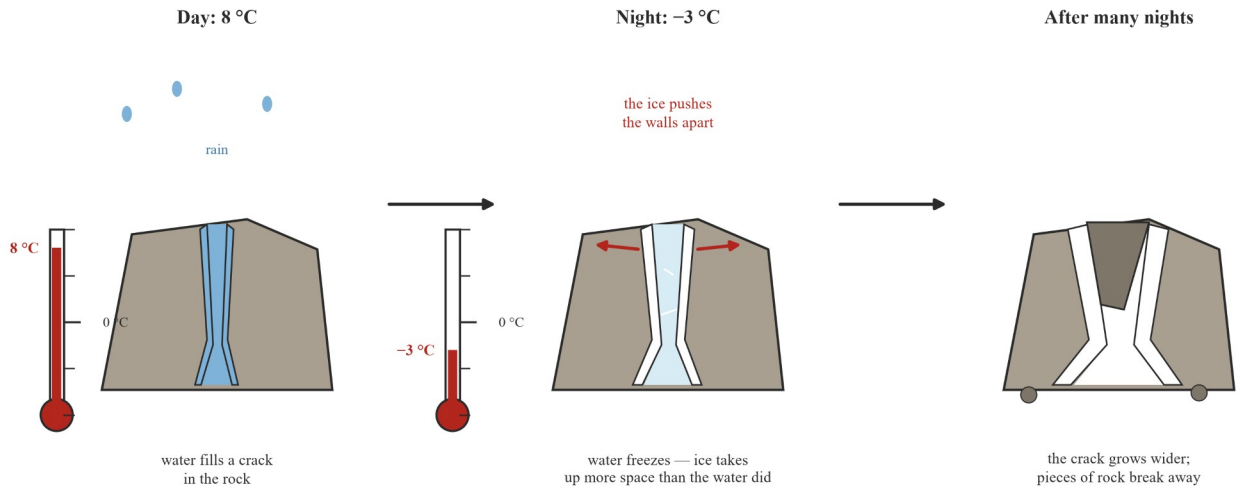


Three panels: on a hot day the sun heats a rock and small arrows show it expanding a little; on a cold night the rock cools and arrows show it contracting a little; after many years of this, cracks have opened and surface pieces break away.

Rock gets hot in the sun and cold at night. When rock is heated it **expands** (grows a tiny bit), and when it cools it **contracts** (shrinks a tiny bit). One day of this does almost nothing. But in places where days are very hot and nights are very cold, the surface of the rock is pushed and pulled a little every single day. After many years of these cycles, cracks open and thin flakes of rock break away. This is mechanical weathering too: the rock breaks down where it sits.

Mechanical weathering: frost wedging

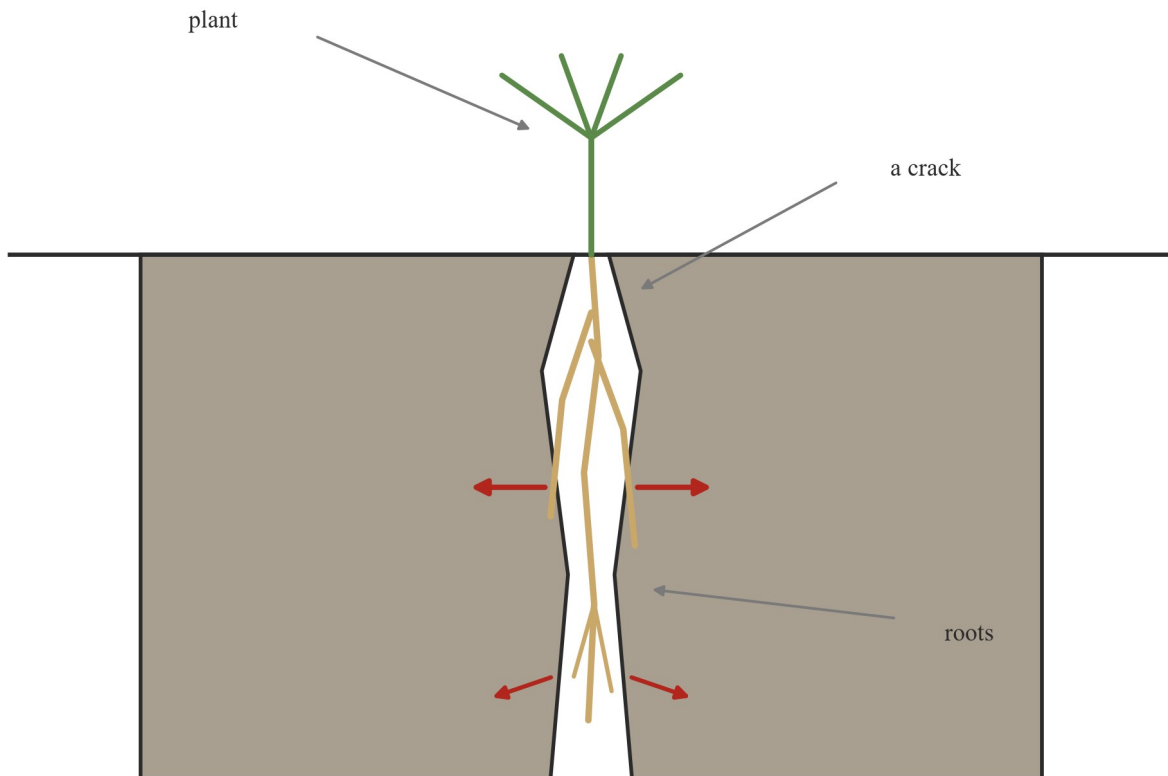
Frost wedging: water freezes in a crack and splits the rock



Three panels with labelled thermometer scales. Day, 8 °C: rain fills a crack in a rock. Night, -3 °C: the water freezes and the ice forces the crack wider. After many nights: the crack is much wider and a wedge of rock is working loose.

Water from rain or melting snow runs into cracks in rock. Look at the thermometer scales in the figure: on the day shown, the temperature reads 8 °C, so the water stays liquid. At night it falls to -3 °C, below the 0 °C mark, so the water in the crack freezes. When water freezes it turns to ice, and the ice takes up more space than the water did. The growing ice pushes hard on the walls of the crack and forces them a little wider. Next day the ice melts, more water runs in, and at night it freezes and pushes again. After many freeze-thaw cycles the crack is wide, and pieces of rock break away. This splitting by ice is called **frost wedging**. It is why the tops of mountains are full of broken rock.

Biological weathering: roots

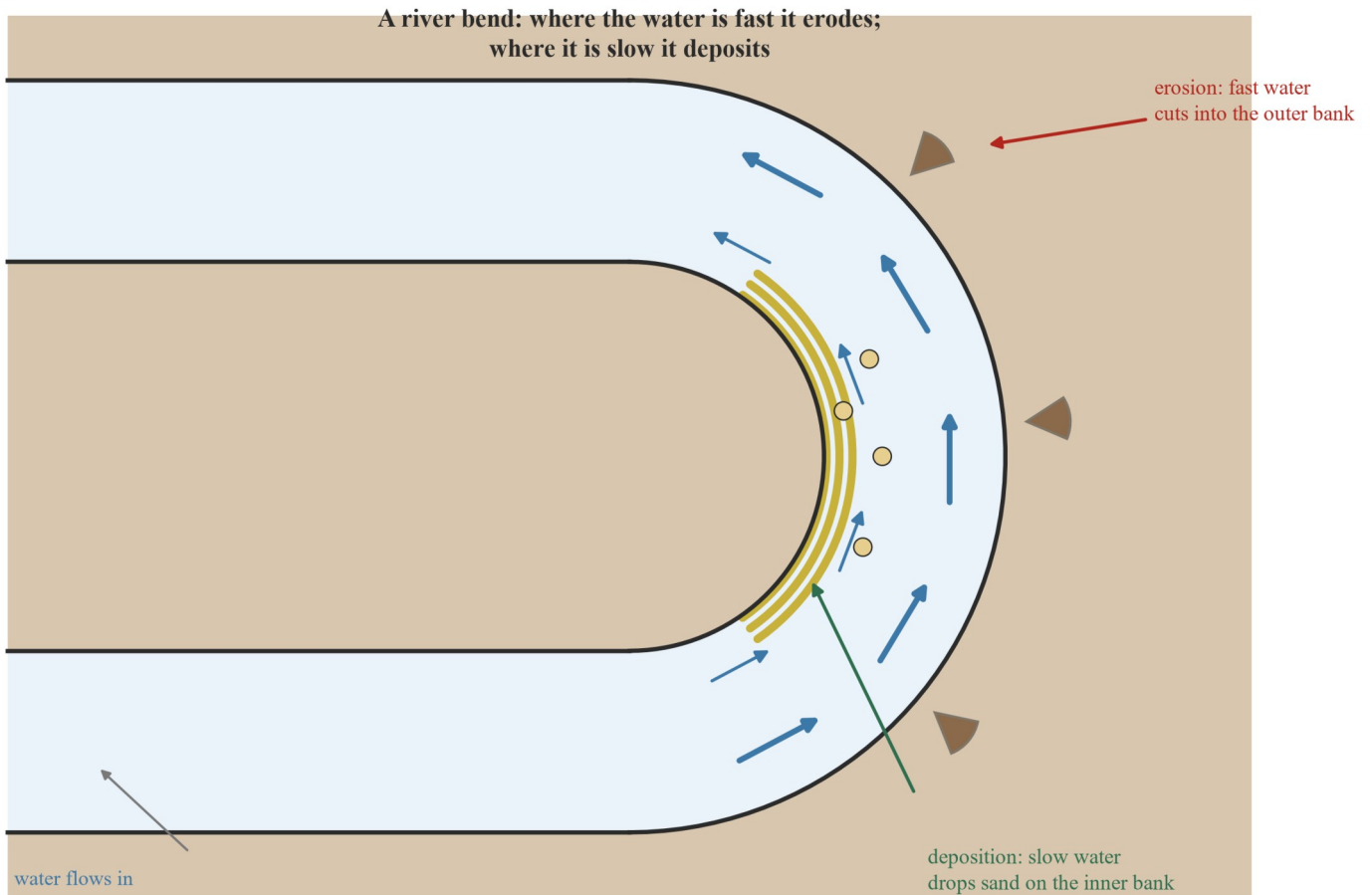


**Roots grow into cracks; as they get thicker,
they push the rock apart**

A plant growing on top of a rock with a crack running down through it; the plant's roots grow into the crack and branch, and red arrows show the thickening roots pushing the two halves of the rock away from each other.

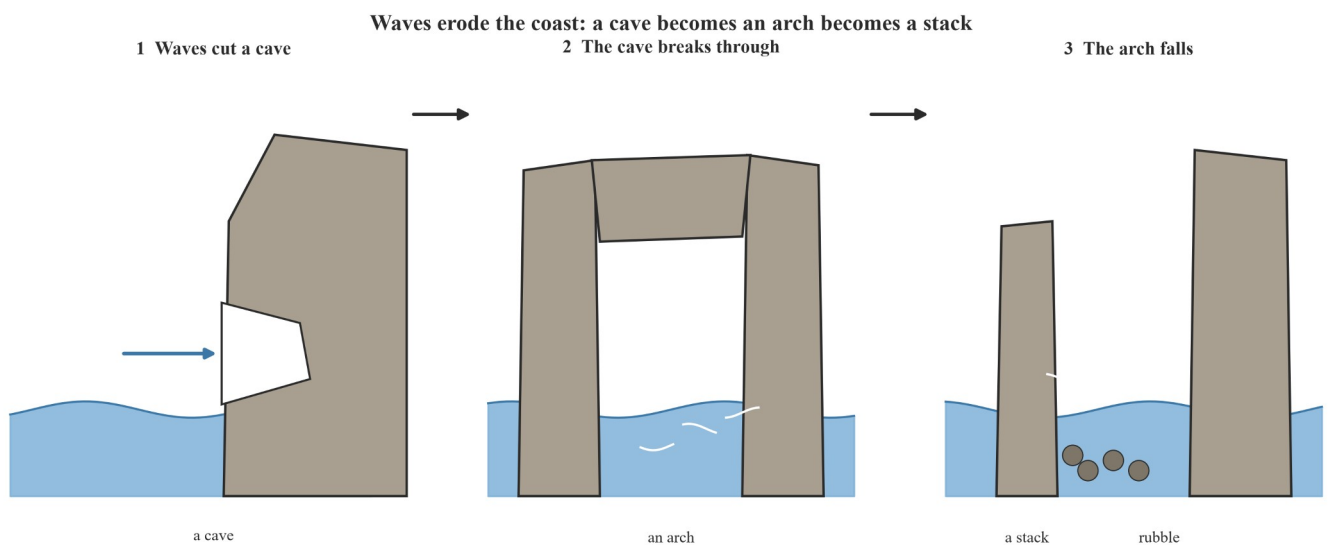
Living things weather rock too. A seed that lands in a crack can grow, and its roots grow down into the crack. Roots get thicker as the plant grows, and a thickening root pushes on the walls of the crack just as ice does. Slowly the crack is forced wider and the rock splits. Because a living thing does the breaking, this is called **biological weathering**. You may have seen it in a footpath, where a tree root has cracked the concrete.

Erosion by moving water



Plan view of a river bend: long arrows show fast water on the outside of the bend cutting notches into the outer bank, short arrows show slow water on the inside, and bands of sand with grains are deposited along the inner bank.

Moving water is one of the largest causes of erosion on Earth. Water does not wear all places the same way: it erodes most where it moves fastest. In a river bend, the water flows fast on the outside of the bend, where it cuts into the bank and picks up soil and rock pieces. On the inside of the bend the water moves slowly, and slow water drops sand, building it up into a shallow bank. So the bend slowly changes shape: cut on the outside, built up on the inside.



Three panels of a rocky coast: waves cut a cave into a headland; the cave breaks through to form an arch; the top of the arch falls, leaving a stack of rock standing alone with rubble at its base.

Waves erode coasts in the same way. Wave after wave hammers a headland, and the rock it hits is picked up and dragged away. A weak spot is cut into a **cave**, the cave may break through to form an **arch**, and when the top of the

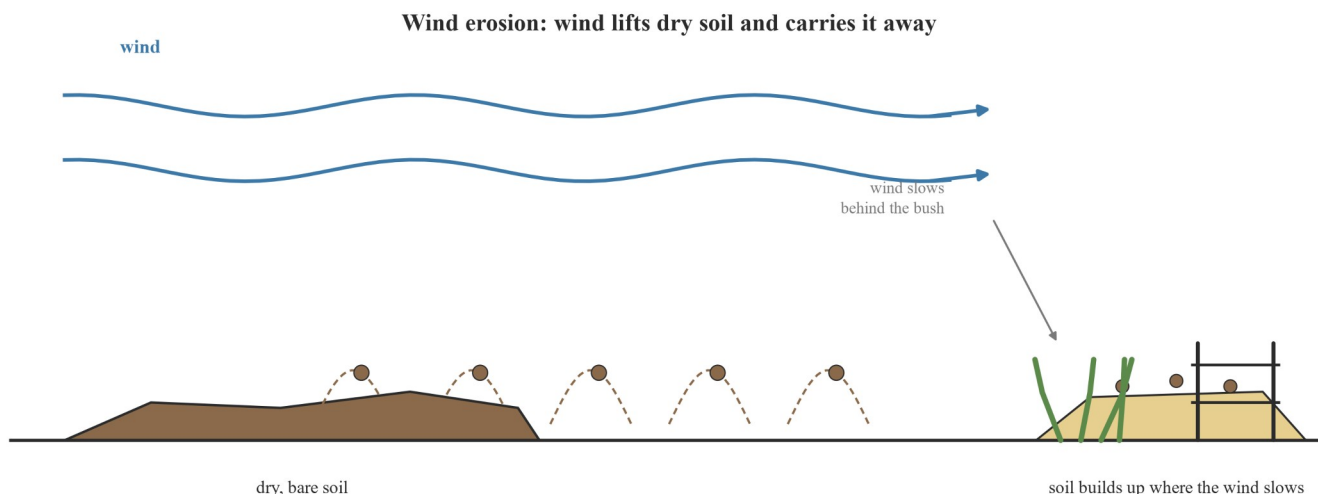
arch falls, a **stack** is left standing alone. Australia has plenty of coast to erode: its coastline is about 34 000 km long, and satellites have been used to map how its coasts change from year to year.

Source: Geoscience Australia, “Australia’s coasts and estuaries”, retrieved 21 August 2026.

Coastal erosion can be slow, or it can be rapid. Sandy beaches are systems of loose sand that are always being moved by waves: sand is taken in storms and some is returned in calmer weather. In a very large storm — the kind expected about once in 100 years — waves may cut several metres into a dune in a single day. That is erosion happening fast enough to watch.

Source: OzCoasts (Geoscience Australia), “Beach erosion”, retrieved 21 August 2026.

Erosion by moving air

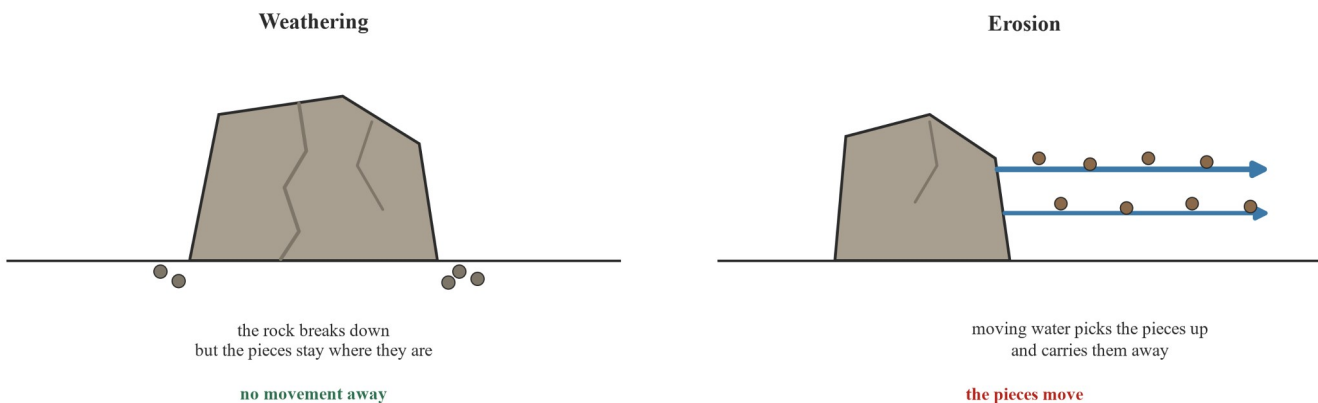


Side view of wind blowing over dry, bare soil; grains hop along the ground in short bouncing paths, and where the wind slows behind a bush and a fence, sand and soil build up in a low mound.

Moving air erodes too. Wind can lift dry, bare soil and carry it away — this is why a bare paddock can lose its topsoil in a strong, dry wind. Wind erosion works best where the ground is dry, bare and flat, and the grains move in short hops close to the ground. Where the wind slows down — behind a bush, a fence or a building — it drops what it was carrying, and soil builds up.

Weathering is not erosion

Weathering breaks rock apart — erosion moves the pieces away

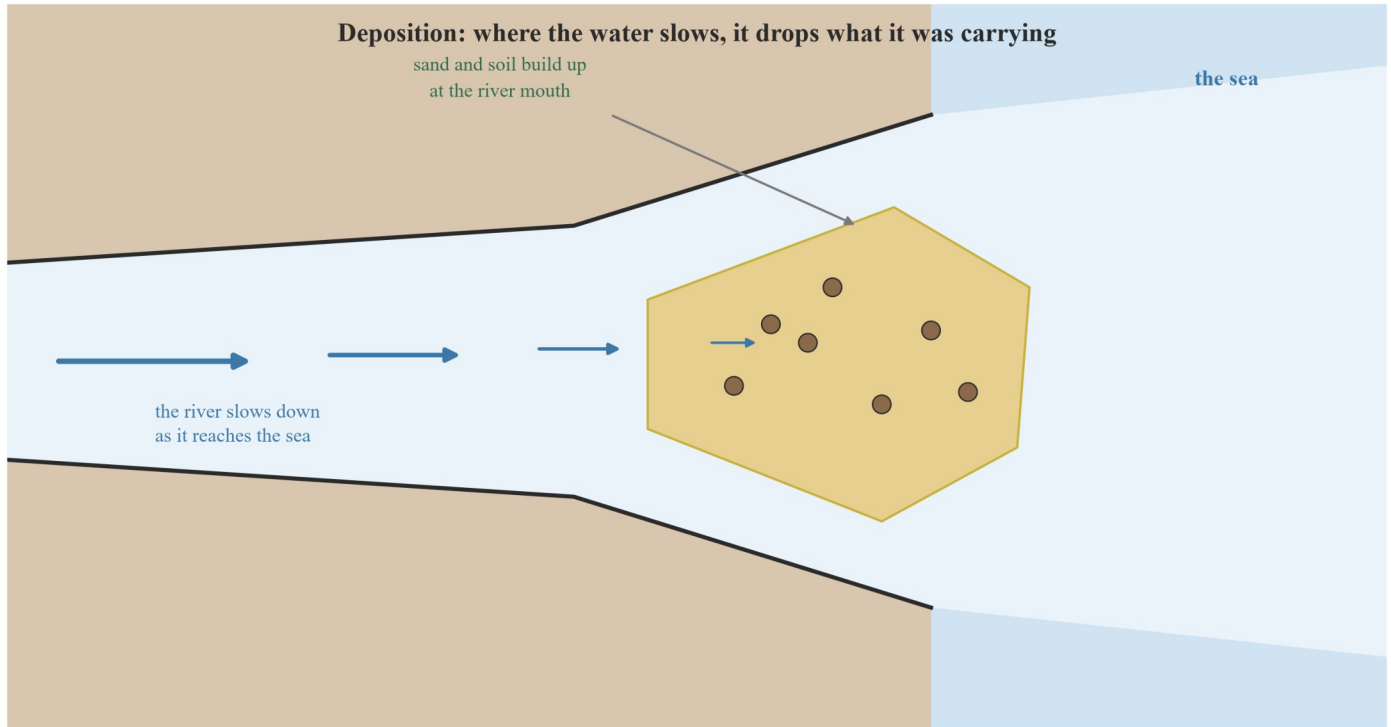


Two panels side by side. Weathering: a cracked rock with broken pieces sitting at its base, captioned “no movement away”. Erosion: a second rock with moving water sweeping the broken pieces away to the right, captioned “the pieces move”.

These two words are often mixed up, so here is the rule: **weathering breaks rock down where it is; erosion moves the pieces away.** A rock cracked by frost or split by roots has been weathered, even though nothing has moved. The moment moving water or wind picks those pieces up and takes them, erosion has begun.

The two processes also run on different clocks. Weathering is usually slow — a crack growing for years, a face of rock worn over hundreds or thousands of years. Erosion can be slow too, but it can also be rapid: a flood can take a riverbank in an afternoon, and a big storm can cut several metres into a sand dune in a day.

Transportation and deposition

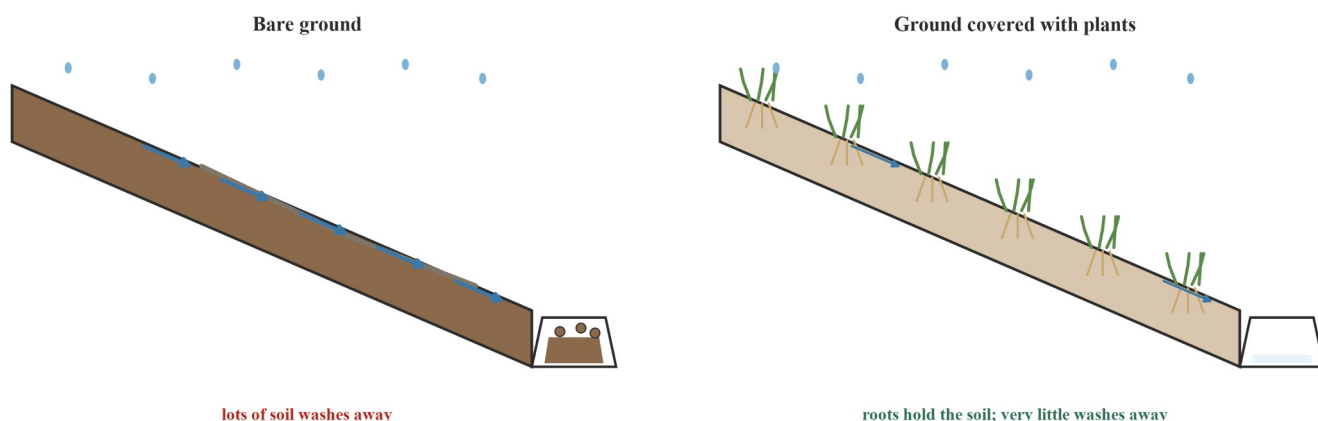


Plan view of a river reaching the sea: long flow arrows higher up the river become shorter and shorter as the water slows at the mouth, and a fan of sand with scattered grains builds up where the river meets the sea.

Between erosion and deposition, the pieces have to travel. **Transportation** is that journey: muddy water in a creek is transportation at work, with grains of sand and soil carried along in the flow (and wind carrying dust is transportation too). The water keeps its load as long as it keeps its speed. Where the water slows down — for example where a river reaches the sea and spreads out — it can no longer carry the load, and the grains sink and build up. That dropping is **deposition**, and over time the deposited sand and soil can form new land at a river mouth. The same rule works for wind: fast wind carries, slow wind drops.

Humans change the rate

The same rain falls on both slopes — the cover makes the difference



Two identical slopes with the same rain falling on them. On bare ground, strong run-off arrows sweep down the slope and a collecting dish fills with washed soil. On ground covered with plants, roots hold the soil and the collecting dish stays almost clean.

Plants are a natural brake on erosion. Leaves and stems slow the rain before it hits the ground, and roots hold the soil together. When humans clear plants — for farms, buildings or tracks — the brake comes off, and rain and wind can pick the soil up and move it away much more quickly. The figure shows the same rain on two slopes: the bare slope loses a lot of soil, while the planted slope holds on to almost all of it.

A real example is being fixed right now on the Yarra River at Warrandyte. Years of informal tracks, foot traffic and dogs off-lead had worn the plants away, and the bare riverbank was being eroded and washed into the river. The repair plan is exactly what the figure predicts: fencing to keep feet and paws off, rocks to shield the bank, and about 10 000 native plants along a 500 m stretch to hold the soil with their roots.

Source: Melbourne Water, “Restoring the Birrarung: riverbank recovery works planned in Warrandyte”, retrieved 21 August 2026.

The same idea shows up across a whole city. When it rains, water runs off streets, gardens and farms, carrying soil — and things we do not want in our waterways — into the bay. Hard, bare surfaces make run-off faster and speed up erosion; plants and soil slow it down.

Source: Melbourne Water, home page, retrieved 21 August 2026.

So when you are asked to **predict** what a human change will do to the rate of erosion, ask one question first: *does the change leave the ground bare, or covered?* Clearing plants, building tracks or sealing the ground with a hard surface will speed erosion up. Fencing, planting and leaving leaf litter or grass will slow it down.

Modelling erosion in the classroom

Real erosion can take years, so to study it we build a **simulated slope**: a tray of soil propped up like a hillside, with water poured on it like rain. A model lets us change one thing at a time — the cover on the ground, for example — and see in minutes what might take years outside. A model is not the real thing, and we have to say which parts of it stand for what (the tray stands for a hillside, the watering can stands for rain), but it lets us test a fair question and collect real measurements. The practical on the next pages does exactly this.

Worked examples

Example 1 — with support

Four things are happening. Say which of the four processes — weathering, erosion, transportation or deposition — is mainly at work in each, and give the clue word that told you.

Working	Comment
(i) Wind-blown sand rubs a rock in the desert.	Rubbing breaks the rock <i>where it stands</i> — nothing is carried away. Breaking in place is weathering (abrasion).
(ii) Flood water lifts soil off a paddock.	The water <i>picks the pieces up</i> and takes them. Picking up and moving is erosion .
(iii) A creek carries sand 10 km downstream.	The sand is <i>carried along</i> in moving water. Carrying is transportation .
(iv) The sand settles where the creek slows at a bend.	The water slows and <i>drops</i> its load. Dropping is deposition .

Notice the clue words: *rubs/breaks* → weathering; *lifts/takes* → erosion; *carries* → transportation; *settles/drops where it slows* → deposition.

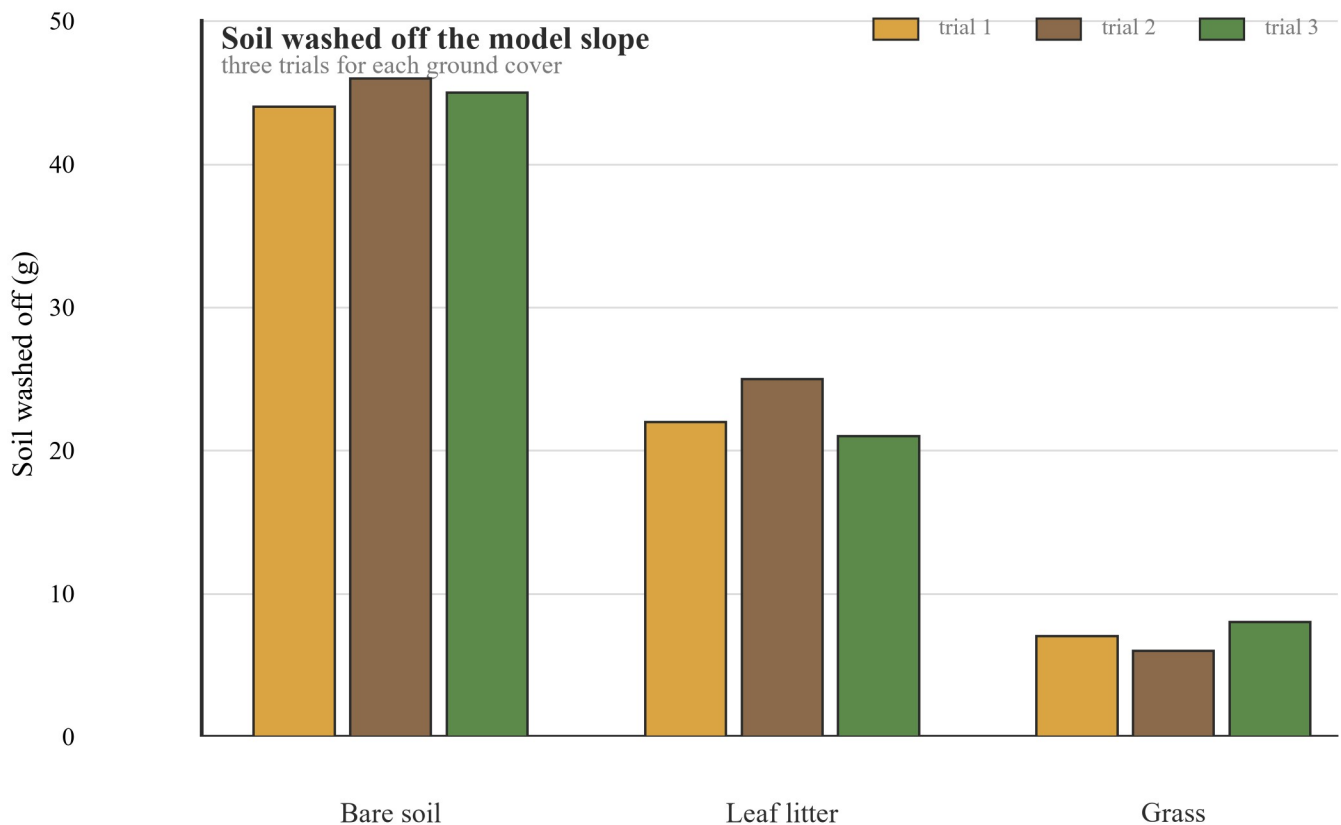
Example 2 — with support

Use the frost-wedging figure. The day thermometer reads 8 °C and the night thermometer reads −3 °C.

Working	Comment
(a) Read the scales: 8 °C is above the 0 °C mark; −3 °C is below it. Counting down from 8 to 0, then on to −3, the temperature falls 11 degrees between day and night.	Read the value off the labelled scale — count the degrees between the two marks.
(b) By day the crack holds liquid water, because 8 °C is above freezing.	Water only freezes below 0 °C.
(c) By night the water freezes; the ice takes up more space than the water did, so it forces the walls of the crack wider.	Freezing water expands — that push is the “wedge”.
(d) After many day–night cycles the crack is wider and pieces break away. The rock broke down where it sat, so this is weathering.	No moving water or wind took the pieces: breaking in place = weathering.

Example 3 — by yourself

SCENARIO — one class’s results from the slope practical, shown as an example.



Column graph titled “Soil washed off the model slope”: for bare soil the three trials read 44 g, 46 g and 45 g; for leaf litter 22 g, 25 g and 21 g; for grass 7 g, 6 g and 8 g. A key shows one colour per trial.

Use the graph. (a) Read off the three trials for bare soil. (b) Do the three bare-soil trials agree with each other? Say how you decided. (c) Which ground cover lost the least soil, and what numbers tell you so?

Practice questions

With support

Q1 (4 marks) — Sort each event into weathering, erosion, transportation or deposition. (a) Ice in a crack freezes and splits a rock. (b) Waves drag sand off a cliff face. (c) Wind carries dust across a plain. (d) Dust settles and builds up behind a fence.

Q2 (2 marks) — Put these frost-wedging steps in order, starting with “rain fills a crack”. (a) The ice pushes the walls of the crack away from each other. (b) Rain fills a crack in the rock. (c) After many cycles, pieces of rock break away. (d) At night the temperature falls below 0 °C and the water freezes.

Q3 (4 marks) — Tick each as **mechanical** or **biological** weathering. (a) wind abrasion; (b) tree roots thickening in a crack; (c) frost wedging; (d) heating and cooling cycles.

Q4 (2 marks) — Finish the sentences about the river-bend figure. “On the outside of the bend the water moves _____, so it _____ the bank. On the inside of the bend the water moves _____, so it _____ sand.”

Q5 (1 mark) — In the frost-wedging figure the day reads 8 °C and the night reads –3 °C. Count on the thermometer scales: by how many degrees does the temperature fall from day to night?

Q6 (2 marks) — Which of the two processes — weathering or erosion — can be *rapid*? Give one example from this section to back up your answer.

By yourself

Q7 (4 marks) — In your own words, say what each process does, and give the one difference between (a) weathering and erosion, and (b) transportation and deposition.

Q8 (4 marks) — Name the main process at work: weathering, erosion, transportation or deposition. (a) Tree roots grow thicker in a crack and split the rock. (b) A flood picks up soil from a bare paddock. (c) A river carries muddy water 40 km to the sea. (d) Sand settles at the river mouth and builds new ground.

Q9 (3 marks) — A mountain region has warm, sunny days and nights below 0 °C. Explain, step by step, how frost wedging breaks its rocks. Use the figure to help.

Q10 (2 marks) — A rock in the desert has one face that is smooth and pitted, and that face points into the wind. Explain why.

Q11 (3 marks) — Use the river-bend figure. Explain why the outer bank of a bend is cut away while the inner bank builds up with sand.

Q12 (3 marks) — At Warrandyte, the bare bank of the Yarra River was eroding into the river. (a) What had people been doing that left the bank bare? (1 mark) (b) The repair plan uses fencing, rocks and about 10 000 native plants. Explain how the plants will slow the rate of erosion. (2 marks)

Q13 (2 marks) — Erosion can be slow or rapid. Use the beach-erosion information in this section to give one example of *rapid* erosion, and say roughly how fast it was.

Q14 (3 marks) — *SCENARIO — one class's results, shown as an example.* Use the results graph. (a) Read off the three trials for grass. (1 mark) (b) Compare the three grass trials with each other. Do they agree? (1 mark) (c) The class concludes that grass cover protects soil better than leaf litter. Do the numbers support this? Use figures to back up your answer. (1 mark)

Q15 (3 marks) — In the slope practical, name: (a) the one thing we change; (b) the one thing we measure; (c) one thing we keep the same.

Q16 (6 marks) — A single grain of sand starts life inside a rock high in some hills, and ends up on a beach at the sea. Tell the grain's story in four short paragraphs, using the words **weathering**, **erosion**, **transportation** and **deposition** correctly (one process per paragraph). In a fifth paragraph, add one thing humans could do nearby that would speed the story up or slow it down, and say which.

Practical — Does the cover on the ground change how much soil washes off a slope?

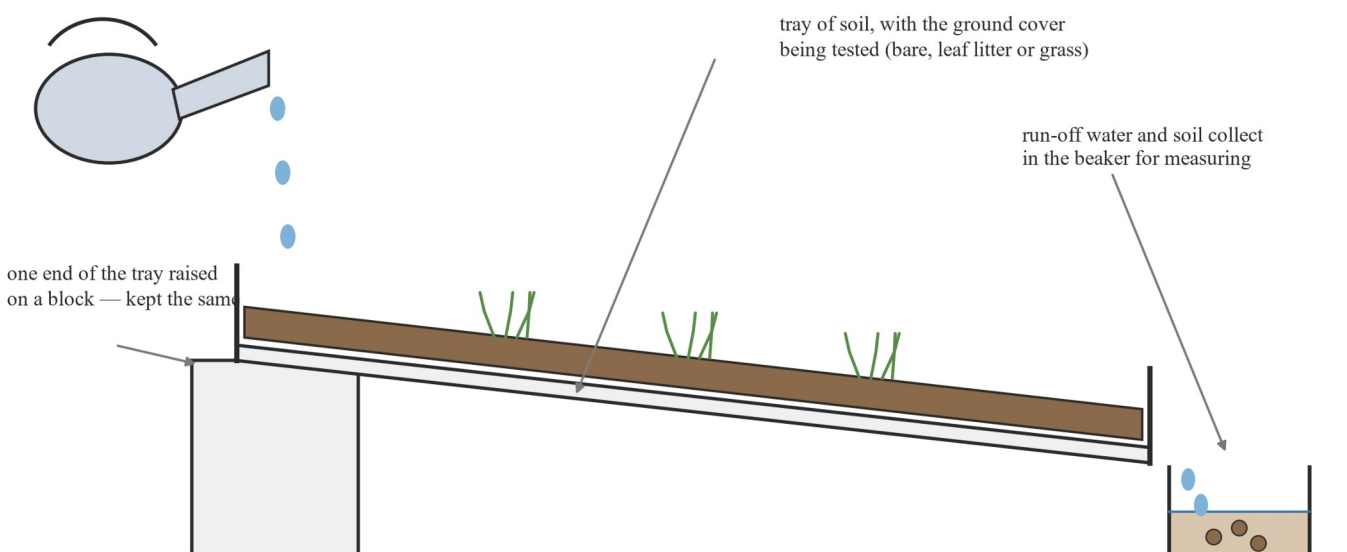
PRACTICAL — this page plans or analyses work done in the classroom, laboratory or field. It is not a substitute for doing it.

Question — How does the cover on the ground (bare soil, leaf litter, or grass) change the mass of soil washed off a simulated slope by the same “rain”?

Equipment — three identical trays of soil prepared the same way (one bare, one covered with leaf litter, one with grass turf); a block to raise one end of each tray by the same height; a watering can holding the same measured amount of water for every trial; a large beaker to catch run-off at the low end; a balance to measure mass in grams; a paper filter and a warm place to dry the collected soil; safety glasses; paper and pencil for mapping.

Modelling erosion on a simulated slope

water poured gently —
the same amount each trial



Labelled side view of the model: a tray of soil with one end raised on a block, water poured gently from a watering can at the raised end, tufts showing the cover being tested, and run-off water and soil collecting in a beaker under the low end for measuring.

Safety

Risk	How we manage it
Soil or water spilt on the floor makes a slipping risk.	Wipe spills up straight away; keep the floor around the bench dry.
Dust or splashes getting into eyes while handling soil.	Wear safety glasses while setting up and pouring; do not rub your eyes with soil on your hands.
Trays and beakers are heavy when full and can drop on feet.	Carry trays with two hands; set them down, do not drop them.

Variables

The one we change	The one we measure	The ones we keep the same
the cover on the ground: bare soil, leaf litter or grass	the mass of soil washed off, in grams	the slope angle (same block height); the amount of water and the way it is poured; the size of the tray and the soil in it

Method

1. Set the tray on the bench and raise one end on the block. Check the block height is the same for every trial.
2. Start with the bare-soil tray. Place the beaker under the low end to catch run-off.
3. Pour the measured amount of water gently over the whole top of the slope, from the same height each time.
4. Watch what happens. On a sheet of paper, draw a plan (a map from above) of the tray and mark any little channels the water cuts, and where soil was taken and left.

5. Let the beaker stand until the soil settles to the bottom. Carefully pour off the clear water, and set the soil on a filter to dry (your teacher may dry it for you).
6. Measure the mass of the dried soil in grams and record it.
7. Repeat steps 2–6 two more times with the same cover, so you have three trials.
8. Repeat the whole set with the leaf-litter tray and then the grass tray, keeping everything else the same.

Results — mass of soil washed off (g)

Ground cover	Trial 1	Trial 2	Trial 3
Bare soil			
Leaf litter			
Grass			

Compare your three trials for each cover. Do the readings agree with each other, or is there one that does not fit? If one trial is very different, think about what might have gone wrong (poured harder? spilt some?) before you trust it.

Mapping and graphing — Use your plan drawings to describe where the water cut channels on the bare tray compared with the grass tray. Then graph your results as a column graph with one column per trial, like the example graph in the worked examples. Do **not** squash your three trials into one number: keep all three columns so anyone can see how well your trials agreed.

Thinking about the results

1. Which cover lost the most soil, and which lost the least? How can you tell from your graph?
2. The model slope stands for a real hillside. What does the watering can stand for? What does the soil in the beaker stand for on a real hill?
3. A developer wants to clear the plants off a real slope to build houses. Use your results to predict what will happen to the rate of erosion when it rains. Give your evidence.
4. Suggest one change to the method that would make your results easier to trust.

Claim and evidence — Write one sentence that claims an answer to the question (for example, “Grass cover washes off the least soil because...”). Then write two sentences that support it: one using numbers from your results, and one explaining *why* the cover makes the difference, using what you know about roots and rain.

Answers

Example 3 (by yourself) — (a) 44 g, 46 g, 45 g. (b) Yes — the three readings sit close together (a 2 g spread), so the trials agree. (c) Grass: 7 g, 6 g, 8 g — every grass trial is far below every leaf-litter trial (21–25 g), so grass lost the least soil.

Q1 — (a) weathering; (b) erosion; (c) transportation; (d) deposition. **Q2** — b, d, a, c. **Q3** — (a) mechanical; (b) biological; (c) mechanical; (d) mechanical (1 mark each). **Q4** — fast ... erodes (cuts); slowly ... deposits (drops). **Q5** — 11 degrees (8 down to 0, then 3 more down to -3). **Q6** — erosion; e.g. a 1-in-100-year storm cutting several metres into a dune in a day (or a flood taking a bank in an afternoon). **Q7** — weathering breaks rock in place; erosion picks the pieces up and moves them; transportation carries them; deposition drops them when the water or wind slows. (a) weathering breaks without moving, erosion moves; (b) transportation carries, deposition drops. **Q8** — (a) weathering; (b) erosion; (c) transportation; (d) deposition. **Q9** — warm day: water in cracks stays liquid; night below 0 °C: water freezes; ice takes more space and pushes the walls away from each other; repeated cycles widen the crack until pieces break away. **Q10** — wind-blown sand (abrasion) rubs the face that points into the wind, wearing it smooth and pitting it. **Q11** — water is fast on the outside, so it erodes/cuts the outer bank; water is slow on the inside, so it deposits sand there. **Q12** — (a) informal tracks, foot traffic and dogs off-lead wore the plants away. (b) roots hold the soil together and leaves slow the rain, so less soil is picked up and washed into the river. **Q13** — in a 1-in-100-year storm, waves may cut several metres into a dune in a single day. **Q14** — (a) 7 g, 6 g, 8 g. (b) yes — within 2 g of each other. (c) yes — grass 6–8 g vs leaf litter 21–25 g; every grass trial is lower. **Q15** — (a) the cover on the ground; (b) the mass of soil washed off (g); (c) any one of: slope angle / amount and way of pouring water / tray and soil. **Q16** — four paragraphs using the words in order with correct meanings, plus a human change with a correct prediction (clearing plants speeds up; planting or fencing slows down).

Fully-worked solutions

Example 3 — (a) Reading the bare-soil columns against the scale: trial 1 = 44 g, trial 2 = 46 g, trial 3 = 45 g. (1 mark for all three correct) (b) Yes — read off the columns, the three readings are all within 2 g of each other and there is no odd one out, so the trials agree. (1 mark: “yes” + a reason from the numbers) (c) Grass columns: 7, 6, 8 g; leaf litter: 22, 25, 21 g. The highest grass reading (8 g) is far below the lowest leaf-litter reading (21 g), so grass lost the least soil. (1 mark: choice + correct numbers)

Q1 — 1 mark each. (a) The rock is split *where it sits* — weathering. (b) The waves *take* sand away — erosion. (c) The dust is *carried* by moving air — transportation. (d) The dust *settles and builds up* where the wind slows — deposition.

Q2 — 1 mark for the order **b** → **d** → **a** → **c**; 1 mark for matching it to the figure (rain → freeze below 0 °C → ice pushes → pieces break away after many cycles).

Q3 — 1 mark each: (a) mechanical — wind-blown sand is non-living; (b) biological — a living tree does the breaking; (c) mechanical — ice is non-living; (d) mechanical — heat and cold are non-living.

Q4 — 1 mark per half-sentence pair: outside = fast → erodes/cuts; inside = slowly → deposits/drops.

Q5 — Counting down the scale: 8 degrees from 8 °C to 0 °C, then 3 more from 0 °C to -3 °C: 8 + 3 = **11 degrees**. (1 mark)

Q6 — 1 mark for naming erosion; 1 mark for a correct rapid example with its timescale (storm cutting several metres of dune in a day; flood taking a bank in an afternoon). Weathering is the slow one here.

Q7 — 1 mark each: (a) weathering breaks rock down without moving it, while erosion picks the pieces up and moves them away; (b) transportation carries the pieces along, while deposition drops them when the water or wind slows; plus 1 mark each for stating any two of the four process meanings correctly while making those differences.

Q8 — 1 mark each, with the clue: (a) roots split in place → weathering; (b) flood lifts and takes → erosion; (c) river carries → transportation; (d) settles and builds → deposition.

Q9 — 1 mark per correct step, any three of: warm days keep crack-water liquid; nights below 0 °C freeze it; ice takes up more space and pushes the crack walls away from each other; melting refills and refreezing repeats the push; after many cycles the crack widens and pieces break away.

Q10 — 1 mark: wind-blown sand rubs that face (abrasion); 1 mark: the rubbing wears the rock away, leaving it smooth and pitted.

Q11 — 1 mark: water flows fast on the outside of the bend; 1 mark: fast water erodes, cutting the outer bank; 1 mark: water is slow on the inside, so it deposits sand there.

Q12 — (a) 1 mark: informal tracks / foot traffic / dogs off-lead wore the plants off the bank. (b) 2 marks: 1 for roots holding the soil together (and leaves/stems slowing the rain), 1 for linking it to the rate — less soil is picked up and washed into the river, so erosion slows.

Q13 — 1 mark: a very large (1-in-100-year) storm on a sandy coast; 1 mark: waves cutting several metres into the dune in a single day.

Q14 — (a) 1 mark: 7 g, 6 g, 8 g. (b) 1 mark: yes, they agree — all within 2 g, no odd one out. (c) 1 mark: yes — grass (6–8 g) is far below leaf litter (21–25 g) in every trial.

Q15 — 1 mark each: (a) the ground cover (bare / leaf litter / grass); (b) the mass of soil washed off, in grams; (c) slope angle, or the amount and way of pouring the water, or the tray and its soil.

Q16 — 1 mark per paragraph that uses the right process correctly (four): weathering breaks the grain free from the hillside rock (frost, roots, abrasion...); erosion — rain or a creek picks the grain up; transportation — the creek carries the grain towards the sea; deposition — the water slows at the sea and drops the grain on the beach. 1 mark for a sensible human change; 1 mark for a correct prediction with reason (clearing plants → faster run-off → faster erosion; planting or fencing → soil held → slower erosion).

Sudden change and natural hazards

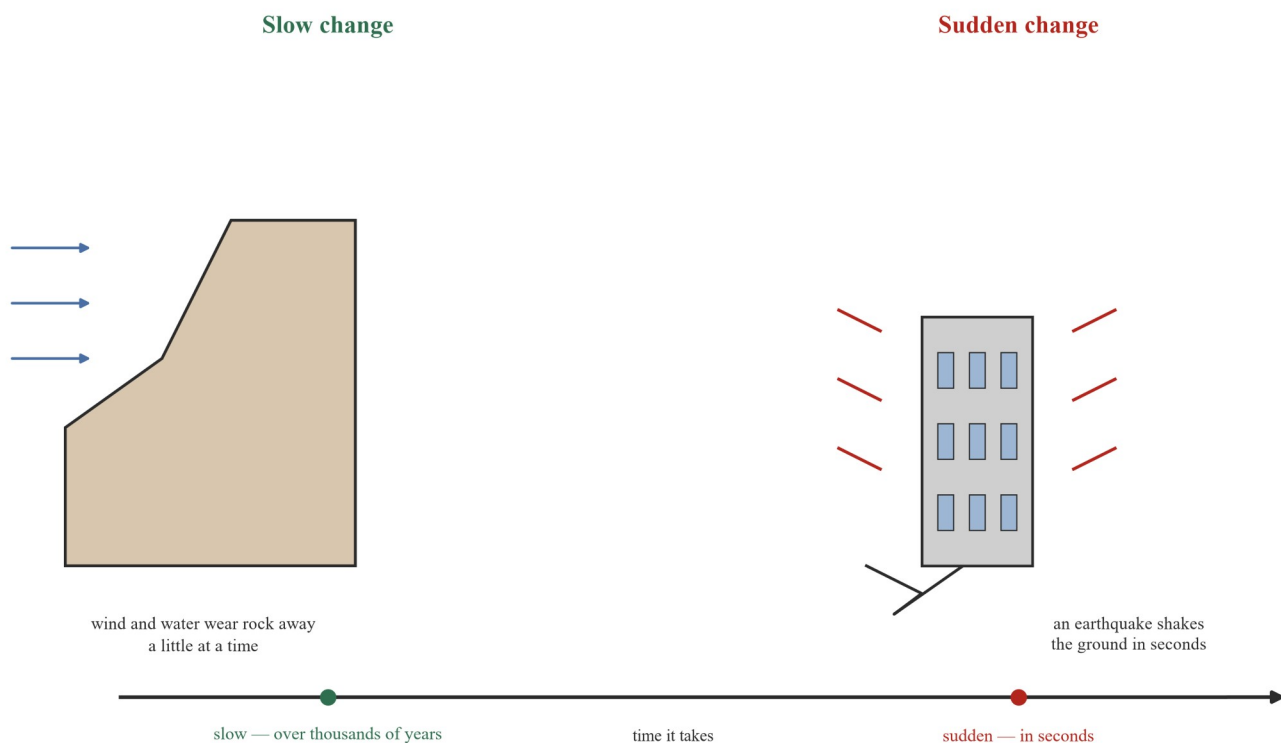
Words to know natural hazard · earthquake · fault · tsunami · magma · lava · vent · crater · bushfire · flood · drought · levee · desalination

In 8A we met slow change: wind and water wear rock away a little at a time, over thousands of years. This section is about the other kind of change — **sudden change**. The ground can shake in seconds. A river can rise in a day. A fire can spread in an afternoon. A natural event that can harm people, places or the environment is called a **natural hazard**. In this section we meet earthquakes, volcanic eruptions, bushfires, floods, droughts and tsunamis, and we look at how human actions and technology can reduce the harm they do.

Theory

Sudden change affects the surface and the air

The **surface** of the Earth is the land we live on — the rock, soil, coast and ground. The **atmosphere** is the blanket of air around the Earth. Sudden geological change (change in the rock and ground) and extreme weather can affect both. An earthquake cracks and lifts the ground. A volcanic eruption covers the land with hot rock and blows ash into the air. A flood spreads water and mud over the land. A bushfire fills the air with smoke.



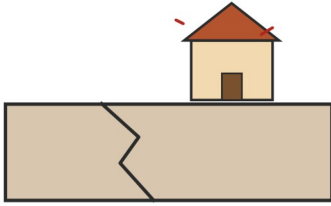
Two panels on a time line: slow change, where wind and water wear a cliff away a little at a time over thousands of years, set against sudden change, where an earthquake shakes a building in seconds.

Natural hazards

A **natural hazard** is a natural event that can harm people, places or the environment. Six hazards we study in this section are shown below. Not every hazard is sudden — a drought builds slowly over years — but each one can do great harm, and for each one there are things people can do to reduce that harm.

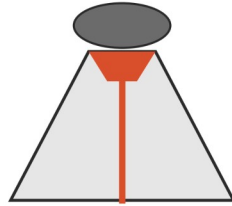
Natural hazards — sudden events that can harm people and places

Earthquake



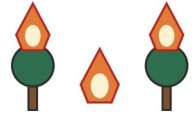
a natural hazard

Volcanic eruption



a natural hazard

Bushfire



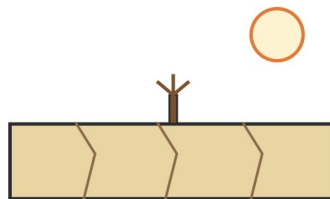
a natural hazard

Flood



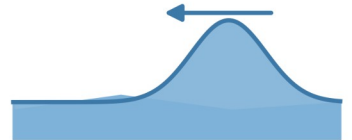
a natural hazard

Drought



a natural hazard

Tsunami



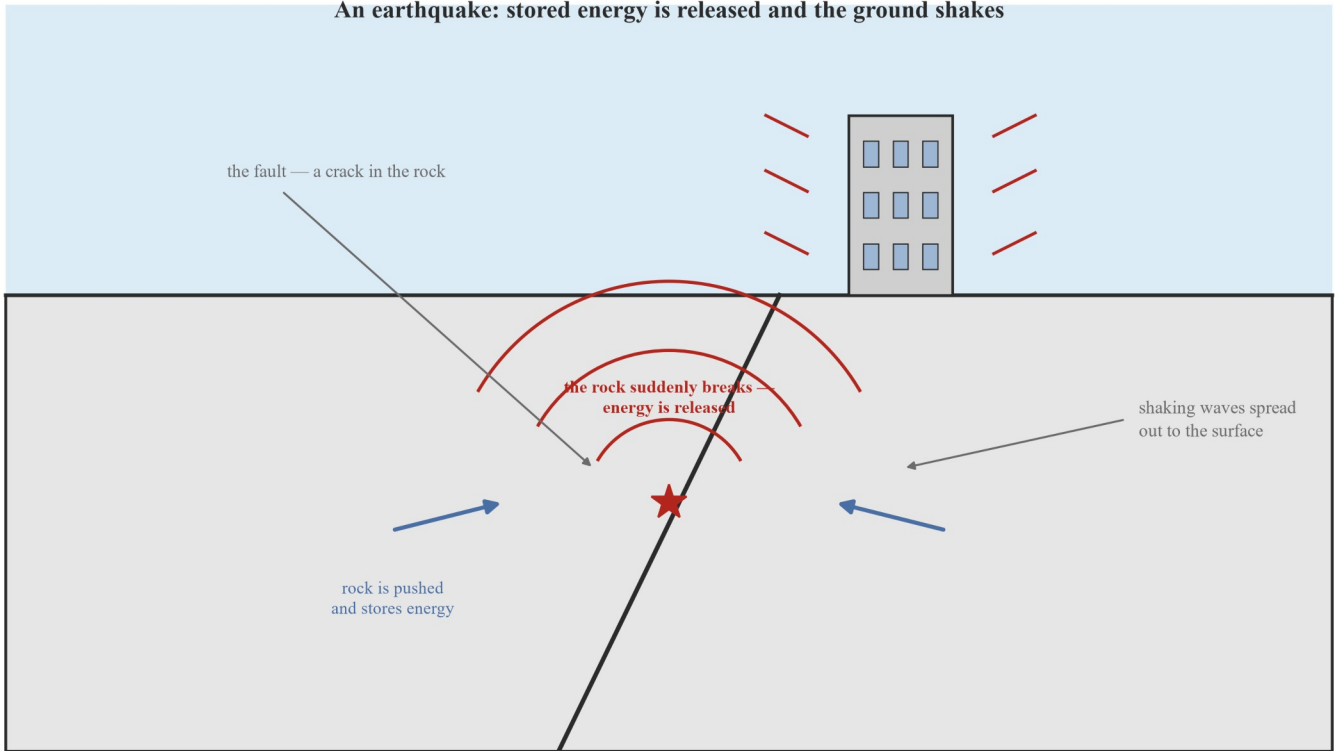
a natural hazard

Six tiles, one for each named natural hazard: an earthquake shown as cracked ground and a shaking house; a volcanic eruption shown as a cone with lava and an ash cloud; a bushfire shown as burning trees; a flood shown as a house half under water; a drought shown as cracked dry ground, a bare tree and a hot sun; a tsunami shown as a very large wave moving toward the coast.

Earthquakes

An **earthquake** is a sudden shaking of the ground. Rock deep in the ground is pushed and squeezed for a long time, and it stores energy. In time, the rock suddenly breaks along a **fault** — a crack or break in the rock. The stored energy is released, and shaking waves spread out from the break to the surface. When the waves reach the surface, the ground shakes.

An earthquake: stored energy is released and the ground shakes

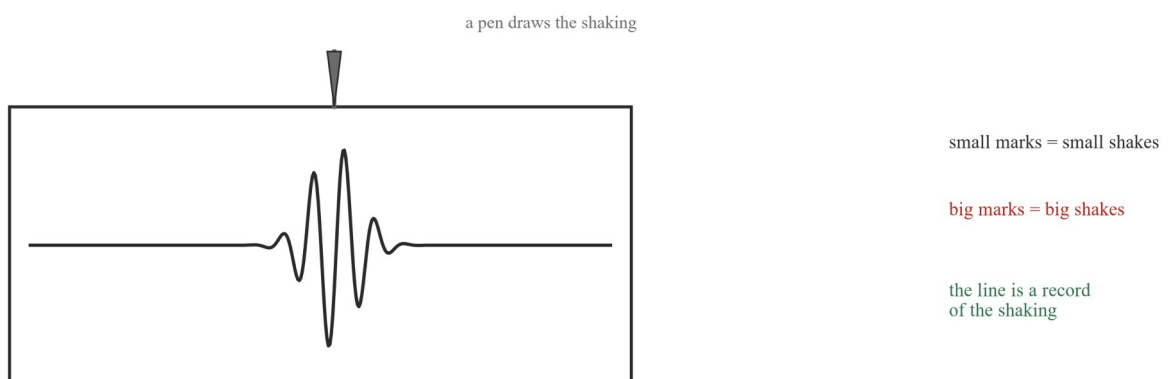


Cut-away view of the ground: two blocks of rock are pushed toward a slanting fault; a star marks where the rock suddenly breaks and releases energy; red curved lines show shaking waves spreading out to the surface, where a building shakes.

At the surface, an earthquake can crack the ground, lift one side of a fault up or drop it down, and break buildings, roads and bridges. The shaking usually lasts less than a minute, but the damage can be very large.

The shaking can be recorded. An instrument with a pen draws a line on a rolling drum of paper; when the ground shakes, the line jumps. Small shakes make small marks and big shakes make big marks, so the line is a record of how strong the shaking was.

An instrument can record the shaking of an earthquake



An instrument with a pen drawing a line on a rolling drum: the line is nearly flat, then shows a band of big jumps where the shaking was strong, then settles to small marks again.

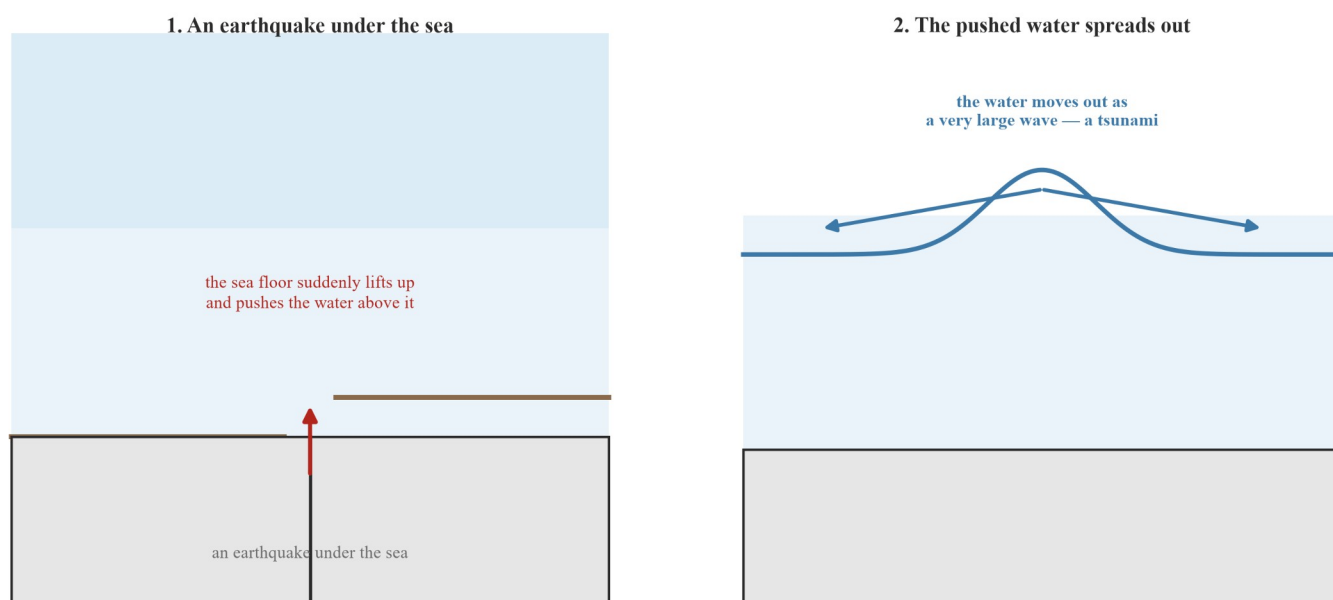
A real record — the Newcastle earthquake. On 28 December 1989, at 10:27 a.m. (AEDT), an earthquake measuring 5.6 struck Newcastle, New South Wales. Thirteen people died and more than 160 were hurt.

Over 35,000 homes, 147 schools and 3,000 other buildings were damaged, and the cost is put at about A\$4 billion. At the time, Australian building rules did not make buildings resist earthquake shaking — Newcastle showed why they should.

Source: Wikipedia, “1989 Newcastle earthquake” (Geoscience Australia earthquake records), en.wikipedia.org — retrieved 2026-08-21.

Earthquakes under the sea can cause tsunamis

An earthquake under the sea can lift part of the sea floor very quickly. The lifted sea floor pushes the water above it up, and the pushed water spreads out as a very large wave called a **tsunami**. Out at sea the wave is low and hard to see, but as it reaches shallow water near the coast it piles up and can flood the land.



Two panels: first, a cut-away view of the ocean where an earthquake lifts one side of the sea floor and pushes the water above it up; second, the pushed water spreading out in both directions as a very large wave — a tsunami.

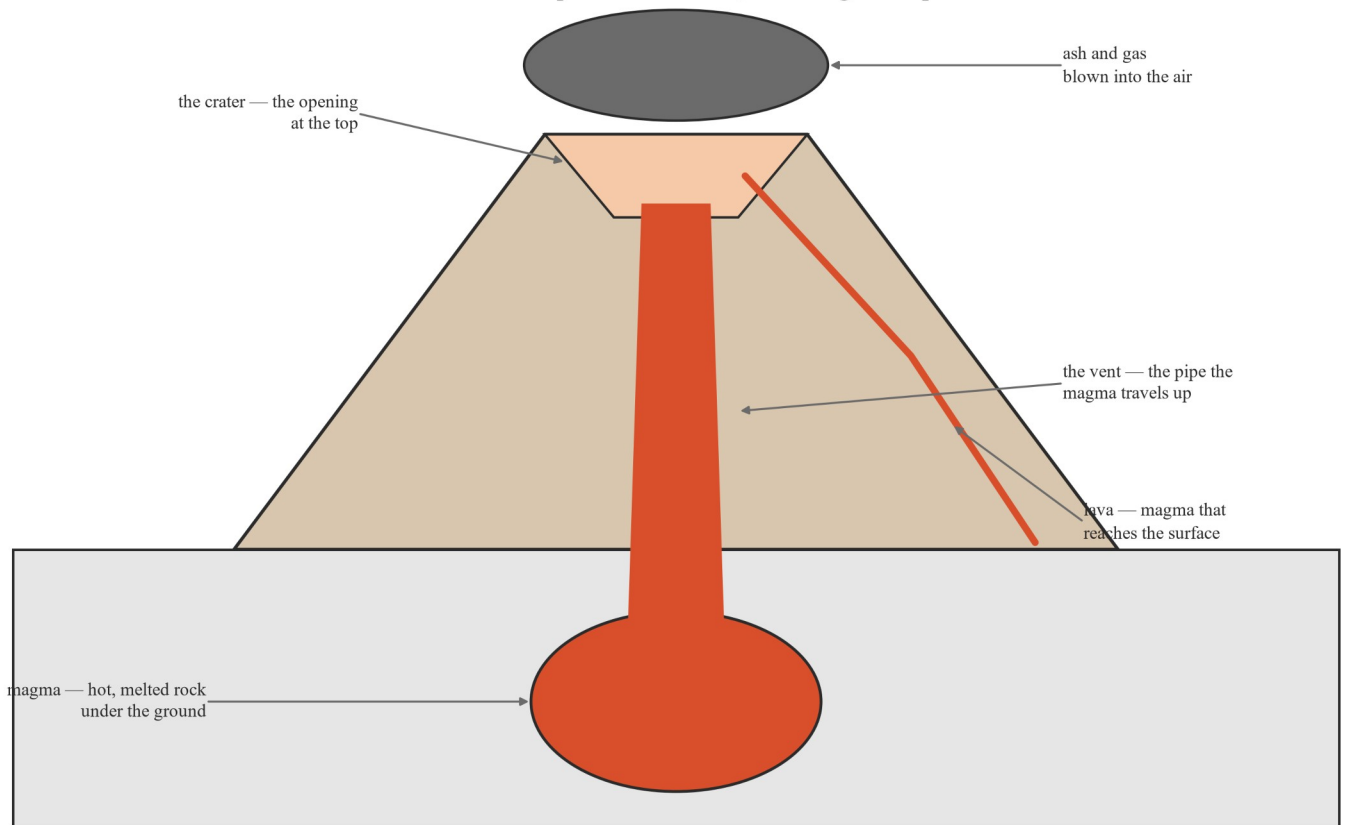
A real tsunami — 26 December 2004. An earthquake measuring 9.2–9.3 under the Indian Ocean, off Sumatra, lifted the sea floor and pushed up about 30 cubic kilometres of water. The tsunami that followed killed about 227,900 people in 14 countries — the deadliest tsunami in history.

Source: Wikipedia, “2004 Indian Ocean earthquake and tsunami”, en.wikipedia.org — retrieved 2026-08-21.

Volcanic eruptions

A **volcano** is a place where hot, melted rock from deep underground reaches the surface. The melted rock under the ground is called **magma**. When magma rises through a pipe called the **vent** and reaches the surface through the opening at the top, called the **crater**, the magma is called **lava**. In an eruption, lava, ash and gas escape. Lava flows can cover the land, and ash and gas are blown high into the atmosphere.

A volcanic eruption — hot rock, ash and gas escape



Victoria's volcanoes are long quiet — the last eruptions here were about 5,000 years ago.

Labelled cut-away view of a volcano: a chamber of magma (hot, melted rock) under the ground; the vent, the pipe the magma travels up; the crater, the opening at the top; lava, magma that reaches the surface, flowing down one side; and an ash cloud blown into the air. A note says Victoria's volcanoes are long quiet — the last eruptions here were about 5,000 years ago.

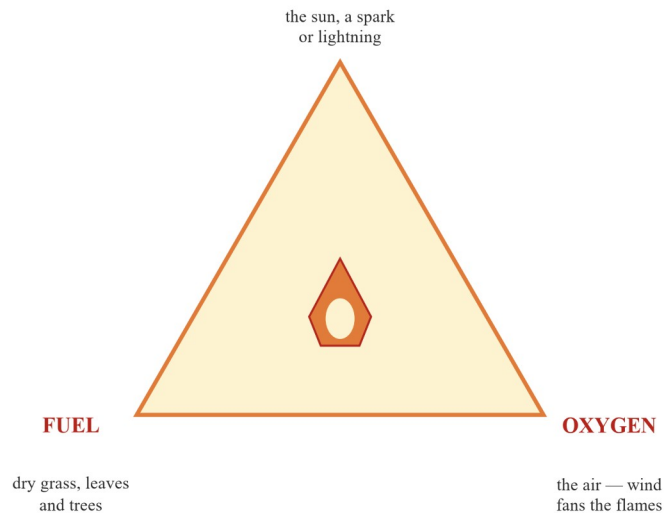
Volcanoes in Victoria. The youngest volcanoes in Australia are the Newer Volcanics Province, a field of volcanoes across western Victoria and South Australia. Mount Gambier and Mount Schank last erupted about 5,000 years ago. These volcanoes are quiet now, so a volcanic eruption is not a hazard Victorians live with today — but the lava plains around Melbourne show that the ground here was once suddenly changed by eruptions.

Source: Wikipedia, “Newer Volcanics Province” (Geoscience Australia volcano records), en.wikipedia.org — retrieved 2026-08-21.

Bushfires

A **bushfire** (also called a wildfire) is a fire that spreads through grass, scrub or forest. A fire needs three things: **heat**, **fuel** (something to burn, like dry grass or wood) and **oxygen** from the air. Take any one of the three away, and the fire stops.

A fire needs all three — take one away and it stops
HEAT



A bushfire is a fire that spreads through grass, scrub or forest.

A triangle with a flame in the middle and a corner for each thing a fire needs: heat (the sun, a spark or lightning), fuel (dry grass, leaves and trees) and oxygen (the air — wind fans the flames). The caption says a fire needs all three — take one away and it stops.

Bushfires burn plants, homes and habitat, and their smoke and ash fill the atmosphere. Hot, dry, windy days are the most dangerous days for bushfires, because the fuel is dry and the wind fans the flames and carries the fire quickly.

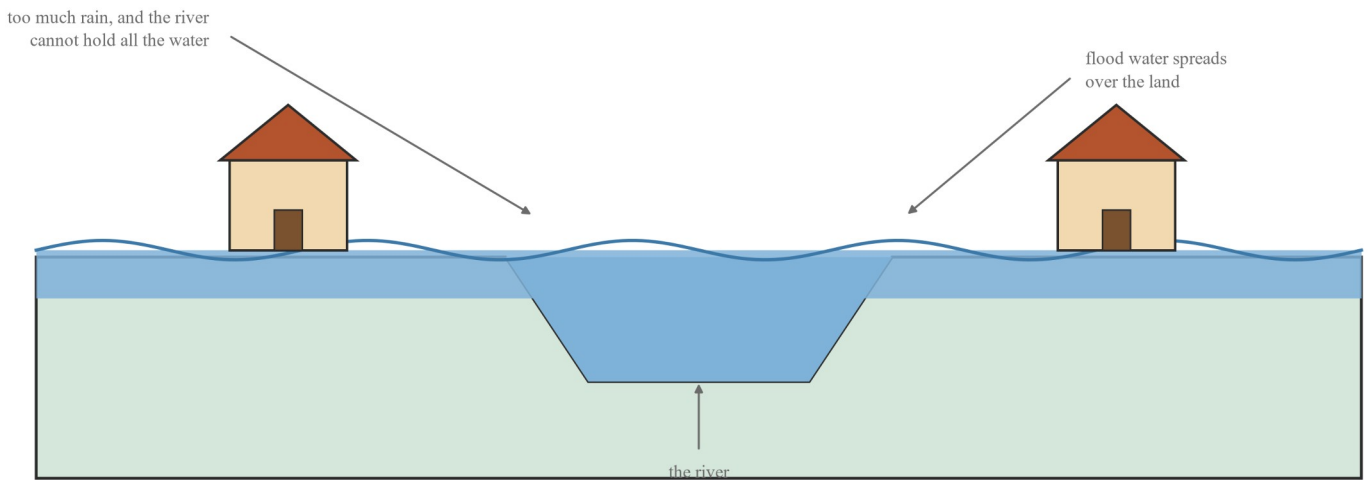
A real record — Black Saturday, 7 February 2009. Australia's deadliest bushfire disaster killed 173 people in Victoria. More than 2,000 houses were destroyed and about 450,000 hectares burned; the Kilmore East fire was the deadliest of the day.

Source: Wikipedia, "Black Saturday bushfires" (CFA and Emergency Management Victoria records), en.wikipedia.org — retrieved 2026-08-21.

Floods

A **flood** happens when water covers land that is usually dry. After heavy rain, a river can receive more water than its channel can hold. The river then bursts its banks and the water spreads out over the flat land beside it, called the floodplain.

A flood — a river bursts its banks and water covers the land



Cut-away view of a river valley: heavy rain fills the river until it bursts its banks, and flood water spreads over the floodplain on both sides, reaching houses built on the flat land.

Flood water harms homes and crops, and it also changes the surface: moving water picks up soil, sand and mud and carries them downstream, so a flood can dig out banks and lay down mud far from the river. In parts of Asia and the Pacific, the heavy monsoon rains of the wet season do this on a grand scale, moving huge amounts of mud and sand down rivers and out to sea.

A real flood — Victoria, January 2011. Very heavy rain on 12–14 January 2011 made rivers across Victoria burst their banks, including the Goulburn and the Yarra. About 600 houses flooded in Horsham and around 200 — about 80% of the town — in Rochester. Two people died, more than 1,730 properties flooded, and the cost was about A\$2 billion.

Source: Wikipedia, “2011 Victorian floods” (Bureau of Meteorology flood records), en.wikipedia.org — retrieved 2026-08-21.

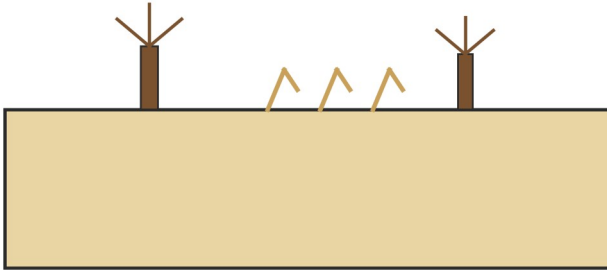
Droughts

A **drought** is a long time — months or years — with much less rain than normal. A drought affects both the living and the non-living parts of the environment. Living things suffer: crops dry out, animals go thirsty and hungry, and trees can die. Non-living things change too: the soil dries and cracks, and rivers and dams run low.

A drought is a long time with very little rain — it affects living and non-living things

Living parts

crops and trees dry out;
animals have less food and water



Non-living parts

soil dries and cracks;
dams and rivers run low



Two panels: living parts affected by drought (dried crops and bare, dead trees) and non-living parts affected by drought (cracked dry soil and a dam nearly empty of water).

A real drought — the Millennium Drought. From 1996 to 2010, south-eastern Australia, including the Murray–Darling farming region, had very low rainfall; the hardest years were 2001 to 2009. Water use on farms dropped by 37% between 2000–01 and 2004–05 as there was simply less water to use.

Source: Wikipedia, “Drought in Australia” (Bureau of Meteorology climate records), en.wikipedia.org — retrieved 2026-08-21.

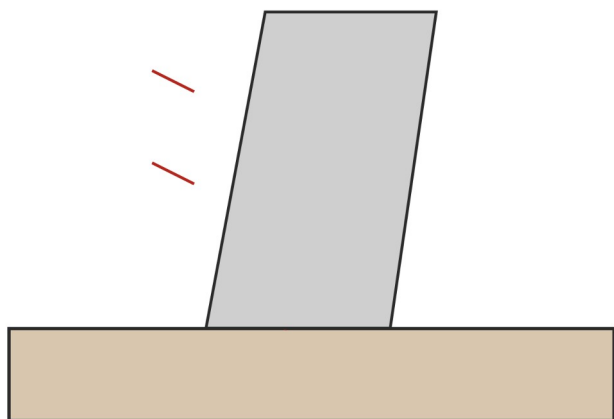
Reducing the impacts of natural hazards

We cannot stop an earthquake, a flood or a drought from happening, but the **impacts** — the harm a hazard does — can be reduced by human actions and by technological innovations (new pieces of technology). For each hazard, the trick is to act on the mechanism: weaken the thing that does the harm.

Earthquakes. The shaking cannot be stopped, but how a building is made changes the harm. Stiff walls crack and can fall; a frame with diagonal cross-braces can sway with the shaking without breaking. After the Newcastle earthquake, Australia brought in building rules so that new buildings are made to sway safely.

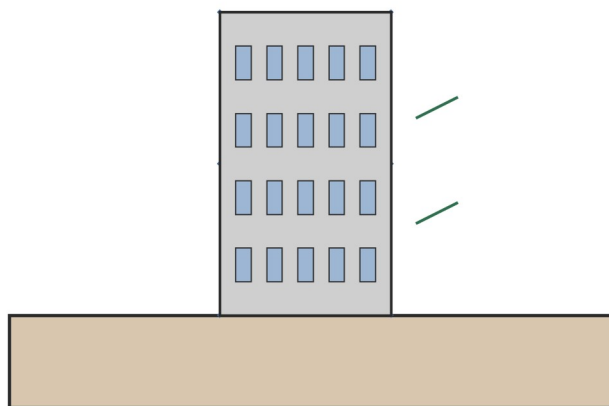
Reducing the damage: how a building is made matters

Not built for earthquakes



stiff walls crack and the building can fall

Built to sway with the shaking

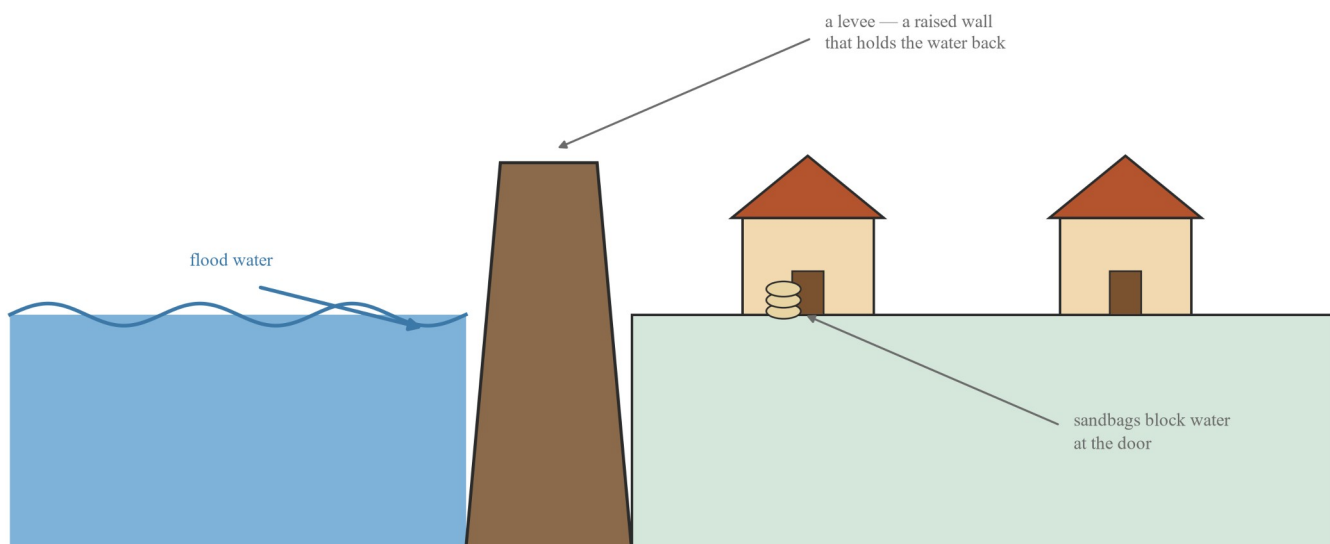


cross-braces let it sway without breaking

Two panels: a stiff building not built for earthquakes cracks and leans in the shaking, and a building with diagonal cross-braces sways with the shaking but stays standing — the braces let it sway without breaking.

Floods. A **levee** is a raised wall of earth built along a river bank to hold flood water back, and sandbags can block water at doorways. Technology helps too: river gauges measure how high the water is, and computers turn those readings into flood warnings that give towns time to act.

Reducing flood damage — keep the water away from homes

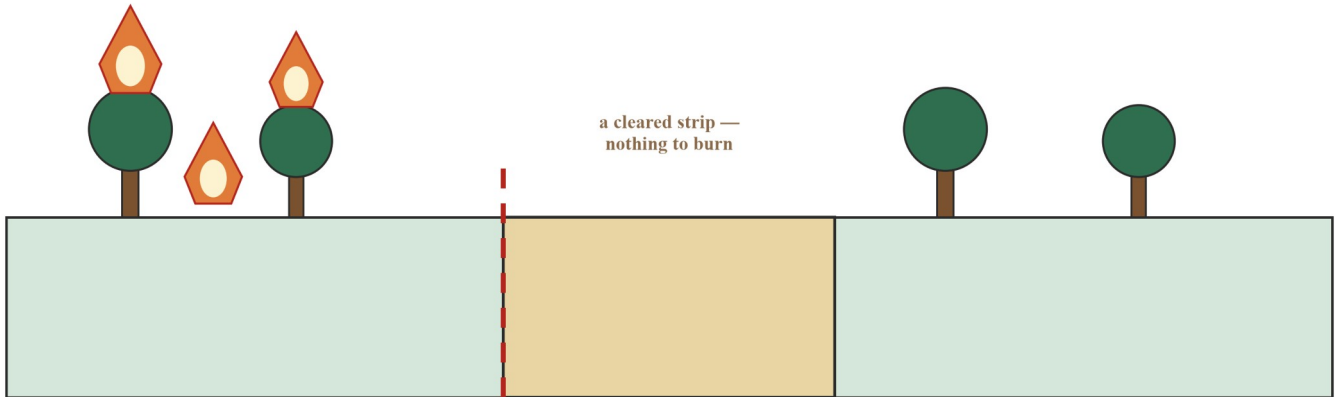


Cut-away view of a river in flood: a raised levee holds the flood water back so that houses behind it stay dry, and sandbags are stacked at a doorway to block the water.

Bushfires. A fire needs fuel to travel, so removing the fuel stops the fire. A cleared strip of land with nothing to burn — no grass, no leaves, no trees — can stop a fire spreading across it. Clearing leaves from around a house, and aircraft dropping water on a fire, work the same way: they take away or wet down the fuel.

Reducing bushfire spread — a fire needs fuel to travel

removing the fuel stops the fire crossing

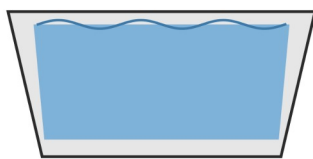


A fire burning through trees on the left stops at a cleared strip of bare ground with nothing to burn, while the trees on the right stay safe.

Droughts. Water stored in dams in wet years can be used in dry years. When drought hits, water restrictions cut the amount used. Technology also helps: a desalination plant takes the salt out of sea water to make fresh water, so a city can keep drinking even when the dams run low.

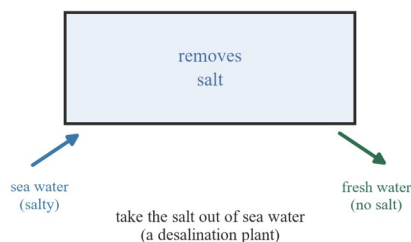
Reducing drought impacts — store water, make more, and use less

Store water in dams



keep water from wet times
to use in dry times

Make fresh water from the sea



Use less water



water restrictions — shorter
showers, no watering lawns

Three panels: a full dam storing water from wet times; a desalination plant taking in salty sea water and sending out fresh water with no salt; and a tap running a single drop, standing for using less water under water restrictions.

The Victorian Desalination Plant. Built on the coast near Wonthaggi in response to the Millennium Drought, the plant uses reverse osmosis — pushing sea water through a fine filter that holds the salt back — to make fresh water. It can supply up to 150 billion litres of water a year to Melbourne and Geelong.

Source: Wikipedia, “Victorian Desalination Plant” (AquaSure, Victorian water corporations), en.wikipedia.org — retrieved 2026-08-21.

Tsunamis. A tsunami cannot be stopped, but deep-sea buoys and sea-floor instruments can detect one soon after it forms. The warning is sent to sirens, radios and phones, and people near the coast move to higher ground. The wave is not stopped — the harm is reduced because people are not in its way.

Worked examples

Example 1 — with support

Use the record of the Newcastle earthquake (28 December 1989): an earthquake measuring 5.6 struck at 10:27 a.m.; 13 people died; over 35,000 homes, 147 schools and 3,000 other buildings were damaged; the cost was about A\$4 billion; buildings at the time were not made to resist shaking. From this record: (a) name the hazard; (b) give two impacts on people and buildings; (c) give one impact on Earth's surface; (d) name one human action that reduces this impact, and say how it works.

Working	Comment
(a) The hazard is an earthquake — a sudden shaking of the ground.	The record names the event and the shaking.
(b) 13 people died and more than 160 were hurt; over 35,000 homes, 147 schools and 3,000 other buildings were damaged.	Impacts on people and buildings are read straight from the record.
(c) The shaking cracked the ground and broke buildings — the surface was suddenly changed.	Earth's surface is the ground and what stands on it.
(d) Building rules that make new buildings sway with the shaking without breaking.	The action works on the mechanism: the shaking still happens, but the building does not break.
∴ The record shows an earthquake and its impacts, and building design is a human action that reduces the harm.	Human actions reduce impacts even when they cannot stop the hazard.

Example 2 — with support

Sort these impacts of the Millennium Drought into impacts on **living** parts of the environment and impacts on **non-living** parts: crops drying out; river levels falling; sheep going thirsty; soil cracking; trees dying; dams running nearly empty.

Working	Comment
Living: crops drying out; sheep going thirsty; trees dying.	Crops, sheep and trees are alive, so these are impacts on living parts.
Non-living: river levels falling; soil cracking; dams running nearly empty.	Rivers, soil and dam water are not alive, so these are impacts on non-living parts.
∴ A drought affects both the living and the non-living parts of the environment.	This is exactly what the content of this section asks us to see.

Example 3 — by yourself

On 26 December 2004, an earthquake measuring 9.2–9.3 struck under the Indian Ocean, off Sumatra. Explain, step by step, how this earthquake caused a tsunami. Then name one piece of technology that now gives people on coasts time to move to higher ground before a tsunami arrives.

Practice questions

With support

Q1. Write a sentence, in your own words, for each term: (3 marks) (a) natural hazard (b) earthquake (c) drought

Q2. This section studies six natural hazards. Four are the earthquake, the volcanic eruption, the bushfire and the flood. Name the other two. (2 marks)

Q3. Say whether each is a sudden change or a slow change: (3 marks) (a) a cliff worn away by waves over thousands of years (8A) (b) the ground shaking in an earthquake (c) a river bursting its banks after two days of heavy rain

Q4. A fire needs three things. (2 marks) (a) Name them. (b) Which one does a cleared strip of land with nothing to burn take away?

Q5. The figure of the shaking record shows small marks, then a band of big marks, then small marks again. (2 marks) (a) What does the band of big marks tell you about the shaking? (b) What was happening before and after the band?

Q6. Match each hazard to the action that reduces its impact. (4 marks)

Hazard	Action
1 earthquake	A a levee and flood warnings
2 flood	B buildings with cross-braces
3 bushfire	C storing water in dams and desalination
4 drought	D a cleared strip with nothing to burn

By yourself

Q7. Give two ways an earthquake can affect Earth's surface. (2 marks)

Q8. (a) What is a fault? (1 mark) (b) Explain, in two or three sentences, how stored energy in rock leads to the shaking of an earthquake. (2 marks)

Q9. Name the part of a volcano that is: (4 marks) (a) the hot, melted rock under the ground (b) the pipe the melted rock travels up (c) the opening at the top (d) the melted rock once it reaches the surface

Q10. (a) Explain how heavy rain can cause a flood. (2 marks) (b) Give one way flood water changes Earth's surface as it moves. (1 mark)

Q11. Explain, step by step, how an earthquake under the sea can cause a tsunami. (3 marks)

Q12. The Black Saturday record says 173 people died, more than 2,000 houses were destroyed and about 450,000 hectares burned. (3 marks) (a) Which hazard caused this disaster? (b) Name the two other things a fire needs besides fuel. (c) Name one human action that reduces the spread of a bushfire, and say which of the three it removes.

Q13. Sort these drought impacts into living and non-living parts of the environment: grass drying out; the soil cracking; cattle going thirsty; a dam running low; crops dying; a creek bed drying out. (3 marks)

Q14. SCENARIO — A river town like those in the 2011 Victorian floods. River gauges higher up the river show the water rising fast after heavy rain, and a flood warning is issued two days before the water peaks. The town stacks sandbags at doorways, moves cars and animals to high ground, and people leave the lowest homes. (a) Name the technology that made the early warning possible. (1 mark) (b) Name two human actions the town took. (2 marks) (c) Choose one of those actions and explain how it reduced the impact of the flood. (1 mark)

Q15. (a) Which two hazards put ash or smoke into the atmosphere? (2 marks) (b) Which hazard can crack and lift the ground? (1 mark)

Q16. The Victorian Desalination Plant takes in sea water and supplies fresh water to Melbourne and Geelong. (3 marks) (a) What is taken out of the water at the plant? (b) Explain how the plant reduces the impact of a drought. (c) Why is the plant called a technological innovation?

Practical — do cross-braces help a frame hold its shape?

PRACTICAL — this page plans or analyses work done in the classroom, laboratory or field. It is not a substitute for doing it.

Question: Does adding diagonal cross-braces help a square frame hold its shape when it is pushed sideways, as a building must in an earthquake?

Equipment: 10 drinking straws; masking tape; a ruler; a flat desk.

Safety: This is a low-risk activity. Keep straws and tape on the desk so nobody slips on them, and do not put straws in your mouth.

Risk	How we stay safe
Straws or tape on the floor	Keep everything on the desk; pick up anything dropped straight away.
Straws in mouths	Straws stay on the desk — they are building material, not toys.
Frame popping open when pushed	Push gently; keep your face away from the frame.

Variables (the things we change, measure and keep the same):

Variable	Choice
The one we change	the frame: no braces, then two diagonal cross-braces
The one we measure	how far the top corner moves sideways when pushed gently (cm)
The ones we keep the same	the same four straws and tape; the same gentle one-finger push; the same desk

Method:

1. Tape four straws into a square. Stand it up on the desk and hold its bottom edge flat on the desk.
2. With one finger, push the top corner gently sideways. Hold the push, and your partner uses the ruler to measure how far the top corner has moved (cm). Record it.
3. Let go and repeat steps 1–2 until you have three trials for the unbraced frame.
4. Tape two more straws across the square as diagonal cross-braces (an X).
5. Repeat the gentle push and measurement three times for the braced frame.

Results: record your measurements in a table like this one.

Trial	Top corner movement, no braces (cm)	Top corner movement, with braces (cm)
1		
2		
3		

Compare your three trials for each frame. Do the trials agree with each other?

Thinking about the results:

1. Describe what happened to the shape of the unbraced frame when it was pushed, and what happened to the braced frame.
2. Which frame held its shape better? How do your measurements show this?
3. Buildings in earthquake country are built with diagonal cross-braces. Use your results to explain why.

Make a claim and defend it. Finish this writing frame in full sentences:

- I claim that cross-braces _____.
- My evidence is _____.
- This matters in an earthquake because _____.
- If someone claimed the braces made the frame stronger by stopping it moving at all, I would answer _____.

Answers

Q1 (a) A natural hazard is a natural event that can harm people, places or the environment. (b) An earthquake is a sudden shaking of the ground. (c) A drought is a long time with much less rain than normal. **Q2** The tsunami and the drought. **Q3** (a) Slow. (b) Sudden. (c) Sudden. **Q4** (a) Heat, fuel and oxygen. (b) Fuel. **Q5** (a) The shaking was strong for a while. (b) The shaking was small (or there was little shaking) before and after. **Q6** 1–B; 2–A; 3–D; 4–C. **Q7** Any two: it cracks the ground; it lifts or drops one side of a fault; it breaks buildings, roads and bridges. **Q8** (a) A fault is a crack or break in the rock. (b) Rock is pushed and stores energy; the rock suddenly breaks along the fault; the released energy spreads out as shaking waves, so the ground shakes. **Q9** (a) Magma (the magma chamber). (b) The vent. (c) The crater. (d) Lava. **Q10** (a) Heavy rain puts more water into a river than its channel can hold, so the river bursts its banks and water spreads over the land. (b) Moving flood water picks up and carries soil, sand and mud, digging out banks and laying down mud. **Q11** The earthquake lifts part of the sea floor; the lifted sea floor pushes the water above it up; the pushed water spreads out as a very large wave — a tsunami. **Q12** (a) A bushfire (wildfire). (b) Heat and oxygen. (c) Any one: a cleared strip with nothing to burn removes fuel; clearing leaves around a house removes fuel; water-bombing aircraft wet down the fuel. **Q13** Living: grass drying out; cattle going thirsty; crops dying. Non-living: the soil cracking; a dam running low; a creek bed drying out. **Q14** (a) River gauges (and the computers that turn their readings into warnings). (b) Any two: stacking sandbags; moving cars and animals to high ground; leaving the lowest homes. (c) For example, sandbags block the water at doorways, so water cannot get in and damage the house. **Q15** (a) Volcanic eruptions (ash) and bushfires (smoke). (b) An earthquake. **Q16** (a) Salt. (b) When dams run low in a drought, the plant still makes fresh water from the sea, so people keep drinking water. (c) It is a new piece of technology that reduces the harm a hazard does.

Worked solutions

Example 3 (4 marks) The earthquake lifted part of the sea floor very quickly. *1 mark* The lifted sea floor pushed the water above it up. *1 mark* The pushed water spread out as a very large wave — a tsunami. *1 mark* Technology: deep-sea buoys and sea-floor instruments detect the tsunami and send warnings, so people have time to move to higher ground. *1 mark*

Q1 (3 marks: *1 each*) (a) A natural hazard is a natural event that can harm people, places or the environment. *1 mark* (b) An earthquake is a sudden shaking of the ground, caused by energy released when rock breaks along a fault. *1 mark* (c) A drought is a long time — months or years — with much less rain than normal. *1 mark*

Q2 (2 marks: *1 each*) The tsunami and the drought. *1 mark each*

Q3 (3 marks: *1 each*) (a) Slow change — it takes thousands of years. *1 mark* (b) Sudden change — the ground shakes in seconds. *1 mark* (c) Sudden change — the river rises in days. *1 mark*

Q4 (2 marks: *1 each*) (a) Heat, fuel and oxygen. *1 mark* (b) A cleared strip takes away the fuel — there is nothing to burn on it, so the fire cannot cross. *1 mark*

Q5 (2 marks: *1 each*) (a) The band of big marks shows the shaking was strong for a while — an earthquake was recorded. *1 mark* (b) Before and after, the small marks show only small shakes, so the ground was quiet. *1 mark*

Q6 (4 marks: *1 each*) 1–B (cross-braces let a building sway without breaking). 2–A (a levee holds flood water back, and warnings give time to act). 3–D (a cleared strip removes the fuel a fire needs to travel). 4–C (stored water and desalination keep water coming in dry years). *1 mark each*

Q7 (2 marks: *1 each*) Any two of: it cracks the ground; *1 mark* it lifts one side of a fault up or drops it down; *1 mark* it breaks buildings, roads and bridges. (*any two score*)

Q8 (3 marks) (a) A fault is a crack or break in the rock. *1 mark* (b) Rock is pushed and squeezed and stores energy; *1 mark* when the rock suddenly breaks along the fault, the energy is released as shaking waves that spread to the surface, so the ground shakes. *1 mark*

Q9 (4 marks: *1 each*) (a) Magma. *1 mark* (b) The vent. *1 mark* (c) The crater. *1 mark* (d) Lava. *1 mark*

Q10 (3 marks) (a) Heavy rain sends more water into a river than its channel can hold; *1 mark* the river bursts its banks and the water spreads over the floodplain. *1 mark* (b) Moving water picks up soil, sand and mud and carries them downstream, so a flood digs out banks and lays down mud — it changes the surface. *1 mark*

Q11 (3 marks) The earthquake suddenly lifts part of the sea floor. *1 mark* The lifted sea floor pushes the water above it up. *1 mark* The pushed water spreads out as a very large wave — a tsunami. *1 mark*

Q12 (3 marks: 1 each) (a) A bushfire (wildfire). *1 mark* (b) Heat and oxygen. *1 mark* (c) For example: a cleared strip with nothing to burn stops the fire crossing — it removes the fuel. (Clearing leaves around a house, or water-bombing aircraft, also remove or wet down the fuel.) *1 mark*

Q13 (3 marks: 1 per correct group) Living: grass drying out; cattle going thirsty; crops dying — grass, cattle and crops are alive. *1 mark* Non-living: the soil cracking; a dam running low; a creek bed drying out — soil, dam water and a creek bed are not alive. *1 mark* All six sorted correctly with a reason. *1 mark*

Q14 (4 marks) (a) River gauges higher up the river, with computers turning their readings into a flood warning. *1 mark* (b) Any two of: stacking sandbags at doorways; moving cars and animals to high ground; people leaving the lowest homes. *1 mark each* (2) (c) Sandbags block the water at doorways, so flood water cannot get inside and the house is not damaged; (or: moving to high ground keeps people and animals out of the water; or: leaving low homes means people are not in the water when it arrives). *1 mark*

Q15 (3 marks: 1 each) (a) Volcanic eruptions blow ash into the atmosphere, and bushfires fill it with smoke. *1 mark each* (b) An earthquake cracks and lifts the ground. *1 mark*

Q16 (3 marks: 1 each) (a) Salt is taken out of the sea water. *1 mark* (b) In a drought the dams run low, but the sea does not — the plant keeps making fresh water, so people keep drinking water. *1 mark* (c) It is a new piece of technology (reverse osmosis on a city scale) that reduces the harm a natural hazard does — that is what a technological innovation is. *1 mark*

Gravity, orbits, and Earth's daily and yearly cycles

Words to know gravity · orbit · rotation · revolution · axis · tilt · hemisphere · equator · sunrise · sunset · daylight · latitude · elapsed time

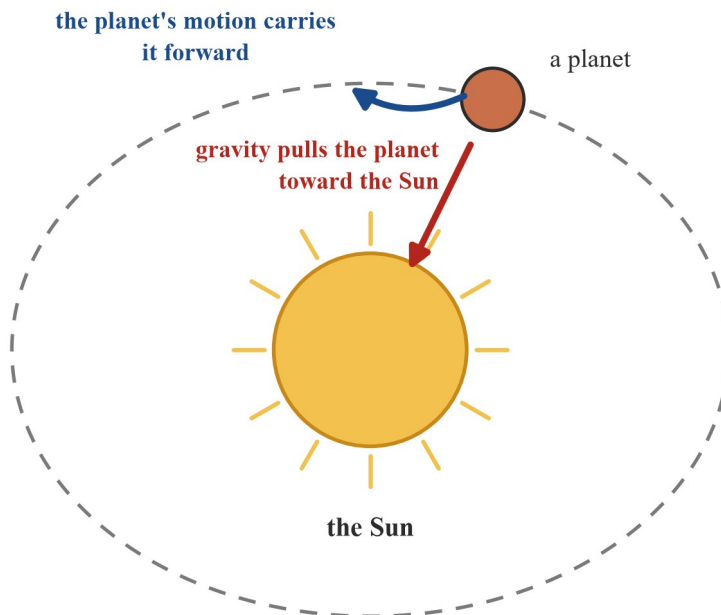
In 8A and 8B we looked at change on the ground — slow change and sudden change. Now we look up. The ground itself moves: it turns once a day and travels around the Sun once a year, and **gravity** — the pull between objects — holds Earth and the other planets in their paths around the Sun. In this section we meet the force of gravity as the thing that keeps the planets in **orbit**, and we connect Earth's **rotation** (its daily turn on its **axis**) and its **revolution** (its trip around the Sun, once a year), together with the **tilt** of the axis, to the things we can see from a backyard in Victoria: day and night, and the changing length of the day through the year.

Theory

Gravity keeps the planets in orbit

Every object pulls on every other object with a force called **gravity**. The Sun is huge, so its pull is strong, and it pulls every planet toward it. If that were all, the planets would fall straight into the Sun. But each planet is also moving sideways, fast. The pull of gravity and the planet's own forward motion together bend its path into a closed curve around the Sun — an **orbit**. The force of gravity keeps Earth and the other planets of the solar system in orbit around the Sun.

A planet keeps going around because of two things at once



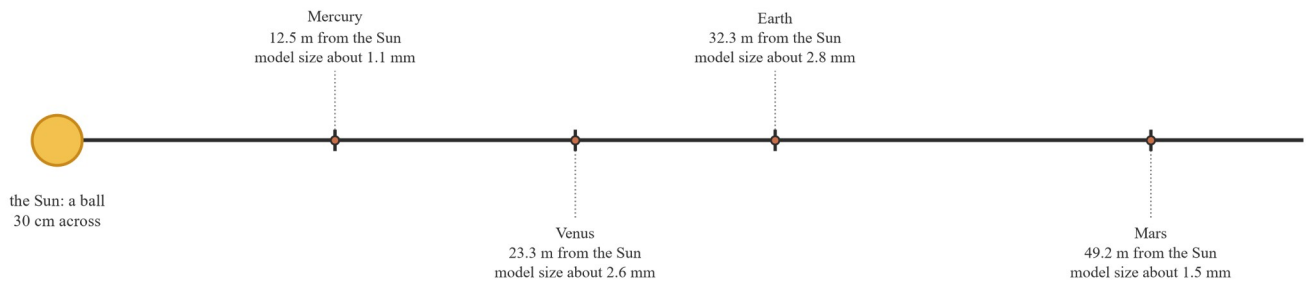
The pull of gravity and the planet's own motion together make a curved path around the Sun — an orbit.

The Sun at the centre with a dashed oval orbit around it and a planet on the orbit: a red arrow shows gravity pulling the planet toward the Sun, and a blue curved arrow shows the planet's own motion carrying it forward; together the two make the curved path of an orbit.

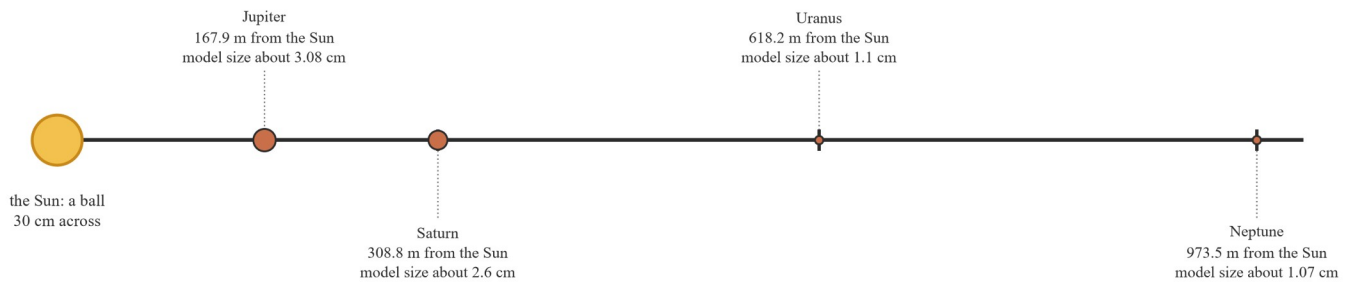
Size and distance in the solar system

The solar system is nearly all empty space, and the distances in it are hard to picture. One way to picture them is to build a model in real space — a school oval, a long straight road — with the distances **supplied**, like the model below. The Sun is a ball 30 cm across; at that size, Earth is a bead 2.8 mm across standing 32.3 m away, and Neptune is a bead just over a centimetre across standing almost a kilometre from the Sun ball.

The inner planets — out to 50 m of the schoolyard



The outer planets — out to almost 1 km



Two horizontal strips showing the pocket solar-system model with a 30 cm Sun ball at zero: the inner strip places Mercury 12.5 m, Venus 23.3 m, Earth 32.3 m and Mars 49.2 m from the Sun, with each bead's model size shown beside it; the outer strip places Jupiter 167.9 m, Saturn 308.8 m, Uranus 618.2 m and Neptune 973.5 m from the Sun, with each size shown beside it.

A real record — the true distances. The model distances above come from the real ones: Mercury is about 57.9 million km from the Sun, Venus 108.2 million km, Earth 149.6 million km, Mars 228.0 million km, Jupiter 778.5 million km, Saturn 1,432.0 million km, Uranus 2,867.0 million km and Neptune 4,515.0 million km. The Sun itself is 1,391,400 km across.

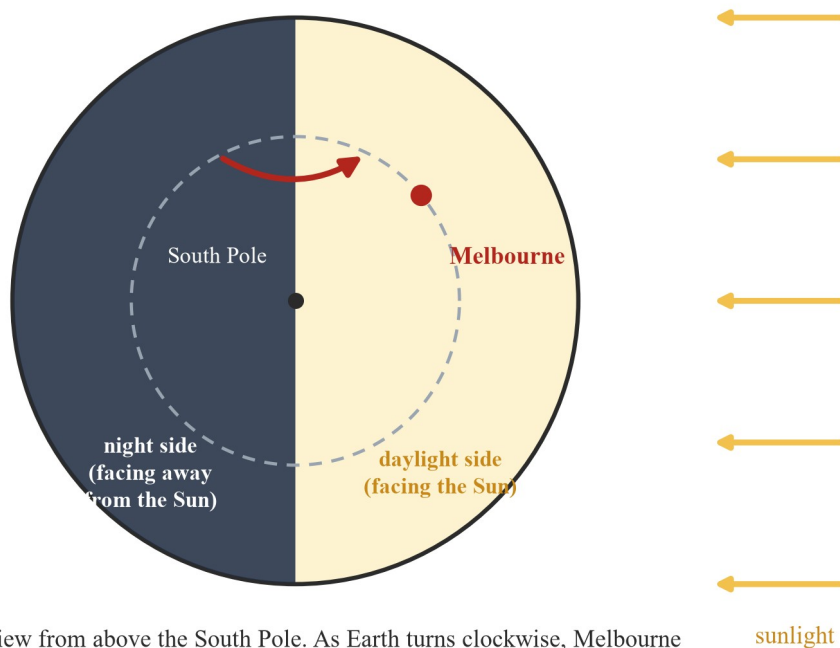
Source: NASA Planetary Fact Sheet and Sun Fact Sheet (Dr. David R. Williams, NASA GSFC), nssdc.gsfc.nasa.gov — retrieved 2026-08-21 (via web.archive.org snapshot while the NASA site was under maintenance).

Try the model for real: one person is the Sun with the ball, and walkers carry beads or drawn cards out to the supplied distances. Two things surprise every group: how tiny the planets are at this size, and how much empty space there is between them.

Rotation makes day and night

Earth turns like a top, once every 24 hours. The line it turns on, through its centre from the North Pole to the South Pole, is its **axis**. At any moment, half of Earth faces the Sun and is in daylight, and half faces away and is in darkness. As Earth turns, a place such as Melbourne is carried around the axis: into the daylight half (day) and then around into the dark half (night). That turning, called **rotation**, is why the Sun appears to rise in the east, climb the sky, and set in the west.

One turn every 24 hours: Earth's rotation



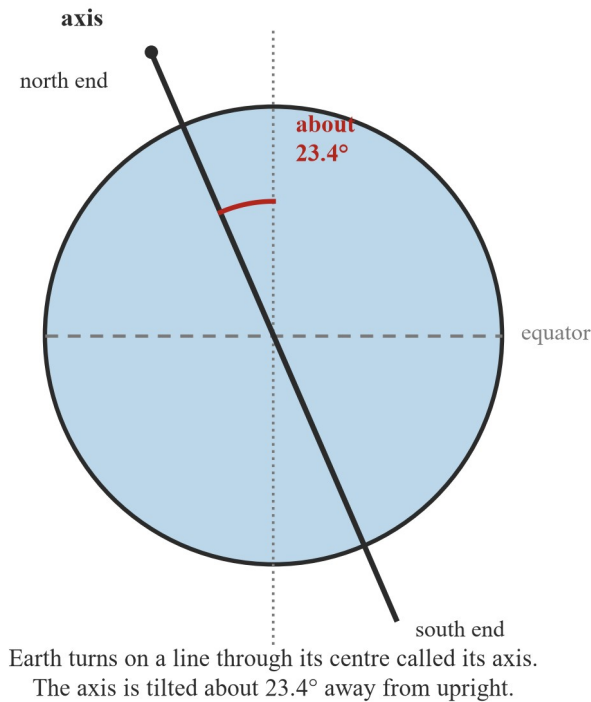
View from above the South Pole. As Earth turns clockwise, Melbourne is carried into daylight (day) and then around into the dark (night).

A disc of Earth seen from above the South Pole, sunlight coming from the right: the right half is the daylight side facing the Sun and the left half is the night side facing away; Melbourne is a dot on a dashed ring around the pole, and a red arrow shows the clockwise turn that carries it into daylight and back into the dark once every 24 hours.

Earth's axis is tilted

Earth's axis is not upright. It leans over by about 23.4° — the **tilt** of the axis. The **equator** is the line around Earth's middle, halfway between the poles, and the two halves of Earth either side of it — the northern **hemisphere** and the southern hemisphere — take turns leaning toward the Sun as Earth travels.

Earth does not stand upright

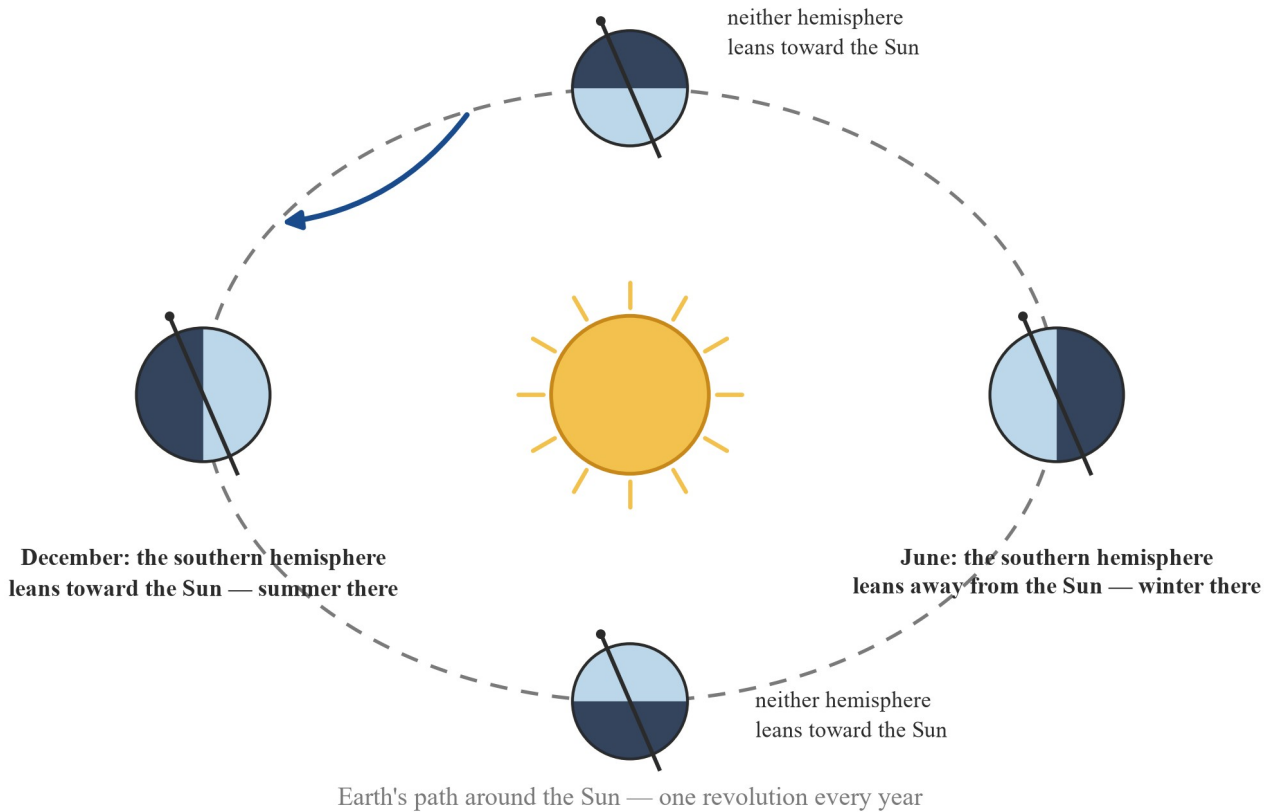


A disc of Earth with the equator as a dashed horizontal line, a dotted upright reference line, and the real axis drawn as a solid line leaning over; a red curved line marks the tilt of about 23.4 degrees between upright and the axis, with the north and south ends labelled.

Tilt plus revolution change the length of day and night

Earth travels around the Sun once a year — one **revolution** — and all that time its axis keeps pointing the same way in space. So at one part of the orbit the southern hemisphere leans toward the Sun, and six months later it leans away. When our half leans toward the Sun (around December), the Sun climbs high and stays up for most of the day: summer in Victoria. When our half leans away (around June), the Sun stays low and is up for only part of the day: winter. Around March and September — the two **equinoxes** — no hemisphere leans toward the Sun, and days and nights are about equal.

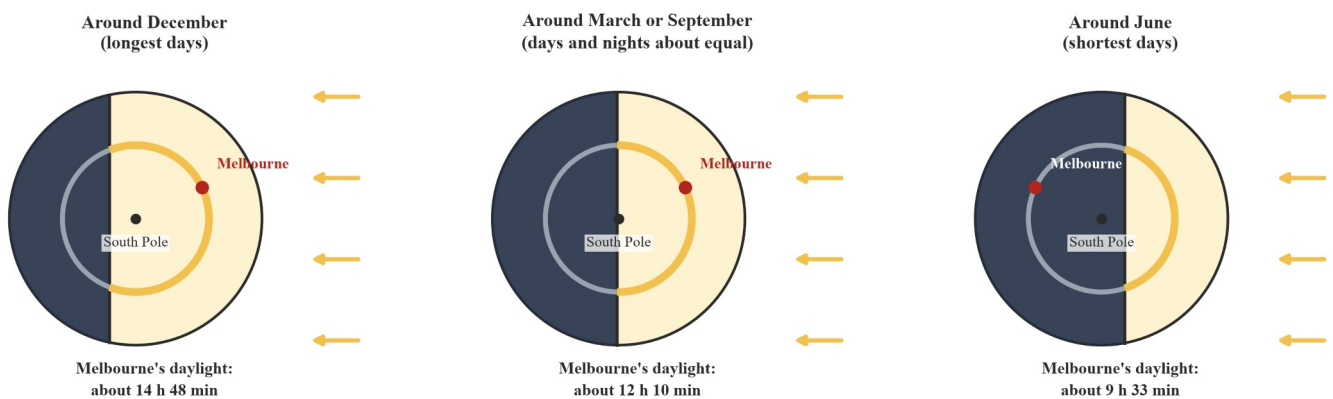
The axis keeps pointing the same way all year



The Sun at the centre with Earth drawn at four positions on its orbit, the axis leaning the same way at every position: at the left (December) the southern hemisphere leans toward the Sun, at the right (June) it leans away, and at the top and bottom no hemisphere leans toward the Sun.

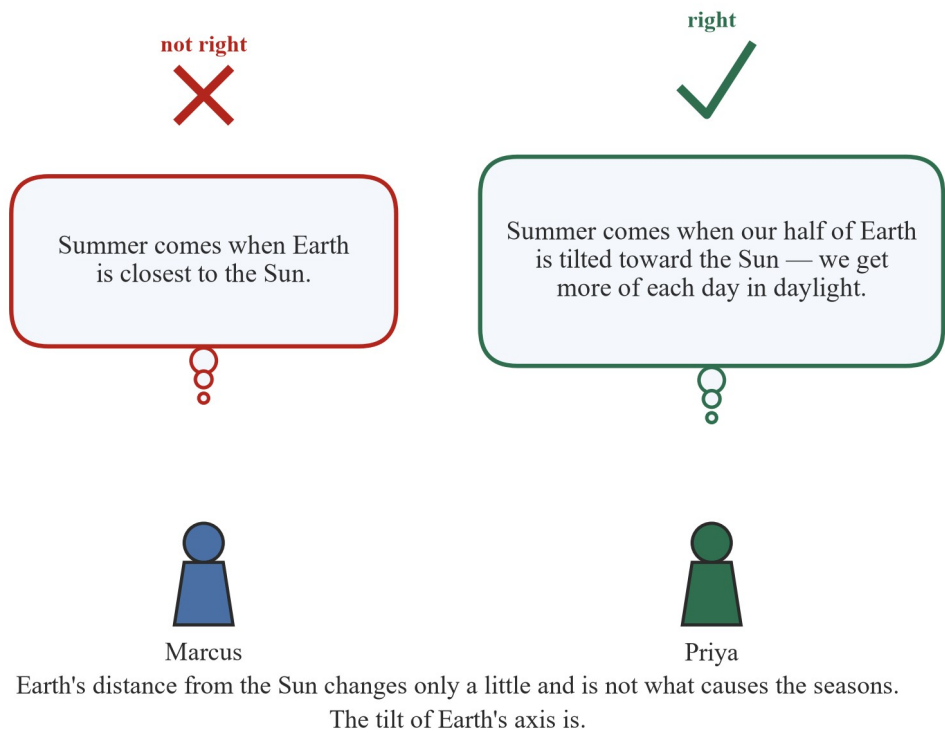
The tilt does not just change the seasons — it changes how much of each daily turn a place spends in daylight. The three views below are drawn from Melbourne's real day lengths.

View from above the South Pole — sunlight comes from the right. The gold part of Melbourne's ring is the part of each 24-hour turn spent in daylight, drawn from Melbourne's real day lengths.



Three discs of Earth seen from above the South Pole with sunlight from the right, one for around December, one for around March or September and one for around June: a vertical day-and-night line sits left of the pole in December so the pole is lit, through the pole at the equinoxes, and right of the pole in June so the pole is dark; on Melbourne's ring the gold part is the share of the 24-hour turn spent in daylight — about 14 h 48 min in December, about 12 h 10 min at the equinoxes and about 9 h 33 min in June.

A wrong idea worth stopping here: summer is **not** when Earth is closest to the Sun. Earth’s orbit is slightly oval. The closest point actually falls in January — in the middle of Victoria’s summer — and the far point falls in July, our winter. If nearness caused the seasons, Victoria would be coldest in January. What makes the seasons is the tilt.



Two students with thought bubbles: Marcus thinks summer comes when Earth is closest to the Sun, marked with a red cross as not right; Priya thinks summer comes when our half of Earth is tilted toward the Sun so we get more of each day in daylight, marked with a green tick as right.

A real record — closest in summer. Earth’s orbit takes it from 147.1 million km at its closest point to the Sun to 152.1 million km at its far point, and the closest point falls in January, during the southern hemisphere’s summer. Nearness to the Sun cannot be what makes the seasons.

Source: NASA Planetary Fact Sheet (Dr. David R. Williams, NASA GSFC), nssdc.gsfc.nasa.gov — retrieved 2026-08-21 (via web.archive.org snapshot while the NASA site was under maintenance).

Sunrise and sunset in a Victorian town

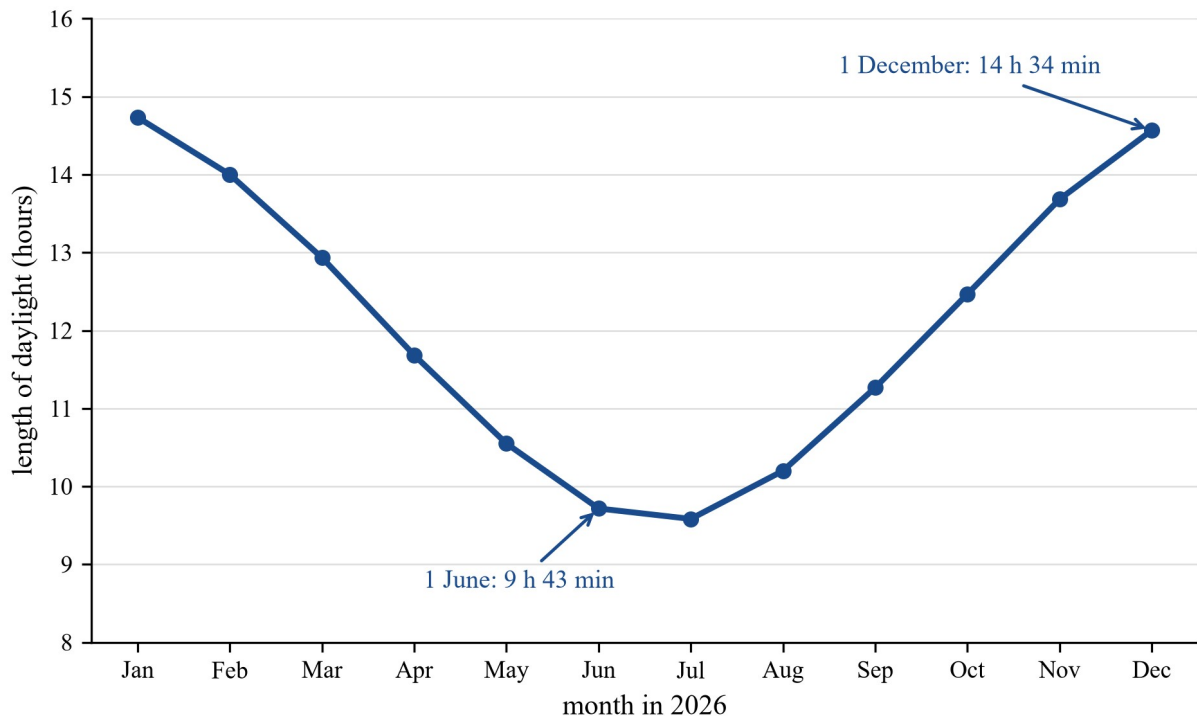
All of this can be checked with real numbers. The table below gives sunrise and sunset in Melbourne on the first day of each month of 2026, in 24-hour time, together with the length of daylight — the **elapsed time**, the time that passes, between sunrise and sunset. Victoria’s clocks run on Australian Eastern Standard Time (AEST) in the cooler months and on Australian Eastern Daylight Time (AEDT), one hour ahead, over summer — the table shows which clock applies on each date. The clock label changes, but the length of daylight is simply the gap between sunrise and sunset, so the clocks do not change it.

A real record — Melbourne, 2026. Sunrise and sunset in Melbourne on the first of each month of 2026, from Geoscience Australia’s sunrise and sunset calculator. The length of daylight is worked out as the elapsed time between the two clock times.

Source: Geoscience Australia sunrise and sunset calculator (geodesyapps.ga.gov.au/sunrise) — retrieved 2026-08-21.

Date	Clock	Sunrise	Sunset	Length of daylight
1 January	AEDT	06:01	20:45	14 h 44 min
1 February	AEDT	06:33	20:33	14 h 00 min
1 March	AEDT	07:04	20:00	12 h 56 min
1 April	AEDT	07:33	19:14	11 h 41 min

Date	Clock	Sunrise	Sunset	Length of daylight
1 May	AEST	07:00	17:33	10 h 33 min
1 June	AEST	07:26	17:09	9 h 43 min
1 July	AEST	07:36	17:11	9 h 35 min
1 August	AEST	07:20	17:32	10 h 12 min
1 September	AEST	06:42	17:58	11 h 16 min
1 October	AEST	05:56	18:24	12 h 28 min
1 November	AEDT	06:13	19:54	13 h 41 min
1 December	AEDT	05:52	20:26	14 h 34 min



A line graph of the length of daylight in Melbourne on the first of each month of 2026: the line starts high at about 14.7 hours in January, falls to a low of about 9.6 hours in June and July, and climbs back to about 14.6 hours by December, with the points for 1 June (9 h 43 min) and 1 December (14 h 34 min) labelled.

Two latitudes: Melbourne and the far south

Latitude measures how far a place is from the equator. The further a place is from the equator, the more its day length changes through the year. Near the South Pole the change is extreme: the Sun stays up all day for months over summer, and stays down all day for months over winter. Geoscience Australia’s calculator marks a day of Sun all day with the symbol + and a day of Sun down all day with the symbol –.

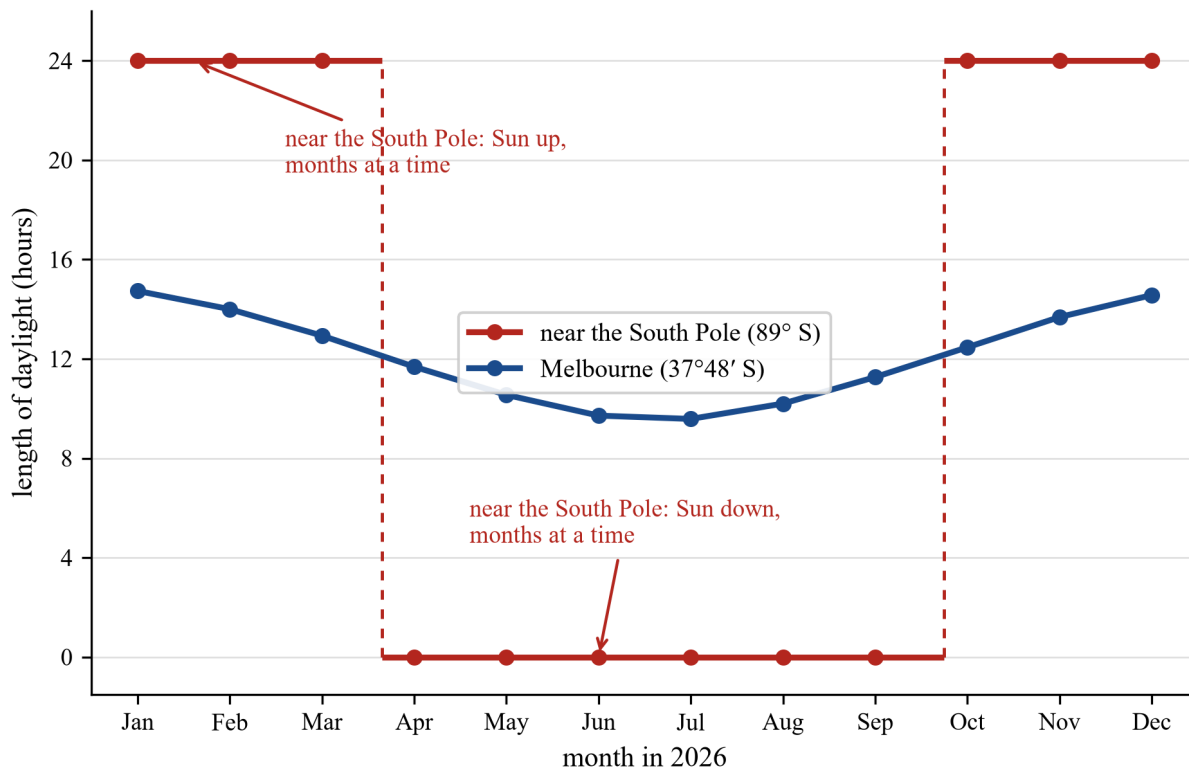
A real record — near the South Pole, 2026. Sun up or down all day at a point near the South Pole (89° S) on the first of each month of 2026, from Geoscience Australia’s sunrise and sunset calculator. In 2026 the Sun sets for winter there on about 21 March and rises again on about 24 September.

Source: Geoscience Australia sunrise and sunset calculator (geodesyapps.ga.gov.au/sunrise) — retrieved 2026-08-21.

Date	1 January	1 February	1 March	1 April	1 May	1 June	1 July	1 August	1 September	1 October	1 November	1 December
Daylight near the	+	+	+	–	–	–	–	–	–	+	+	+

	1	1	1	1				1	1	1	1	1
Date	January	February	March	April	May	June	July	August	September	October	November	December

South Pole

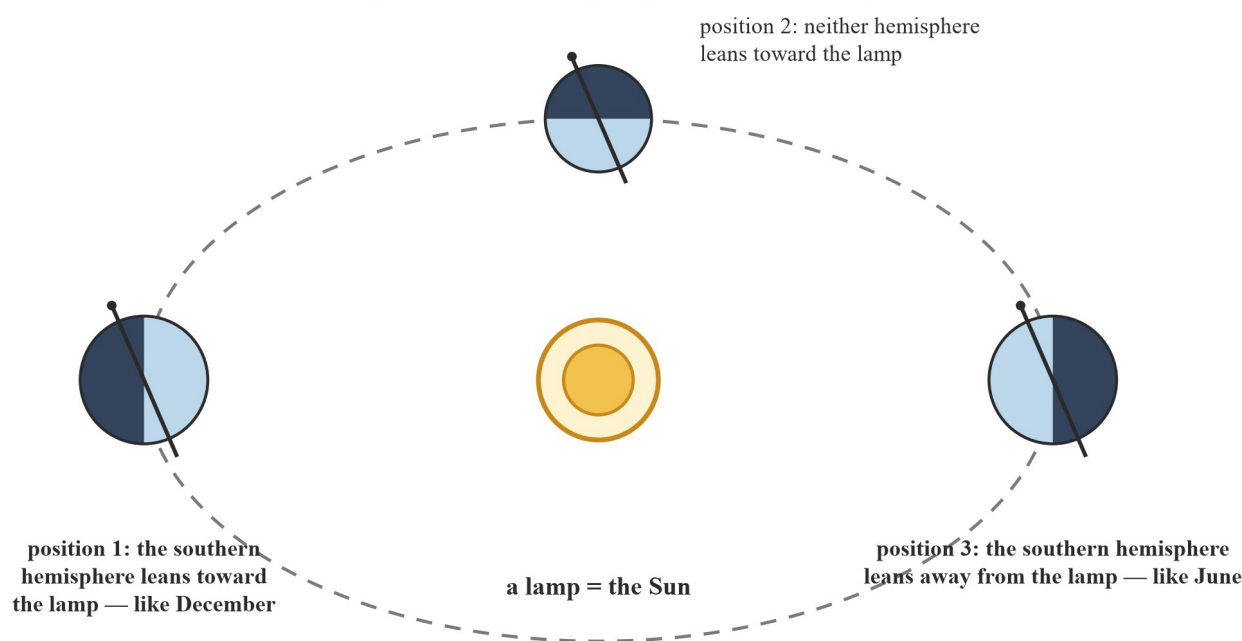


A line graph across 2026 with two series: Melbourne’s length of daylight as a smooth blue curve from about 14.7 hours in January down to about 9.6 hours in June and July and back up again, and a red step line for a point near the South Pole at 24 hours from January to late March, dropping to 0 hours from late March to late September, and back at 24 hours from late September to December.

Modelling all of it in three dimensions

The whole story can be modelled on a desk: a lamp for the Sun and a globe for Earth. Carry the globe around the lamp **without letting the axis swivel** — it must keep pointing the same way, the way Earth’s axis does — and watch which hemisphere faces the lamp most at each position. That one steady axis gives you summer, winter and the in-between seasons, and the changing share of each turn spent in daylight.

Modelling it in 3D: a lamp, a globe and a steady axis



Carry the globe around the lamp with the axis always pointing the same way. Watch which hemisphere faces the lamp most at each position.

A lamp at the centre standing for the Sun, with a tilted globe carried around it on a dashed circular path at three positions: at position 1 the southern hemisphere leans toward the lamp (like December), at position 2 no hemisphere leans toward the lamp, and at position 3 the southern hemisphere leans away (like June); the axis points the same way at all three positions.

Worked examples

Example 1 — with support

Use the Melbourne table. Work out the length of daylight on (a) 1 January 2026 and (b) 1 June 2026 by finding the elapsed time between sunrise and sunset in 24-hour time. (c) Between April and October Victoria's clocks run on AEST instead of AEDT. Does that clock change alter the length of daylight? Explain.

Working	Comment
(a) 1 January: sunrise 06:01, sunset 20:45. From 06:01 to 20:01 is 14 h, and from 20:01 to 20:45 is 44 min. So the daylight lasts 14 h 44 min.	Count on in 24-hour time: whole hours first, then the leftover minutes.
(b) 1 June: sunrise 07:26, sunset 17:09. From 07:26 to 17:26 would be 10 h, but sunset at 17:09 is 17 min before 17:26. So $10\text{ h} - 17\text{ min} = 9\text{ h } 43\text{ min}$.	When the sunset minutes are fewer than the sunrise minutes, count to the next whole hour and take the extra minutes away.
(c) No. AEST and AEDT are just names for the clock. The length of daylight is the elapsed time between sunrise and sunset, and both times shift together when the clock changes.	That is why the table can give a clock column and a daylight column: the daylight column does not depend on the clock.
$\therefore$ 1 January has 14 h 44 min of daylight and 1 June has 9 h 43 min — about five hours more daylight at the start of summer than at the start of winter.	The gap is the tilt at work, not the clocks.

Example 2 — with support

Use the two-latitudes graph and the near-South-Pole table. (a) What is the length of daylight near the South Pole on 15 June? (b) About how long is the day in Melbourne on 1 December? (c) Describe what happens near the South Pole at the end of March and at the end of September.

Working	Comment
(a) 0 hours. 15 June sits between April and September, when the table shows – (Sun down all day), and the red line is at 0.	A – day has no sunrise and no sunset: the Sun never climbs above the horizon.
(b) About 14.5 hours — the table’s value for 1 December is 14 h 34 min, and the blue curve at December sits just under 15 hours.	Read the blue Melbourne line at December, or take the exact value from the table.
(c) At the end of March the Sun sets for winter: from then until late September it is – every day, months of darkness. At the end of September the Sun rises again and stays up: months of daylight.	The red line jumps from 24 hours to 0 hours in late March and back in late September.
∴ The further a place is from the equator, the more its day length changes through the year — Melbourne’s day length moves between about 9.5 and 14.7 hours, while near the pole it swings all the way from 0 to 24 hours.	Same tilt, same year, different latitude.

Example 3 — by yourself

Melbourne’s longest days come in December and its shortest in June. Using the idea of the steady axis, explain in three or four sentences why this is so. Refer to how much of Melbourne’s daily turn is spent in daylight at each time of year, as shown in the three-panel figure of Melbourne’s ring.

Practice questions

With support

- Q1.** Write a sentence, in your own words, for each term: (4 marks) (a) gravity (b) orbit (c) rotation (d) revolution
- Q2.** The figure of the planet in orbit shows two things at once that keep the planet going around the Sun. (2 marks) (a) Name them. (b) What would happen to the planet’s path if gravity suddenly switched off?
- Q3.** Use the pocket solar-system model. (3 marks) (a) Which planet’s bead stands about 32 m from the Sun ball? (b) Which two planets stand beyond 50 m but before 400 m? (c) Which planet’s bead is the largest, and how wide is it on this model?
- Q4.** Earth’s rotation. (2 marks) (a) How long does one full turn take? (b) Name the half of Earth where you would find Melbourne at midnight.
- Q5.** Use the tilt figure. (2 marks) (a) About how far does the axis lean from upright? (b) What happens to the direction the axis points as Earth travels around the Sun?
- Q6.** Match each cause to what it explains. (4 marks)

Cause	Explains
1 Earth’s rotation	A the year, and the march of the seasons
2 Earth’s revolution	B day and night
3 the tilt of the axis	C the planets staying in their paths around the Sun
4 gravity	D the changing length of day and night through the year

By yourself

- Q7.** Explain, in two or three sentences, why there is day and night on Earth. (2 marks)
- Q8.** (a) Name the force that keeps Earth in orbit around the Sun. (1 mark) (b) Earth is pulled toward the Sun the whole time, yet it never falls in. Explain why. (2 marks)
- Q9.** A class builds the pocket solar-system model on a straight 1 km road, with the Sun ball at the gate. (3 marks) (a) The road is 50 m long before it leaves the school ground. Which planets stand on the school ground? (b) A walker

carries the Neptune bead to its mark. Describe, in words, where they end up on this model. (c) Name one thing about the real solar system that this model shows well.

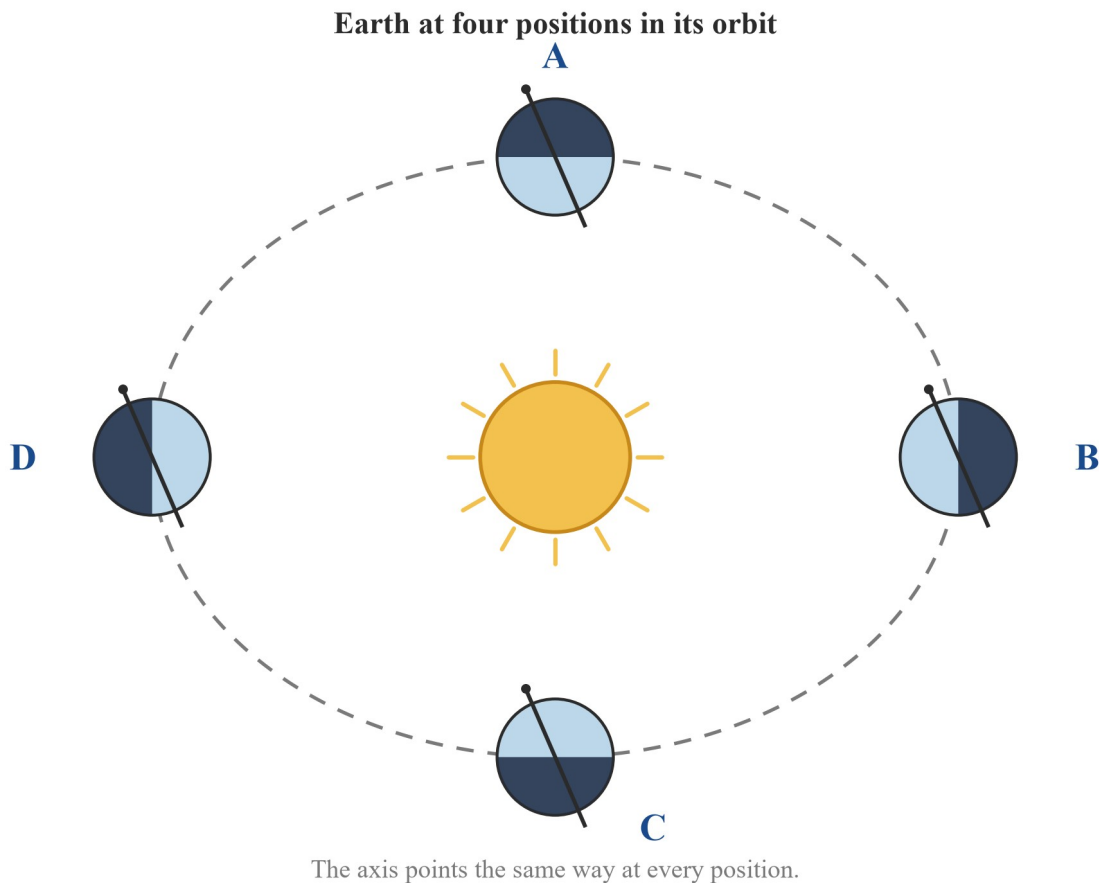
Q10. On 1 November 2026 the Sun rose in Melbourne at 06:13 and set at 19:54 (AEDT). Work out the length of daylight that day in 24-hour time. (2 marks)

Q11. To a watcher in Melbourne, the Sun appears to rise in the east and set in the west. Use Earth's rotation to explain why the Sun *appears* to move across the sky. (2 marks)

Q12. Use the three-panel figure of Melbourne's ring. (3 marks) (a) In which panel is the South Pole itself in daylight? (b) Which panel matches June in Victoria? (c) Explain, using the gold part of Melbourne's ring, why December days in Melbourne are longer than June days.

Q13. Use the two-latitudes graph and tables. (3 marks) (a) Give the length of daylight near the South Pole on 1 July and on 1 January. (b) In which months of 2026 is the Sun down all day near the South Pole? (c) In which month is Melbourne's daylight shortest, and about how long is it?

Q14. SCENARIO — Two schools plan the same experiment: one at Warrnambool on Victoria's south coast (further from the equator) and one at Mildura in Victoria's north-west (closer to the equator). Both record the length of daylight on the first of each month for a year. (3 marks) (a) Which school's day length would you expect to change more through the year? (b) Use the two-latitudes graph to back up your choice. (c) Would either school ever record a day with the Sun up for 24 hours? Explain.



The Sun at the centre with Earth drawn at four positions on its orbit, labelled A, B, C and D: A at the top, B at the right, C at the bottom and D at the left; at every position the axis leans the same way.

Q15. Use the figure of Earth at four positions A–D in its orbit. (4 marks) (a) At which letter is the southern hemisphere leaning toward the Sun? (b) At which letter is it winter in Victoria? (c) At which two letters are days and nights about equal on all of Earth? (d) The axis points the same way at all four positions. Why does that fact matter for the seasons?

Q16. Marcus says summer comes when Earth is closest to the Sun. (3 marks) (a) In which month does Earth reach its closest point to the Sun? (b) Which season is that in Victoria? (c) Explain, in one or two sentences, why this kills Marcus's idea.

Practical — shadows through a day, and day length at two latitudes

PRACTICAL — this page plans or analyses work done in the classroom, laboratory or field. It is not a substitute for doing it.

Question: How do the length and direction of a stick's shadow change through a sunny day in Victoria, and how does the length of daylight compare between Melbourne and a place near the South Pole across a year?

Part A — one stick through a day

Equipment: one straight stick about 30 cm long; modelling clay to stand it up; a flat sunny patch of ground; a metre ruler or tape measure; chalk or small stones to mark each shadow tip; a compass (or the compass on a phone); a watch showing 24-hour time.

Safety: Work in a safe sunny spot and use sun protection (hat, sunscreen). Never look straight at the Sun.

Risk	How we stay safe
Sun exposure during repeated outdoor readings	Hat and sunscreen; work in the shade between readings.
Looking toward the Sun when finding its direction	Look at the shadow, never at the Sun; use the compass for direction.
Trip hazard from the stick and stones	Place the stick where people are not walking; pack up when done.

Variables (the things we change, measure and keep the same):

Variable	Choice
The one we change	the time of day (three or more set times, e.g. 09:00, 12:00, 15:00)
The ones we measure	the shadow's length (cm) and the direction it points
The ones we keep the same	the same stick, the same clay base, the same flat patch of ground, the same day

Method:

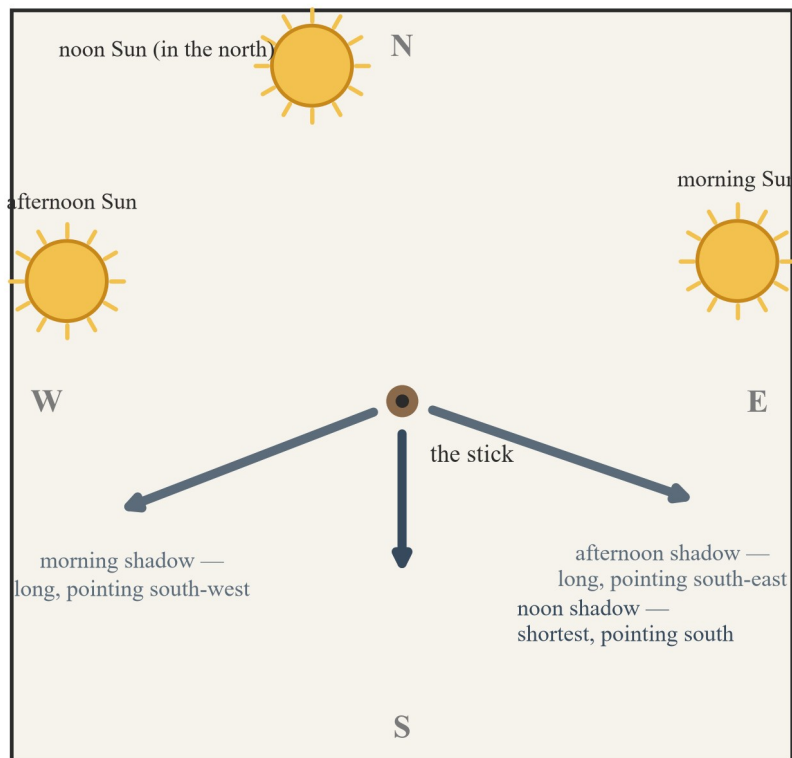
- Stand the stick upright in the clay on the flat patch before 09:00.
- At each set time, mark the tip of the shadow with chalk (or lay a small stone at the tip), then measure from the base of the stick to the mark with the ruler or tape (cm). Record the time in 24-hour time, the length, and the direction the shadow points (which way it lies on the compass).
- Repeat the whole day on a second sunny day, at the same set times.

Results: record your measurements in a table like this one.

Time (24-hour)	Day 1 shadow length (cm)	Day 1 shadow direction	Day 2 shadow length (cm)	Day 2 shadow direction
09:00				
12:00				
15:00				

Compare your two days at each time. Do the trials agree with each other?

One stick, three shadows



Top-down view. The shadow always points away from the Sun, and it is shortest when the Sun is highest around noon.

A top-down view of a stick standing on flat ground marked with the compass points north, south, east and west: the morning Sun is in the north-east and the long morning shadow points between south and west, the noon Sun is in the north and the noon shadow is the shortest and points south, and the afternoon Sun is in the north-west and the long afternoon shadow points between south and east; the shadow always points away from the Sun.

Part B — day length at two latitudes

- Copy the two tables from earlier in this section (Melbourne on the first of each month, and the +/- table for near the South Pole) into your book. Turn the near-pole +/- symbols into hours: + is 24 h, - is 0 h.
- On one graph, draw months along the bottom and length of daylight up the side, from 0 to 24 hours. Plot Melbourne as points joined by a line, and the near-pole values as points joined by a second line. Give the graph a title and label both lines.

Thinking about the results:

- Describe how your stick's shadow changed length and direction from morning to afternoon, and explain the change using where the Sun was in the sky.
- At which of your times was the shadow shortest, and which way did it point? Check against the shadow figure's noon shadow (pointing south in Victoria).
- On your graph, which line changes more through the year? Explain the difference using the tilt of Earth's axis.
- Near the South Pole your line jumps from 24 hours to 0 hours. In which months did you draw it at 0, and what is happening there at that time?

Make a claim and defend it. Finish this writing frame in full sentences:

- I claim that the length and direction of a shadow through a day tell us about _____.
- My evidence is _____.
- This connects to day length at two latitudes because _____.

- If someone claimed the shadow got shorter at noon because the stick moved closer to the Sun, I would answer _____.

Answers

Q1 (a) Gravity is the pull between objects; the Sun's gravity pulls the planets toward it. (b) An orbit is the closed curved path a planet follows around the Sun. (c) Rotation is Earth's daily turn on its axis, once every 24 hours. (d) Revolution is Earth's trip around the Sun, once a year. **Q2** (a) The pull of gravity toward the Sun, and the planet's own forward motion. (b) It would stop curving and travel off in a straight line. **Q3** (a) Earth. (b) Jupiter (167.9 m) and Saturn (308.8 m). (c) Jupiter's bead, about 30.8 mm (about 3 cm) across. **Q4** (a) 24 hours. (b) The night side — the half facing away from the Sun. **Q5** (a) About 23.4° . (b) Nothing: it keeps pointing the same way all year. **Q6** 1–B; 2–A; 3–D; 4–C. **Q7** Earth turns on its axis once every 24 hours; the half facing the Sun is in daylight and the half facing away is in darkness, so as a place turns into and out of the daylight half it has day and night. **Q8** (a) Gravity. (b) Earth is moving sideways, fast; gravity bends that motion into a closed curve around the Sun instead of a fall into it. **Q9** (a) Mercury (12.5 m), Venus (23.3 m), Earth (32.3 m) and Mars (49.2 m). (b) Near the far end of the 1 km road — 973.5 m from the gate, almost a kilometre away. (c) Any one: the planets are tiny compared with the gaps between them; the solar system is nearly all empty space; the outer planets are much further from the Sun than the inner ones. **Q10** 13 h 41 min. **Q11** Earth turns toward the east, so the Sun appears to climb up from the eastern horizon, cross the sky, and sink in the west; it is we who move, not the Sun. **Q12** (a) The December panel. (b) The June panel. (c) In December the gold part of the ring is much more than half the turn (about 14 h 48 min of the 24 h), and in June much less (about 9 h 33 min), so December days are longer. **Q13** (a) 1 July: 0 hours; 1 January: 24 hours. (b) From April to September. (c) July, about 9.5 hours (9 h 35 min on 1 July). **Q14** (a) Warrnambool, the school further from the equator. (b) The graph shows the further from the equator a place is, the more its day length changes — near the pole the change runs from 0 to 24 hours. (c) No — even Warrnambool is far from the pole; only places very close to the pole get 24-hour days. **Q15** (a) D. (b) B. (c) A and C. (d) Because the axis keeps pointing the same way, different hemispheres lean toward the Sun at different parts of the orbit — that changing lean is the seasons. **Q16** (a) January. (b) Summer. (c) If nearness made the seasons, Victoria would be coldest when Earth is closest; it is warmest — so nearness is not the cause; the tilt is.

Worked solutions

Example 3 (4 marks) Earth's axis keeps pointing the same way while Earth revolves, so in December the southern hemisphere leans toward the Sun and Melbourne's daily turn carries it through a long daylight stretch — the gold part of its ring is much more than half the turn (about 14 h 48 min). *1 mark* In June the southern hemisphere leans away, so Melbourne's turn carries it through a short daylight stretch — the gold part is much less than half the turn (about 9 h 33 min). *1 mark* More of each turn in daylight means longer days, so Melbourne's days are longest in December and shortest in June. *1 mark* The axis never swivels; the change comes from where Earth is in its orbit, not from any change in the axis. *1 mark*

Q1 (4 marks: 1 each) (a) Gravity is the pull between objects; the Sun's strong pull draws the planets toward it. *1 mark* (b) An orbit is the closed curved path a planet follows around the Sun. *1 mark* (c) Rotation is Earth's turn on its axis, once every 24 hours. *1 mark* (d) Revolution is Earth's trip around the Sun, once a year. *1 mark*

Q2 (2 marks: 1 each) (a) The pull of gravity toward the Sun, and the planet's own forward motion. *1 mark* (b) With no pull to bend its path, the planet would travel on in a straight line and leave its orbit. *1 mark*

Q3 (3 marks: 1 each) (a) Earth — its bead stands 32.3 m from the Sun ball. *1 mark* (b) Jupiter, at 167.9 m. Saturn stands at 308.8 m, which is beyond 200 m, so Jupiter is the only planet between 50 m and 200 m. *1 mark* (c) Jupiter's bead, about 30.8 mm — about 3 cm — across. *1 mark*

Q4 (2 marks: 1 each) (a) 24 hours. *1 mark* (b) The night side — the half of Earth facing away from the Sun. *1 mark*

Q5 (2 marks: 1 each) (a) About 23.4° from upright. *1 mark* (b) It keeps pointing the same way all year — the axis does not swivel as Earth travels. *1 mark*

Q6 (4 marks: 1 each) 1–B (one turn on the axis brings one day and one night). 2–A (one trip around the Sun is one year, and the seasons march through it). 3–D (the steady tilt makes each hemisphere's share of daylight change through the year). 4–C (the Sun's pull bends the planets' paths into orbits). *1 mark each*

Q7 (2 marks) Earth turns on its axis once every 24 hours. *1 mark* The half facing the Sun is in daylight and the half facing away is in darkness, so as Melbourne turns into the daylight half it is day, and as it turns into the dark half it is night. *1 mark*

Q8 (3 marks) (a) Gravity — the Sun's pull on Earth. *1 mark* (b) Earth is also moving sideways, fast; *1 mark* gravity bends that forward motion into a closed curve around the Sun, so Earth keeps falling toward the Sun but keeps missing it — an orbit. *1 mark*

Q9 (3 marks: 1 each) (a) Mercury at 12.5 m, Venus at 23.3 m, Earth at 32.3 m and Mars at 49.2 m all stand within 50 m. *1 mark* (b) At 973.5 m — near the far end of the 1 km road, almost a kilometre from the Sun ball. *1 mark* (c) For example: the planets are tiny compared with the empty space between them, so the solar system is nearly all empty space. *1 mark*

Q10 (2 marks) From 06:13 to 19:13 is 13 h, and from 19:13 to 19:54 is 41 min. *1 mark* So the daylight lasts 13 h 41 min. *1 mark*

Q11 (2 marks) Earth's rotation carries us toward the east, so the Sun first appears at the eastern horizon. *1 mark* As our part of Earth keeps turning, the Sun appears to climb, cross the sky, and set in the west — the apparent motion is really Earth turning. *1 mark*

Q12 (3 marks: 1 each) (a) The December panel — the day-and-night line sits on the Melbourne side of the pole, leaving the pole in daylight. *1 mark* (b) The June panel — the pole is in darkness and Melbourne's gold stretch is short. *1 mark* (c) In December the gold part of Melbourne's ring is far more than half the turn (about 14 h 48 min in daylight), while in June it is far less (about 9 h 33 min), so the December day is about five hours longer. *1 mark*

Q13 (3 marks: 1 each) (a) 1 July: 0 hours (–); 1 January: 24 hours (+). *1 mark* (b) April to September — the – months. *1 mark* (c) July; about 9.5 hours (the table gives 9 h 35 min on 1 July). *1 mark*

Q14 (3 marks: 1 each) (a) Warrnambool, because it is further from the equator. *1 mark* (b) The two-latitudes graph shows that the further a place is from the equator, the more its day length changes through the year — Melbourne's curve swings over about 5 hours, and near the pole the swing runs from 0 to 24 hours. *1 mark* (c) No: 24-hour days happen only very close to the pole, and both towns are far from it — even the longest day at Warrnambool stays near 15 hours. *1 mark*

Q15 (4 marks: 1 each) (a) D — the southern hemisphere leans toward the Sun there. *1 mark* (b) B — the southern hemisphere leans away, so Victoria has winter. *1 mark* (c) A and C — no hemisphere leans toward the Sun, so days and nights are about equal. *1 mark* (d) Because the axis keeps pointing the same way, the lean of each hemisphere toward the Sun changes as Earth revolves — that changing lean, not any change in the axis, is what makes the seasons. *1 mark*

Q16 (3 marks: 1 each) (a) January — Earth's closest point to the Sun falls in January. *1 mark* (b) Summer in Victoria. *1 mark* (c) Earth is closest to the Sun in Victoria's summer and at its far point in its winter, so nearness cannot be what makes the seasons; the tilt of the axis is. *1 mark*

Test

Topic 4 test — Earth and space sciences · Chapter 8 · Subtopics 8A, 8B and 8C

This is a school-designed paper. It is not a VCAA instrument. Achievement at Levels 5 and 6 is reported against the Victorian Curriculum achievement standard on teacher judgement; the marks here are one source of evidence towards that judgement.

About this test

Covers	Chapter 8 — subtopics 8A, 8B and 8C
Content descriptions	VC2S6U05 (8A) · VC2S6U06 (8B) · VC2S6U07 (8C)
Total marks	40 — Section A 12 marks, Section B 22 marks, Section C 6 marks
Inquiry marks	13 of 40 — inquiry is examined in its own right (paper minimum: 10)
Suggested time	45 minutes

How to run this test

- No calculator. No formula sheet. No reading time.
- **Untimed completion** — the suggested time is a guide only. A student may take all the time they need.
- **Reading support** — any item may be read aloud to a student who asks. Reading is not being assessed.
- Answer every question in the spaces provided.

Section A — Multiple choice — 12 marks

Choose the best answer for each question. There is only one best answer for each question. Each question is worth 1 mark.

Q1. Which list puts the four processes in the correct order, starting first? (1 mark)

- A. Weathering, transportation, erosion, then deposition
- B. Erosion, weathering, transportation, then deposition
- C. Weathering, erosion, transportation, then deposition
- D. Deposition, then erosion, weathering, transportation

Q2. Wind blowing sand against rock is: (1 mark)

- A. Erosion that carries the rock far away
- B. Chemical weathering
- C. Build-up of material that forms new rock
- D. Mechanical (physical) weathering

Q3. At a coastal site, cracks in a cliff have been widening through weathering over thousands of years. Nearby, storm waves carve metres into a sand dune through erosion in a single day. Which comparison is correct? (1 mark)

- A. Weathering was slow, erosion was rapid
- B. Both changes happened at the same speed because both happened at the coast
- C. Weathering was rapid, erosion was slow
- D. Weathering and erosion cannot change Earth's surface this much

Q4. A farmer clears all plants from a slope, leaving the ground bare. What is most likely to happen to the rate of erosion when heavy rain falls? *(1 mark)*

- A.** It slows down because water soaks straight into bare ground
- B.** It speeds up because no leaves slow the rain and no roots hold the soil together
- C.** It stays the same because the rain that falls is the same
- D.** It stops completely because only wind can move bare soil

Q5. What is a natural hazard? *(1 mark)*

- A.** Any event that happens quickly, even if it harms nothing
- B.** A change caused only by humans that damages buildings
- C.** A slow change that never harms the environment
- D.** A natural event that can harm people, places or the environment

Q6. An earthquake is caused by: *(1 mark)*

- A.** Sudden movement along a fault deep underground
- B.** Strong winds shaking the ground
- C.** Heavy rain soaking deep into the soil
- D.** The Moon pulling on the land surface

Q7. An earthquake happens under the sea. Which other natural hazard can it cause? *(1 mark)*

- A.** A drought
- B.** A bushfire
- C.** A tsunami
- D.** A flood from a river bursting its banks

Q8. Before bushfire season, workers clear a strip of land so nothing grows on it — no grass, no leaves, no trees. How does this strip reduce the impact of a bushfire? *(1 mark)*

- A.** The bare strip takes oxygen away from the fire, so the fire goes out
- B.** Fire needs fuel to move, and the strip removes the fuel, so the fire cannot spread across it
- C.** The strip cools the air so much that fire cannot burn
- D.** The strip soaks up the heat and sends it back into the ground

Q9. What force keeps planets in orbit around the Sun? *(1 mark)*

- A.** Gravity
- B.** Magnetism
- C.** Friction from space dust
- D.** Wind blowing out from the Sun pushing them along

Q10. What causes day and night on Earth? *(1 mark)*

- A.** The Sun moves around the Earth once every day
- B.** The Moon moves between the Earth and the Sun every night

- C. The Earth moves closer to the Sun in the day and further away at night
- D. The Earth turns once every 24 hours, so each place turns into and out of the Sun's light

Q11. Near the South Pole there are days when the Sun does not rise at all. When in the year does this happen? (1 mark)

- A. In December and January, in the middle of summer
- B. From about April to September, during the Southern Hemisphere's winter
- C. On only one day each year
- D. It never happens: the Sun rises every day there

Q12. In December, the Southern Hemisphere leans towards the Sun. What does this mean for a place like Melbourne in December? (1 mark)

- A. Melbourne spends less than half of each daily turn in daylight, so its days are short
- B. Melbourne's day and night are exactly the same length every day in December
- C. Melbourne spends more than half of each daily turn in daylight, so its days are long
- D. Melbourne has 24 hours of daylight every day in December

Section B — Short response — 22 marks

Write your answers in the spaces provided.

Q13. SCENARIO — a class fair test built on the simulated-slope practical from 8A, invented for skill practice. A class builds two simulated slopes (model slopes made in the classroom): two trays with the same soil, tilted to the same steepness. One tray stays bare; the other is covered with grass. The class pours the same amount of water onto each tray and measures the mass of soil washed away. (3 marks)

- (a) Which variable does the class change? (1 mark)
- (b) Which variable does the class measure? (1 mark)
- (c) Name one variable the class keeps the same. (1 mark)

Q14. Name which of the four processes — weathering, erosion, transportation or deposition — is mainly at work in each description. (3 marks)

- (a) Rainwater freezes in a crack in a rock and forces the crack wider. None of the pieces have moved yet. (1 mark)
- (b) Floodwater lifts soil from a riverbank and carries it away. (1 mark)
- (c) A creek drops its sand where the water slows down at a bend. (1 mark)

Q15. The Yarra River at Warrandyte has a worn, bare riverbank. Years of informal tracks, foot traffic and dogs off-lead wore the plants away, and the bare bank was being eroded and washed into the river. Melbourne Water's recovery plan includes fencing to keep feet and paws off, rocks to shield the bank, and about 10,000 native plants along a 500 m stretch. (2 marks)

Source: Melbourne Water, "Restoring the Birrarung: riverbank recovery works planned in Warrandyte" — retrieved 2026-08-21.

- (a) How do the roots of the new native plants slow the erosion? (1 mark)
- (b) Name one other part of the recovery plan and say how it slows the erosion. (1 mark)

Q16. (3 marks)

- (a) An earthquake happens under the sea. Name the other natural hazard it can cause. (1 mark)

- (b) Explain how the undersea earthquake starts that hazard. (1 mark)
- (c) People cannot stop this hazard. Name one way people reduce its impact, and say how that way works. (1 mark)

Q17. A real record — the Victorian floods of January 2011. Very heavy rain on 12–14 January 2011 made rivers across Victoria, including the Goulburn and the Yarra, burst their banks. About 600 houses flooded in Horsham, and in Rochester about 200 — around 80% of the town. Two people died, more than 1,730 properties flooded, and the cost was about A\$2 billion. (3 marks)

Source: Wikipedia, “2011 Victorian floods” (Bureau of Meteorology flood records), en.wikipedia.org — retrieved 2026-08-21.

- (a) According to the record, how many properties flooded? (1 mark)
- (b) Name one human action or technology that reduces the impact of floods, and say how it works. (1 mark)
- (c) The council wants to warn families about what to do when a flood warning is issued. Which format suits this purpose best — a scientific report, a short poster, or a table of raw data? Give your reason. (1 mark)

Q18. (3 marks)

- (a) Name the force that keeps the Earth in orbit around the Sun. (1 mark)
- (b) The Earth is pulled towards the Sun all the time, yet it does not fall into the Sun. Explain why not. (1 mark)
- (c) SCENARIO — imagine the Sun’s gravity suddenly stopped pulling on the Earth while the Earth was moving. What would the Earth do next? (1 mark)

Q19. SCENARIO — invented for skill practice, built on the shadow-measuring practical from 8C. A class measures the length of the same stick’s shadow three times, one straight after the other. The readings are 24.1 cm, 24.2 cm and 27.9 cm. (2 marks)

- (a) Which reading does not fit the other two? (1 mark)
- (b) What should the class do next? (1 mark)

Q20. (3 marks)

- (a) What is a drought? (1 mark)
- (b) Name one impact of a drought on living things. (1 mark)
- (c) Name one impact of a drought on non-living things. (1 mark)

Section C — Extended response — 6 marks

Q21. Use the table to answer this question. (6 marks)

A real record — Melbourne, 2026. The table shows the sunrise and sunset times in Melbourne on the first day of each month of 2026, in 24-hour time, and the daylight time — the elapsed time between sunrise and sunset. Victoria’s clocks use Australian Eastern Standard Time (AEST) in the cooler months, and Australian Eastern Daylight Time (AEDT), one hour ahead, during summer.

Date	Clock	Sunrise	Sunset	Daylight time
1 January	AEDT	06:01	20:45	14 h 44 min
1 February	AEDT	06:33	20:33	14 h 00 min
1 March	AEDT	07:04	20:00	12 h 56 min
1 April	AEDT	07:33	19:14	11 h 41 min
1 May	AEST	07:00	17:33	10 h 33 min
1 June	AEST	07:26	17:09	9 h 43 min
1 July	AEST	07:36	17:11	9 h 35 min

Date	Clock	Sunrise	Sunset	Daylight time
1 August	AEST	07:20	17:32	10 h 12 min
1 September	AEST	06:42	17:58	11 h 16 min
1 October	AEST	05:56	18:24	12 h 28 min
1 November	AEDT	06:13	19:54	13 h 41 min
1 December	AEDT	05:52	20:26	14 h 34 min

Source: Geoscience Australia sunrise and sunset calculator (geodesyapps.ga.gov.au/sunrise) — retrieved 2026-08-21.

- Which date in the table has the shortest daylight time? Give the date and the daylight time. *(1 mark)*
- Show by working that the elapsed time between sunrise at 05:52 and sunset at 20:26 on 1 December is the daylight time shown in the table. *(1 mark)*
- A student says: “Melbourne’s days are short in June because the Earth is closest to the Sun in June.” Is the student correct? Give your reason. *(2 marks)*
- Write one new investigable question that this table raises. *(1 mark)*
- The class wants to share one finding from this table on a poster for the school community. Write a heading for the poster that states the finding itself. *(1 mark)*

Marking guide

This guide is written so a teacher without a science background can mark the paper. Accept the student's own words wherever the meaning matches the answer given here. Spelling and grammar are not marked. Every item traces to the achievement-standard extract of 8A (VC2S6U05), 8B (VC2S6U06) or 8C (VC2S6U07) in §4.1; inquiry items also name the inquiry code they rehearse, per §4.3.

Inquiry-strand marks on this paper: 13 of 40 (Q13 × 3, Q17(a) × 1, Q17(c) × 1, Q19 × 2, Q21(a) × 1, Q21(b) × 1, Q21(c) × 2, Q21(d) × 1, Q21(e) × 1). The paper minimum is 10.

Section A — answers

Every multiple-choice item is drawn from the MCQ bank keyed to this band's content descriptions; the bank item id keeps the §4 join. Items are printed with stem and options verbatim; only the positions of the options have changed for this paper (the bank stores most correct answers in position A, and a printed paper must spread the answers). One item carries a one-phrase vocabulary repair, noted below; the repair changes no key and no code.

Q	Answer	CD	Bank item
1	C — Weathering, erosion, transportation, then deposition	VC2S6U05	VC2S6U05.S01.D1.V01
2	D — Mechanical (physical) weathering	VC2S6U05	VC2S6U05.E01.S01.D1.V01
3	A — Weathering was slow, erosion was rapid	VC2S6U05	VC2S6U05.E03.S01.D2.V01
4	B — It speeds up because no leaves slow the rain and no roots hold the soil together	VC2S6U05	VC2S6U05.E05.S01.D1.V01
5	D — A natural event that can harm people, places or the environment	VC2S6U06	VC2S6U06.S01.D1.V01
6	A — Sudden movement along a fault deep underground	VC2S6U06	VC2S6U06.E02.S01.D1.V01 (repaired)
7	C — A tsunami	VC2S6U06	VC2S6U06.E03.S01.D1.V01
8	B — Fire needs fuel to move, and the strip removes the fuel, so the fire cannot spread across it	VC2S6U06	VC2S6U06.S01.D2.V01
9	A — Gravity	VC2S6U07	VC2S6U07.E02.S01.D1.V01
10	D — The Earth turns once every 24 hours, so each place turns into and out of the Sun's light	VC2S6U07	VC2S6U07.E03.S01.D1.V01
11	B — From about April to September, during the Southern Hemisphere's winter	VC2S6U07	VC2S6U07.E04.S01.D1.V01
12	C — Melbourne spends more than half of each daily turn in daylight, so	VC2S6U07	VC2S6U07.E05.S01.D2.V01

its days are long

Repairs. Q6: the bank's correct option reads "Sudden movement along a fault in Earth's crust"; it is printed as "Sudden movement along a fault deep underground" because the book teaches the idea as "rock deep in the ground" without introducing *crust* at this point. The repair follows the word-level policy's rewrite channel; the item stays keyed to its code.

Why each answer is correct.

- Q1: rock must break down first (weathering); the pieces are then loosened and moved (erosion and transportation) and finally dropped somewhere new (deposition).
- Q2: wind-blown sand grinding against rock is abrasion, a form of mechanical (physical) weathering — the rock is being broken down in place, not carried away.
- Q3: cracks widening over thousands of years is slow weathering; waves carving metres in a single day is rapid erosion.
- Q4: with no leaves to slow the rain and no roots to hold the soil together, rain erodes bare ground faster.
- Q5: a natural hazard is a natural event that can harm people, places or the environment — speed alone, or a human-caused change, does not make something a natural hazard.
- Q6: earthquakes happen when rock deep underground moves suddenly along a fault.
- Q7: an undersea earthquake can lift the sea floor and start a tsunami.
- Q8: fire needs fuel to move; a cleared strip removes the fuel, so the fire cannot spread across it.
- Q9: gravity is the force that keeps the planets in orbit around the Sun.
- Q10: Earth turns once every 24 hours, so each place turns into and out of the Sun's light — that is day and night. The Sun does not move around the Earth.
- Q11: near the South Pole the Sun stays down for months at a time, from about April to September — the Southern Hemisphere's winter.
- Q12: in December the Southern Hemisphere leans towards the Sun, so Melbourne spends more than half of each daily turn in daylight and its days are long.

Section B — answers and marking

Q13 (3 marks: 1 each) — inquiry: planning a fair test (rehearses VC2S6I02, anchored at 8A); content VC2S6U05. (a) The ground cover — whether the tray is bare soil or covered with grass. 1 mark (b) The mass of soil washed away. 1 mark (c) Any one of: the amount of water poured; the steepness of the trays; the kind or amount of soil; the size of the trays; how the water is poured. 1 mark

Q14 (3 marks: 1 each) — content VC2S6U05 (the four processes identified from descriptions). (a) Weathering — accept "frost wedging". The rock is breaking down in place; nothing has moved yet. 1 mark (b) Erosion. 1 mark (c) Deposition. 1 mark

Q15 (2 marks: 1 each) — content VC2S6U05 (human change to the rate of erosion; how erosion is slowed). The example is real: Melbourne Water's Warrandyte riverbank recovery. (a) The roots hold the soil together, so the water cannot lift it as easily. 1 mark (b) Any one of: the fencing keeps feet and paws off the bank, so the plants can grow back and slow the erosion; the rocks shield the bank from moving water. 1 mark — the part plus how it works.

Q16 (3 marks: 1 each) — content VC2S6U06 (hazard chains; reducing impacts). (a) A tsunami. 1 mark (b) The earthquake lifts part of the sea floor suddenly; the lifted floor pushes the water above it up, and the pushed water spreads out as very large waves. 1 mark — accept any answer that links the sudden sea-floor movement to the water being pushed. (c) Any one mitigation with its mechanism, for example: deep-sea buoys and instruments on the sea floor detect the tsunami early, so warnings go out (sirens, radio, phones) and people move to higher ground — fewer people are in the wave's path. 1 mark — accept any reasonable tsunami mitigation with a working explanation.

Q17 (3 marks: 1 each) — content VC2S6U06; part (a) is inquiry: reading a real hazard record (rehearses VC2S6I04, anchored at 8B); part (c) is inquiry: matching a format to purpose and audience (rehearses VC2S6I06). (a) More than 1,730 — accept "1,730" or "over 1,730". 1 mark Note: 600 is the number of houses in Horsham, not the total number

of properties. (b) Any one of: a levee (a raised wall of earth along a riverbank) holds floodwater back; sandbags block water at doorways; river gauges measure the water height and computers turn the readings into warnings, giving towns time to act. *1 mark* — the action or technology plus how it works. (c) A short poster. *0.5 mark* The reason must suit the purpose and the audience: families need the message at a glance in a warning; a scientific report sets out every step in detail and is too slow to read in a warning, and a table of raw data does not tell anyone what to do. *0.5 mark*

Q18 (3 marks: 1 each) — content VC2S6U07 (gravity and orbits). (a) Gravity. *1 mark* (b) The Earth's own forward motion and the Sun's pull together bend its path into an orbit around the Sun. *1 mark* — accept “the Earth is moving sideways fast, and gravity keeps bending its path”. (c) It would move roughly straight on in the direction it was already moving. *1 mark* — accept “fly off in a straight line”.

Q19 (2 marks: 1 each) — inquiry: repeat measurements (rehearses VC2S6I03, anchored at 8C's shadow practical); content VC2S6U07. This book handles repeats without averaging (D16) — do not credit “find the average”. (a) 27.9 cm. *1 mark* (b) Measure the shadow again — accept “repeat the measurement” or “check that reading again and keep the reading that fits”. *1 mark*

Q20 (3 marks: 1 each) — content VC2S6U06 (drought and its impacts). (a) A long time — months or years — with much less rain than usual. *1 mark* — both ideas (“a long time” and “much less rain than usual”) are needed. (b) Any one of: crops dry out; animals go thirsty and hungry; trees die. *1 mark* (c) Any one of: the soil dries out and cracks; rivers and dams run low. *1 mark*

Section B subtotal: 22 marks.

Section C — answers and marking

Q21 (6 marks) — content VC2S6U07 (variable day length from the relative positions of Earth and the Sun); part (a) and part (b) rehearse VC2S6I04 (reading and working from a supplied data table), parts (c) and (d) rehearse VC2S6I05 (judging a claim with evidence; proposing a next question), and part (e) rehearses VC2S6I06 (stating a finding for an audience). The table is real Geoscience Australia data for Melbourne.

- (a) 1 July, 9 h 35 min. *1 mark* — the date and the daylight time together. Note that 1 June (9 h 43 min) is close but not the shortest.
- (b) Correct working reaching 14 h 34 min. *1 mark* — accept any valid elapsed-time method, for example: 05:52 to 17:52 is 12 hours, and 17:52 to 20:26 is 2 h 34 min, so 12 h + 2 h 34 min = 14 h 34 min. The result must match the table's daylight time for 1 December.
- (c) Judgement: no, the student is not correct. *1 mark* Reason: either — the Earth's closest point to the Sun falls in January, Victoria's summer, so being close to the Sun cannot explain short days; or — day length is set by the tilt of Earth's axis: in June the Southern Hemisphere leans away from the Sun, so Melbourne spends less than half of each daily turn in daylight. *1 mark* — accept either reason. A student who says “correct” cannot earn either mark.
- (d) Any genuinely investigable question raised by the table, for example: “Does the same pattern happen in a town much closer to the South Pole?” or “How does Melbourne's daylight time on 1 December compare with Cairns'?” *1 mark* — the answer must be a question that could be answered by finding things out. Do not credit a statement, or a question the table already answers.
- (e) A heading that states the finding itself, for example: “Melbourne's daylight: longest in summer, shortest in winter” or “In Melbourne, December days are about five hours longer than June days”. *1 mark* — reject a topic-only heading such as “Daylight times in Melbourne”.

Traceability

Item	Marks	CD	Achievement-standard evidence	Inquiry
Q1–Q4	4	VC2S6U05	models key processes that change Earth's surface	—

Item	Marks	CD	Achievement- standard evidence	Inquiry
Q5–Q8	4	VC2S6U06	identifies natural hazards and proposes human actions that can reduce their impacts	—
Q9–Q12	4	VC2S6U07	models the relationship between the Sun and planets; explains how the relative positions of Earth and the Sun relate to variable day and night length	—
Q13	3	VC2S6U05 + VC2S6I02	variables changed, measured and kept the same in a fair test	3
Q14	3	VC2S6U05	the four processes identified and ordered	—
Q15	2	VC2S6U05	human change to the rate of erosion; how erosion is slowed	—
Q16	3	VC2S6U06	hazard chains; reducing impacts with a mechanism	—
Q17	3	VC2S6U06 + VC2S6I04/VC2S6I06 (parts a, c)	reads a real hazard record; matches format to purpose and audience	2
Q18	3	VC2S6U07	gravity, orbits and forward motion	—
Q19	2	VC2S6U07 + VC2S6I03	repeat measurements; the reading that does not fit	2
Q20	3	VC2S6U06	drought impacts on living and non-living things	—
Q21	6	VC2S6U07 + VC2S6I04/VC2S6I05/VC2S6I06	reads real daylight data; judges a claim with evidence; proposes a next question; states a finding for an audience	6
Total	40			13

Mark record

Question	Code	Worth	Given
Q1 — order of the four	VC2S6U05	1	



Question	Code	Worth	Given
processes			
Q2 — wind-blown sand	VC2S6U05	1	
Q3 — slow and rapid change	VC2S6U05	1	
Q4 — clearing plants on a slope	VC2S6U05	1	
Q5 — what is a natural hazard	VC2S6U06	1	
Q6 — cause of an earthquake	VC2S6U06	1	
Q7 — hazard caused by an undersea earthquake	VC2S6U06	1	
Q8 — firebreaks	VC2S6U06	1	
Q9 — force keeping planets in orbit	VC2S6U07	1	
Q10 — cause of day and night	VC2S6U07	1	
Q11 — winter dark near the South Pole	VC2S6U07	1	
Q12 — tilt and December daylight	VC2S6U07	1	
Q13 — variables in a fair test	VC2S6U05 + VC2S6I02	3	
Q14 — naming the processes	VC2S6U05	3	
Q15 — Warrandyte riverbank recovery	VC2S6U05	2	
Q16 — from earthquake to tsunami	VC2S6U06	3	
Q17 — reading a flood record	VC2S6U06 + VC2S6I04/VC2S6I06	3	
Q18 — gravity and orbits	VC2S6U07	3	
Q19 — repeat measurements of a shadow	VC2S6U07 + VC2S6I03	2	
Q20 — droughts	VC2S6U06	3	
Q21 — extended response on real daylight data	VC2S6U07 + VC2S6I04/VC2S6I05/VC2S6I06	6	
Total		40	