INFOGRAPHHUB SERIES · 9 PARTS · AGES 11–16

Plate Tectonics

Nine infographics on the moving plates beneath our feet, and the earthquakes and volcanoes they cause.

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Each part is one printable infographic. Work through them in order, or use the part you need. The quiz answers are printed upside down at the foot of the quiz. Sources for every part are listed on its page at infographhub.com.

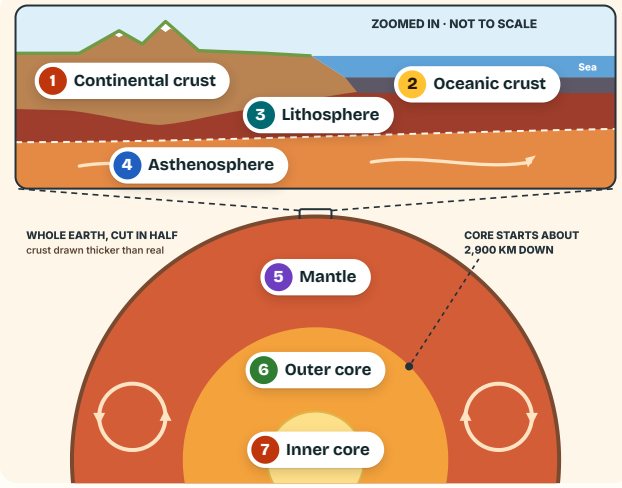
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PLATE TECTONICS PART 1 OF 9 · AGES 11–16

Plate Tectonics Explained

Earth's stiff outer shell is broken into plates that slide over a softer layer of hot rock, a few centimetres every year.



1 Continental crust

The thick crust that forms the land: about 25 to 70 km deep, thickest under big mountain ranges.

2 Oceanic crust

Thin, dense crust under the sea floor, only about 5 to 10 km thick. New oceanic crust forms at mid-ocean ridges.

3 Lithosphere

The crust plus the stiff top of the mantle, averaging at least 80 km thick. It is broken into tectonic plates.

4 Asthenosphere

Hot, softer rock in the upper mantle. It is mostly solid but can flow very slowly, so the plates above can move.

5 Mantle

About 2,900 km of hot, dense rock. Slow convection currents carry heat upwards and help to drive the plates.

6 Outer core

About 2,200 km of liquid iron and nickel. Earthquake S waves cannot pass through it, which is how we know it is liquid.

7 Inner core

A solid ball of iron and nickel about 1,250 km thick at Earth's centre, kept solid by enormous pressure.

Slow but unstoppable

The Atlantic widens about 2.5 cm a year at the Mid-Atlantic Ridge. That is 25 km every million years, enough to build an ocean.

NEXT IN THE SERIES
2. Types of Plate Boundary, with Real Examples

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PLATE TECTONICS PART 2 OF 9 · AGES 11–16

Types of Plate Boundary

Plates pull apart, push together or slide past each other. Here is what each kind of boundary builds, with a real place to remember it by.

Divergent: ocean ridge

Plates move apart under the sea and rising magma makes new oceanic crust. Example: the Mid-Atlantic Ridge, spreading about 2.5 cm a year, with Iceland on top.

Divergent: rift valley

A continent starts to split, opening a long rift valley with faults and volcanoes. Example: the East African Rift, over 3,000 km long.

Ocean meets continent

Convergent. Dense oceanic plate sinks under a continent, making a trench, volcanoes and mountains. Example: the Nazca Plate sinking under South America, building the Andes.

Ocean meets ocean

Convergent. One oceanic plate sinks under another, forming a deep trench and an arc of volcanic islands. Example: the Mariana Trench, nearly 11,000 m deep.

Continents collide

Convergent. Neither plate sinks, so the crust crumples and stacks up into huge mountains. Example: India pushing into Asia for about 50 million years, raising the Himalayas.

Transform fault

Plates grind sideways past each other: no crust is made or destroyed, but the locked fault causes earthquakes. Example: the San Andreas Fault, moving about 5 cm a year.

Same boundaries, different names

Divergent = constructive, convergent = destructive, transform = conservative. Use whichever set of words your course or exam uses.

NEXT IN THE SERIES
3. How an Earthquake Happens, Step by Step

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PLATE TECTONICS · PART 3 OF 9 · AGES 11–16

How an Earthquake Happens

From a stuck fault to waves racing around the planet: the six stages of an earthquake, and how scientists measure it.

1

Stress builds up

Plates keep moving, but the rough edges of a fault stick together. The rock on each side bends slightly and stores energy, sometimes for hundreds of years.

2

The rock snaps

When the stress beats the friction, the fault slips suddenly. The point underground where the slip starts is the hypocentre, or focus.

3

Seismic waves spread out

Energy races out in all directions. P waves arrive first, then S waves, then slower surface waves that roll the ground and do most damage.

4

The surface shakes

Shaking is usually strongest near the epicentre, the point on the surface above the hypocentre. Soft ground shakes more than solid rock.

5

Seismometers locate it

The time gap between P and S waves gives each station's distance. Circles drawn around three stations cross at the epicentre.

6

Size is measured

Scientists give one moment magnitude (Mw). Each whole step is 10 times bigger waves and about 32 times more energy. Aftershocks follow.

Lightning and thunder

P waves are like lightning and S waves like thunder. The longer the gap between them on a seismogram, the further away the earthquake was.

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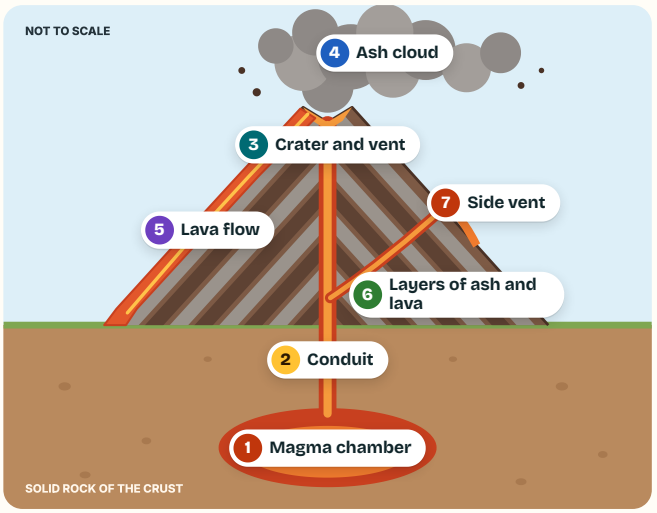
4. Inside a Volcano: The Parts of a Stratovolcano

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PLATE TECTONICS PART 4 OF 9 · AGES 11–16

Inside a Volcano

A cross-section of a stratovolcano, the steep cone-shaped kind, from the magma chamber deep in the crust to the ash cloud above.



1 Magma chamber

A store of molten rock in the crust beneath the volcano. Magma rises because it is lighter than the solid rock around it.

2 Conduit

The main pipe that carries magma from the chamber up through the volcano to the surface.

3 Crater and vent

The bowl-shaped hollow at the summit. The vent in its floor is the opening where magma erupts.

4 Ash cloud

Explosions shatter magma into ash and rock fragments. Fine ash can rise miles high and travel far on the wind.

5 Lava flow

Molten rock that pours out of the vent and down the slope. A stratovolcano's sticky lava cools before it flows far.

6 Layers of ash and lava

Each eruption adds a layer of lava or of ash and cinders. The layers build the steep cone that gives the volcano its name.

7 Side vent

A branch off the conduit that lets magma escape through cracks on the volcano's slopes instead of the summit.

⚠ Too fast to outrun

A pyroclastic flow is a glowing avalanche of hot gas, ash and rock. It can race downhill at up to about 160 km/h, which is why people are evacuated well before an eruption.

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5. Earthquakes and Volcanoes by the Numbers

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PLATE TECTONICS · PART 5 OF 9 · AGES 11–16

Earthquakes and Volcanoes by the Numbers

How big, how often and how fast: eight numbers that show just how restless Earth's surface really is.

Mw 9.5

the largest earthquake ever recorded, in Chile on 22 May 1960

It broke a fault about 1,600 km long. The bigger the fault area that slips, the bigger the earthquake.

500,000

detectable earthquakes happen around the world each year

About 100,000 are strong enough to feel, and about 100 cause damage.

~55 a day

earthquakes located by the USGS earthquake centre

That is about 20,000 a year, pinpointed by seismometers all over the world.

16

major earthquakes (magnitude 7 or more) in an average year

About 15 in the magnitude 7 range and one of magnitude 8 or more, based on records since about 1900.

~90%

of the world's earthquakes strike around the Pacific's Ring of Fire

That includes about 81% of the very largest earthquakes.

1,350

potentially active volcanoes on land worldwide

Not counting the long belts of volcanoes along the mid-ocean ridges on the sea floor.

15+ cm/yr

the fastest sea-floor spreading, at the East Pacific Rise

About six times faster than the Mid-Atlantic Ridge, which opens about 2.5 cm a year.

< 80 km

most earthquakes start shallower than this

The deepest earthquakes begin hundreds of kilometres down, but only where a plate is sinking.

The longest mountain range is underwater

The mid-ocean ridge system winds about 64,000 km through every ocean, making it the longest mountain range on Earth. It is a chain of divergent plate boundaries.

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6. From Continental Drift to Plate Tectonics: A Timeline

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PLATE TECTONICS · PART 6 OF 9 · AGES 11–16

From Continental Drift to Plate Tectonics

How a rejected idea about moving continents became the theory that explains earthquakes, volcanoes and mountains.

1596 — Ortelius spots the fit
Map-maker Abraham Ortelius suggests the Americas were torn away from Europe and Africa, judging by the shapes of their coasts.

1912 — Wegener: continental drift
Alfred Wegener proposes that all the continents were once joined in one supercontinent and have slowly drifted apart.

1915 — The Origin of Continents and Oceans
Wegener's book sets out his evidence: matching fossils, rocks and mountain ranges, and ancient glacier traces in hot places. Most geologists reject it.

1929 — Holmes: mantle convection
Arthur Holmes argues that heat makes the mantle churn in slow convection currents that could carry continents. Few geologists take notice.

1950s — Mapping the ocean floor
Ocean surveys reveal a global chain of mid-ocean ridges, thin sea-floor sediment and strange magnetic stripes in the rock.

1962 — Hess: seafloor spreading
Harry Hess proposes that new sea floor forms at mid-ocean ridges, spreads outwards and sinks back into the mantle at trenches.

1963 — Vine and Matthews: magnetic stripes
Fred Vine and Drummond Matthews (and, separately, Lawrence Morley) show the stripes are mirror images either side of the ridges.

1965 — Wilson: transform faults
J. Tuzo Wilson describes a third type of plate boundary, where plates slide past each other without making or destroying crust.

1968 — Drilling clinches it
The ship Glomar Challenger drills the Atlantic floor: rock gets older away from the ridge. Plate tectonics becomes the accepted theory.

Right idea, missing engine

Wegener's evidence that the continents had moved was strong, but he could not explain how. The answer came from the ocean floor, decades after his death in 1930.

NEXT IN THE SERIES
7. Staying Safe in an Earthquake: Drop, Cover and Hold On

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PLATE TECTONICS · PART 7 OF 9 · AGES 11–16

Staying Safe in an Earthquake

What emergency experts around the world advise you to do before, during and after the shaking. Always follow your local emergency services.

1. Drop

As soon as you feel shaking, drop onto your hands and knees. Get down before the earthquake knocks you down.

2. Cover

Cover your head and neck with your arm. Crawl under a sturdy table if one is close; if not, get next to an inside wall away from windows.

3. Hold On

Hold on until the shaking stops. Under a table, grip it and be ready to move with it if it shifts.

In bed? Outside? In a car?

In bed: stay there and cover your head with a pillow. Outside: move into the open, away from buildings and power lines. In a car: pull over and stay inside.

Don't run or use a doorway

Running outside is dangerous: glass and bricks fall next to walls. In modern homes a doorway is no stronger than anywhere else.

Near the coast? Think tsunami

After strong shaking, if the sea drains away, rises fast or roars, go to high ground or inland at once. Don't wait for an official warning.

Prepare a kit and a plan

Water and food for several days, torch, first-aid kit, whistle, charger and sturdy shoes. Agree a meeting place with your family.

After: expect aftershocks

Drop, Cover and Hold On again in every aftershock. Leave damaged buildings, text rather than call, and listen for official alerts.

Practise until it is automatic

Shaking can be so strong that you cannot walk. People who have practised Drop, Cover and Hold On react in the first second instead of freezing or running.

NEXT IN THE SERIES
8. Earthquake and Volcano Myths and the Real Science

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PLATE TECTONICS · PART 8 OF 9 · AGES 11–16

Earthquake and Volcano Myths

Eight things many people believe about earthquakes and volcanoes, and what geologists have found instead.

1

✕ MYTH **One day a big earthquake will make California fall into the sea.**

✓ FACT The sea floor is just lower land, so there is nowhere to fall. The Pacific Plate is sliding north-west past North America about as fast as fingernails grow.

2

✕ MYTH **Pets and other animals can warn us that an earthquake is coming.**

✓ FACT No reliable link has been found. Animals may feel the first, weaker waves slightly before people do, so it looks as if they knew.

3

✕ MYTH **Hot, still or stormy days are 'earthquake weather'.**

✓ FACT Earthquakes start many kilometres underground, out of the weather's reach. No link between weather and earthquakes has been found.

4

✕ MYTH **Scientists can predict when and where the next big earthquake will strike.**

✓ FACT No one has ever predicted a major earthquake's date, place and size. Scientists can only give the chance of one in an area over many years.

5

✕ MYTH **During an earthquake the ground can split open and swallow people.**

✓ FACT Faults do not gape open: the two sides slide past each other. Only shallow cracks form, where shaking makes loose ground slump or slide.

6

✕ MYTH **Earthquakes only ever happen at the edges of plates.**

✓ FACT Most do, but not all. Earthquakes also occur inside plates, such as the powerful New Madrid earthquakes in the central United States in 1811–1812.

7

✕ MYTH **Volcanoes only form where two plates meet.**

✓ FACT Hawaii's volcanoes are over 3,200 km from a plate boundary. They grew as the Pacific Plate passed over a hotspot, a very hot region in the mantle.

8

✕ MYTH **Lots of small earthquakes release the pressure and stop a big one.**

✓ FACT It would take about 32 magnitude 5s, or 1,000 magnitude 4s, to release the energy of one magnitude 6. There are never enough small ones.

Check the source

After every big earthquake, rumours of predictions spread online. A real prediction must give the date, place and size. If a claim is missing any of the three, it is not a prediction.

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9. Plate Tectonics Quiz: Earthquakes and Volcanoes

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PLATE TECTONICS · PART 9 OF 9 · AGES 11–16

Plate Tectonics Quiz

Ten questions on the whole series. Answer them all, then turn the page round to check.

1 **Which layer of Earth is liquid?**

- A Inner core
- B Mantle
- C Outer core
- D Crust

2 **At which type of plate boundary do plates move apart and make new crust?**

- A Convergent
- B Transform
- C Divergent
- D Collision

3 **How did the Himalayas form?**

- A An ocean plate sinking under a continent
- B Two continental plates colliding
- C Two plates sliding past each other
- D A hotspot under the plate

4 **What is the point on the surface directly above where an earthquake starts called?**

- A Hypocentre
- B Epicentre
- C Fault plane
- D Focus

5 **Which seismic waves reach a seismometer first?**

- A P waves
- B S waves
- C Surface waves
- D They all arrive together

6 **In a volcano, what carries magma up from the magma chamber to the vent?**

- A The crater
- B The conduit
- C The ash cloud
- D The lava flow

7 **Roughly what share of the world's earthquakes happen around the Pacific's Ring of Fire?**

- A About 10%
- B About 50%
- C About 90%
- D All of them

8 **Which of these statements is true?**

- A Animals can reliably predict earthquakes
- B Hot, still days are earthquake weather
- C Earthquakes can happen inside plates
- D California will fall into the sea

9 **Alfred Wegener had good evidence for continental drift. Why did most geologists reject his idea?**

10 **You are on a beach. After strong shaking, the sea suddenly drains away. What should you do, and why?**

Scoring

8–10: you have the whole topic. 5–7: reread the parts you missed. 0–4: start again from Part 1, Plate Tectonics Explained.

ANSWERS

1. C: Outer core (S waves cannot pass through it)
2. C: Divergent (also called constructive)
3. B: Two continental plates colliding (India and Asia)
4. B: Epicentre (hypocentre and focus are the underground start point)
5. A: P waves (they are the fastest)
6. B: The conduit
7. C: About 90% (USGS)
8. C: Earthquakes can happen inside plates (the rest are myths)
9. He could not explain what force could move whole continents. Mantle convection and seafloor spreading later supplied it.
10. Go to high ground or inland at once, without waiting for a warning: a draining sea is a natural sign of a tsunami.

SERIES COMPLETE

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