



**KIDS
DISCOVER**

Ice Age: Continental Drift

The Science Behind The Drift



A collaboration between KIDS DISCOVER and
ICE AGE: CONTINENTAL DRIFT



The Continental Drift Theory

Piecing It All Together



PERMIAN

250 million years ago

The Atlantic and Indian oceans did not exist, and all the continents were configured into the universal landmass of Pangaea. The land was surrounded by one global ocean, called Panthalassa.

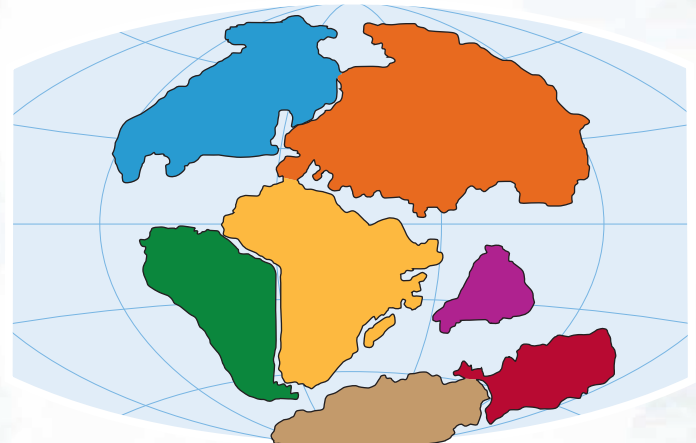
Two hundred and fifty million years ago, the landmasses of Earth were clustered into one supercontinent called Pangaea. As millions of years passed, Pangaea broke apart, and large pieces of land slowly moved away to form the continents as we know them today.



TRIASSIC

200 million years ago

The breakup of Pangaea began. Rifts formed, splitting West Gondwana from East Gondwana. India separated from Antarctica. Laurasia split from South America and Africa.



JURASSIC

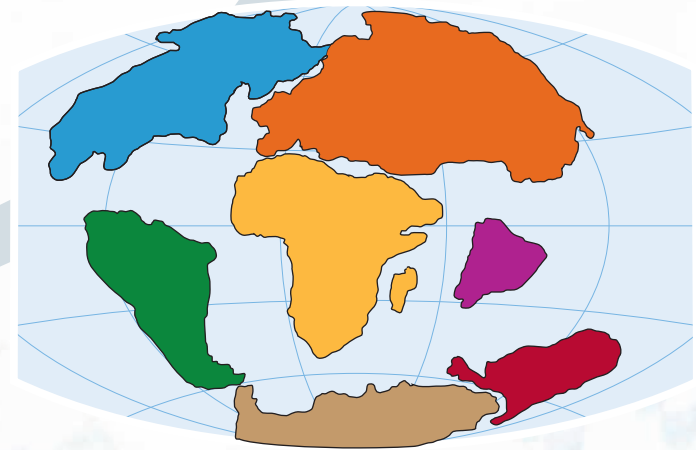
145 million years ago

Seafloor spreading further opened the central North Atlantic and Indian oceans. At the end of the period, a new rift split South America from Africa.



PRESENT DAY

New Zealand is split from Australia's east coast. The North and South Atlantic oceans are more open. Africa is slightly north, and India is joined with Asia.



CRETACEOUS

65 million years ago

The movement continued. Madagascar drifted away from Africa, which continued its move north. The northward drift of India continued, and Australia split from Antarctica.





The Continental Drift Theory

In the early twentieth century, German scientist Alfred Wegener and others observed something peculiar about Earth's continents: They seemed to fit together like pieces in a jigsaw puzzle.

Consider the shapes of South America and Africa. Without the Atlantic Ocean between them, the eastern edge of the American continent could snuggle neatly under the bump of western Africa.

More research revealed other peculiarities. For example, on the shores of both South America and South Africa, scientists discovered fossils of Mesosaurus, a reptile that lived before the dinosaurs. Mesosaurus was a freshwater animal; it could not have crossed the Atlantic. The fact that Mesosaurus fossils existed in both locations suggested that at one time they shared a single environment.

In other examples, mountain rock in South America and Africa has the same mineral content and is the same age. This is also true for mountains in Scotland and eastern North America.

There was more: Fossils of the same species of fern plant were discovered in Africa, Antarctica, Australia, India, and South America. And fossils of the large land reptile Lystrosaurus were found in India, Africa, and Antarctica. Were these just odd coincidences? Wegener didn't think so.

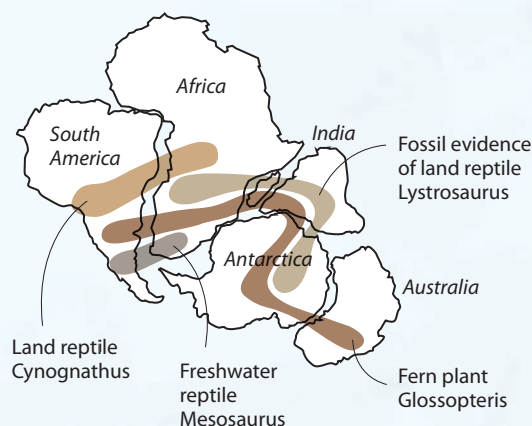
Wegener believed they were examples of a new theory—continental drift, the gradual movement of continents across Earth's surface. In 1915, Wegener published his ideas in a book, *On the Origin of Continents and Oceans*.

According to Wegener's theory, 225 million years ago, all the land on Earth was part of one huge landmass. Wegener named the landmass Pangaea, which means "all lands" in Greek. At a rate of 1–10 centimeters per year (about 1/2–4 inches), Pangaea began to break apart. After 25 million years, it had split into two supercontinents—Laurasia to the north and Gondwana to the south.



The evidence

The locations of certain plant and animal fossils on present-day continents form definite patterns, suggesting the continents were once joined.



By the age of the dinosaurs 135 million years ago, the two supercontinents had begun to break apart. Laurasia separated into what would become North America, Greenland, Europe, and Asia. Gondwana split into the Africa, South America, Antarctica, and Australia of future millennia.

By the time the dinosaurs died out 65 million years ago, South America and Africa were recognizable continents. But North America was still one landmass with Europe and Asia, and Antarctica was still connected to Australia.

The continents continued to drift and separate until they reached their present positions. To us, the continents seem fixed where they are, but they aren't. North and South America are drifting west; Australia is drifting north. What do you think will happen? What will our planet look like 65 million years from now?



Plate Tectonics

The Science Behind the Drift



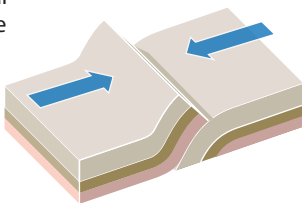
The plates

Earth's outermost layer is fragmented into plates that are moving relative to one another as they sit on top of the hot, semifluid material beneath them.



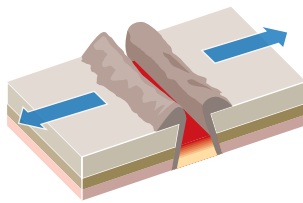
Where plates meet

There are four types of plate boundaries.



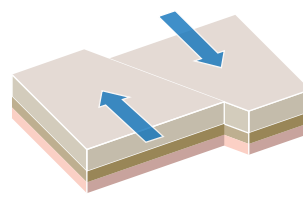
1. Convergent boundary

Occurs where two plates slowly slide towards each other, usually forming a subduction zone



2. Divergent boundary

Occurs where plates are moving apart, as magma pushes up from the mantle, creating new crust

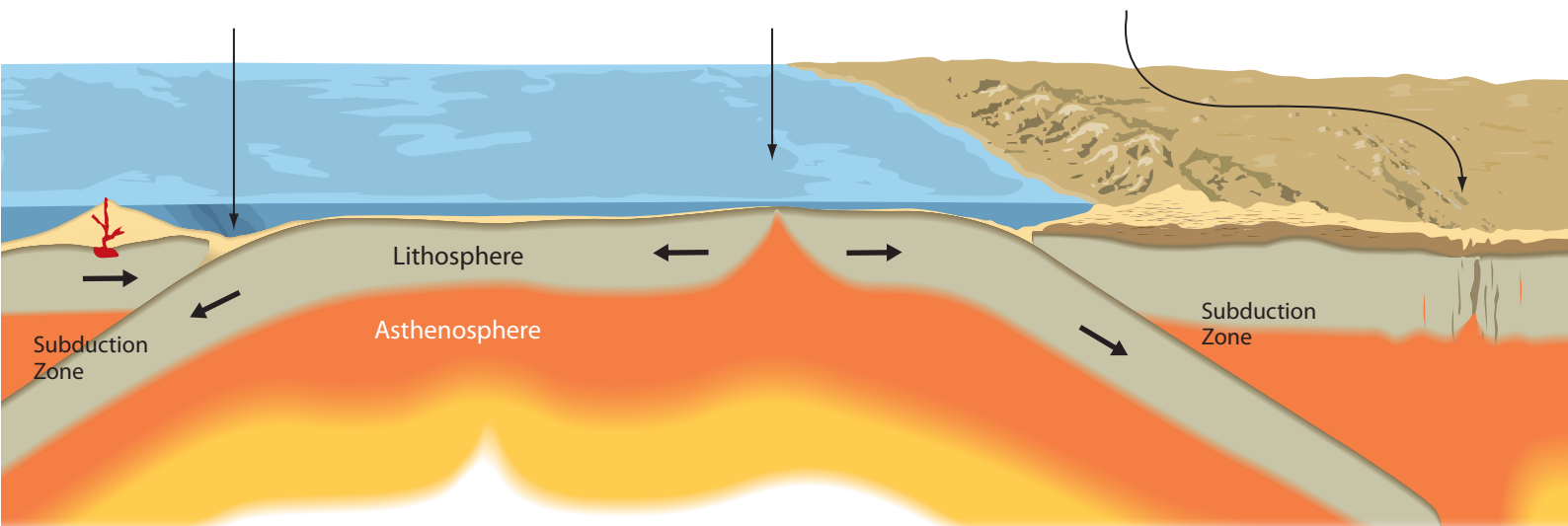


3. Convergent boundary

Occurs where plates slide or grind past each other

4. Plate boundary zone

Usually occurs along a broad belt where the interactions are unclear, and the boundaries are not well defined





The Science Behind the Drift

Alfred Wegener's theory of continental drift was extremely controversial. Most scientists simply refused to accept the idea of continents floating around on Earth's surface. Instead, they believed that repeating cycles of heating and cooling caused the changes in Earth's landforms. Wegener's problem was that he could not prove his ideas. At the time of his death in 1930, the technology needed to validate continental drift was still decades away.

Later, seismometers—instruments that measure the motions of the ground—and other technologies showed that continental drift was real. With that, the theory of plate tectonics was born.

Plate tectonics involves the idea that Earth is made of layers, like an onion. From Earth's center, the layers include the inner core, the outer core, the mantle, and the crust. The crust is where we live and also forms the ocean floor.

Earth's crust feels solid underfoot, but it is not one continuous layer of rock. It is actually made up of 15 major plates that fit together like pieces in a jigsaw puzzle. The plates sit on the mantle, much like sheets of ice sit on a frozen lake. The boundaries, or places where the plates meet, are where the action is and where continental drift takes place. Here's the story:

The mantle just below the crust is neither liquid nor solid, but something in between. The intense heat of Earth's interior melts the rock, which forms a thick, molten material. To get an idea of what molten rock is like, think of the texture of caramel candy left in the sun on a hot summer day.

Piercing the mantle that lies under Earth's oceans are deep wells called "hot spots." Hot spots force magma, or molten rock, from Earth's interior toward the surface. As the magma pushes up between plate boundaries, the plates move apart. The magma cools and hardens. New crust forms. The ocean floor expands. And the continents "drift" apart. Scientists refer to this phenomenon as seafloor spreading.

As more and more magma emerges and hardens, a mountain chain forms on the ocean floor. Many of these seafloor mountains are taller than even the highest mountains on land.

Continental drift is connected to other changes on Earth's crust. For example, it may cause two plates to collide or to pull apart from each other. Or it may cause one plate to slide under another. The result?

Earthquakes happen. Volcanoes erupt. Islands form. Mountains rise from flat land. And the shapes of Earth's landforms continue to change.

