- Evolution

ENVIRONMENT

HOW EARTH EVOLVED

Our planet has never stood still over billions of years. Slowly, the continents are shifting under our feet, with oceans getting wider and mountains higher

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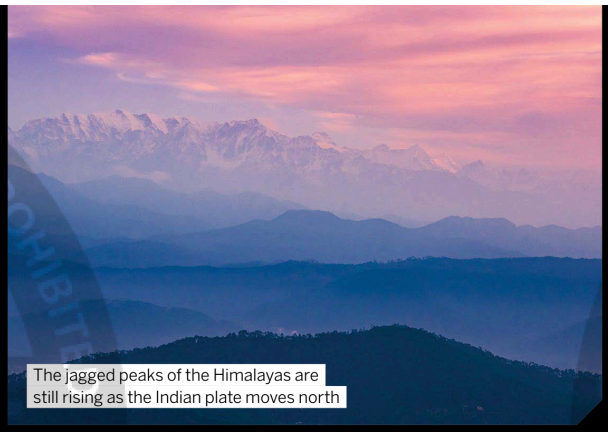
Our planet didn't always look the way it does today. And if you've ever looked at a globe and wondered if eastern South America would fit into the western edge of Africa, then you're right – it did. If you wanted to walk from Nigeria to Brazil without the Atlantic Ocean in the way, however, you'd need to travel back 140 million years when weak spots in the Earth's crust began to pull apart as the tectonic plates beneath it moved. Seawater poured into the gap, creating the immense ocean we know today, and magma from Earth's mantle rose to the surface, making the seabed. But it took a very long time.

These plates – rigid sections of Earth's crust that slowly move and shape the continents we know today – are in constant motion. It's a process known as plate tectonics, and they have been moving for most of the planet's 4.6-billion-year history. The plates drive the evolution of Earth through their motion, especially when they grind against one another or push their neighbours downward into the hot mantle, causing volcanic activity and earthquakes.

This process is also responsible for pushing India into Asia and throwing up the Himalayan mountain range, and it is heat from the mantle that powers it. Early on in its history, Earth was a much hotter planet, with asteroid bombardment melting the surface. But as life has evolved on Earth, we've been fortunate not to be on the receiving end of such an onslaught. The Atlantic is still getting wider by as much as ten centimetres every year, many millions of years after it started to form. A new ocean could be about to form as the East African Rift Valley slowly pulls apart, showing that the planet remains geologically active and in a constant – if slow – state of change.



The jagged peaks of the Himalayas are still rising as the Indian plate moves north

AGES OF EARTH

In its 4.6-billion-year lifetime, our planet has gone through significant changes



1 HADEAN
4.6 TO 4 BILLION YEARS AGO

Hot and constantly bombarded by space rocks, including a massive impact that created the Moon, the surface of the early Earth was molten rock. But liquid water may have existed on the planet due to the high atmospheric pressure.

2 LATE ARCHEAN TO EARLY PROTEROZOIC
2.8 TO 2.2 BILLION YEARS AGO

Oceans, continents and plates were all formed by this point. However, an atmosphere of methane and nitrogen with virtually no oxygen and no ozone layer made Earth a harsh place for the microbial life that was beginning to flourish in the seas.

3 NEOPROTEROZOIC
1 BILLION TO 538.8 MILLION YEARS AGO

In this era, a supercontinent known as Rodinia had gathered all the land on Earth into one huge chunk. Life had still not left the oceans, but this is the earliest time we find complex fossils from, in the form of undersea sponges.

4 SNOWBALL EARTH
650 MILLION YEARS AGO

Scientists don't know if only the land was capped with ice while the oceans were open water, or whether the oceans froze to the seabed, too. We do know that this was an era when Earth experienced an extreme ice age, and glaciers spread all the way from the poles to the equator.

Did you know?

Plate tectonics may also occur on Jupiter's moon Europa

DID YOU KNOW? Plate tectonics was theorised in 1912, but it took 60 years for scientists to decide this was right

MOVING ISLANDS

The movement is too slow for us to see happening, but by placing sensors on the volcanic islands of Hawaii, scientists have been able to use GPS to track them. Over a period of 14 years, the island of Maui shifted 48 centimetres in latitude and 84 centimetres in longitude as the Pacific plate takes the archipelago towards Japan. This motion carries the plate over a volcanic hotspot, so new islands are created by the lava. These organise into distinctive island arcs.



The caldera of the dormant Haleakalā volcano on the island of Maui

8 HOLOCENE NOW
We live in a warm interglacial epoch, with polar ice caps and currents in the ocean and atmosphere creating a variety of climate conditions across the planet. However, average temperatures are rising, which may lead to dramatic changes in our lifetime.

7 PLEISTOCENE ICE AGES 18,000 YEARS AGO
Another jump forward and the continents were where we know them today. Ice sheets covered much of the north and south. The sea level was much lower, and ice age animals such as mammoths dominated the land along with humans.

6 MIDDLE JURASSIC 170 MILLION YEARS AGO
Fast forward a couple of hundred million years and another supercontinent, Pangaea, was breaking up. Dinosaurs, early mammals and the first birds lived on land covered with ferns and conifers, while the seas were full of fish and marine reptiles.

5 CAMBRIAN 500 MILLION YEARS AGO
Famous for its 'explosion' of undersea life, the Cambrian period saw Rodinia break up and the climate warm. Early plants may have begun to move onto land, which at the time was mostly located in the Southern Hemisphere.

5 FACTS A CHANGING PLANET

1 CONTINENTAL DRIFT
Plate tectonics is the modern term for the process of Earth's moving plates, but it was called 'continental drift' when first hypothesised.

2 LAYER CAKE
Earth is made up of layers. The solid plates are on the lithosphere, riding on top of the more fluid asthenosphere.

3 RIDGE RACER
The Mid-Atlantic Ridge is spreading the seabed as fast as your fingernails grow, while the Nazca plate is moving at the speed your hair grows.

4 BOUNDARIES
Plate boundaries, where tectonic plates meet, can see mountains, volcanoes, ridges and trenches created. They are often the site of earthquakes due to their movement.

5 SAN ANDREAS
The famous San Andreas Fault in California is where the Pacific and North American plates meet, rubbing against each other. It has been the site of many strong earthquakes.



Volcanic eruptions, such as this one in Iceland, often take place at the boundaries between tectonic plates.

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