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Active Earth

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• From the rattle of earthquakes to the sizzle of volcanoes, Earth is full of action. Journey to the planet's deepest layers to explore the action from the inside out.

The JR bobbed in the Pacific Ocean. The boat's drill spun deeper and deeper into the ocean floor. It pounded away at rock under the seabed. The geologists on the ship were excited. If they could drill deep enough, they just might discover new details about Earth's story.

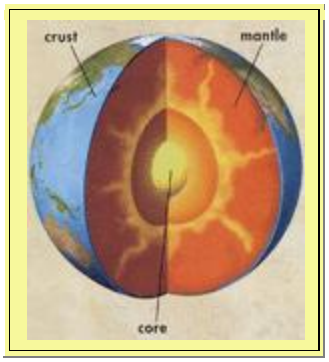
Cool Planet

And what a long, long story it is. Earth is over 4.5 billion years old! When Earth first formed, it didn't have different layers. It didn't have oceans or mountains, either. In fact, you might not have recognized our cool, blue planet. It was just a big, sizzling blob of melted rock.

Slowly, Earth cooled. As it cooled, the heaviest materials, such as iron, sank down. Lighter materials, such as the mineral silica, rose to the surface. Over hundreds of millions of years, the materials settled into three layers.

No one has drilled to Earth's deepest layers yet. Even so, geologists have an idea of what those layers are like from studying seismic waves. Those are waves of energy caused by earthquakes. As they travel through Earth, the waves move quickly through some layers and more slowly through others. Geologists know some layers are made of liquid metal, such as iron. They know others are solid rock.

Core To Crust



To picture Earth's layers, think of a hard-boiled egg. Picture the yolk, the egg white, and the eggshell. Earth's "yolk" is called the core. It's thousands of miles below your feet--and it's hotter than hot! Temperatures in the core can reach over 6,650°C (12,000°F). The core is made of metals--mostly iron and nickel.

Above the core, like an egg white, is Earth's thick mantle. The mantle is made of partially melted rock. Finally, above the mantle is Earth's cool crust--the eggshell.

The crust is our home sweet home. All you can see is part of it--canyons, fields, even oceans. The crust varies in thickness from 5 to 100 kilometers (3 to 62 miles). That may sound thick, but compared to Earth's other layers, the crust is thinner than that eggshell.

Giant Jigsaw

The crust may seem rock-solid to you. In fact, it's cracked! Like a jigsaw puzzle, the crust is broken into huge pieces, called **tectonic plates**.

These plates don't stay put. They are always on the move. At first, scientists weren't sure what pushed the plates around. They now believe the answer comes from Earth's core.

The core is like a hot burner. It heats the mantle above. Rock in the mantle gets lighter as it heats up. That causes the partially melted rock to rise. As it moves farther from the core's heat, the rock cools down and then sinks again. This constant rising and sinking makes a slow, circular current.

The plates float on top of it all. The currents push and pull at the plates from below, causing them to move. As the plates shift, they take the continents along for a bumpy ride!

Slow Going

The plates don't exactly zoom along quickly. The fastest-moving plate only moves about 15 centimeters (6 inches) per year. Yet over time, those inches start to add up. Inch by inch, continents are pulled apart and oceans are split.

About 225 million years ago, all the continents were nestled together in a mass called Pangaea. As the plates moved, they slowly pulled the continents apart. Look closely at the east coast of South America and the west coast of Africa. You'll see that it's almost a perfect fit!

That's no coincidence. These continents were once joined. At one point in time, Antarctica was in the tropics. And Australia was in the Antarctic! Talk about topsy-turvy. In 100 million years, Earth's map will look quite different than it does today.

Collision!

As the plates move, they crash into each other like bumper cars. We see and feel the shifting in many ways: earthquakes, volcanoes, mountain ranges--even hot springs!

Most of this action happens at the edges of the plates, where they meet. Plates can meet at convergent, divergent, or transform boundaries. A **convergent boundary** is where two plates collide. A collision between two continents is a real head-banger. It causes the plates to push upward.

That's what's been happening as India crunches into the Asian plate. The plate carrying Asia has been pushed up. Way up. In fact, the collision has created the towering Himalaya mountains! This huge collision is still going on. As it does, the Himalaya grow taller.

Something different happens when an ocean plate collides with a continental plate. Instead of rising up, the heavier ocean plate takes a dive. The deeper into Earth, the hotter it gets.

Pull and Push

The second type of boundary is called a **divergent boundary**. That's where two plates move apart. As they split, deep rift valleys form. Volcanoes sizzle as magma, or molten rock, oozes into the gap.

The East African Rift Zone, for example, is filled with volcanoes. Iceland straddles two plates, too. In places, you can peer right into the gap between the plates.

The third type of boundary is a **transform fault.** That's where two plates slide past each other. This is happening in California. There, the land is split by a deep fracture called the San Andreas Fault.

On the west side of this fault, the Pacific plate creeps north. Earthquakes rattle and shake California as the Pacific plate jerks and grinds along. Guess what's riding on top of it. The city of Los Angeles! In about 29 million years, Los Angeles will slide right past San Francisco.

Ring of Fire

If you really want to catch some plate boundary action, head for the Ring of Fire. That's what geologists call the edges of the Pacific plate. The Ring of Fire is definitely action-packed. In fact, it is home to 75 percent of Earth's active land volcanoes and about 80 percent of the planet's earthquakes.

To see the Ring, check out a map of the Pacific Ocean. Volcanoes cluster all around it! To the north, volcanoes dot Alaska's Aleutian Islands. In the west, Japan and Indonesia shake, rattle, and roll with strong earthquakes and fiery, hot volcanoes.

Closer to home on the Pacific's eastern edge, volcanoes poke out of the Cascade Arc. The Arc covers areas of northern California, Oregon, Washington, and parts of Canada. Here, you can find towering volcanic giants such as Mount St. Helens and Mount Rainier.

Into the Mantle?

We know that Earth's hot, active interior shapes our rocky home on the surface. But deep down, Earth still holds many secrets. Scientists, like those aboard *The JR*, have barely scratched the surface. They aren't trying to drill to the core, or even the mantle.

Not yet, at least. For now, they just want to reach deep into the crust. By the fall of 2009, they had drilled over a mile into the crust.

It'll probably be another 10 to 20 years before scientists reach the mantle. But when they do, it will be a quite a thrilling moment. What will real mantle rock look like? What new things will it reveal about Earth?

There are so many more questions left to answer. Yet until scientists actually reach the mantle, they'll keep asking questions and wondering what's really going on deep down in our planet.

Wordwise

convergent boundary: place where one of Earth's plates collides with or dives under another plate

divergent boundary: place where two of Earth's plates move apart

tectonic plate: huge, slow-moving piece of Earth's crust and upper mantle

transform fault: place where two of Earth's plates grind against each other

Reading Strategy

As you read this story, use the writer's words to picture what Earth's layers are like.

About the Story

Earth is an active, dynamic planet. It shakes and rattles, sizzles and oozes. In this story, students will learn about geological processes that occur above and below Earth's surface. Readers will explore Earth's three main layers and discover how ever-shifting tectonic plates create earthquakes, volcanoes, and mountain ranges.

Access Science Content

Before you read "Active Earth" above, preview the story. Decide what you want to learn and complete the sentence.

1. I want to read the story to _____.

As you read the story, record what the writer says about each of Earth's layers. Then write what you imagine.

Layer	Writer's Words	What I Imagine
2.		
3.		
4.		

Complete each sentence to show what you learned.

5. The _____ is Earth's deepest layer.

6. Everything we see around us is part of Earth's _____.

7. Earth's core is 6,650°C and made of _____.

8. Earth's crust is broken into _____.

9. Volcanoes occur where _____.

10. Earthquakes are caused when _____.

Comprehension Check

Answer these questions about "Active Earth." For items 1-4, circle the correct answer. Write your answer to item 5.

1. Which part of Earth does the author compare to an egg yolk?
A. the mantle
B. the crust
C. the core
D. the plates

2. If you could stand in Earth's core, what would you say?

A. "I'm cold."
B. "I'm drifting!"
C. "It's hot down here!"
D. "Hello, I'm Pangaea."

3. Which phrase best describes Earth's crust?

A. huge, slow-moving pieces
B. connected continents
C. far below Earth's surface
D. solid and unchanging

4. What caused the Himalaya to form?

A. a transform fault
B. a convergent boundary
C. a divergent boundary
D. a volcanic eruption

5. Think about how Earth's continents have changed over time. Explain why the east coast of South America and the west coast of Africa would fit together like two puzzle pieces.