NAME: Date: Class

ROGRAM 6: PLATE DYNAMICS

DIRECTIONS: GO TO THE FOLLOWING WEBSITE AND CLICK ON THE "VOD" TAB

[*WWW.LEARNER.ORG/RESOURCES/SERIES78.HTML*](http://www.learner.org/resources/series78.html)

PROGRAM 6: PLATE DYNAMICS BIRTH OF A THEORY

0:00-1:53 Images • Remarks by series host

Active lava pools are a model of Earth's tectonic **(1)** , rigid slabs of rock that make up Earth's surface. They are very large, moving and interacting at their boundaries. Because of the interaction of plates, earthquakes occur, land is uplifted, and mountains form. Earthquakes along the **(2)** in California can be explained by tectonic plate movement. Plate boundaries are directly related to geologic hazards, to the formation of petroleum and mineral resources, and to the geologic development of the landscape. Understanding how plates move and interact is one of the most important goals of current geologists.

1:54-3:52 Animation • Images

Most plates contain both continents and oceans. One place where a plate boundary can be seen is Iceland. In one section of Iceland, rifts break the landscape. Geysers and hot springs that give off steam and basaltic eruptions demonstrate that the crust is hot. As the crust is pulled apart, new magma fills the fissures that form. The magma cools and hardens, adding new crust to the plates. Boundaries of this type where plates are moving apart are called **(3)** .
Another example of a divergent boundary exists on the African continent: the **(4)** of eastern Africa.

A. **Divergent boundaries.**	C. **Plates**
B. **Rift Valley**	D. **San Andreas Fault**

3:53-4:57 Animation • Images

Oceanic crust makes up about 70% of Earth's crust. This oceanic crust has formed by injection and eruption of magma at divergent boundaries. **(5)** is the process by which new oceanic crust is added at rift boundaries. Plates grow larger by sea-floor spreading yet Earth's volume remains constant. For this to happen, other plates must get smaller. Plates grow smaller or become destroyed where they **(6)** . Deep marine **(7)** form as one plate slips beneath another at a **(8)** . Some plates, however, are too buoyant to subduct and simply crumple together forming mountains.

A. Converge	**B. Sea-floor spreading**	**C. Subduction zone**	**D. Trenches**

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4:58-9:06 Interview with Jason Saleeby, California Institute of Technology (with images and animation)

There are three types of **(9)** : ocean-ocean, ocean-continent, and continent-continent. Examples and descriptions are presented. Oceanic crust is denser and always sinks under continental crust, resulting in **(10)** **.** Since earthquakes occur as one plate subducts under another, plotting them enables seismologists to trace the subducting plate. As oceanic crust subducts, heat is generated, partially melting some of it. The melted crust material is forced upward and reacts with the rocks as it is rising through forming **(11)** magma. The magma erupts forming arc-shaped chains of volcanoes. At sea, volcanic island arcs form; on land, chains of volcanic mountains rise above the continent. Eruptions of this type are hazardous since andesitic magmas are more viscous and gas-rich than **(12)** magmas. **(13)** are also more powerful because of the greater stress formed by plate collisions. Mountain ranges form and the largest mountains form when two continental plates collide.

A. <u>Andesitic</u> B. <u>Basaltic</u> C. <u>Convergent boundaries</u> D. <u>Earthquakes</u> E. <u>Subduction</u>

9:07-10:21 Interview with Jason Saleeby (with animation)

At some plate boundaries, two plates slide past each other forming a **(14)** boundary. Ridge-ridge and San Andreas-type transform faults are described. An animated model of the **(15)** Fault is presented as well as several images along the fault, and its formation is explained.

10:22-14:31 Remarks by series host • Demonstrations (one by Scott Paterson, University of Southern California) • Animation

Geologists debate about what forces drive plate motion. The lithosphere is composed of the crust and rigid upper mantle. It is broken into plates that float around the soft, partially melted **(16)** below. Unequal distribution of heat in Earth's mantle causes **(17)** currents to form. Convection currents are the most widely accepted mechanism for plate movement. A demonstration of convection currents is presented. They are thought to occur when cool, dense matter sinks, forcing the less dense, warmer matter upward. Silly putty is used as an analogy for showing how stress affects rocks when applied at different rates. This analogy is then applied to what might happen to rocks near Earth's surface, at depth within Earth, and in the mantle. The ability of rock to flow in part allows the convection process to occur inside Earth.

A. Transform fault B. San Andreas C. Asthenosphere D. Convection currents

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14:32-21:04 Interviews with Jason Saleeby; Gary Ernst, Stanford University (with animation)

Convection currents are driven by primary heat from Earth's formation and heat from the decay of radioactive elements. This heat needs to escape and does so by **(18) .** Various explanations exist as to how convection affects the movement of lithospheric plates. Varying speeds of plate movement provide clues on how convection might be the driving force. Current models use the **(19)** theory of convection (two-tiered model). Evidence from seismic studies of Earth's interior points to a two-tiered process. Rapid convection within Earth's core is thought to be responsible for the magnetic field. Evidence taken of Earth from satellites shows how convection changes its shape. Upwelling convection currents tend to make bumps in Earth's surface and downwelling cold currents tend to make depressions in the sea floor; so the shape of Earth enables geologists to map convection patterns.

21:05-25:36 Interview with Tanya Atwater, University of California, Santa Barbara (with animation and images)

A special kind of convection takes place beneath lithospheric plates. **(20)** plumes are narrow columns of hot mantle that rise from below. They can be compared to the processes that form thunderhead clouds in Earth's atmosphere. Evidence of these mantle plumes are **(21) .** Islands and seamounts are often related to hot spots. As the rising magma flows onto the sea floor, islands or **(22)** are formed. As the plate moves over these seemingly stationary hot spots, new volcanoes are formed in a line as is seen in the Hawaiian Islands and Emperor Seamounts. In fact, the Hawaiian-Emperor island chain shows a history of Pacific Plate movement. A cross-sectional look at the erosion of a seamount/island (guyot) also indicates subsidence of the ocean floor. Evidence also indicates that Yellowstone National Park with its hot springs and geothermal vents is located over a hot spot.

A. Boundary layer	**B. Convection currents**	**C. Hot spots**	**D. Mantle**	**E. Seamounts**

25:37-end Remarks by series host

Plate tectonics is a model of the way Earth works. The significance of this theory is that it connects many seemingly unrelated phenomena, such as **(23)** , volcanic activity, **(24)** building, and **(25)** . We don't fully understand the mechanisms of plate tectonics, and in some places, the theory doesn't seem to fit. This just means more work is needed to understand the dynamic Earth.

A. Earthquakes	**B. Mountain**	**C. Sea-floor spreading**