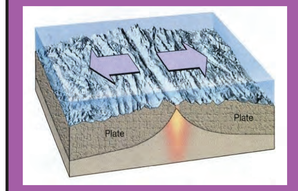
The Life Cycle of the Seafloor: Seafloor Spreading Centers Unit

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Unit Overview: Seafloor Spreading Centers



This 10 block-day lesson plan leads students through the discovery of Plate Tectonics in much the same way scientists learned about it in the 1960's. Beginning with preexisting key evidence of continental drift such as the fit of landmasses and matching fossil records bridging continents, to understanding the features of the seafloor, and discovering the symmetric pattern of seafloor magnetic stripes and ages, students will piece together the evidence pointing from Continental Drift to seafloor spreading and finally to the unified theory of Plate Tectonics. This unit climaxes with the concepts of seafloor formation and destruction, emphasizing the process of seafloor spreading and the cause of the Pacific "Ring of Fire".

California State Science Standards

Earth Science Grades 9 through 12

3. Plate tectonics operating over geologic time has changed the patterns of land, sea, and mountains on Earth's surface. As the basis for understanding this concept:

a. Students know features of the ocean floor (magnetic patterns, age, and sea-floor topography) provide evidence of plate tectonics.

Including portions of the following:

b. Students know the principal structures that form at the three different kinds of plate boundaries.

c. Students know how to explain the properties of rocks based on the physical and chemical conditions in which they formed,including plate tectonic processes.

e. Students know there are two kinds of volcanoes: one kind with violent eruptions producing steep slopes and the other kind with voluminous lava flowsproducing gentle slopes.

f. Students know the explanation for the location and properties of volcanoes that are due to hot spots and the explanation for those that are due to subduction.

San Diego High School: Media, Visual, and Performing Arts School



The Arts School is one of six specialized schools on the San Diego High Educational Complex.

Classes Taught:
Marine Science

Grade Level:
10th-12th grade science elective

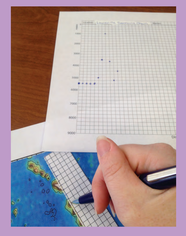
Lesson 1: Exploring Continental Drift

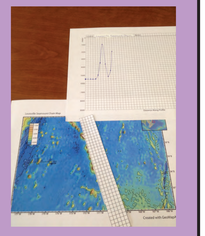


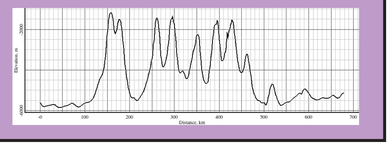


Summary: The continents and seafloor change shape throughout history. Evidence bridging the continents, including rock types, plant and animal fossils, and mountain chains, indicate that there was previously only one landmass on Earth, the supercontinent called Pangea, and that the continents have since broken up and drifted apart. This is the theory of Continental Drift. In this lecture and activity, students will learn about the movement of the continents and the evidence scientists used to link together continents that are no longer next to each other.
Activities: Students use their knowledge of the supporting evidence to assemble a puzzle-map of Pangea from the individual continents.

Lesson 2: Seafloor Features

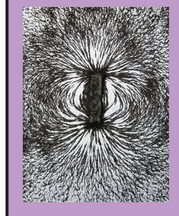


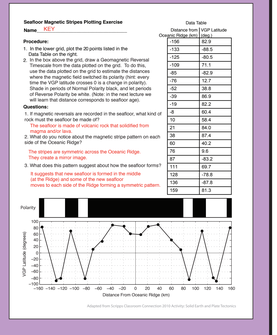




Summary: The seafloor has a wide range of depths and features. Certain features, such as the mountain chain formed by seafloor spreading and trenches formed by subduction, are products of plate tectonics and our ever-changing earth. Main points of this actitvity are: 1) The seafloor is not flat, but has many different features; 2) The deepest parts of the oceans are actually nearer to the continents than to the middle of the seafloor; 3) The mountain range that exists throughout all of the ocean basins is the LONGEST geologic feature on Earth.
Overview: The unit begins by teaching students the methods used by scientists to study the seafloor.
Activities: Students perform a mapping and graphing activity meant to familiarize them with the range of depths and features on the seafloor.

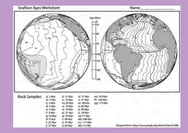
Lesson 3: Seafloor Magnetic Stripes

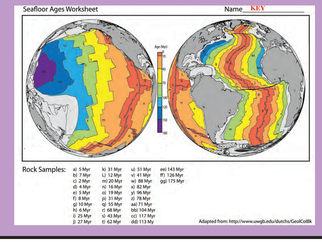




Summary: The discovery of a pattern of rock magnetization directions (polarity) locked within the rocks of the seafloor was an important piece of evidence used by scientists in the discovery of seafloor spreading and the development of the theory of plate tectonics. In this lesson, Earth's magnetic field and its reversals are reviewed and used to explain the magnetic stripes observed in oceanic crust.
Activities: Students discover the symmetric pattern in magnetic stripes on either side of the oceanic ridges by plotting the polarity of various rock samples.
Extra: Check out this website for a cool magnetic stripes demonstration:
http://earthguide.ucsd.edu/eoc/teachers/t_tectonics/p_paleomag.html

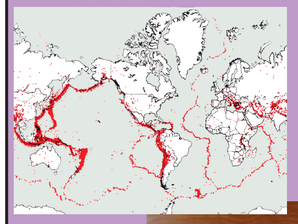
Lesson 4: Seafloor Ages

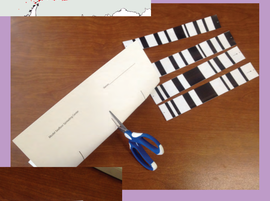


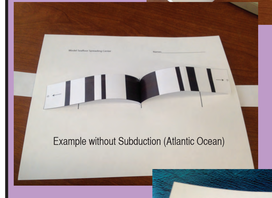


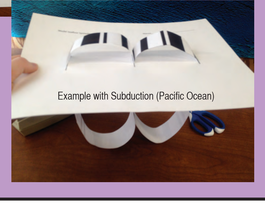
Summary: The ages of the seafloor, young towards the center of the oceans and oldest toward the ocean boundaries, are evidence of seafloor spreading. The ages reveal important detail on how continental drift may work. The oldest seafloor crust is <200 Myr old indicating that the seafloor is constantly being created and destroyed. Main points are: 1) The ocean is much younger than the continents; 2) Scientists use seafloor drilling and age dating of rocks to figure out the global distribution of seafloor age; 3) The ages of the seafloor form a symmetric (or mirror image or reflection) pattern across the mid-oceanic ridges.
Activities: Students follow the steps of scientists to uncover the symmetric pattern observed in the ages by correlating rock age and location on a map.

Lesson 5: Seafloor Spreading, "Ring of Fire," & Subduction









Summary: Seafloor spreading is the basis for the modern theory of Plate Tectonics. It is the process by which new seafloor is created as the plates are pulled apart and new material emerges in the center gap. As seafloor ages and moves outward, it often eventually collides with continents and is destroyed causing catastrophic earthquakes and volcanoes. This is the life cycle of the seafloor. Main points are: 1) New seafloor forms at seafloor spreading centers and spreads out to both sides of the middle causing the symmetric/mirror image pattern of seafloor ages and magnetic stripes; 2) Seafloor forms at different rates in different oceans, but always has the same mirrored pattern; 3) Because seafloor spreading occurs on a sphere, the spreading center is broken up into many "ridge segments" that are connected by other features called transform faults and fracture zones; 4) Seafloor is destroyed at areas called subduction zones, where the seafloor dives underneath another plate and into the mantle; 5) The deepest places on earth (called Trenches) are associated with subduction zones and are located near the coasts of the continents (in most cases); 6) Subduction causes devastating earthquakes and explosive volcanoes, many of which are located around the coasts of the Pacific ocean and termed the "Ring of Fire"; 7) The Pacific ocean is shrinking over time due to subduction, while the Atlantic ocean is growing because it has no subduction.
Activities: Students will observe "seafloor" spreading in the classroom through a paper towel spreading center demonstration illustrating the relative motion of the plates, and will complete a worksheet to test for understanding. Students the construct a paper model spreading center with and without subduction and watch a video on the Ring of Fire. Differences between Pacific and Atlantic Oceans are discussed.