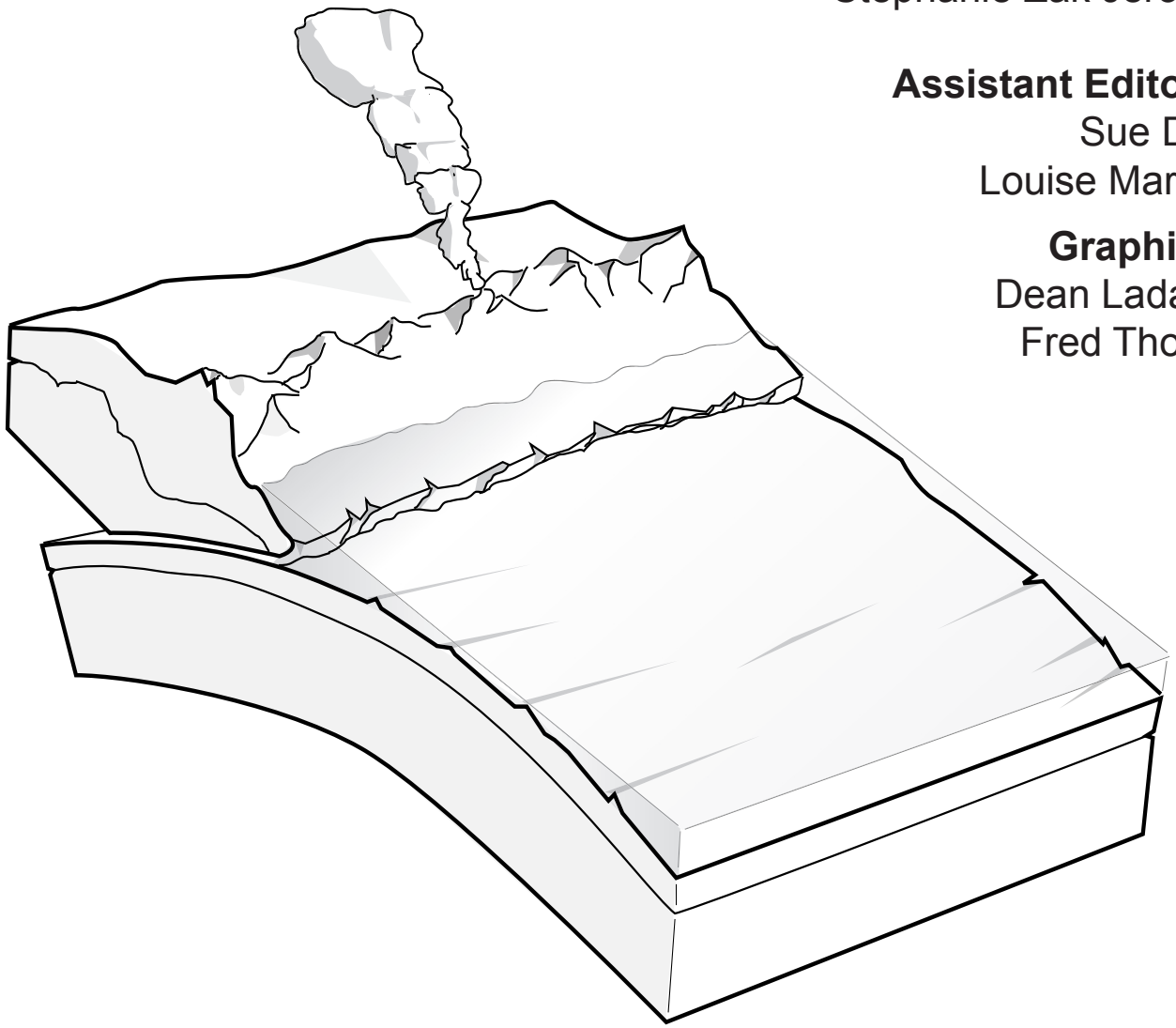
Plate Tectonics

Teacher's Guide
Middle School

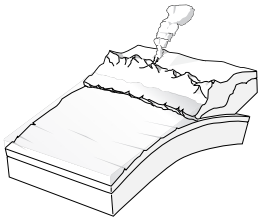
Editors:
Brian A. Jerome, Ph.D.
Stephanie Zak Jerome

Assistant Editors:
Sue Dier
Louise Marrier

Graphics:
Dean Ladago
Fred Thodal



Visual Learning Company
www.visuallearningco.com
1-800-453-8481
25 Union Street
Brandon, Vermont



Use and Copyright:

The purchase of this video program entitles the user the right to reproduce or duplicate, in whole or in part, this teacher's guide and the blackline master handouts for the purpose of teaching in conjunction with this video, *Plate Tectonics*. The right is restricted only for use with this video program. Any reproduction or duplication, in whole or in part, of this guide and student masters for any purpose other than for use with this video program is prohibited.

ISBN 1-59234-073-3

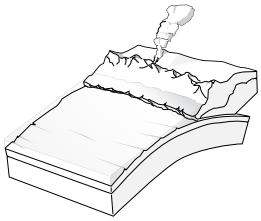
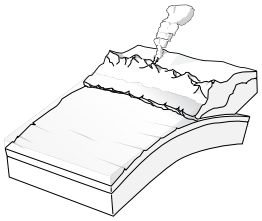


Table of Contents



Viewing Clearances

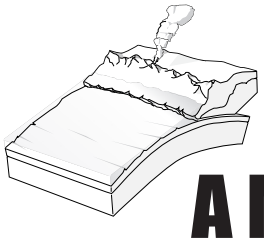
The video and accompanying teacher's guide are for instructional use only. In showing these programs, no admission charges are to be incurred. The programs are to be utilized in face-to-face classroom instructional settings, library settings, or similar instructional settings.

Duplication rights are available, but must be negotiated with the *Visual Learning Company.*

Television, cable or satellite rights are also available, but must be negotiated with the *Visual Learning Company*.

Closed circuit rights are available, and are defined as the use of the program beyond a single classroom but within a single campus. Institutions wishing to utilize the program in multiple campuses must purchase the multiple campus version of the program, available at a slightly higher fee.

Discounts may be granted to institutions interested in purchasing programs in large quantities. These discounts may be negotiated with the *Visual Learning Company.*



A Message from our Company . . .

Dear Educator:

Thank you for your interest in the educational videos produced by the Visual Learning Company. We are a Vermont-based, family owned and operated business specializing in the production of quality educational science videos and materials.

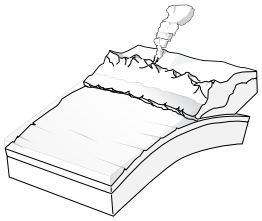
We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher, and to earn a Ph.D. in education, and lead Stephanie to work on science educational programs at NASA.

In developing this video, accompanying teacher's guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome



National Standards Correlations

National Science Education Standards
(Content Standards: 5-8, National Academy of Sciences, c. 1996)

Earth and Space Science – Content Standard D:

As a result of their activities in grades 5-8, all students should develop an understanding that:

- The solid earth is layered with a lithosphere; hot convecting mantle and dense, metallic core.
- Lithospheric plates on the scales of continents and oceans constantly move at rates of centimeters per year in response to movements in the mantle. Major geological events, such as earthquakes, volcanic eruptions, and mountain building result from these plate motions.
- Some changes in the solid earth can be described as the "rock cycle". Old rocks at the earth's surface weather, forming sediments that are buried, then compacted, heated, and often recrystallized into new rock. Eventually, those new rocks may be brought to the surface by the forces that drive plate motions, and the rock cycle continues.

Benchmarks for Science Literacy
(Project 2061 – AAAS, c. 1993)

The Physical Setting – Processes that Shape the Earth – (4C)

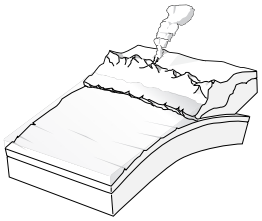
By the end of 12th grade, students should know that:

- The solid crust of the earth - including both the continents and ocean basins consist of separate plates that ride on a denser, hot, gradually deformable layer of the earth. The crust sections move very slowly, pressing against one another in some places, pulling apart in other places. Ocean floor plates may slide under continental plates, sinking deep into the earth. The surface layers of these plates may fold, forming mountain ranges.
- Earthquakes often occur along the boundaries between colliding plates, and molten rock from below creates pressure that is released by volcanic eruptions, helping to build up mountains. Under the ocean basins, molten rock may well up between separating plates to create new ocean floor. Volcanic activity along the ocean floor may form undersea mountains, which can thrust above the ocean's surface to become islands.

Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students will be able to do the following:

- Describe Wegner's theory of the Continental Drift.
- Explain how specific evidence including the geographic fit of the continents provided support for Wegner's Theory of Continental Drift.
- Describe how mid-ocean ridges make up the longest mountain ranges in the world.
- Describe the theory of sea-floor spreading.
- Explain how the discovery of ocean floor magnetic fields, relatively young oceanic rocks, and sea-floor spreading provided evidence supporting Wegner's Theory of Continental Drift.
- Describe some of the characteristics of tectonic plates.
- Identify the Pacific Plate as the largest tectonic plate.
- Differentiate between divergent boundaries, convergent boundaries and transform boundaries.
- Differentiate between continental and oceanic plates.
- Define the process of subduction.
- Identify where the majority of the earth's new crust is found.
- Describe how convection currents may cause tectonic plate movement.



Assessment

Preliminary Test:

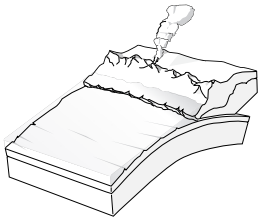
The Preliminary Test, provided in the Student Masters section, is an assessment tool designed to gain an understanding of student preexisting knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

Video Review:

The Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. There are two main parts. The first part contains questions titled “You Decide” that can be answered during the video. The second series of ten questions consists of a video quiz to be answered at the conclusion of the video.

Post-Test:

The Post-Test, provided in the Student Masters section, can be utilized as an assessment tool following student completion of the video and student activities. The results of the Post-Test can be compared against the results of the Preliminary Test to assess student progress.



Introducing the Video

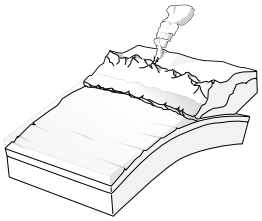
Before viewing the video, show the class a map of the world. Ask the students to look carefully at the shapes of the continents, and record their observations. Next, discuss their observations: Did they notice that the continents look like pieces of a giant jigsaw puzzle and may have even once fit together? Continue the discussion by asking students if they think the continents moved and if so, how? Explain that over many years several scientific discoveries led to the present day theory of plate tectonics. Tell students to watch the video closely for further information about these discoveries. Also tell them to pay close attention to see how plate movement is related to earthquakes, volcanoes, and mountain building.

Video Viewing Suggestions

The student Master "Video Review" is provided for distribution to students. You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

The program is approximately 20-minutes in length and includes a ten-question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher's guide. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.



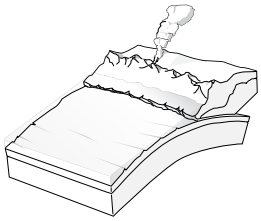
Student Assessments And Activities

Assessment Masters:

- Preliminary Test
- Video Review
- Post-Test

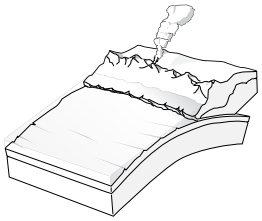
Student Activity Masters:

- Diverging, Sliding and Colliding Plates
- Moving and Grooving Plates
- Crater Lake is Born
- Vocabulary of *Plate Tectonics*



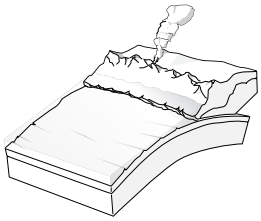
Video Script: Plate Tectonics

1. You've probably admired beautiful mountain landscapes.
2. Perhaps you have seen pictures of a volcanic eruption.
3. Or maybe you have witnessed steam streaming from the earth…
4. … or even boiling water shooting out of the ground.
5. Or maybe you have experienced an earthquake…
6. … or seen a picture of the devastating damage earthquakes can cause.
7. What do all these things have in common?
8. All these exciting events are related to the dynamic movement of the earth.
9. During the next few minutes we are going to explore some of earth's amazing forces such as earthquakes, volcanoes, and mountain building. And we'll examine how they are related to the earth's slowly moving surface.
10. Let's begin by taking a look at the earth from outer space.
11. **Graphic Transition – The theory of Continental Drift**
12. The view of earth from space shows a mostly blue planet dominated by water.
13. …that water is interrupted by large pieces of solid land called continents.
14. Look closer and the continents look like pieces of a giant jigsaw puzzle. They even appear to fit together.
15. People throughout the ages have wondered if this was a coincidence or if there was a deeper explanation.
16. Other questions perplexed scientists such as, "Why are fossils of the same organism found on widely separated continents, which today have very different climates?"
17. And why did the same types of rock appear on different continents thousands of miles apart?
18. In 1912, a scientist by the name of Alfred Wegner proposed a very innovative idea on the origin of the continents.
19. Building on the work of previous scientists, Wegner proposed that present day continents once were joined together in a large super continent called Pangaea – which means all earth.
20. His theory stated that over time the continents drifted away from each other to their present day positions.
21. Wegner compiled several pieces of evidence to support this theory of continental drift.
22. Perhaps the most convincing evidence was the geographic fit of the continents.
23. For example, notice how Africa and South America fit together so well.
24. Wegner also cited fossil evidence, stating that fossils of the same organism were found on different continents – suggesting the landmasses were once connected.
25. For example, a plant fossil called glossopteris was found on four different continents including…
26. Antarctica – an icy continent where this plant could not grow today.



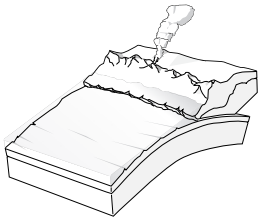
Script (cont.)

27. Similar glacial effects on all five continents further supported the notion the continents were once connected.
28. Rock structures and even mountain ranges which end abruptly at the edges of continents and pick up on the edge of another continent also provided evidence.
29. In spite of all the evidence proposed by Wegner, his theory of continental drift did not gain widespread acceptance for several decades.
30. **Graphic Transition – New Evidence of Continental Drift**
31. Alfred Wegner's theory of continental drift was not readily accepted for a variety of reasons.
32. Wegner could not explain how or why the continents drifted apart, or when this occurred.
33. And, furthermore, how could the drifting continents plow through the solid ocean floor?
34. In the 1940's, 1950's, and early 1960's more remote regions of the earth were explored, especially the oceans.
35. New technologies such as deep diving submarines allowed scientists to explore, map and take samples from the sea floor.
36. Previously unknown valleys, mountains, and ridges were discovered.
37. Of particular interest were underwater mountain ranges called mid-ocean ridges.
38. You Decide! What is the longest mountain range in the world?
39. Maps from the ocean floor revealed that mid-ocean ridges form the longest mountain range in the world – over 80,000 kilometers in length.
40. Explorers also discovered that tremendous volcanic activity occurred along mid-ocean ridges in large cracks called rift valleys.
41. In the early 1960's it was proposed that at the mid-ocean ridges the seafloor was actually separating.
42. According to the theory of sea-floor spreading, the sea-floor is moving, and segments of the sea-floor separate at mid-ocean ridges. This is where lava wells up from rifts, and forms a new ocean floor.
43. This was a key theory in that it helped explain how the continents moved.
44. Scientists surmised that instead of the continents drifting, they actually rode on top of drifting pieces of the ocean floor.
45. As the ocean floor moves, it takes a continent with it.
46. Rock samples from the sea floor added further evidence to support the theory of sea-floor spreading.
47. Scientists found ocean floor rocks to be relatively young, especially compared to rocks found on the continents.
48. This present day image illustrates the relative ages of sea floor rocks on the mid-Atlantic ridge. The youngest rocks in red are located closest to the separating plates, and the older green rocks are located further away from the ridge.
49. Another piece of evidence supporting sea-floor spreading relates to the magnetic orientation of minerals in basaltic rocks found in the ocean floor.



Script (cont.)

50. Basaltic rocks emit a magnetic field, which aligns itself with the poles of the earth.
51. Scientists found that magnetic fields in the ocean floor basalt coincide with changes in earth's magnetic orientation over time.
52. Furthermore, scientists found a matching pattern of parallel magnetic stripes on either side of the mid-ocean ridges. This indicates a new ocean crust was being added at the same rate, further supporting the notion of sea-floor spreading.
53. **Graphic Transition – Theory of Plate Tectonics**
54. These amazing discoveries led scientists to elaborate even more on Wegner's theory of continental drift.
55. Their findings were incorporated into the new theory of plate tectonics.
56. In the theory of plate tectonics, it is proposed that a number of tectonic plates ride across the earth's surface.
57. You Decide! What is a tectonic plate?
58. Tectonic plates are made up of the crust and upper mantle, which, when combined make up the lithosphere.
59. The thickness of the plates can be compared to the thickness of the skin on this apple.
60. Plates vary in thickness but average around 100 kilometers thick.
61. The lithospheric plates are less dense than the hot, partially molten mantle below, and "float" on top of the denser asthenosphere…
62. … much like ice floats on a lake.
63. There are seven major lithospheric plates.
64. In many cases, lithospheric plates carry continents.
65. The largest plate is the Pacific Plate.
66. There are a number of other smaller plates, including the Juan de Fuca Plate located off western North America.
67. The way plates move in relation to each other is responsible for many of the exciting geological events and features we experience on the earth's surface.
68. **Graphic Transition – Plates Colliding**
69. These mountains are part of the Cascade mountain range, a range of mountains running from southern British Columbia…
70. … through northern California. The Cascade range contains numerous volcanoes such as Lassen Peak …
71. … Mount Shasta…
72. … the recently erupted Mount Saint Helens…
73. …and even Crater Lake – the former site of a huge volcano which exploded, leaving this large caldera which eventually filled in with water.
74. You Decide! What force formed these volcanic mountains?
75. The movement of lithospheric plates is responsible for forming these volcanic mountains.
76. Geologic activity like earthquakes and volcanic activity typically occurs where these plates meet, called plate boundaries.

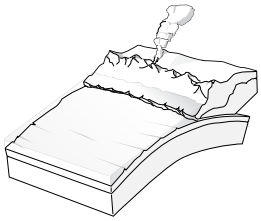


Script (cont.)

77. As we already stated, plates are in a constant state of slow motion.
78. Two plates interact with each other in one of three ways: they can move away from each other; move toward each other; or. slide past each other.
79. The arrows on this diagram of the lithospheric plates indicate the direction the plates are moving at some plate boundaries.
80. Off the coast of Oregon, Washington, and southern British Columbia…
81. …is a small plate, called the Juan de Fuca plate.
82. The place where it meets the North American Plate is called a convergent boundary.
83. A convergent boundary is a place where two plates collide.
84. The Juan de Fuca plate is an oceanic plate and is denser than the continental North American plate which overrides it.
85. The process of one plate plunging beneath another is called subduction.
86. As a result of this process, magma is forced to the surface leading to the formation of volcanoes.
87. Subduction zones are often referred to as destructive zones because the oceanic lithosphere is destroyed in these areas where it is subducted.
88. Deep-sea trenches are common characteristics found in subduction zones.
89. The Japanese Islands are the result of magma being forced to the surface as a consequence of subduction.
90. Encircling the Pacific plate are areas of convergence leading to the formation of volcanoes.
91. For this reason the area is often referred to as the Ring of Fire.
92. The Ring of Fire is also known for intense earthquake activity.
93. When continents converge, as is the case of India and Asia colliding, mountains often form.
94. Along this convergence zone, the highest continental mountains in the world, the Himalayas, were formed as the two plates collided and compressed up the crust.
95. This process is similar to pushing a carpet against a wall. See how folds are formed, simulating the process by which mountains are formed by colliding plates.

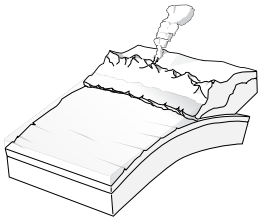
96. Graphic Transition – Diverging and Sliding Plates

97. As we discussed earlier, scientists discovered that at many places on the ocean floor, the sea floor is spreading.
98. Sea-floor spreading is characterized by two plates moving away from each other.
99. A divergent plate boundary forms where plates are separating.
100. Mid-ocean ridges are the result of plate divergence.
101. Most of the earth's volcanic activity occurs along diverging plate boundaries.
102. You Decide! Where is most of the earth's new crust found?
103. Most of the earth's new crust is found on the ocean floors where molten rock rises to the surface as plates separate. Divergent plate boundaries are often referred to as constructive regions because new crust is created.
104. A third type of plate boundary occurs where plates slide past each other.



Script (cont.)

105. This type of boundary is commonly referred to as a transform fault.
106. and is characterized by shallow earthquakes, but little volcanic action.
107. The San Andreas Fault is a transform fault boundary where the Pacific plate and North American plate are sliding past each other.
108. Scientists are not completely sure what causes the plates to move…
109. …but they hypothesize that forces within the earth called convection currents drive plate movement.
110. Convection currents are movements of material caused by differences in temperature.
111. Convection currents can be seen in this boiling water where the hot water rises from the bottom then cools and sinks.
112. If you were to bore into the earth, you would find the temperature increases the deeper you go.
113. In the mantle, earth materials are very hot, existing in a plastic like state.
114. Nearer the surface, the cooler material sinks and in turn hotter material rises.
115. This process is repeated forming a circular moving convection cell.
116. It is believed that this circular motion causes the plates to move.
117. Graphic Transition – Land of Fire and Ice
118. One of the most fascinating places to witness the power of tectonic plate movement is Iceland.
119. Located in the North Atlantic it is a country dominated by cold temperatures, glacial ice, and volcanic activity.
120. Iceland straddles the mid-Atlantic ridge.
121. This rift separates the North American plate which is moving westward and the Eurasian plate which is moving eastward.
122. The combined effect of straddling diverging plates and sitting atop a hotspot make for frequent volcanic eruptions…
123. … and other geologic activity such as an abundance of hot springs.
124. Iceland also has many geysers, which eject superheated water high into the air.
125. Icelanders have developed ingenious ways to tap these forces and use geothermal energy to fuel over 75% of their homes.
126. It heats their greenhouses and even their outdoor swimming pools.
127. They even use steam from deep underground to generate electricity in plants such as this one.
128. So while living atop the mid-Atlantic ridge has its dangers
129. … these rugged people have managed to harness the powerful forces of nature to their advantage.
130. Graphic Transition – Summing Up
131. During the past few minutes we explored some of the theories, which help us, better understand the dynamic geologic movements of our planet.
132. We studied the theory of continental drift.

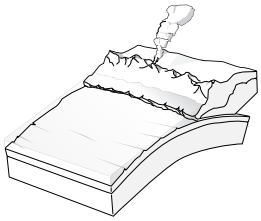


Script (cont.)

133. And how with the addition of more information the theory of plate tectonics developed.
134. The key aspects supporting the theory of plate tectonics were discussed, including the discovery of mid-ocean ridges, sea-floor spreading, and geologic evidence from the sea floor.
135. We also took a quick look at how plates can interact with each other along plate boundaries,
136. …and how these interactions may be responsible for many exciting features.
137. So the next time you see a mountain range…
138. …hear about a volcanic eruption…
139. …or see a picture of a geyser.
140. Think about some of the amazing things we learned about plate tectonics.
141. You just might look at the world a little differently.

Fill in the correct word to complete the sentence. Good luck and let's get started.

1. Wegner introduced the idea of continental _____.
2. The largest mountain range in the world is the _____ ridge.
3. Oceanic rocks are _____ than rocks on continents.
4. Sea-floor spreading is the process of plates _____.
5. Tectonic plates consist of the _____ and the upper mantle.
6. The largest plate is the _____ plate.
7. A _____ boundary occurs where two plates collide.
8. _____ occurs when one plate thrusts under another.
9. The San Andreas Fault is a _____ fault.
10. Iceland straddles the _____ ridge.



Answers to Student Assessments

Preliminary Test (pgs. 20-21)

1. plate boundary
2. lithosphere
3. seven
4. divergent plate
5. Pacific Plate
6. Alfred Wegner
7. convection currents
8. subduction
9. rift valleys
10. transform fault
11. true
12. false
13. false
14. true
15. true
16. true
17. false
18. true
19. true
20. false

Video Review (pg. 22)

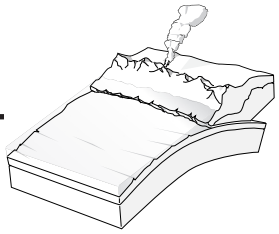
1. Mid-ocean ridges make up the longest mountain range in the world.
2. Tectonic plates consist of the crust and upper mantle, which when combined make up the lithosphere.
3. The movement of lithospheric plates is responsible for forming these volcanic mountains.
4. Most of the earth's new crust is found on the ocean floors where molten rock rises to the surface as plates separate.

Video Quiz (pg. 22)

1. drift
2. mid-ocean
3. younger
4. separating
5. crust
6. Pacific
7. convergent
8. subduction
9. transform
10. mid-Atlantic

Post Test (pgs. 23-24)

1. true
2. false
3. true
4. true
5. false
6. false
7. true
8. true
9. true
10. false
11. subduction
12. seven
13. Alfred Wegner
14. transform fault
15. plate boundary
16. Pacific Plate
17. lithosphere
18. rift valleys
19. divergent plate
20. convection currents



Answers to Student Activities

Diverging, Sliding and Colliding Plates (pg. 25)

Landform	Type of Boundary Movement	Plates Involved	Describe Movement (use paper as guide)
Mid-Atlantic Ridge	divergent	Eurasian and North American	
San Andreas Fault	transform fault	Pacific and North American	
Great Rift Valley	divergent	Somalia and African Plate	
Andes	convergent	Nazca and South American	
Cascade Mountains	convergent	Juan de Fuca and North American	
Himalayan Mountains	convergent	Eurasian and Indian	

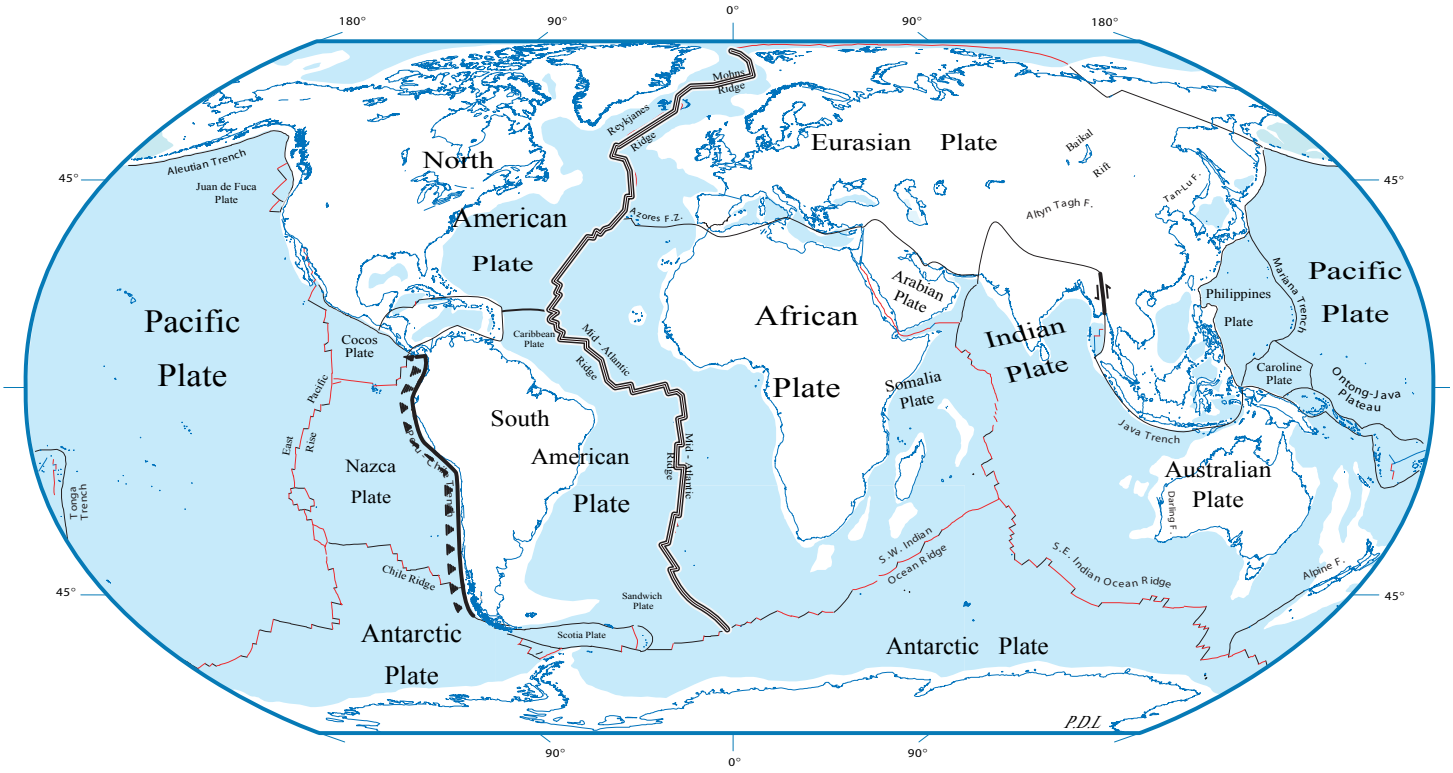
Crater Lake is Born (pg. 29)

1. a strato or composite volcano
2. convergent plate movement
3. the Juan de Fuca Plate and the North American Plate
4. a large depression centrally located in a volcano.

Vocabulary (pg. 30)

1. subduction, f
2. plate boundary, i
3. convergent boundary, a
4. lithosphere, j
5. plate tectonics, c
6. transform fault, h
7. convection currents, b
8. oceanic plate, g
9. divergent boundary, d
10. continental plate, e

Moving and Grooving Plates (pg. 27)

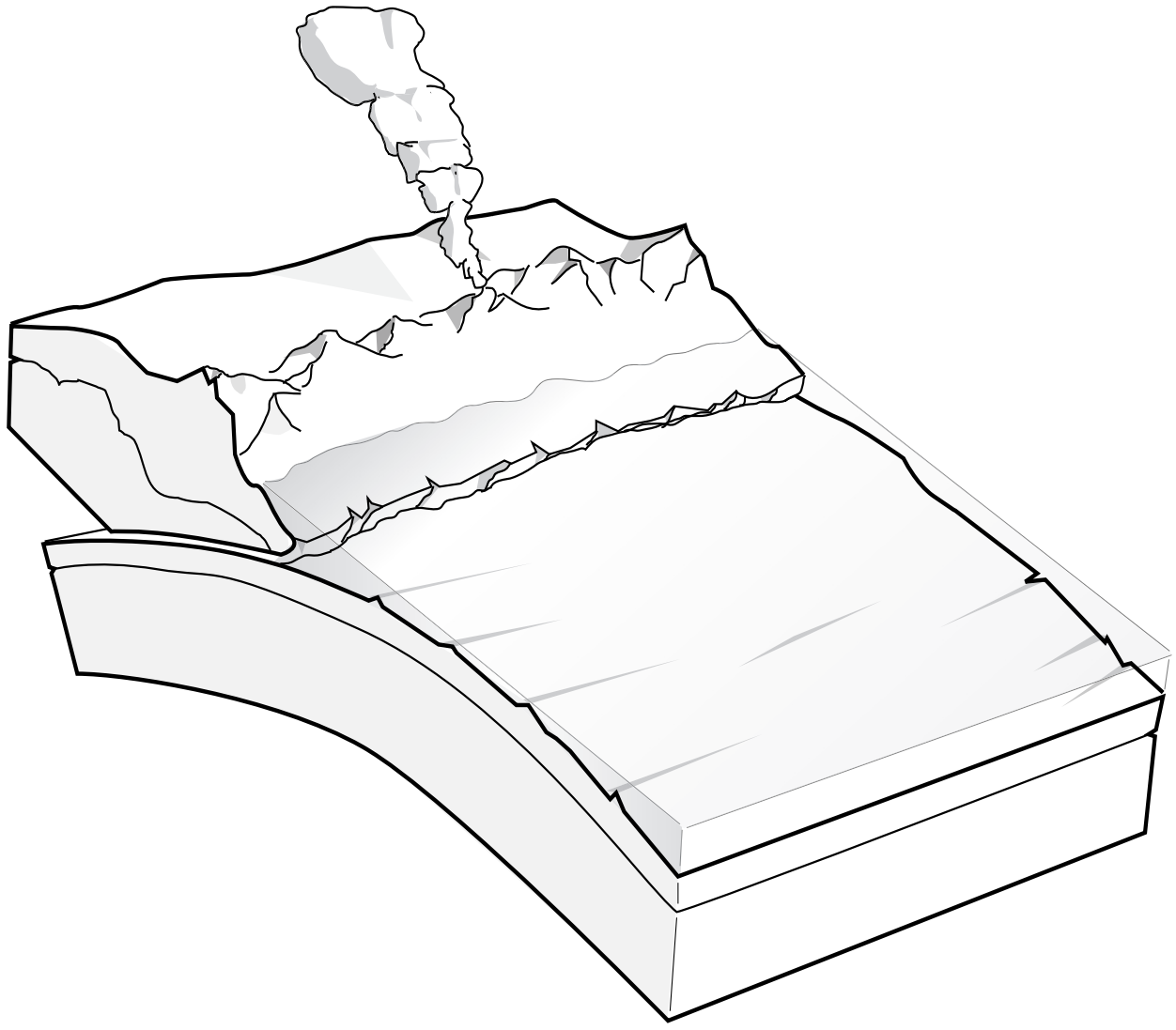


Moving and Grooving Plates (pg. 27)

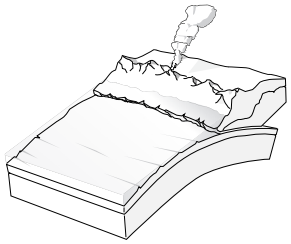
1. The Pacific Plate is the largest plate.
2. The theory of continental drift was supported by the fit of the continents, fossil evidence, the geological similarities found on different continents, and other evidence.
3. Plates interact by either colliding, sliding past each other or pulling apart.

Assessment and Student

Activity Masters



Name _____



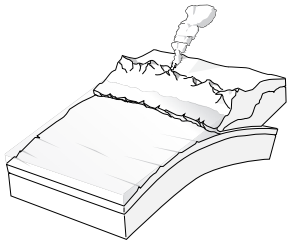
Preliminary Test

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. A _____ _____ is the place where plates meet.
2. Tectonic plates consist of the crust and upper mantle, and when combined make up the _____.
3. There are _____ major lithospheric plates on the earth.
4. A _____ _____ boundary forms where plates are separating.
5. The _____ _____ is the largest plate.
6. _____ _____ theorized that present day continents once were joined together in a large continent.
7. _____ _____ are movements of material caused by differences in temperature.
8. _____ is the process of one lithospheric plate descending under another.
9. Volcanic activity occurrs along mid-ocean ridges in large cracks called _____ _____.
10. A boundary where two plates slide by each other is called a _____ _____.

seven
divergent plate
asthenosphere
African Plate
ten
convection currents
Alfred Wegner
Harry Hess
Pacific Plate
rift valleys
five
subduction
transform fault
lithosphere
plate boundary

Name _____



Preliminary Test

Directions: Decide whether the answer is True (T) or False (F).

11. When lithospheric plates meet, volcanoes are often formed. T F

12. Tectonic plates are in a constant state of swift motion. T F

13. Mid-ocean ridges are the result of plate convergence. T F

14. Newly formed rocks can be found on the ocean floor. T F

15. Rocks on the ocean floor containing iron emit a magnetic field. T F

16. A plant fossil called glossopteris was found on numerous continents. T F

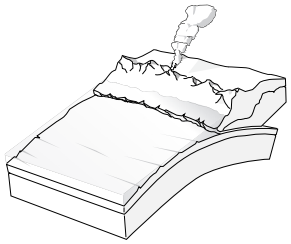
17. Scientists have discovered that the ocean floor is totally flat. T F

18. The mid-ocean ridge is over 80,000 kilometers in length. T F

19. Continents ride on top of tectonic plates. T F

20. Sea-floor spreading is characterized by two adjacent plates moving toward each other. T F

Name _____



Video Review

Directions: During the course of the program, answer the "You Decide" questions as they are presented in the video. Answer the Video Quiz questions at the end of the video.

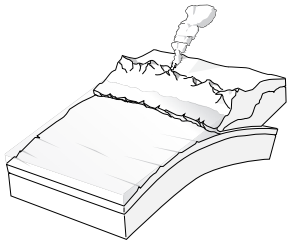
You Decide:

1. What is the longest mountain range in the world? Answer _____
2. What is a tectonic plate? Answer _____
3. What force formed these volcanic mountains? Answer _____
4. Where is most of earth's new crust found? Answer _____

Video Quiz:

1. Wegner introduced the idea of continental _____.
2. The largest mountain range in the world is the _____ ridge.
3. Oceanic rocks are _____ than rocks on continents.
4. Sea-floor spreading is the process of plates _____.
5. Tectonic plates consist of the _____ and the upper mantle.
6. The largest plate is the _____ plate.
7. A _____ boundary occurs where two plates collide.
8. _____ occurs when one plate thrusts under another.
9. The San Andreas Fault is a _____ fault.
10. Iceland straddles the _____ ridge.

Name _____



Post Test

Directions: Decide whether the answer is True (T) or False (F).

1. A plant fossil called glossopteris was found on numerous continents. T F

2. Sea-floor spreading is characterized by two adjacent plates moving toward each other. T F

3. Newly formed rocks can be found on the ocean floor. T F

4. When lithospheric plates meet, volcanoes are often formed. T F

5. Scientists have discovered that the ocean floor is totally flat. T F

6. Mid-ocean ridges are the result of plate convergence. T F

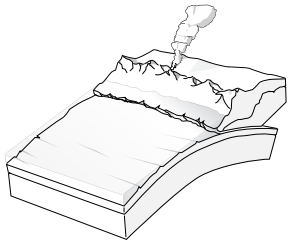
7. Continents ride on top of tectonic plates. T F

8. Rocks on the ocean floor containing iron emit a magnetic field. T F

9. The mid-ocean ridge is over 80,000 kilometers in length. T F

10. Tectonic plates are in a constant state of swift motion. T F

Name _____



Post Test

Directions: Fill in the blank with the correct word. Choose from the list of possible answers at the bottom of the page.

11. _____ is the process of one lithospheric plate descending under another.

12. There are _____ major lithospheric plates on the earth.

13. _____ _____ theorized that present day continents once were joined together in a large continent.

14. A boundary where two plates slide by each other is called a _____ _____.

15. A _____ _____ is the place where plates meet.

16. The _____ _____ is the largest plate.

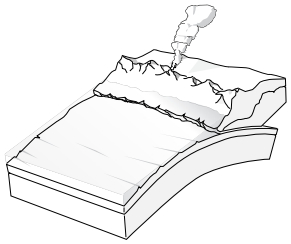
17. Tectonic plates consist of the crust and upper mantle, and when combined make up the _____.

18. Volcanic activity occurs along mid-ocean ridges in large cracks called _____ _____.

19. A _____ _____ boundary forms where plates are separating.

20. _____ _____ are movements of material caused by differences in temperature.

Harry Hess
seven
asthenosphere
divergent plate
Pacific Plate
transform fault
rift valleys
subduction
five
plate boundary
lithosphere
Alfred Wegner
ten
African Plate
convection currents



Diverging, Sliding and Colliding Plates

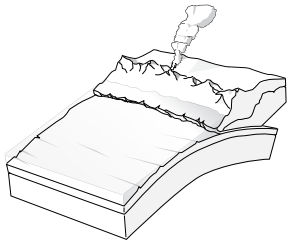
Objectives: Students will demonstrate the movement of convergent, divergent and transform plate boundaries.

Background: The tectonic plates are comprised of the earth's crust and part of the upper mantle, also referred to as the lithosphere. The layer below the lithosphere is a hot, semi-liquid layer called the asthenosphere. The lithospheric plates (also called tectonic plates) float over the asthenosphere, much like ice floats on a lake. When plates move, they form features such as volcanoes and mountains, and cause earthquakes. Two plates can interact in three possible ways. Plates that move away from each other form divergent boundaries. Sea-floor spreading is the result of divergent boundaries. The mid-Atlantic ridge was created as a result of the North American and Eurasian plates diverging. Another example of divergent boundary movement is the Great Rift Valley in East Africa. As the Somalia Plate slowly moves away from the larger African Plate the rift valley is being enlarged.

Convergent boundaries occur when two plates move toward each other and collide, causing earthquakes and mountain building. During convergent collisions subduction often occurs. Subduction is the process of a denser plate thrusting under a less dense plate. Volcanic mountains such as the Cascade Mountains were formed when the denser Juan de Fuca Plate was subducted under the less dense North American Plate. Similarly, the Andes Mountain Range was formed when the Nazca Plate slid under the South American Plate. The formation of the Himalayan Mountains, the tallest mountains on earth, occurred as a result of plates colliding. They formed when the denser Indian Plate collided with the Eurasian Plate. The compression forced the land upward and is still forcing the Himalayas to continue to rise today.

When plates slide by each other in the same direction at different speeds or in the opposite direction transform faults are formed. Earthquakes can occur along these boundaries. Earthquakes frequently occur along the San Andreas Fault as the Pacific Plate slides past the North American Plate.

Name _____



Diverging, Sliding and Colliding Plates

Activity: Students will demonstrate plate boundary movement.

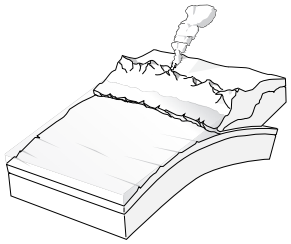
Material: One piece of 8 1/2 x 11 paper cut in two for each student, copy of the boundary table, and a world map.

Directions: 1) Fill in the boundary table. Use the paper to demonstrate each type of plate boundary movement. 2) After the table is completed locate each area on a world map.

Boundary Table

Landform	Type of Boundary Movement	Plates Involved	Describe Movement (use paper as guide)
Mid-Atlantic Ridge			
San Andreas Fault			
Great Rift Valley			
Andes			
Cascade Mountains			
Himalayan Mountains			

Name _____



Moving and Grooving Plates

Objectives: The students will locate and identify major and minor tectonic plates. The students will identify and label divergent, convergent, and transform plate boundaries.

Background: Look closely at a world map. The continents appear to be pieces of a giant puzzle. In 1912, Alfred Wegener proposed that the present day continents were once joined together as a large single continent called Pangaea - which means “all the earth”. Wegener theorized that over time the continents drifted away from each other, until they arrived in their present positions. Wegener’s theory of continental drift was supported by the fit of the continents, fossil evidence, and other geologic similarities found on different continents. This evidence supported the theory that the continents moved, but not why or how they moved. New scientific theories such as sea-floor spreading provided additional evidence to support Wegener’s theory of continental drift. Sea-floor spreading is when the sea floor moves by spreading apart at mid-ocean ridges.

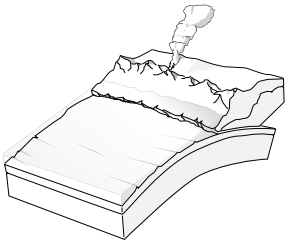
Continental drift and sea-floor spreading provided scientists with the framework for the theory of plate tectonics. Scientists surmised that instead of the continents drifting, they actually rode on top of moving ocean floor pieces. As the ocean floor moves it takes a continent along with it. The earth’s surface is actually divided into many moving plates. The plates make up the earth’s lithosphere layer which contains the earth’s crust and part of the upper mantle.

Plates continually move at differing rates and directions. Plate movements cause three types of interactions at plate boundaries. When plates collide or move toward each other, they form convergent boundaries. Plates that pull apart or move away from each other form divergent boundaries. Two plates that move or slide past each other form transform fault boundaries.

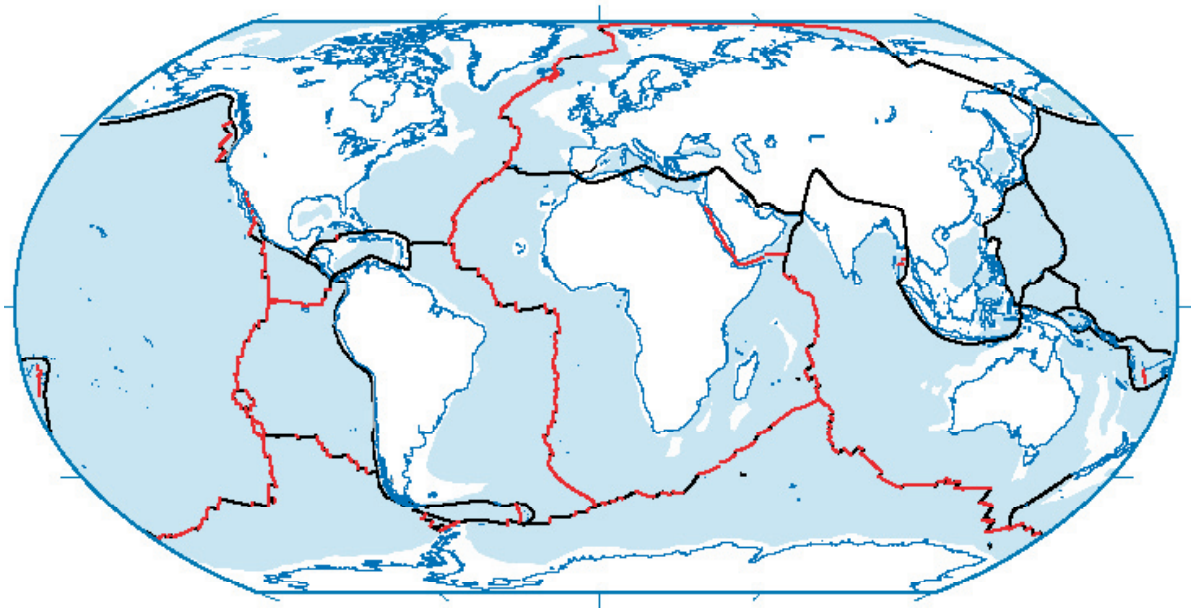
Materials: Map of tectonic plates indicating boundary type and three colored pencils.

Directions: 1. Label the tectonic plates listed below the map using a provided map 2. Use the colored pencils to label each boundary type (see key).

Name _____



Moving and Grooving Plates



KEY

Convergent  Divergent  Transform Fault 

1) Label the following: Pacific Plate, North American Plate, South American Plate, Antarctic Plate, Eurasian Plate, Australian Plate, African Plate, Juan de Fuca Plate, Philippines Plate, Nazca Plate, Scotia Plate, Indian Plate, Arabian Plate, Caribbean Plate, Cocos Plate, Mid-Atlantic Ridge, Somalia Plate.

2) Mark one of each of the following boundaries on the map: convergent, divergent, and transform fault using the key above and the colored pencils.

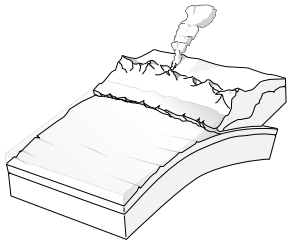
Questions:

1. Which plate is the largest?

2. What evidence supported the theory of continental drift?

3. What are the three ways boundaries interact?

Name _____



Crater Lake is Born

Imagine you are a young member of the Klamath or Modoc Native American tribes approximately 7,700 years ago. You and a friend are out gathering food when suddenly the ground shakes, then the sky becomes dark and pieces of pumice and ash begin to rain down on you. Fire is in the sky and all around you. What is happening? Is it the end of the world or angry spirits? Actually, the most explosive volcanic eruption in North America since the ice age was occurring right before your eyes!

Scientific evidence and Klamath legends provide clues to what actually occurred thousands of years ago. Volcanoes began to form eons ago as the Juan de Fuca oceanic plate and the North American continental plate collided. During the collision the Juan de Fuca plate was subducted under the North American plate. Subduction occurs when a heavier, denser plate slides or sinks beneath a less dense plate. Over time a chain of volcanic mountains formed called the Cascade Range. Mount Mazama located in Oregon was the site of a huge volcanic eruption thousands of years ago. Mt. Mazama is a strato volcano or composite volcano which formed a caldera. A caldera is a large depression formed as a result of a volcano collapsing. When Mt. Mazama erupted, a huge volume of earth material blew out of the volcano. The magma chamber was emptied when the volcano erupted. The volcano had no inner structure left to support the weight of the mountain, and it collapsed. A large caldera formed on top of the collapsed mountain. Over the years the caldera filled with rainwater and snowfall forming a beautiful, deep blue lake we know today as Crater Lake.

Questions:

1. What type of volcano was Mt. Mazama?

2. What type of plate movement formed Mt. Mazama?

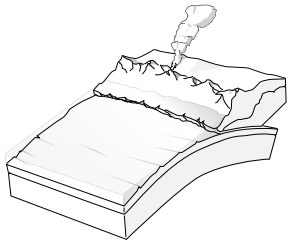
3. What plates were involved in forming the Cascade Mountains?

4. What is a caldera?

References:

Harris, H.L. (1998). Agents of Chaos. Missoula: Mountain Press Publishing Company.
Warfield, R.G., Juillerat, L & Smith, L. (1999). Crater Lake The Story Behind the Scenery. Las Vegas: KC Publications, Inc.

Name _____



Vocabulary of Plate Tectonics

Directions: Unscramble the vocabulary words in the first column. Match the words to the definitions in the second column.

____1) duciontbus _____

____2) teapl darynoub _____

____3) genvertcon ybnoudar _____

____4) eretholsphi _____

____5) atelp cttenosci _____

____6) rmofsnart ultfa _____

____7) ectnoinovc entsrrcu _____

____8) eicnaoc telpa _____

____9) ergeivdtn unaobdyr _____

____10) ilanenttcon aelpt _____

a. a boundary where two plates move together and collide.

b. movements of material caused by differences in temperature.

c. the theory that a number of lithospheric plates ride across the earth's surface.

d. a boundary where two plates move away from each other.

e. plate that consists primarily of the earth's outer crust.

f. the process of one lithospheric plate descending under another.

g. a plate that consists primarily of oceanic crust and little or no continental crust.

h. a plate boundary where the plates slide past each other.

i. the place where plates meet each other.

j. the outer layer of the earth which includes the crust and uppermost part of the mantle.