NTTI Media-Rich Lesson

Lorrie D. Green

NAME

Playful Plates

LESSON TITLE

Fifth Graders

GRADE LEVELS

120 Minutes

TIME ALLOTMENT

OVERVIEW

Using a variety of instruments, geologists have measured the directions and rates of plate movement at the surface of the Earth. They have found that plates move in three basic ways. In some places, two plates move apart from each other; this is called a diverging plate boundary. Elsewhere two plates move together; this is a converging plate boundary. Finally plates can also slide past each other horizontally. This is called a transform plate boundary.

All of the plates move slowly. Their speeds vary from a few millimeters per year to a maximum of 15 centimeters per year. On average, the plates move about as fast as human fingernails grow.

Volcanoes and earthquakes help define the boundaries between the plates. Earthquakes occur at all three types of boundaries. Because the plates are rigid, they tend to stick together, even though they are constantly moving. When the strength of the rocks at the plate boundary is exceeded, they move rapidly, "catching up" with the rest of the plates. We feel this release of energy as an earthquake. At diverging plate boundaries, earthquakes occur as the plates pull away from each other. Volcanoes form between the plates, as magma rises upward from the underlying mantle. Two situations

are possible at converging plate boundaries. First, earthquakes occur when two plates collide (obduct), building a mountain range. Second, both volcanoes and earthquakes form where one plate sinks under the other, instead of colliding. This process is called subduction. Transform plate boundaries commonly have only earthquakes.

SUBJECT MATTER

Earth Science and Social Studies

LEARNING OBJECTIVES

Students will be able to:

- Explain the theory of plate tectonics.
- Recognizes and describes the topography of the ocean floor.
- Explores and discusses changes in the Earth's surface due to plate tectonics. Uses maps to illustrate Mid-Atlantic Ridge, major fault zones, etc.
- Describes features created by faults.

STANDARDS

Georgia Quality Core Curriculum Standard #27: Explores and discusses change in the Earth's surface due to plate tectonics.

MEDIA COMPONENTS

Video

The Earth Revealed #106: Plate Dynamics

Websites

World Map - http://go.hrw.com/atlas/norm_htm/world.htm (optional)

Hands-On Activity:

Tectonic Plate Puzzle-

http://volcano.und.nodak.edu/vwdocs/vwlessons/activities/p_number6.html

Plate Tectonic Demonstration Box-

http://volcano.und.nodak.edu/vwdocs/vwlessons/activities/p_number5.html

Assessment - Students can take an **interactive quiz** on continental drift/plate tectonics

at the following website:
http://www.enchantedlearning.com/subjects/astronomy/activities/radiobuttonquiz/Tectonicspz.shtml

Literature

Earthquakes (*Earth Watch* series). Sally M. Walker. Illustrated with various photographs, diagrams, and maps. Carolrhoda. 48pp. ISBN library: 0-87614-888-7.

The Children's Atlas Of Natural Wonders. Joyce Pope. Illustrated with photographs and maps. Millbrook. 96pp. ISBN library: 1-56294-564-5; paperback: 1-56294-886-5.

MATERIALS

- One Tectonic Plate Puzzle on cardstock
- Scissors
- Large construction paper
- Ziploc bags (one bag per group)
- Markers
- Tape
- Copy paper
- Copy paper case box top
- Exacto® knife

PREP FOR TEACHERS

Prior to teaching this lesson, do the following:

Engage, Explore & Explain – Technology Prep

- Obtain a computer, projector, and screen.
  (Note: You may require speakers as well according to the volume of your projector)
- Obtain a TV and VCR with a remote.
- Cue the video tape
- Bookmark or download the websites used in the lesson on each computer in your classroom.

Explore – Plate Tectonic Puzzle

- Print out a puzzle for each group of students from the website on cardstock.

Explain – Plate Tectonic Demonstration

- Cut a narrow slit in the top of a copy paper box top. Cut a larger square in the side of the box top. Slide two pieces of paper through the slit and about half-way

into the box top. Tape a block of cardboard or folded paper on the outside edge of one sheet of paper.

INTRODUCTORY ACTIVITY (Engage): SETTING THE STAGE

A Better Fit: Plate Tectonic Puzzle

Step 1

Begin by grouping students to complete this activity, and have available for each group a copy of the plate tectonics puzzle.

Step 2

Have groups cut out each tectonic plate piece, and direct groups to reassemble the tectonic plate pieces together.

Step 3

Have groups discuss why this Plate Tectonic puzzle fits better than the Continent puzzle in the previous lesson. *Make sure students understand that the continents are connected to the ocean floor that surrounds it, and that is why it is a better fit.*

LEARNING ACTIVITY 1 (Explore):

Types of Plate Boundaries

Step 1

Provide students with a **Focus for Media Interaction**, by having students read the questions on the Plate Tectonics worksheet and prepare to answer the questions during the video clip.

Step 2

Leave the lights on and direct students to view the ***The Earth Revealed #106 -video clip on Plate Dynamics*.** **Play** a short clip about the actions of tectonic plates (1:17 – 3:14), and **PAUSE** the video.

Step 3

Have students answer the following questions on their worksheet:

- **Describe tectonic plates and how they behave.** *They are rigid slabs of rock that are found on the outer surface of the earth. They move and can be as large as continents. When plates interact with each other they can cause mountain ranges, volcanoes, deep sea trenches, and earthquakes.*
- **Give an example of how plates interact to form the San Andreas Fault.** *The North American plate grinds against Pacific plate causing earthquakes and high mountain ranges.*

Step 4

Play a short clip about boundary plates (3:15 – 3:38), and **PAUSE** the video.

Step 5

Have students answer the following questions on their worksheet:

- **What makes up most plate boundaries?** Plate boundaries don't correspond with edges of continents; therefore, most plates consist of a continent and ocean basin.

Step 6

Play a short clip about divergent boundaries (3:39- 5:44), and **PAUSE** the video.

Step 7

Have students answer the following questions on their worksheet:

- **Describe the actions, location and example of a two continental plates and ocean-continental plates at a divergent boundary.**
  Divergent boundaries occur where plates move away from each other. The Mid-Atlantic Ridge, in Iceland, is where two continental plates on either side of the ridge are moving away from each other causing earthquakes and lava craters. Also, a rift in Africa has caused it to split from Saudi Arabia.
  Oceanic crust makes up 70% of earth's surface. In the ocean, the large volcanic ridge, Mid Atlantic Ridge, runs right down the middle of the Atlantic Ocean. Volcanic eruptions take place where the two oceanic plates are moving away fro each other. As these undersea volcanoes cough up new lava, they form new crust (new sea floor). As new seafloors forms, the older seafloor is shoved sideway, this is called sea floor spreading.

Step 8

Play a short clip about convergent boundaries (5:45 – 10:29), and **PAUSE** the video.

Step 9

Have students answer the following questions on their worksheet:

- **Describe the actions, location and example of a two continental plates and ocean-continental plates at a convergent boundary.** *Convergent boundaries occur where two continental plates collide, two oceanic plates collide or a continental and an oceanic plate collide.*
- *The oceanic plate will slip under the continental plate forming a subduction zone. In a subduction zone, the softer oceanic plate will melt as it slides under the continental plate. Volcanoes are formed above the subduction zone; earthquakes are occur because of the movement of the plates. An example is the Andes mountains where the Pacific plate slips under the South American plate.*
- *When two continental plates collide, a mountain range is formed, such as the, Himalayas and the Alps. At one time, there was an ocean between these two plates. Also, violent volcanoes and earthquakes occur over the subduction zone.*
- *When two oceanic plates collide, a trench forms, such as, the Marine Trench and Island. Also, a volcanic chain*

Step 10

Play a short clip about transform faults (10:30 – 11:42), and **PAUSE** the video.

Step 11

Have students answer the following questions on their worksheet:

- **Describe the actions, location and example of a two continental plates and ocean-continental plates at a transform fault.** *Transform faults occur when two plates slide by each other. An example would be the San Andreas Faults*

Step 12

Play a short clip about the plate tectonics (11:43 – 11:50), and **PAUSE** the video.

Step 13

Have students answer the following questions on their worksheet:

LEARNING ACTIVITY 2 (Explain):

Hands-On Activity (B):

Step 1

Cut a narrow slit in the top of a box. Cut a larger square in the side of the box. Slide two pieces of paper through the slit and about half-way into the box. Tape a block of cardboard or folded paper on the outside edge of one sheet of paper.

Step 2 – Mid-Ocean Ridges/ Rift Valley

Have groups demonstrate motion at a divergent boundary by pushing the paper up from inside the box. The sheets of paper will move away from each other just like new oceanic crust at *mid-ocean ridges or continental crust at rift valleys*.

Step 3 – Volcanoes (Subduction Zone)

Have students demonstrate motion at convergent boundaries by pulling the plain sheet of paper down from inside the box. Move the sheet with the continent so that the continent is adjacent to the narrow slit. The oceanic plate will disappear beneath the edge of the continent just like oceanic crust at *subduction zones - volcanoes*.

Step 4 – Mountains

Have students demonstrate convergence and collision of two plates with continental crust by taping cardboard blocks on the outside of each sheet of paper. Pull the two sheets into the box through the slit. Note that the sheets are disappearing into the slit similar to oceanic plates at a subduction zone. As the sheets (plates) are consumed, the continents move closer together and ultimately collide. Such a collision is currently forming up the Himalaya Mountains.

CULMINATING ACTIVITIES (Evaluate):

Assessment Activity (A):

Step 1
On the Plate Tectonic Puzzle, you assembled earlier in the lesson. Describe the major geologic features that correspond to plate tectonic boundaries, i.e., mid-ocean ridges, trenches, and mountain ranges.

Hands-On Activity (B):

Step 1

Using the Tectonic box, have groups demonstrate each of the following:
1. Oceanic Divergent Boundaries-Mid-Ocean Ridge
2. Continental Divergent Boundaries-Rift Valley
3. Oceanic Convergent Boundaries-Volcanoes
4. Continental Convergent Boundaries-Mountains

CROSS-CURRICULAR EXTENSIONS

COMMUNITY CONNECTIONS

NTTI Media-Rich Lesson Planning Guide

Title Playful Plates

Time Allotment 120 minutes

Grade Level(s) 5th Graders

Overview

Using a variety of instruments, geologists have measured the directions and rates of plate movement at the surface of the Earth. They have found that plates move in three basic ways. In some places, two plates move apart from each other; this is called a diverging plate boundary. Elsewhere two plates move together; this is a converging plate boundary. Finally plates can also slide past each other horizontally. This is called a transform plate boundary.

All of the plates move slowly. Their speeds vary from a few millimeters per year to a maximum of 15 centimeters per year. On average, the plates move about as fast as human fingernails grow.

Volcanoes and earthquakes help define the boundaries between the plates. Earthquakes occur at all three types of boundaries. Because the plates are rigid, they tend to stick together, even though they are constantly moving. When the strength of the rocks at the plate boundary is exceeded, they move rapidly, "catching up" with the rest of the plates. We feel this release of energy as an earthquake. At diverging plate boundaries, earthquakes occur as the plates pull away from each other. Volcanoes form between the plates, as magma rises upward from the underlying mantle. Two situations are possible at converging plate boundaries. First, only earthquakes occur when two plates collide (obduct), building a mountain range. Second, both volcanoes and earthquakes form where one plate sinks under the other, instead of colliding. This process is called subduction. Transform plate boundaries commonly have only earthquakes.

Subject Matter
Earth Science and Social Studies

Learning Objectives
Students will be able to:

- Explain the theory of plate tectonics.
- Recognizes and describes the topography of the ocean floor.
- Explores and discusses changes in the Earth's surface due to plate tectonics. Uses maps to illustrate Mid-Atlantic Ridge, major fault zones, etc.
- Describes features created by faults.

Standards
Georgia Quality Core Curriculum Standard #27: Explores and discusses change in the Earth's surface due to plate tectonics.

Media Components Video

The Earth Revealed #106: Plate Dynamics

Media Components - Web

Tectonic Plate Puzzle-

http://volcano.und.nodak.edu/vwdocs/vwlessons/activities/p_number6.html

Plate Tectonic Demonstration Box-
http://volcano.und.nodak.edu/vwdocs/vwlessons/activities/p_number5.html

Prep for Teacher

Prior to teaching this lesson, do the following:

Engage, Explore & Explain – Technology Prep

- Obtain a computer, projector, and screen.
  (Note: You may require speakers as well according to the volume of your projector)
- Obtain a TV and VCR with a remote.
- Cue the video tape
- Bookmark or download the websites used in the lesson on each computer in your classroom.

Explore – Plate Tectonic Puzzle

- Print out a puzzle for each group of students from the website on cardstock.

Explain – Plate Tectonic Demonstration

- Cut a narrow slit in the top of a copy paper box top. Cut a larger square in the side of the box top. Slide two pieces of paper through the slit and about half-way into the box top. Tape a block of cardboard or folded paper on the outside edge of one sheet of paper.

Introductory Activity *(remember to number each step)* Materials

A Better Fit: Plate Tectonic Puzzle

- One Tectonic Plate Puzzle on cardstock (Handout 1)
- Scissors
- Large construction paper
- Ziploc bags (one bag per group)
- Markers
- Tape

Step 1

Begin by grouping students to complete this activity, and have available for each group a copy of Handout 1 - the plate tectonics puzzle.

Step 2

Have groups cut out each tectonic plate piece, and direct groups to reassemble the tectonic plate pieces together.

Step 3

Have groups discuss why this Plate Tectonic puzzle fits better than the Continent puzzle in the previous lesson. *Make sure students understand that the continents are connected to the ocean floor that surrounds it, and that is why it is a better fit.*

Learning Activities 1 *(remember to number each step)* Materials

Types of Plate Boundaries

Step 1

Provide students with a Focus for Media Interaction, by having students read the questions on Handout 2 the Plate Tectonics worksheet and prepare to answer the questions during the video clip.

Step 2

Leave the lights on and direct students to view the *The Earth Revealed #106 -video clip on Plate Dynamics*. Play a short clip about the actions of tectonic plates (1:17 – 3:14), and PAUSE the video.

Step 3

Have students answer the following questions on their worksheet:

- Describe tectonic plates and how they behave. Give an example of how plates interact to form the San Andreas Fault.

Step 4

Play a short clip about boundary plates (3:15 – 3:38), and **PAUSE** the video.

Step 5

Have students answer the following questions on their worksheet:

- What makes up most plate boundaries?

Step 6

Play a short clip about divergent boundaries (3:39- 5:44), and **PAUSE** the video.

Step 7

Have students answer the following questions on their worksheet:

- Describe the actions, location and example of a two continental plates and ocean-continental plates at a divergent boundary.

Step 8

Play a short clip about convergent boundaries (5:45 – 10:29), and **PAUSE** the video.

Step 9

Have students answer the following questions on their worksheet:

- Describe the actions, location and example of a two continental plates and ocean-continental plates at a convergent boundary.

Step 10

Play a short clip about transform faults (10:30 – 11:42), and **PAUSE** the video.

Step 11

Have students answer the following questions on their worksheet:

- Describe the actions, location and example of a two continental plates and ocean-continental plates at a transform fault. *Transform faults occur when two plates slide by each other. An example would be the San Andreas Faults*

Step 12

Play a short clip about the plate tectonics (11:43 – 11:50), and PAUSE the video.

Learning Activities 2 *(remember to number each step)* Materials

- Markers
- Tape
- Copy paper
- Copy paper case box top
- Exacto® knife

Hands-On Activity (B):

Step 1

Cut a narrow slit in the top of a box. Cut a larger square in the side of the box. Slide two pieces of paper through the slit and about half-way into the box. Tape a block of cardboard or folded paper on the outside edge of one sheet of paper.

Step 2 – Mid-Ocean Ridges/ Rift Valley

Have groups demonstrate motion at a divergent boundary by pushing the paper up from inside the box. The sheets of paper will move away from each other just like new oceanic crust at *mid-ocean ridges or continental crust at rift valleys*.

Step 3 – Volcanoes (Subduction Zone)

Have students demonstrate motion at convergent boundaries by pulling the plain sheet of paper down from inside the box. Move the sheet with the continent so that the continent is adjacent to the narrow slit. The oceanic plate will disappear beneath the edge of the continent just like oceanic crust at *subduction zones - volcanoes*.

Step 4 – Mountains

Have students demonstrate convergence and collision of two plates with continental crust by taping cardboard blocks on the outside of each sheet of paper. Pull the two sheets into the box through the slit. Note that the sheets are disappearing into the slit similar to oceanic plates at a subduction zone. As the sheets (plates) are consumed, the continents move closer together and ultimately collide. Such a collision is currently forming up the Himalaya Mountains.

Culminating Activity *(remember to number each step)* Materials

Assessment Activity (A):

Step 1

On the Plate Tectonic Puzzle, you assembled earlier in the lesson. Describe the major geologic features that correspond to plate tectonic boundaries, i.e., mid-ocean ridges, trenches, and mountain ranges.

Hands-On Activity (B):

Step 1

Using the Tectonic box, have groups demonstrate each of the following:

5. Oceanic Divergent Boundaries-Mid-Ocean Ridge
6. Continental Divergent Boundaries-Rift Valley
7. Oceanic Convergent Boundaries-Volcanoes
8. Continental Convergent Boundaries-Mountains

Cross-Curricular Extensions

Language Arts

Research the 1992 Landers, California earthquake, write a report, and pretend you are a reporter giving news about the earthquake.

Technology

Research the *Glomar Challenger* and *seismic tomography,* and discuss how this technology helps us study earth's activities.

Community Connections

- A **Seismologist** will provide up-to-date information on earthquakes, and volcanic activity. A seismologist will also provide career information.
- An **Oceanographer** will provide information on technology used to explore the ocean floor. An Oceanographer will also provide career information.

Student Materials


PBA30
ATLANTA'S PBS STATION

Atlanta Public Schools
Our Focus... Student Success

GE Fund

cpb
Corporation for Public Broadcasting

Cisco Systems
Foundation

thirteen
WNET NEW YORK

NTTI

Playful Plates NTTI Lesson

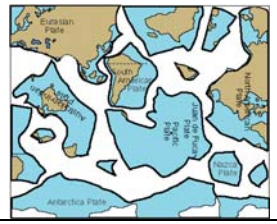
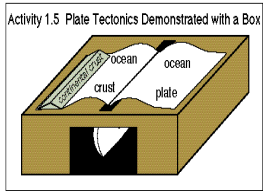
5E Model	Activities	Strategies	Resources
Engage	**A Better Fit - Tectonic Plate Puzzle** http://volcano.und.nodak.edu/vwdocs/vwlessons/activities/p_number5.html Cut out the tectonic plate pieces and reassemble the tectonic map. Describe the major geologic features that correspond to plate tectonic boundaries, i.e., mid-ocean ridges, trenches, and mountain ranges.	Reassemble puzzle 	• Tectonic Plate Puzzle • Scissors • Large construction paper
Explore	**Focus For Media Interaction** What happens when plates move? • Divergent Boundaries • Convergent Boundaries • Transform Faults	Questioning skills	• Video
Explain	**Plate Tectonic Demonstration Box** http://volcano.und.nodak.edu/vwdocs/vwlessons/activities/p_number5.html Cut a narrow slit in the top of a box. Cut a larger square in the side of the box. Slide two pieces of paper through the slit and about half-way into the box. Tape a block of cardboard or folded paper on the outside edge of one sheet of paper.	Hands-on 	• Copy paper • Large box • Scissors • Exacto® knife • Tape
Evaluate	**Performance Assessment** Demonstrate the following: 9. Oceanic Divergent Boundaries-Mid-Ocean Ridge 10. Continental Divergent Boundaries-Rift Valley 11. Oceanic Convergent Boundaries-Volcanoes 12. Continental Convergent Boundaries-Mountains	Demonstration	

Plate Tectonic Demonstration Box

Teacher's Notes

This activity demonstrates divergent and convergent plate boundaries. Cut a narrow slit in the top of a box. Cut a larger square in the side of the box. Slide two pieces of paper through the slit and about half-way into the box. Tape a block of cardboard or folded paper on the outside edge of one sheet of paper.

	represents	
Plain sheet of paper	→	oceanic plate
Sheet with the cardboard	→	a plate with oceanic and continental crust

Note that the continental crust rises above the oceanic crust.

Demonstrate motion at a **divergent plate boundary** by pushing the paper up from inside the box. The sheets of paper will move away from each other just like new oceanic crust at **mid-ocean ridges**.

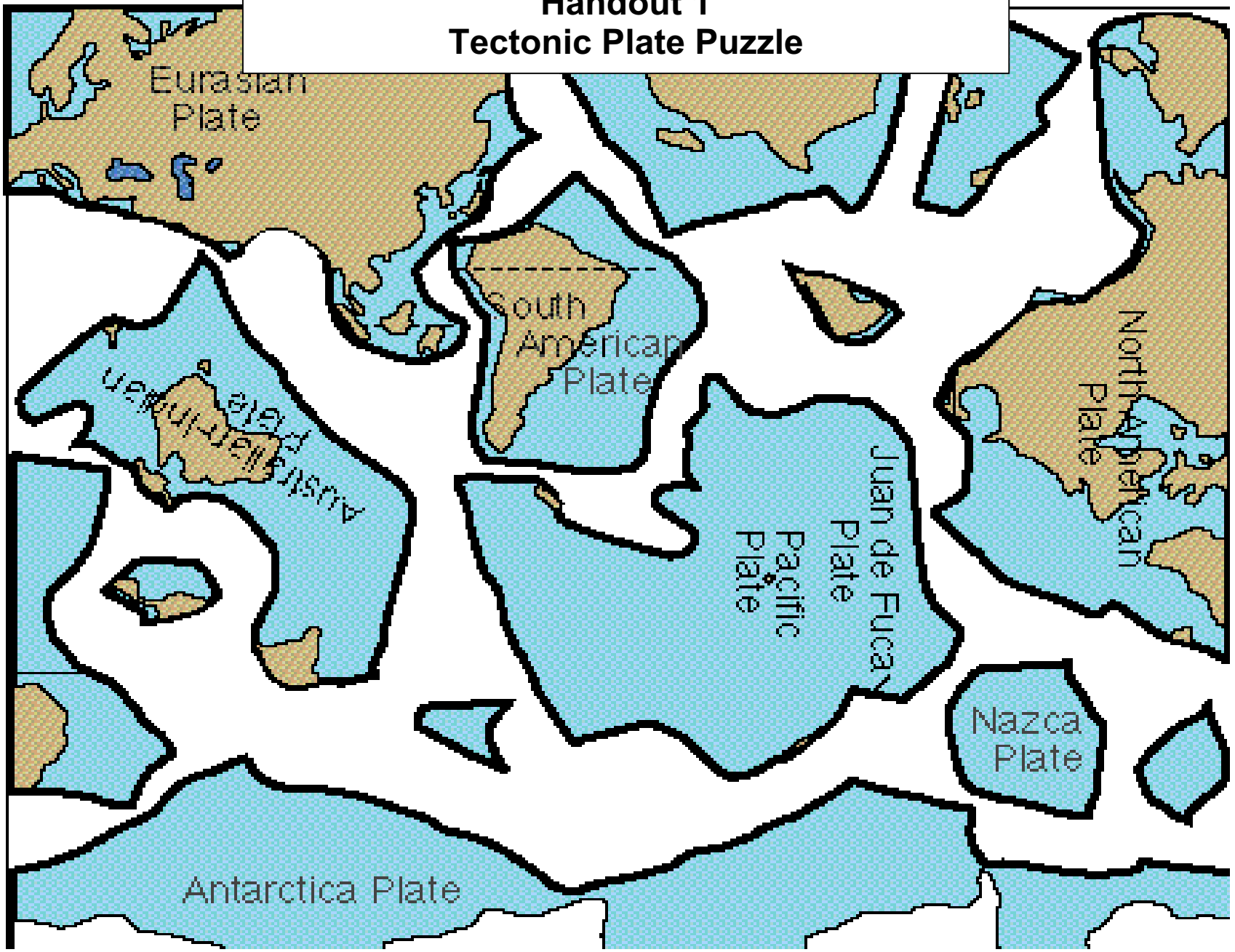
Demonstrate motion at **convergent plate boundaries** by pulling the plain sheet of paper down from inside the box. Move the sheet with the continent so that the continent is adjacent to the narrow slit. The oceanic plate will disappear beneath the edge of the continent just like oceanic crust at **subduction zones**.

Magnetic anomaly patterns can also be demonstrated with the box. Use two plain sheets of paper. With a thick (1 inch) marker, draw on the sheets above the slit. The strip of marked paper represents rocks that are magnetized during a magnetic normal period. Push the paper up from inside the box and expose unmarked paper. The unmarked paper represents rocks that are magnetized during a magnetic reversed period. Create more oceanic crust by pushing the sheets out of the slit and drawing along the slit with the marker. Repeat until the sheets are covered with black (magnetic normal) and white (magnetic reversed) parallel lines. Note that the patterns on each sheet (plate) are symmetrical with respect to the slit (mid-ocean ridge). Compare the pattern to the one in figure 1.12.

The convergence and **collision of two plates with continental crust** can also be demonstrated. Tape cardboard blocks on the outside of each sheet of paper. Pull the two sheets into the box through the slit. Note that the sheets

are disappearing into the slit similar to oceanic plates at a subduction zone. As the sheets (plates) are consumed, the continents move cl[illegible] the Himalaya

Handout 1
Tectonic Plate Puzzle



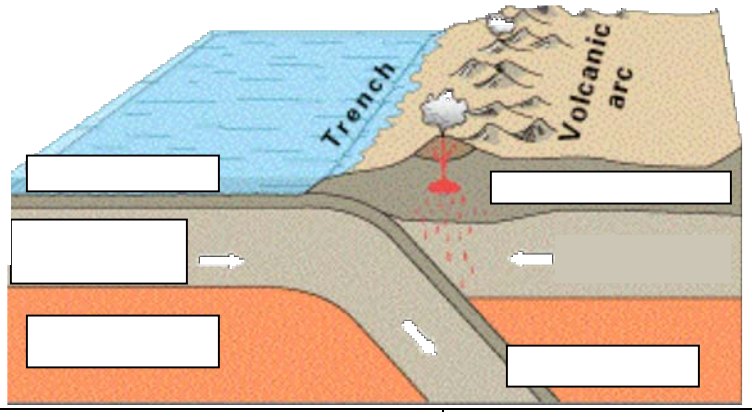
Handout 2
Plate Tectonics Worksheet

Use the following words to label the diagram.

Athenosphere **Continental Crust**

Lithosphere **Oceanic Crust**

Subduction Zone



Describe tectonic plates and how do they behave. **Give an example of how plates interact to form the San Andreas Fault.**	**What makes up most plate boundaries?**

Type of Boundary	Actions	Location	Examples
Divergent (continental-continental)			
Divergent (continental-oceanic)			
Divergent (oceanic-oceanic)			
Convergent (continental-continental)			
Convergent (continental-oceanic)			
Convergent (oceanic-oceanic)			

WORD WALL

Supercontinent	Athenosphere	Continental Crust
Lithosphere	Oceanic Crust	Plate Tectonics
Pangaea	Alfred Wegener	Harry Hess
Sea Floor Spreading	Convergent Boundary	
Divergent Boundary	Mid-Atlantic Ridge	San Andreas Fault
Transform Boundary		