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Science

Quarter 1 – Module 2:

Plate Boundaries



Science – Grade 10
Alternative Delivery Mode
Quarter 1 – Module 2: Plate Boundaries
First Edition, 2020

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Development Team of the Module

| | |
|-------------------------|---|
| Writer: | Gloria C. Magalang |
| Editors: | Ma. Maila C. Justo, Jerry R. Junio |
| Reviewers: | Jaime Campos, Jr., Jerry R. Junio, Ma. Criselda G. Ocang, German J. Ferrer Jr., Ellen F. Fernandez, Gina A. Amoyen Editha T. Giron |
| Illustrator: | Reynaldo C. Poquiz |
| Layout Artists: | Reyna H. Talinio |
| Management Team: | Tolentino G. Aquino, Arlene A. Niro, Gina A. Amoyen, Editha T. Giron, Carmina C. Gutierrez, Rustico P. Abalos, Jr Marilou D. Roldan, Jerry R. Junio |

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Department of Education – Region I

Office Address: Flores St., Catbangen, City of San Fernando, La Union
Telefax: (072) 682-2324; (072) 607-8137
E-mail Address: region1@deped.gov.ph

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Science
Quarter 1 – Module 2:
Plate Boundaries



Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.



What I Need to Know

Plate tectonics is a theory that explains the surface of the earth is broken into large and small lithospheric plates that are moving constantly and slowly. The size and position of these plates change as years pass by. They move against each other at their edges causing intense geologic activity, such as earthquakes, volcanism, and mountain building.

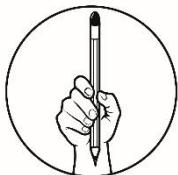
In your previous lesson, you are done with the Plate tectonics and its relationship to the distribution of earthquake epicenters, active volcanoes, and major mountain belts.

This module will provide you with information and activities that will help you understand Plate Boundaries (Divergent, Convergent, and Transform fault).

After going through this module, you are expected to:

1. describe the different types of plate boundaries (**S10 -Ia -j-36.2**);
2. differentiate the types of convergent boundaries; and
3. identify the places/plates that lie on the different types of boundaries.

Before going on, check how much you know about this topic. Answer the pretest on the next page in a separate sheet of paper.



What I Know

Directions: Read carefully each item. Use a separate sheet of paper for your answers. Write only the letter of the best answer for each question.

1. Plates move apart at _____ boundaries.
 - A. convergent
 - B. stable
 - C. divergent
 - D. transform
2. Plates slide past each other at _____.
 - A. subduction zone
 - B. divergent boundary
 - C. convection current

- D. transform fault boundary
3. The boundary between two plates moving toward each other is called a _____.
A. divergent boundary
B. transform boundary
C. lithosphere
D. convergent boundary
4. Seafloor spreading is located at _____.
A. transform plate boundary
B. convergent plate boundary
C. divergent plate boundary
D. Indian plate
5. Plate Tectonic Theory states that continents have moved _____ to their current location.
A. vertically
B. horizontally
C. quickly
D. slowly
6. The East African Rift is an example of a _____.
A. mid-ocean ridge
B. convergent boundary
C. rift valley
D. transform boundary
7. The Himalayan mountain range of India was formed at the _____.
A. divergent boundary
B. convergent boundary
C. hot spot
D. transform boundary
8. Philippine plate moves toward _____.
A. Australian plate
B. Arabian plate
C. Antarctic plate
D. Eurasian plate
9. The _____ is an example of a transform fault boundary.
A. Appalachian Mountains
B. Mid-Atlantic Ridge
C. San Andreas Fault
D. Himalayas
10. This is the type of plate boundary that occurs between the African Plate and the Arabian Plate.
A. divergent boundary
B. transform boundary
C. convergent oceanic-continental plate boundary
D. convergent oceanic-oceanic plate boundary

11. This is the type of plate boundary that occurs between the Nazca Plate and the South American Plate.
- A. convergent oceanic-continental plate boundary
 - B. convergent oceanic-oceanic plate boundary
 - C. convergent continental-continental plate boundary
 - D. transform boundary
12. Based on the current position of the continents, South America is moving away from Africa in what direction?
- A. West
 - B. East
 - C. North
 - D. South
13. At the convergent plate boundary, _____.
- A. new crust is created
 - B. the crust separates
 - C. the older crust is recycled by subduction
 - D. plates slide past one another
14. The force that causes the plates to move is_____.
- A. tectonic force
 - B. gravitational force
 - C. radiation
 - D. convection current
15. Features found at divergent plate boundaries include _____.
- A. mid-ocean ridges
 - B. deep-sea trenches
 - C. crumpled mountains
 - D. island arc volcanoes

How did you find the pretest? What was your score? If you got 15 items correctly, you may skip the module. But if your score is 14 and below, you must proceed with the module.

Have fun learning!

Lesson 1

Plate Boundaries

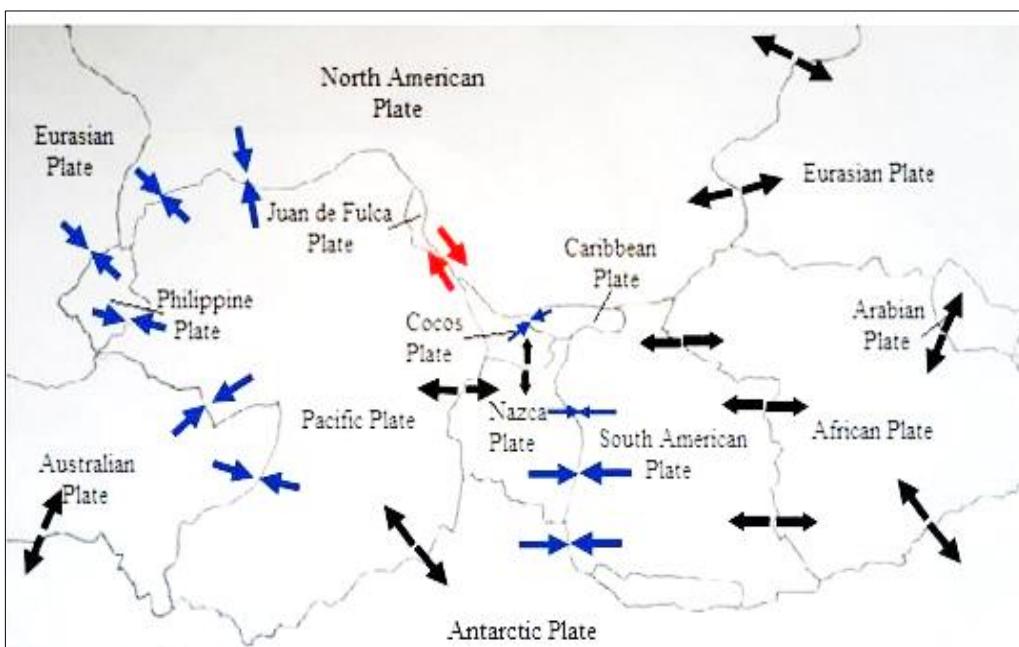


Figure 1. Map of Plate Boundaries

Figure 1 shows large and small lithospheric plates, including the Philippine Plate. These plates are moving very slowly but constantly. The movement of the plate is called Tectonic.

In Module 1, you have learned about Plate Tectonics. In this module, you will learn how this plate tectonics affects the formation of different types of plate boundaries.



What's In

Directions: Below is an activity for you to recall what you have learned in module

Plate Tectonics Crossword Puzzle

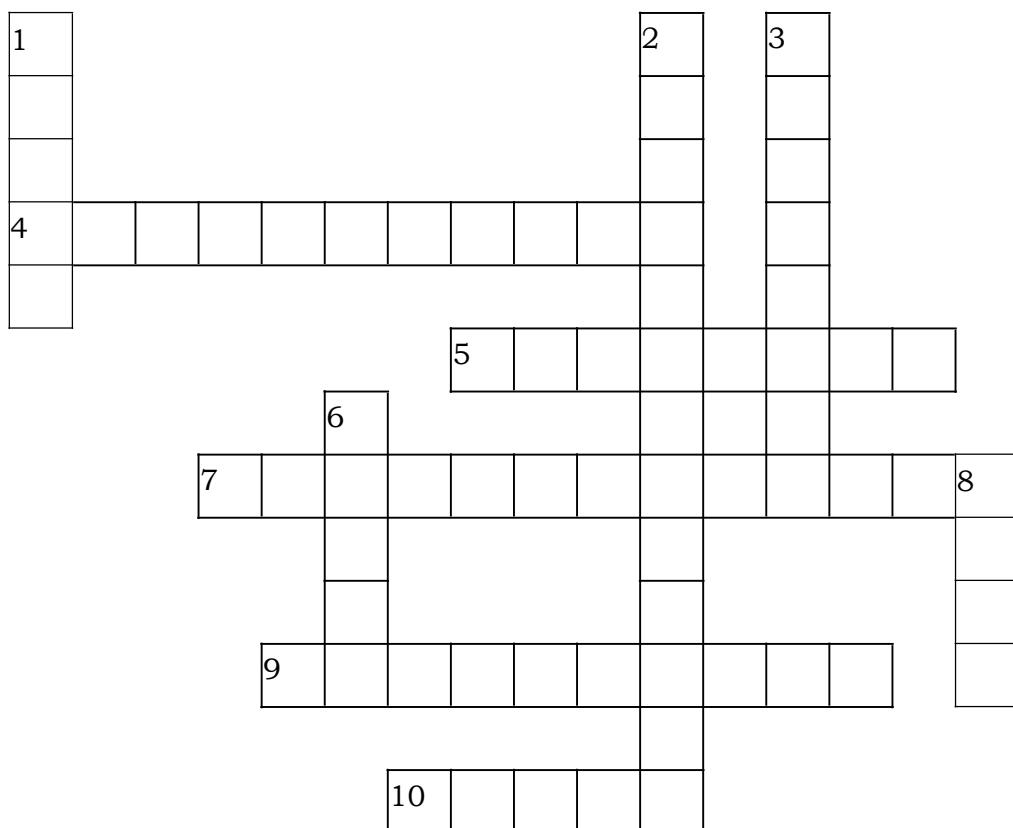
Down:

1. The break in a rock along which movement have occurred
2. Earth crust that is thinner but denser
3. Mt. Pinatubo
6. Molten rocks

8. The innermost layer of the earth

Across:

4. The outermost rigid layer of the earth consists of the crust and upper mantle
5. Borderline
7. Movement of the lithospheric plate
9. The vibration of the Earth due to the release of tremendous energy



Notes to the Teacher

This module contains brief but substantial concepts of Plate Boundaries. Enrichment activities and assessments for the learners are provided.

The teacher will assist and guide the learners while going through this module.



What's New

*For you to understand the lesson well, do the following activities.
Have fun and good luck!*

Activity 1: Read Me! Understand Me!

Directions: Read the three plate boundaries description and characteristics. Understand what you are reading.

Plate boundaries are the lines at the edges of the different pieces of the lithosphere. Lithospheric plates are moving due to the *convection current* in the Earth's interior. The lithosphere is made up of the crust and upper part of the mantle. There are two types of crusts: the continental crust which is thicker but less dense, and the oceanic crust, which is thinner and denser.

According to the Plate Tectonic Theory, the Earth's lithosphere consists of the crust and upper mantle that move slowly and constantly over time. This movement causes the formation of plate boundaries namely: divergent, convergent, and transform fault boundaries.

- (a) **Divergent boundaries** refer to plates that separate and move apart in opposite directions forming new lithosphere - the young seafloor. This either occurs at mid-ocean ridges (seafloor spreading) or at rifted continental margins (rift valley).
- (b) **Convergent boundaries** are formed when two plates move toward each other. The oceanic plate bends downward at the subduction zone. This occurs in two oceanic plates: convergent boundary and continental plate-oceanic plate convergent boundary. Oceanic plate sinks because it is denser than the continental plate. In the case of convergence of two oceanic plates, the older plate sinks. Whereas in the convergence of two continental plates, they collide and buckle up forming mountain ranges. No subduction occurs in this type of convergence.
- (c) **Transform fault boundaries** are plates sliding past or slipping past each other.

Directions: Choose your answer from the given choices. Write your answer on a separate sheet of paper.

- Q1. What plate boundary is formed by the sliding of two plates?
A. Divergent B. Convergent C. Transform-fault
- Q2. What plate boundary is formed by the moving of two plates apart?
A. Divergent B. Convergent C. Transform-fault

Q3. What plate boundary is formed by the collision of two plates?

- A. Divergent B. Convergent C. Transform-fault

Q4. What are the three types of convergent boundaries?

- A. Oceanic-Continental C. Oceanic-Oceanic
B. Continental-Continental D. Lithosphere-Crust

For Q5. Using two arrows (→), draw the direction of the relative motion of the three plate boundaries below:

- A. convergent boundary
B. divergent boundary
C. transform fault boundary



What is It

Divergent Boundary is formed when two tectonic plates move apart from each other creating tension. Molten rocks called magma to rise from the Earth's mantle to the surface. The Earth's surface is cool enough to solidify the magma that rose, thus, creating new oceanic crust or seafloor. A divergent boundary is also known as a *constructive boundary*. The *mid-ocean ridge* is formed by the divergence between oceanic plates while *continental rift valley* is formed between continental plates. Rift valley can also be found at the bottom of the ocean where seafloor spreading occurs. Both the formation of mid-ocean ridge and rift valley had the occurrence of an earthquake. Examples are boundaries between South American plate and African plate, Pacific Plate and Nazca Plate, and North American Plate and Eurasian Plate.

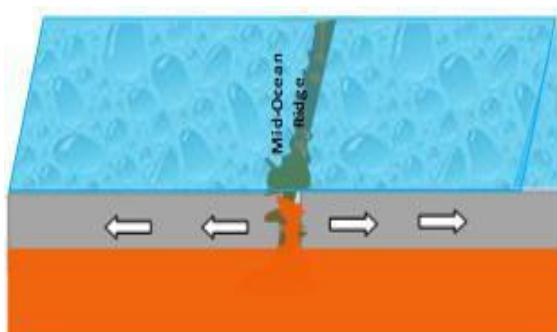


Figure 2. Divergent Boundary

Convergent boundary is formed when two plates move toward each other. This boundary has three types: Oceanic plate -Continental plate boundary, Two Oceanic plates boundary, and Two Continental plates boundary. In Oceanic-Continental plates boundary and two oceanic plates boundary, the oceanic plate bends downward into the mantle through the process called subduction. The leading edge of the subducted plate melts in the mantle and magma

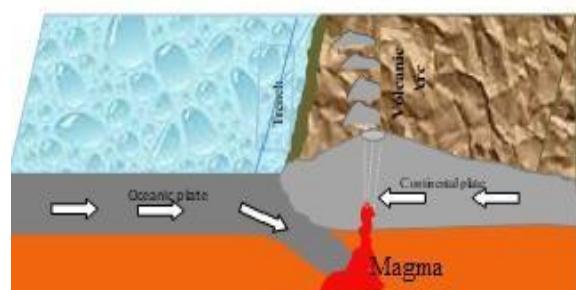


Figure 3. Convergent Boundary

rises forming a continental volcanic arc in oceanic-continental plate boundary, which is parallel to the trench that is formed due to subduction. While in two oceanic plates boundary, island volcanic chain is formed parallel to the trench. An earthquake occurs in both type of boundaries. Since the oceanic plate is destroyed at the convergent boundary, this boundary is also called a *destructive boundary*. Examples are boundaries between the Eurasian plate and the Philippine plate, Nazca Plate and South American Plate, and Pacific Plate and Australian Plate. With two continental plates converging, a compression zone is formed. Both plates collide and buckle up causing mountain ranges such as the Himalayas mountain ranges. There is no subduction, no trench, and no volcanoes formed in this type of convergent boundary.

Transform fault boundary is formed when two plates are sliding past each other. It is also called the Strike-slip fault. Rocks that line the boundary split into pieces as the plates slip at each other. A crack is then formed creating an undersea canyon or linear fault valley. San Andreas Fault is an example of this.

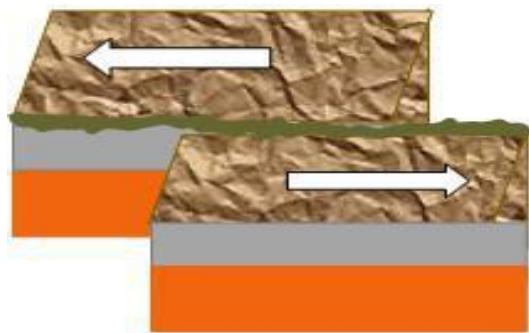
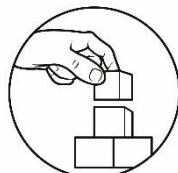


Figure 4. Transform Fault Boundary



What's More

Here are some enrichment activities for you to work on to master and strengthen the basic concepts you have learned from this lesson.

Enrichment Activity 1: Fill the Missing Piece!

What you need

ruler
pencil/pen

What you have to do

1. Get a ruler and pen and draw a table like the one on the next page (page 9) on a separate sheet of paper.
2. Complete the table.
3. Use arrows to represent the direction of the movement.
4. Answer Assessment 1.

| Direction of Movement | Motion | Type of Boundary | Example |
|------------------------------|---|--------------------------|----------------|
| ↔ ↔ | | | |
| | Two plates come together, one sliding under the other, or both are rising up. | | |
| | | Transform fault Boundary | |

Table 1: Plate Boundaries

Assessment 1

Directions: Use a separate sheet of paper for your answers. Write the correct word/s from the choices inside the parenthesis to complete the sentence in each given item.

1. The relative motion of the plates at the transform fault boundary is _____ (moving away, sliding past) each other.
2. The relative motion of the plates at the divergent boundary is moving _____ (away, toward) each other.
3. The relative motion of the plates at the convergent boundary is moving _____ (away, toward) each other.
4. At the convergent boundary between oceanic plate and continental plate, _____ (tension, subduction) zone is formed.
5. _____ (Mid-ocean ridge, Rift valley) is formed by divergence of two oceanic plates.

Enrichment Activity 2: Spot the Difference

1. Study Figure 5, 6, and 7 showing the three types of convergent boundaries.
2. Take note of the differences and similarities between the three figures and answer Assessment 2.

Types of Convergent Boundaries

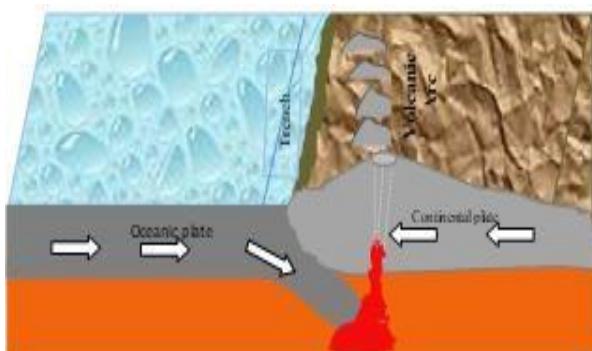


Figure 5: Oceanic-Continental Plate Convergent Boundary

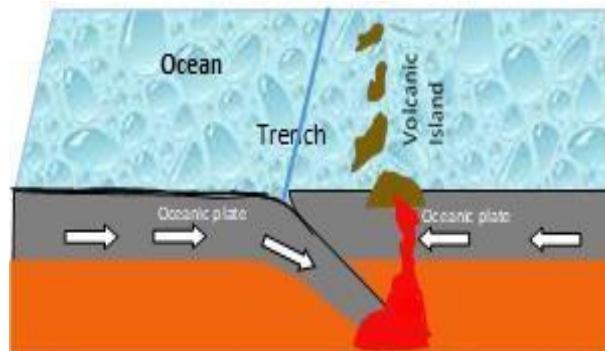


Figure 6: Two Oceanic Plates Convergent Boundary

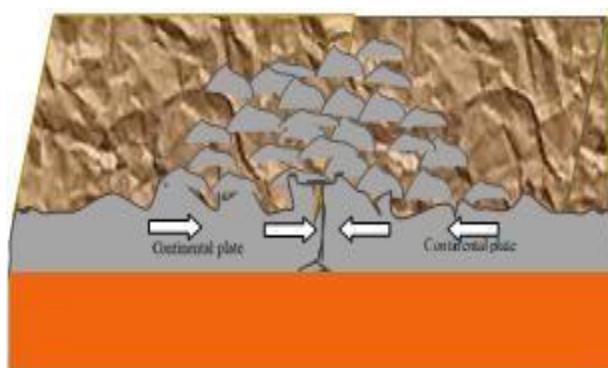


Figure 7: Two Continental Plates Convergent Boundary

Assessment 2

Directions: Arrange the jumbled letters below to form the correct word/s. Use these words to complete the paragraph that follows. Write your answer on a separate sheet of paper.

- A. ICOCEAN PLTEA - _____
- B. CONNITNETAL PTALE - _____
- C. OCIENAC - _____
- D. UOSUBDCTIN - _____
- E. ON - _____

Figure 5 shows two plates which are (1) _____ and (2) _____. The (3) _____ plate subducts. **Figure 6** shows that one of the two oceanic plates bends toward the mantle at the (4) _____ zone. **Figure 7** shows the two continental plates colliding. In this type of convergent boundary, there is (5) __ subduction zone

Enrichment Activity 3: Find the Boundary on the Map!

The seven major plates are African plate, Antarctic plate, Eurasian plate, Australian plate, North American plate, Pacific plate, and South American plate. Plate boundaries are formed between these plates. Can you identify them?

What you need:

Map of the plate boundaries

Pen / pencil

What you have to do

The figure below (Figure 8) shows the relative motion of the plates as indicated by the arrows. Study the direction of the arrows on the map. Identify the plates that lie on the divergent, convergent, and transform fault boundaries.

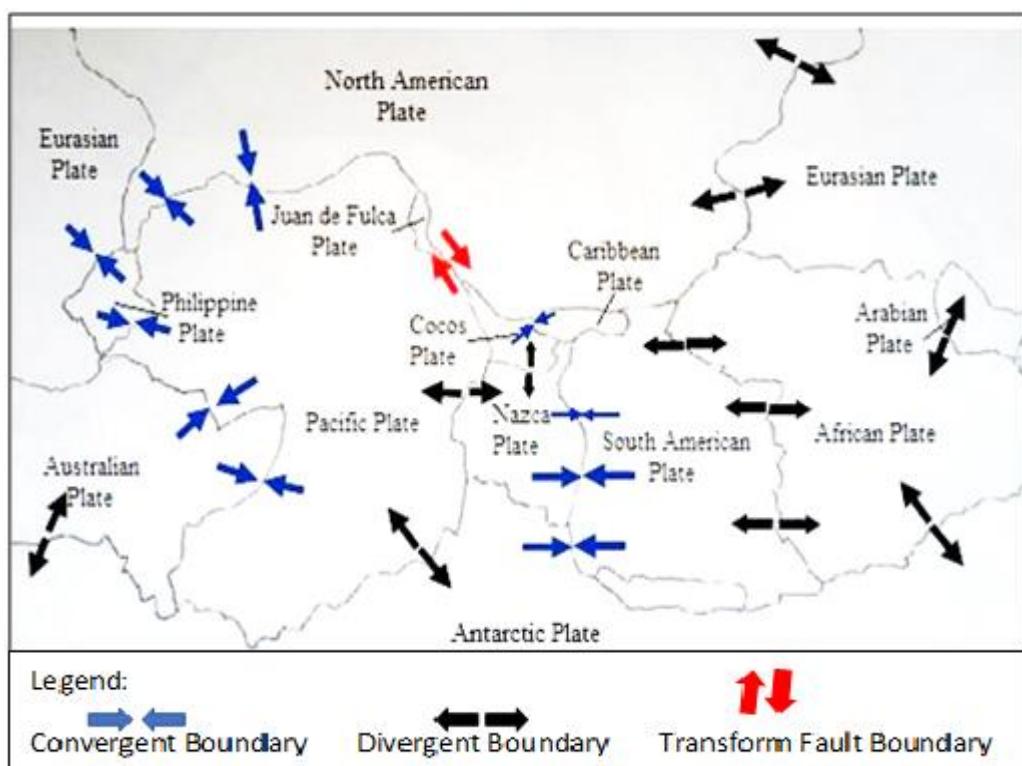


Figure 8. Map of the Plate Boundaries

Assessment 3

Directions: Use a separate sheet of paper for your answers. Write the correct word/s from the choices inside the parenthesis to complete the sentence in each given item.

1. Pacific plate and Nazca plate formed _____ (convergent, divergent) boundary.
2. San Andreas Fault is a transform fault boundary found in _____ (South American plate, North American plate).
3. Philippine plate moves toward _____ (African plate, Eurasian plate) at the convergent boundary.

4. _____ (Convergent, Divergent) is the type of boundary between Australian plate and African plate.
5. The type of boundary between Pacific plate and Antarctic plate is _____ (convergent, divergent) boundary.

*Great job! You have understood the lesson.
Are you now ready to summarize?*

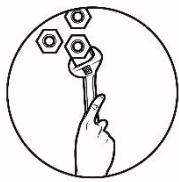


What I Have Learned

Directions: Summarize what you have learned from the lesson and activities by completing the sentences using the words from the box. You can only use each word once. Use a separate sheet of paper for your answers.

| | | | |
|--------------------|---------------------------------|------------|------------------------|
| continental | theory | geologic | divergent |
| lithosphere | plates | subduction | convection current |
| slowly | denser | toward | two continental plates |
| two oceanic plates | oceanic plate-continental plate | | transform fault |

- (1) _____ is made of earth's crust and upper mantle. It is subdivided into portions called (2) _____ that move above the mantle. The two kinds of crust are (3) _____ crust, which is thicker but less dense, and oceanic crust, which is thinner but (4) _____. A (5) _____ that the Earth's crust is made up of plates moving (6) _____ and interact in various ways is Plate Tectonics. The interaction of the plates produces earthquakes, mountains, volcanoes, and other (7) _____ features. (8) _____ from the Earth's interior makes the plates move above the mantle. This movement causes the formation of three types of plate boundaries which are (9) _____ boundary, two plates sliding each other; (10) _____ boundary, two plates moving away from each other and convergent boundary which plates are moving (11) _____ each other. Three types of convergent boundaries are (12) _____ convergent boundary which forms volcanic island arc, (13) _____ convergent boundary forming a continental volcanic arc, and (14) _____ convergent boundary wherein there is no (15) _____.



What I Can Do

At this point, make a plate tectonic model showing the plate boundaries and plate movements. Cutouts of plate boundaries are provided on the next page. The scoring rubric will be used in assessing your outputs.

What you need

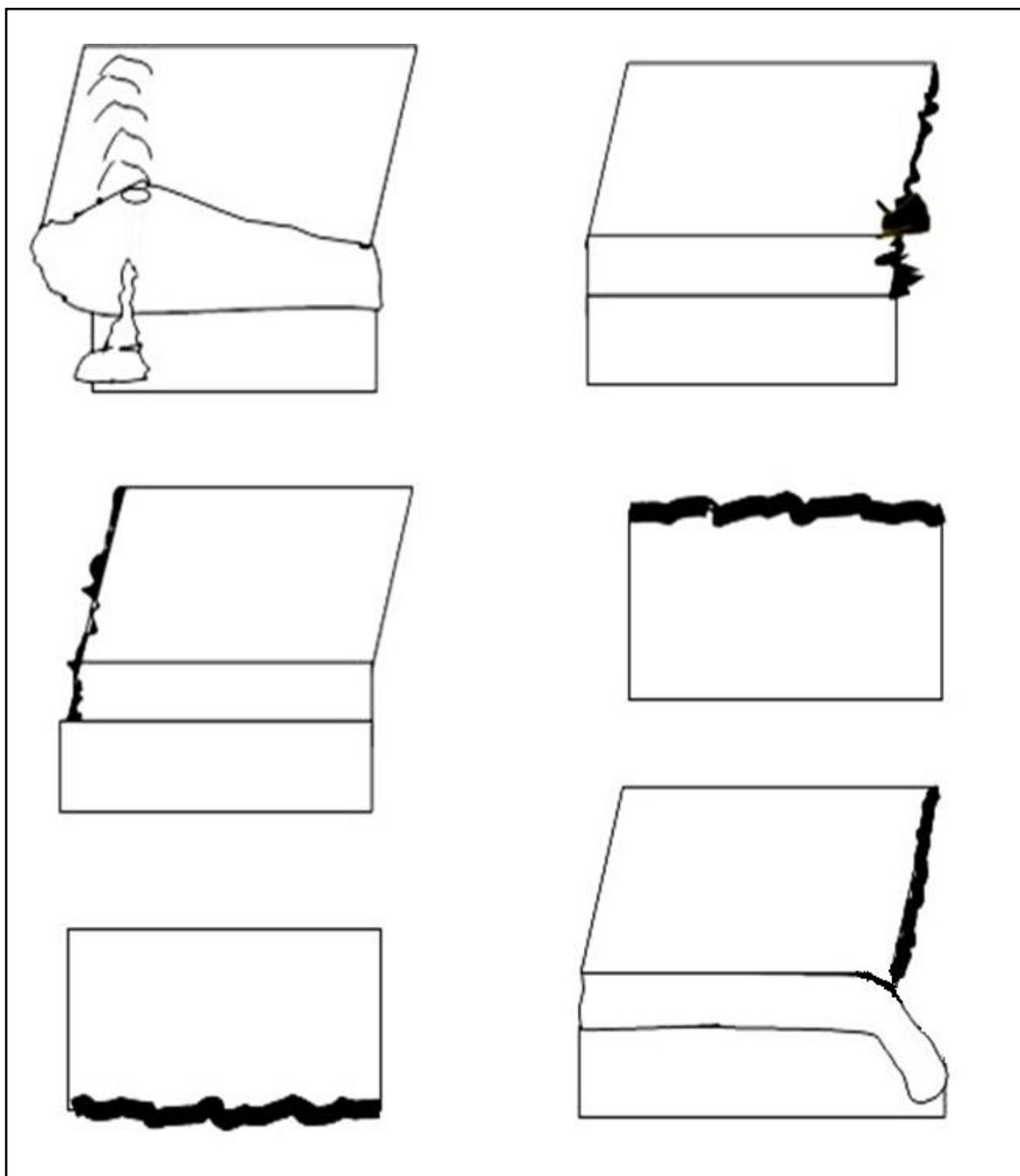
Plate Boundaries cutouts
Pair of scissors
pencil/pen
crayon/color pencils
coupon bond/sheet of paper
paste

What you have to do

1. Cut the drawings on the next page and form models of plate boundaries.
2. Paste-on a piece of a coupon bond or sheet of paper.
3. Put arrows to show the motion of the plates.
4. Color the models. Brown for continental crust, blue for oceanic crust, red orange for magma, gray or dark brown for mountains and volcanoes and black for trench.
5. Label the models such as Convergent Boundary, Divergent Boundary, Transform Fault Boundary.
6. Label each model with Volcanic arc, Trench, Island volcanic chain, Oceanic plate, Continental plate, and Magma.

Copy for the learner: Copy this page in a separate paper and use it as your answer sheet. For the first user of this module, use the spare copy found at the back.

Plate Boundaries Cut outs



Rubrics for Scoring the Output

| Illustrations | Poor 1 point | Fair 3 points | Good 5 points |
|--|--|--|--|
| Plate Boundaries include an illustration of convergent, divergent, and transform fault boundary. | Plate boundaries are not properly labeled or not included. | One of the plate boundaries is missing. | The 3 different types of plate boundaries are properly labeled. |
| Plate movement must include illustrations of the direction of the plate movement, and labeling the different types of plates (oceanic and continental) | The direction of the plate movements is incorrectly labeled. The oceanic and continental plates are missing. | A few arrow directions are missing. Oceanic and continental plates are not properly labeled. | The output includes 6 arrows properly showing the direction of the movement of the plate boundaries. Oceanic and continental plates are properly labeled throughout the model. |
| Earth processes include an illustration of subduction, Mid-ocean ridge, and volcanic arc. | Two or more of the processes are missing; two or more are not properly labeled. | One of the processes is missing; one is not properly labeled. | The output includes subduction, Mid-ocean ridge, and volcanic arc are properly labeled and depicted. |
| Quality of model, neatness, color, and legible handwriting is evident. | The quality of model is sloppy, and labels are not legible. | The quality of the model is fair. | The model is neat and colorful. All labels are easy to read. |

Very well done! You are now ready to take your posttest. You may again go over the lessons, activities, and maps to review for the final assessment.

Good luck!

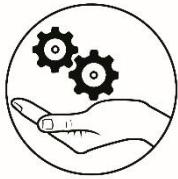


Assessment

Directions: Read carefully each item. Use a separate sheet for your answers. Write only the letter of the best answer for each test item.

1. Convection current causes the lithospheric plate to _____.
A. move slowly but constantly
B. move in any direction
C. move faster
D. create another plate
2. The youngest part of the ocean floor is found at the _____.
A. convergent boundary C. transform-fault
B. divergent boundary D. hot spot
3. What type of plate boundary occurs between the Nazca Plate and the South American Plate?
A. convergent oceanic-continental plate boundary
B. convergent oceanic-oceanic plate boundary
C. convergent continental-continental plate boundary
D. transform boundary
4. The crust and upper mantle make up the Earth's _____.
A. lithosphere C. core
B. asthenosphere D. continents
5. The result of plate movement can be seen at _____.
A. abyssal plains C. plate centers
B. plate boundaries D. ocean margin
6. The theory that suggests that plates are slowly moving is called _____.
A. Magnetic Reversal C. Continental Slope
B. Plate Tectonic D. Continental Drift
7. Plates move apart at _____ boundaries.
A. convergent C. divergent
B. stable D. transform plate

Great job! You are almost done with this module.



Additional Activity

“Find Me”

Directions: Answer the given questions below on a separate sheet of paper. Then find your answers in the Word Search on the next page. (A copy of the Word Search is provided for the learner.)

1. Philippine islands were originated from _____ boundary.
2. What type of plate boundary occurs between the Eurasian plate and the North American plate?
3. Movement of the plate boundary causes shaking of the Earth’s surface called _____.
4. It consists Earth’s crust and upper mantle.
5. What geologic feature is formed between the diverging oceanic plates?
6. It is a transform fault boundary between the Pacific plate and North American plate which extends through California.
7. It is the process wherein the leading edge of one plate bends downward into the mantle beneath the other plate.
8. What type of plate boundary is formed between two plates sliding past each other?
9. Other terms for molten rocks.
10. Convergent boundary is formed between Caribbean plate and _____ plate.

Learner's Copy: Copy the “Plate Boundaries Word Search” in a separate paper and use it as your answer sheet. For the first user of this module, use the spare copy found at the back.

Plate Boundaries Word Search

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | M | I | D | O | C | E | A | N | R | I | D | G | E | B | X | S |
| F | N | Z | A | C | S | N | J | C | U | J | H | U | G | V | T | A |
| T | C | E | G | P | W | L | E | M | R | U | S | T | O | H | I | N |
| R | M | S | G | E | L | J | E | A | T | J | J | G | K | O | T | A |
| A | K | E | A | R | A | A | E | G | R | J | Q | H | E | T | N | N |
| N | N | I | P | E | E | R | T | M | S | E | T | O | U | S | F | D |
| S | O | R | I | F | T | V | A | A | L | E | Y | P | H | P | I | R |
| F | I | M | V | E | D | G | N | H | T | I | P | S | O | O | P | E |
| O | T | O | E | V | R | J | N | O | L | E | R | P | O | T | H | A |
| R | O | I | T | C | E | V | N | O | C | A | C | A | C | L | S | |
| M | E | O | E | O | Z | B | P | Q | P | H | Y | T | A | C | M | F |
| F | V | G | W | C | D | I | V | E | R | G | E | N | T | E | K | A |
| A | N | I | S | O | Q | J | A | M | B | F | I | C | R | N | C | U |
| U | O | S | K | S | E | K | A | U | Q | H | T | R | A | E | I | L |
| L | I | T | H | O | S | P | H | E | R | E | J | V | R | O | G | T |
| T | N | K | G | R | I | V | N | O | I | T | C | U | D | B | U | S |

Great job!

You are now aware of the different types of plate boundaries.

Are you ready to demonstrate precautionary measures when geologic disasters happen?

What's More

Enrichment Activity 1

Table 1. Plate Boundary Characteristics

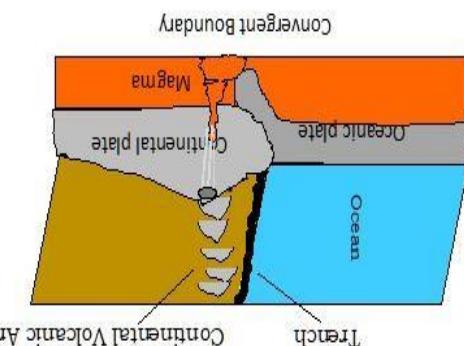
| Direction of Motion | Motion | Type of Plate Boundary | Example |
|---------------------|--|------------------------|---|
| 2. away | 2 plates moving apart | Divergent | African plate and South American plate from each other or answer may vary based on the map. |
| 3. toward | 2 plates coming together, one sliding under the other or plates come together and both are rising up | Convergent | Eurasian plate and Phillipine plate or 2 plates come together, one sliding under the other or both are rising up based on the map. |
| 4. subduction | 2 plates slide past each other. | Transform Fault | San Andreas Fault |
| 5. Mid-Ocean Ridge | | | |

Assessment 1

1. Slide past
2. away
3. toward
4. subduction
5. Mid-Ocean Ridge

Assessment

What Can I Do



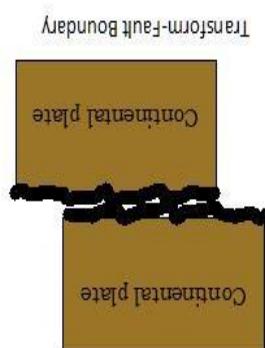
WHAT'S MORE

Ethics in Health Activities 2

- Frigid Activity 3

| | | | | |
|------------------|----------------------|------------|---------------|-------|
| A. OCEANIC PLATE | B. CONTINENTAL PLATE | C. OCEANIC | D. SUBDUCTION | E. NO |
| 1. Oceanic Plate | 2. Continental Plate | 3. Oceanic | 4. Subduction | 5. No |

Points will be based on Rubrics



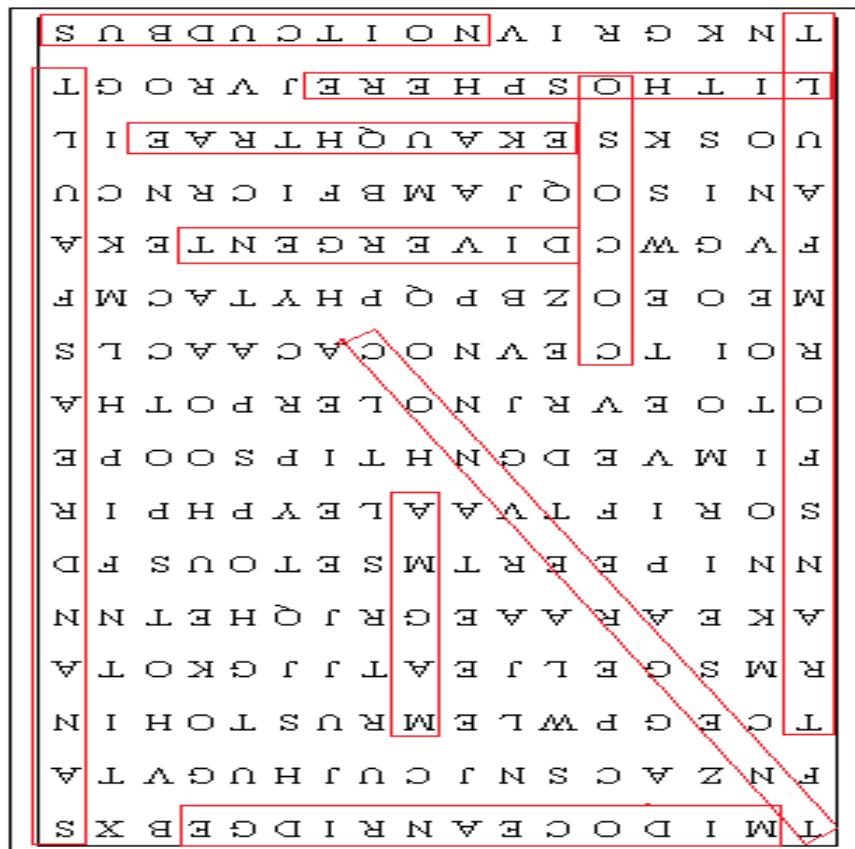
1. Divergent
 2. North American Plate
 3. Eurasian Plate
 4. Divergent
 5. Divergent

Enrichment Activity 3

- TRANSITION-Fault Boundary

Page 1

1. A
2. B
3. A
4. A
5. B
6. B
7. C
8. D
9. D
10. A
11. B
12. C
13. B
14. D
15. C



| "Find Me" | |
|--------------------|----------------------|
| 1. Divergent | 6. San Andreas Fault |
| 2. Convergent | 7. Subduction |
| 3. Earthquake | 8. Transform fault |
| 4. Lithosphere | 9. magma |
| 5. Mid-ocean ridge | 10. Cocos |

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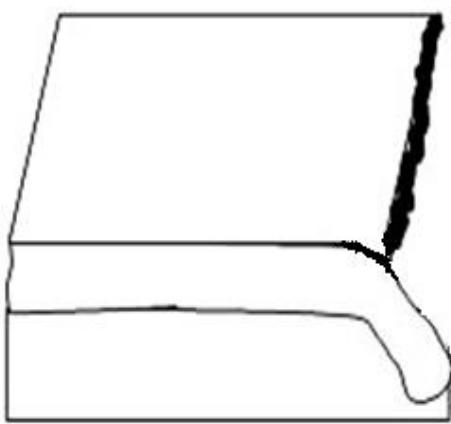
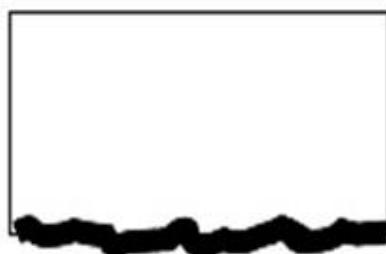
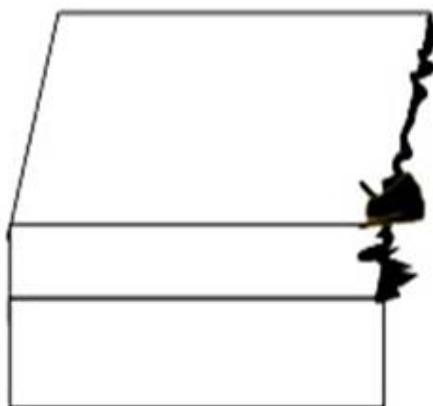
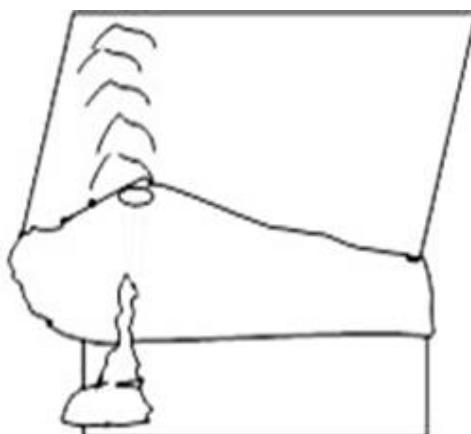
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Copy for the learner

Plate Boundaries Cut outs



Learner's Copy

Plate Boundaries Word Search

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | M | I | D | O | C | E | A | N | R | I | D | G | E | B | X | S |
| F | N | Z | A | C | S | N | J | C | U | J | H | U | G | V | T | A |
| T | C | E | G | P | W | L | E | M | R | U | S | T | O | H | I | N |
| R | M | S | G | E | L | J | E | A | T | J | J | G | K | O | T | A |
| A | K | E | A | R | A | A | E | G | R | J | Q | H | E | T | N | N |
| N | N | I | P | E | E | R | T | M | S | E | T | O | U | S | F | D |
| S | O | R | I | F | T | V | A | A | L | E | Y | P | H | P | I | R |
| F | I | M | V | E | D | G | N | H | T | I | P | S | O | O | E | P |
| O | T | O | E | V | R | J | N | O | L | E | R | P | O | T | H | A |
| R | O | I | T | C | E | V | N | O | C | A | C | A | C | L | S | |
| M | E | O | E | O | Z | B | P | Q | P | H | Y | T | A | C | M | F |
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| U | O | S | K | S | E | K | A | U | Q | H | T | R | A | E | I | L |
| L | I | T | H | O | S | P | H | E | R | E | J | V | R | O | G | T |
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For inquiries or feedback, please write or call:

Department of Education - Bureau of Learning Resources (DepEd-BLR)

Ground Floor, Bonifacio Bldg., DepEd Complex
Meralco Avenue, Pasig City, Philippines 1600

Telefax: (632) 8634-1072; 8634-1054; 8631-4985

Email Address: blr.lrqad@deped.gov.ph * blr.lrpd@deped.gov.ph