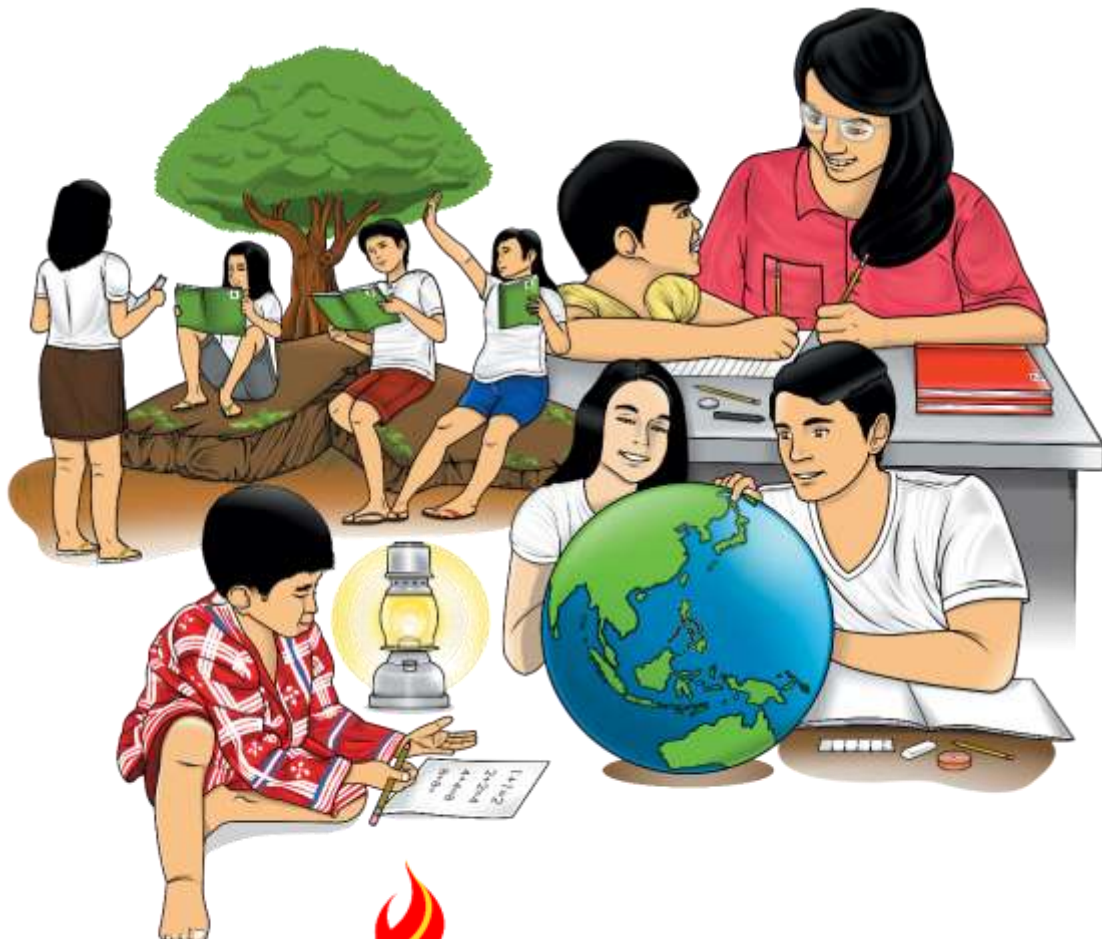


Science

Quarter 1 – Module 4: Earth's Mechanism



Science – Grade 10
Alternative Delivery Mode
Quarter 1 – Module 4: Earth’s Mechanism
First Edition, 2020

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10

Science

Quarter 1 – Module 4: Earth’s Mechanism

Introductory Message

For the facilitator:

Welcome to the **Science 10 Alternative Delivery Mode (ADM) Module 4 on Earth's Mechanism!**

This module was collaboratively designed, developed, and reviewed by educators both from public and private institutions to assist you, the teacher, or facilitator in helping the learners meet the standards set by the K to 12 Curriculum while overcoming their personal, social, and economic constraints in schooling.

This learning resource hopes to engage the learners in guided and independent learning activities at their own pace and time. Furthermore, this also aims to help learners acquire the needed 21st-century skills while taking into consideration their needs and circumstances.

As a facilitator, you are expected to orient the learners on how to use this module. You also need to keep track of the learners' progress while allowing them to manage their own learning. Furthermore, you are expected to encourage and assist the learners as they do the tasks included in the module.

For the learner:

Welcome to the **Science 10 Alternative Delivery Mode (ADM) Module 4 on Volcanoes, Earthquakes, and Mountain Ranges!**

The hand is one of the most symbolized parts of the human body. It is often used to depict skill, action, and purpose. Through our hands, we may learn, create, and accomplish. Hence, the hand in this learning resource signifies that you, as a learner is capable and empowered to successfully achieve the relevant competencies and skills at your own pace and time. Your academic success lies in your own hands!

This module was designed to provide you with fun and meaningful opportunities for guided and independent learning at your own pace and time. You will be enabled to process the contents of the learning resource while being an active learner.

This module has the following parts and corresponding icons:



What I Need to Know

This will give you an idea of the skills or competencies you are expected to learn in the module.



What I Know

This part includes an activity that aims to check what you already know about the lesson to take. If you get all the answers correct (100%), you may decide to skip this module.



What's In

This is a brief drill or review to help you link the current lesson with the previous one.



What's New

In this portion, the new lesson will be introduced to you in various ways, such as a story, a song, a poem, a problem opener, an activity, or a situation.



What is It

This section provides a brief discussion of the lesson. This aims to help you discover and understand new concepts and skills.



What's More

This comprises activities for independent practice to solidify your understanding and skills of the topic. You may check the answers to the exercises using the Answer Key at the end of the module.



What I Have Learned

This includes questions or blank sentences/paragraphs to be filled in to process what you learned from the lesson.



What I Can Do

This section provides an activity that will help you transfer your new knowledge or skill into real-life situations or concerns.



Assessment

This is a task which aims to evaluate your level of mastery in achieving the learning competency.



Additional Activities

In this portion, another activity will be given to you to enrich your knowledge or skill of the lesson learned. This also tends to the retention of learned concepts.



Answer Key

This contains answers to all activities in the module.

At the end of this module, you will also find:

References

This is a list of all sources used in developing this module.

The following are some reminders in using this module:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer *What I Know* before moving on to the other activities included in the module.
3. Read the instruction carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and checking your answers.
5. Finish the task at hand before proceeding to the next.
6. Return this module to your teacher/facilitator once you are through with it.

If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator. Always bear in mind that you are not alone.

We hope that through this material, you will experience meaningful learning and gain an in-depth understanding of the relevant competencies. You can do it!



What I Need to Know

The Earth's whole lithosphere is broken into several rigid sections called plates that move constantly. Do lithospheric plates move quickly or slowly? What must be the reason behind the motion of the massive lithospheric plates?

This module contains different activities that will help you understand the driving force behind plate tectonics.

After going through this module, you should be able to:

1. describe the possible causes of plate movement (S10ES-Ia-j-36.5); and
2. recognize the process of convection current in the mantle.



What I Know

Choose the letter of the best answer. Write your letter of choice on a separate sheet of paper.

1. A convection current is caused by differences in temperature resulting to variation in _____.
 - A. air pressure
 - B. color
 - C. density
 - D. mass
2. Scientists believe that the motion of tectonic plates is caused by _____.
 - A. pressure in Earth's crust
 - B. conveyor belts
 - C. convection currents
 - D. heat in the Earth's core
3. It is a measure of how much mass there is in a volume of a substance.
 - A. volume
 - B. temperature
 - C. density
 - D. mass
4. Hot molten materials in a convection cell rises near the _____.
 - A. outer core
 - B. crust
 - C. inner core
 - D. mantle

5. The idea that Earth's lithosphere is broken up into separate plates that float on the mantle is the theory of _____.
- A. continental drift
 - B. seafloor spreading
 - C. tectonic movement
 - D. plate tectonics
6. The region in which one plate moves under another is _____.
- A. rift valley
 - B. subduction zone
 - C. magma chamber
 - D. vent
7. The motion of gas or liquid caused by differences in temperature is a _____.
- A. tectonic movement
 - B. plate tectonic
 - C. convection current
 - D. magma chamber
8. A driving force for plate motion at mid-ocean ridges as a result of the rigid lithosphere sliding down _____.
- A. slab pull
 - B. ridge push
 - C. convection current
 - D. seafloor spreading
9. The process of one plate moving under another plate is called _____.
- A. drifting
 - B. plate tectonics
 - C. seafloor spreading
 - D. subduction
10. Tectonic plates ride on _____.
- A. inner core
 - B. asthenosphere
 - C. outer core
 - D. lithosphere
11. The region where old crust melted back into magma is _____.
- A. along plate boundaries
 - B. at the mid-ocean ridge
 - C. at deep-sea trenches
 - D. volcano
12. Which of the following is NOT a method of heat transfer?
- A. condensation
 - B. convection
 - C. conduction
 - D. radiation
13. The plastic-like upper portion of the mantle is called
- A. the magma
 - B. the core
 - C. the lithosphere
 - D. the asthenosphere

14. Which of the following is NOT a driving force of tectonic plates?
- A. ridge push
 - B. slab push
 - C. drag force
 - D. mantle convection
15. What is the source of heat in a mantle convection current?
- A. the Sun
 - B. the crust
 - C. the core
 - D. the moon

Lesson

1

Mantle Convection

Earth's mechanism deals with the forces acting on lithospheric plates to move in a particular direction. The motion is a result of thermal convection in the mantle due to the convection current formed. The mantle convection process will be further explained as you go along the module.



What's In

From the previous lesson, you have learned about Theory of Continental Drift in which Wegener thought that the seven continents we know today had been once a part of a supercontinent called Pangaea. It broke apart like pieces of a puzzle and moved to their present location, becoming today's continent. Can you still remember the evidence of the Continental Drift Theory? Can you figure out these evidence that supported this theory? How about the evidence of the Seafloor Spreading Theory? What could be the reasons why scientists rejected Wegener's idea of Continental Drift?

In this lesson, you will learn about mantle convection and forces as a mechanism to the motion of the massive plates of the lithosphere and the development of the Theory of Plate Tectonic.



What's New

Convection in the Mantle Vocabulary

Let's use these materials:

paper, ball pen

Let's do it this way:

1. Arrange the scrambled letters below to form the word defined in each number.
2. Answer on a separate sheet of paper.

Assessment:

1. tmael _____

A layer beneath where the less dense hot molten material rises, and sinks

2. thprehaeosens _____

A soft, weak and plastic-like layer, the upper part of the mantle where lithospheric plates float and move.

3. mmgaa _____

Hot molten rocks formed beneath the Earth's surface.

4. noitcevnoc ctunrre _____

Facilitates the movement of the lithospheric plates.

5. orce _____

The innermost layer of the Earth, which generates heat to the mantle.



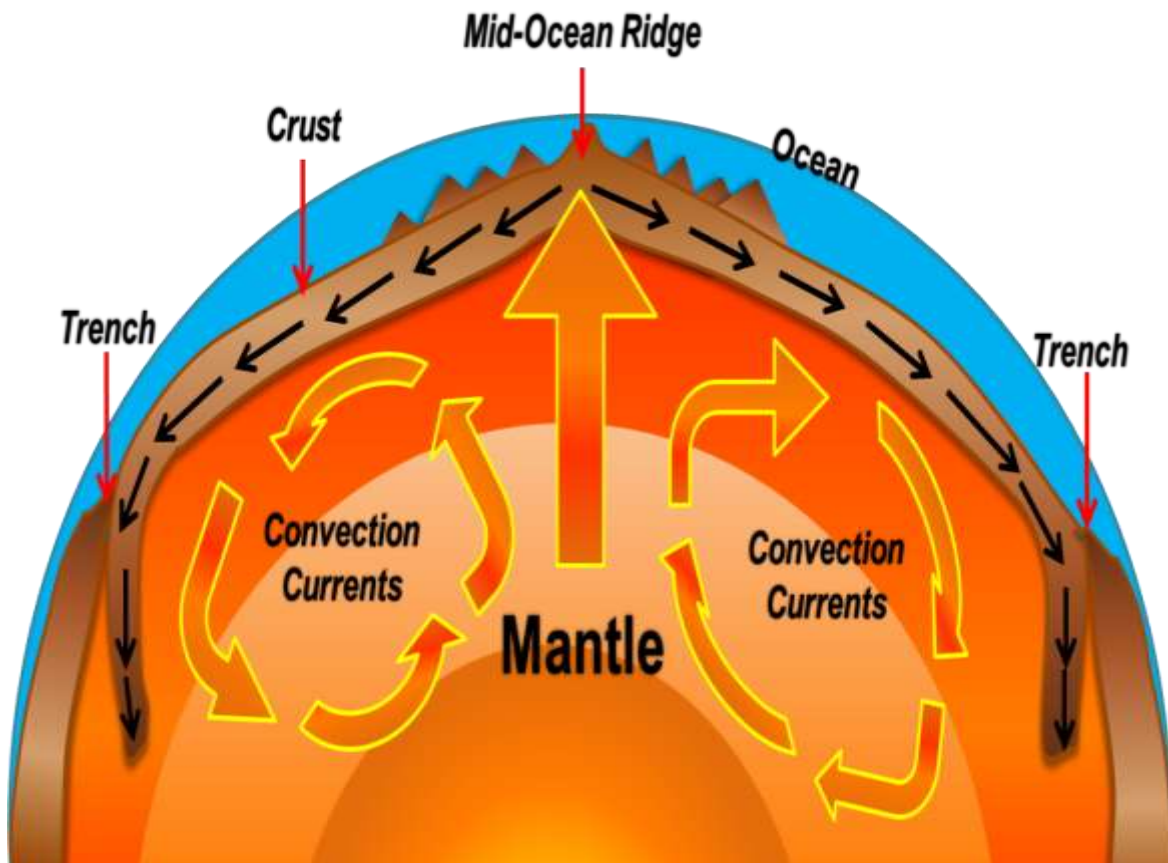
What is It

Plate Tectonic Theory

Plate Tectonic Theory was developed in 1960s, stating that the Earth's lithosphere-the crust and the upper mantle- is broken up into several pieces called plates that move slowly. It explains how the massive plates move along the different types of plate tectonic boundaries (convergent, divergent, and transform fault) where they interact, and the geologic events (earthquakes and subduction) and geologic features (formation of mountains, volcanoes, and trenches) that occur at their boundaries.

What Makes Lithospheric Plates Move?

A convection current is a heat transfer process that involves the movement of energy from one place to another. The convection currents tend to move a fluid, gas particles, or molten rock. These are due to the differences in the densities and the temperature of a specific gas or a fluid. Due to this temperature difference, the hot fluid tends to rise as it expands, whereas cold fluid tends to sink because it contracts. Convection is one of the kinds of heat transfer; the other two are radiation and conduction.



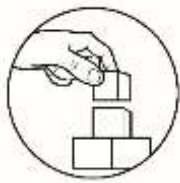
Convection current also happens in the mantle. The mantle is the second inner layer of Earth, made up of mostly hot rocks and magma. It is a very hot layer because of the heat generated by the core. The source of heat from the core is due to the decay or breakdown of radioactive elements. Mantle convection is a process by which thermal convection occurs in the inner layer of the earth. The differences in the temperature at the Earth's interior and surface cause convection currents to occur within the mantle.

Lithospheric plates are the parts of the uppermost layer of the Earth, and they are floating in an area called the asthenosphere. The asthenosphere is a soft, less rigid upper part of the mantle where the lithospheric plates float and move around. Plates move slowly and continuously when the hot less dense material rises. The rising hot material cools down in a certain area. Hence, it becomes denser than the cool, dense material sinks that creates convection cell, with hot rising currents and cool sinking currents are regularly repeated and become a cycle. The movement of

the lithospheric plate is attributed to mantle convection and considered as one of the driving mechanisms for plate motion. The lithosphere at the divergent boundary will uplift and tear apart due to the rising of hot magma. The sinking of magma pulls down the tectonic plate at a convergent boundary. Aside from mantle convection, ridge push, sliding, and slab pull are other forces that move the lithospheric plates.

In the process of slab pull, the presence of a heavier subducting plate pulls down the trailing slab into the subduction zone.

In a ridge push or gravitational sliding process, the old oceanic crust becomes heavier than the new oceanic crust and sinks because of the weight of the raised ridge, which pushes down the older oceanic crust towards the trench at the subduction zone.



What's More

You have learned from the previous activity about what is happening during convection.

Convection is a kind of heat transfer. Heat transfer in convection is caused by differences in temperature and density within a fluid or gas particle.

To further understand this process, answer the first enrichment activity of this module.

Activity 1: Rise and Fall

Let's use these materials:

paper, ball pen, pictures of the heat transfer process

Let's do it this way:

- A. On the space provided, put a checkmark (✓) on the convection process being described.
- B. Write five examples of a situation or object that uses convection current
- C. Answer in a separate sheet of paper

Assessment 1:

1. _____



boiling of water

2. _____



Warming of spoon

3. _____



rising of hot air balloon

4. _____



Burning of wood

5. _____



melting of ice

B. Example of situation or object that uses convection current

1. _____
2. _____
3. _____
4. _____
5. _____

Good job! Can you now explain convection as a kind of heat transfer?

Plates move by bumping, in the opposite direction, and sliding past each other resulting in making areas of volcanic activities, earthquake, and mountain formation. According to scientists, the motion is driven by a convection current mechanism within the earth.

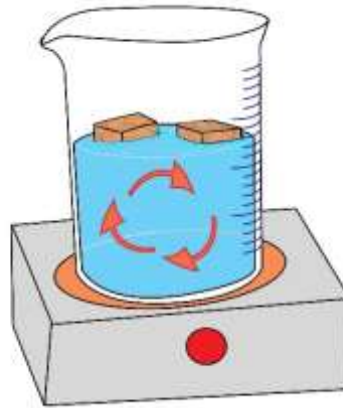
This time, connect your understanding of the convection process from the previous enrichment activity.

You may now continue onto the next activity.

Activity 2: Lithospheric Float

Let's use these materials:

paper, ball pen, a picture showing convection process.



Let's do it this way:

1. Refer to the picture to answer the questions that follow.
2. Answer in a separate sheet of paper

Assessment 2:

Based on the picture,

1. What represents the plates?
2. What represents the mantle?
3. Where is the heat source?
4. Why are the blocks of wood floating?
5. Which part of the water has a greater density? Lesser density?
6. Explain convection current

Continue doing good!

After learning how plates move due to convection current, you are now ready to do the next enrichment activity. You will get acquainted and be familiarized with some geological features and events deep within the Earth.

Activity 3: Get to the Right Track!

Let's use these materials:

1. paper, ball pen

Let's do it this way:

1. Read and understand the statements.
2. Answer in a separate sheet of paper.

Assessment 3:

Arrange the following events in the mantle convection process. Use numbers 1-5.

- ___ a. Lithospheric plates move in the asthenosphere due to the rising and sinking of materials.
- ___ b. The decomposition of radioactive elements causes heat in the interior part of the Earth.
- ___ c. Heat slowly rises to the mantle and creates convection current.
- ___ d. Heat moves to the core.
- ___ e. The process repeats as a cycle.



What I Have Learned

Let's summarize your lesson and activities!

Sum Up Challenge.

Let's use these materials:

1. paper, ball pen

Let's do it this way:

Complete the paragraph by choosing the correct answer from the box.

less	convection
more	sink
magma	current
density	temperature
heat	lithospheric
mantle	rise
core	cycle
asthenosphere	

1. _____ is a kind of 2. _____ transfer caused by differences in 3. _____ and 4. _____ of a gas ,fluid or molten rocks. Hot fluid materials 5. _____ because they are 6. _____ dense, while cold fluid materials 7. _____ because they are 8. _____ dense. In the mantle, the repeating rising and sinking of 9. _____ creates a convection 10. _____ driving the 11. _____ plates that ride on 12. _____ to move slowly and constantly.



What I Can Do

HOW DO WE COOK BY CONVECTION?

Palitaw is a kind of sweet, chewy, and flattened rice cake. This Filipino rice cake is prepared by soaking glutinous rice grains in water overnight and then processed as a dough. The dough is flattened into small pieces and cooked in boiling water until they float; this is the reason it was called palitaw. Based on your knowledge about convection current, make a sketch that can explain why palitaw floats in boiling water. In a separate sheet, sketch the convection current occurring in making the said rice cake.

The scoring rubric below will be used by your teacher in assessing your output.

Category	Excellent (5pts)	Good (4pts)	Satisfactory (3pts)	Needs improvement (1pt)	Score
Accuracy	The sketch is excellently accurate and can explain the information asked.	The sketch is accurate and is able to explain some of the information asked.	The sketch is slightly accurate and cannot fully explain the information needed.	The sketch is not accurate.	
Sketch	The sketch is neat, and necessary markings are found on the paper. It shows a clear and legible concept.	The sketch is legible. The concept is clear and legible but can be neater.	The sketch is somewhat okay but is not exactly neat and legible.	The sketch is not legible or clear at all.	
Understanding of the topic	The learner understood the lesson and is able to apply it to the activity.	The learner has a sufficient comprehension of the lesson and can apply it to the activity.	The learner has a sufficient understanding of the lesson but is not applied in the activity.	The learner has not understood most of the lesson and cannot apply it to the activity.	
				TOTAL (15pts):	



Assessment

Multiple Choice. Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following **DOES NOT** describe a convection process?
 - A. the handle of a metal pot is hot while cooking
 - B. boiling of macaroni pasta
 - C. a sea breeze
 - D. ocean water in the surface is warmer
2. What is the source of heat generated by the core to the mantle?
 - A. gases
 - B. decayed radioactive elements
 - C. molten rocks
 - D. molten metals
3. Which of the following has a faster movement of molecules?
 - A. hot materials
 - B. warm materials
 - C. cold materials
 - D. room temperature materials
4. Which of the following has a lesser density in a convection cell?
 - A. warm fluid materials
 - B. cold fluid materials
 - C. room temperature fluid materials
 - D. hot fluid materials
5. In a convection current, hot materials move _____.
 - A. any direction
 - B. sideward
 - C. upward
 - D. downward
6. The uplifting and tearing apart of lithosphere occurs at _____.
 - A. convergent boundary
 - B. divergent boundary
 - C. transform fault boundary
 - D. mantle
7. The idea that Earth's lithosphere is broken up into separate plates that float on the mantle is the theory of _____.
 - A. continental drift
 - B. seafloor
 - C. tectonic movement spreading
 - D. plate tectonics

8. The region in which one plate moves under another is _____.
- A. rift valley
 - B. subduction zone
 - C. magma chamber
 - D. vent
9. A driving force for plate motion at mid-ocean ridges as a result of the rigid lithosphere sliding down _____.
- A. slab pull
 - B. ridge push
 - C. convection current
 - D. seafloor spreading
10. The motion of gas or liquid caused by differences in temperature is a _____.
- A. tectonic movement
 - B. plate tectonic
 - C. convection current
 - D. magma chamber
11. Where is the source of heat in a mantle convection current?
- A. the Sun
 - B. the crust
 - C. the core
 - D. the moon
12. Which of the following is NOT a driving force of tectonic plates?
- A. ridge push
 - B. slab push
 - C. drag force
 - D. mantle convection
13. It is a measure of how much mass there is in a volume of a substance.
- A. volume
 - B. temperature
 - C. density
 - D. mass
14. The plastic-like upper portion of the mantle is called _____.
- A. the magma
 - B. the core
 - C. the lithosphere
 - D. the asthenosphere
15. Which of the following is NOT a method of heat transfer?
- A. condensation
 - B. convection
 - C. conduction
 - D. radiation



Additional Activities

Mantle Convection Pamphlet

Let's use these materials:

paper folder cut in half (do not cut along the fold), paper, Earth Science book, ruler, scissors, glue stick or paste, pencil, and colored pencils or markers

Let's do it this way:

1. Make a Mantle Convection Pamphlet
2. The pamphlet must include the following focus questions:
 - a. What causes convection currents?
 - b. What causes convection currents in Earth's mantle?

Your output in this activity will be rated by your teacher according to the following criteria.

Category	Excellent (5pts)	Good (4pts)	Satisfactory (3pts)	Needs improvement (1pt)	Score
Pamphlet	The pamphlet is very informative. The focus question was answered by the information in the pamphlet.	The pamphlet contains sufficient information on the topic. Can use more elaboration.	The pamphlet holds enough information, too vague.	The pamphlet does not bear information that subjects to the topic.	
Content	The information is well-organized, with references properly cited. No confusion on the set of content.	The information is organized, with references cited. It is good enough to understand the set of content.	The information needs more organization, and references are not cited properly.	The information is confusing and plagiarized.	

Design	The design of the pamphlet is eye-catching and creative. The color scheme and diagrams are uniform and neat.	The design of the pamphlet is well-made but needs a more uniform theme/concept .	The design of the pamphlet is dull and needs more diagrams.	No design at all.	
				TOTAL (15pts):	

Copy and accomplish this self-rating table adapted from Valdoz (2017) before returning the module to your teacher.

How I Rate My Self...

How much did this module help you	Fair (5 points)	Good (8 points)	Excellent (10 points)
Understand the process of convection			
Explain the convection current in the mantle that drives the lithospheric plates to move			



Answer Key

Assessment

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

What I have learned

1. Convection
2. Heat
3. Density
4. Temperature
5. Rise
6. Less
7. Sink
8. More
9. Magma
10. Current
11. Lithosphere
12. Asthenosphere

Activity 3

- a. 4
- b. 1
- c. 3
- d. 2
- e. 5

Activity 2

1. Wood blocks
2. Water
3. Heat from a hot plate
4. Because of convection current
5. Near the bottom-greater density, near the surface lesser density
6. It is the rising of warm water and sinking of cold water due to their differences in temperature

What I Know

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

What Is It?

- 1. Mantle
- 2. Asthenosphere
- 3. Magma
- 4. Convection
- 5. core current

What's more

Activity 1

- 1. ^
- 2. ^
- 3. ^
- 4. ^
- 5. ^

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Images:

Mantle Convection by Marianne D. Soriano

Boiling of Water by Richard C. Paragas

Warming of spoon by Richard C. Paragas

Rising of hot air balloon by Richard C. Paragas

Burning of wood by Richard C. Paragas

Melting of ice by Richard C. Paragas

Beaker filled with hot water and floating blocks of wood as it sits on top of a hot plate by Richard C. Paragas

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