



Layers of the Earth

By: Kristin Squires

Focus on Inquiry

Students will model the different layers of Earth's interior and differentiate between benefits and limitations of the models.

Lesson Content Overview

Students will model and describe the layers of the Earth, including the crust, lithosphere, asthenosphere, mantle, outer core, and inner core through several hands-on activities.

Duration 80 minutes	Setting Classroom	Grouping Whole class & groups of 3-4 students.	PTI Inquiry Subskills
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Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
<i>Engage</i>	10 Minutes	1.1, 1.3,2.3, 3.1,3.3,3.6,3.7	None	2	Students will cut open a fun size layered candy bar and make observations about the inside, and answer questions that relate the Layered to the Earth's Interior Layers.
<i>Explore</i>	25 Minutes		None	3	Students will look at 4 different baggies, each filled with different substances. These substances will lead the students to describing and figuring out which layer is which.
<i>Explain</i>	15 Minutes		None	2	Students will use a resource to answer and fill out a chart that explains more characteristics of each layer.
<i>Expand</i>	20 Minutes		None	2	Students will use all of their knowledge to figure out a diagram of Earth'
<i>Evaluate</i>	10 Minutes	7.4	None	1	Exit slip will check for student understanding

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

Next Generation Science Standards – Inquiry

NGSS Practice 2: Developing and Using Models
 NGSS Practice 4: Analyzing and Interpreting Data
 NGSS Practice 6: Constructing explanations
 NGSS Practice 7: Engaging in arguments from evidence
 NGSS Practice 8: Obtaining, Evaluating and Communicating Information



Next Generation Science Standards – Earth Science

MS-ESS2-1.: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.



Florida Science Standards – Nature of Science

SC.7.N.3.2: Identify the benefits and limitations of the use of scientific models.



Florida Science Standards – Earth Science

SC.7.E.6.1: Describe the layers of the solid Earth, including the lithosphere, the hot convecting mantle, and the dense metallic liquid and solid cores



Materials and Advance Preparation

Materials List

Class set:

- Earth's Layers Cards (1 set per group)
- Containers to put materials in (1 per group)
- Dough-like clay or putty (about the size of a small bouncy ball per bag)
- Marble (1 per bag)
- Water (1/4 cup per bag)
- Dirt (1 cup per bag)
- Zip close sandwich bags (4 per group)
- Funsized layered candy bars (1 per 2 students)
- Plastic knives (1 per 2 students)

Student materials:

- Blackline Master #1: Earth's Layers Lab
- Container with the following
 - Earth's Layers Cards (Blackline Master #3)
 - 1 zip close sandwich bag labeled A with water (about ¼ full) **OUTER CORE**
 - 1 zip close sandwich bag labeled B with dough-like clay or putty (about the size of a small bouncy ball) **MANTLE**
 - 1 zip close sandwich bag labeled C with dirt (about ½ full) **CRUST**
 - 1 zip close sandwich bag labeled D with a marble **INNER CORE**
- Colored pencils and markers
- Textbook or computer for resource to look up characteristics of each layer

Blackline Masters

1. Blackline Master #1: Earth's Layers Lab
2. Blackline Master #2: Earth's Layers Diagram
3. Blackline Master #3: Earth's Layers Cards
4. Blackline Master #4: Earth's Layers Assessment

Advance Preparation

1. Print out a copy of the lab for each student (Blackline Master #1)
2. Print out the Earth's Layers Cards (Blackline Master #3) and cut them out. There should be 4 cards per set (Crust, Mantle, Outer Core, Inner Core). Each container gets 1 set.
3. Set up the containers. You need one container with all of the following for each group.
 - Earth's Layers Cards (Blackline Master #3)
 - 1 Zip close sandwich bag labeled A with water (about ¼ full) **OUTER CORE**
 - 1 Zip close sandwich bag labeled B with Playdoh (about the size of a small bouncy ball) **MANTLE**
 - 1 Zip close sandwich bag labeled C with dirt (about ½ full) **CRUST**
 - 1 Zip close sandwich bag labeled D with a marble **INNER CORE**

Lesson Information

Learning Objectives

1. The student will be able to correctly identify and label the layers of the Earth and explain specific characteristics of each layer.
2. The student will be able to model Earth's layers and explain the benefits and limitations of their model.

Prior Knowledge Needed by the Students

- Students need to know how to make observations of models.

- Students need to know how to create a bar graph.
- Students should know that the Earth has an interior.

Background Information

The Earth's interior is set up in layers, with each layer different from the previous one. The layer at the surface is called the crust. The crust is the thinnest layer and is made up of dirt, soil and mostly solid rock. The crust extends up to 70 kilometers below the surface and its temperatures can be as high as 400 degrees Celsius (close to the mantle). The next layer, the Mantle, is the thickest layer at about 2900 kilometers thick. Temperatures range from 2800-3200 degrees Celsius. In the upper part of the mantle, rocks are melted, forming magma. The mantle is considered to be a semi-solid layer. The next layer is the Outer core which is about 2250 kilometers thick and made up of liquid iron and nickel. Temperatures range between 4,000-5,000 degrees Celsius. The inner most layer is called the inner core and it is 1280 kilometers thick with temperatures at about 6,000 degrees Celsius. The inner core is made up of solid nickel and iron because the pressure of the layers above it compress it into a solid.

Lesson Procedure

Engage

1. Pass out the student lab activity (Blackline Master #1) and a layered candy bar and plastic knife. Give 1 fun size layered per 2 students.
2. Direct students to cut the layered candy bar in half as neatly as possible. Once done cutting the candy bar, students will answer the observation questions in their lab activity. Once all questions have been answered students may eat the candy (optional).
3. Review the Engage questions by having the students share their responses.
 - a. *What did you observe about each of the layers? Students responses may include each layer is a different thickness, different consistencies, different colors, different materials.*
 - b. *How do you think this relates to the Earth? Student's responses may include, that the Earth's interior is in layers, the Earth is made up of different materials.*
 - c. *What are the benefits and limitations of using the candy bar to model the layers of the Earth? Student's responses may include, that the model only had 3 layers and the Earth has more, the model is too small, Earth is not made of chocolate, benefit includes that it allows them to see the layers and imagine that they are like the layers of the Earth.*

Explore

1. Pass out the buckets containing materials for the lab and explain how the data table will be filled out.
2. Remind students that in each bucket they have 4 zip close sandwich bags containing different materials and their goal is to make observations about each bag and figure out which layer that bag represents. Each bag is labeled with a letter and that letter will represent that bag in the data table.
3. Once students have made their observations they will use the 4 layer cards to figure out which layer each bag represents and write it in the data table.

Explain

1. Once students have completed the data table, students will answer the questions:
 - a. *What do you observe about the composition of each layer? Answers will vary*
 - b. *How are they similar or different? Answers will vary*
2. Next, students will create a bar graph.
 - a. Make sure to remind students to put labels for the x and y axis, as well as a title.
3. Once the graph is complete, students will answer the following questions:
 - a. *Looking at your graph, how is the temperature of layer related to the location of the layer? Student responses will vary, but should include that the temperature goes up as you get deeper and deeper into the Earth.*

- b. *Hypothesize why you think the temperatures are different for each layer. Answers will vary*
 - c. *Describe the relationship between a layer's composition and its temperature. Student responses will vary, but should include that hotter layers are more liquid like the mantle and the outer core. Students may not be able to explain that the inner core is solid because of the immense pressure.*
4. Students will then complete the characteristics chart about each layer and answer conclusion questions. When completing the chart, students should use whatever resources your school has available (textbook, computers, etc.)
5. Questions that are asked as part of the conclusion questions:
 - **Which layer is the thickest?** *Possible student answers are the mantle (correct), or any of the other layers if they got the thicknesses incorrect in the chart.*
 - **Which layer is the hottest?** *Possible student answers are the inner core (correct), or any of the other layers if they got the temperatures incorrect in the chart.*
 - **Between the mantle and the crust there are 2 sub-layers called the lithosphere and asthenosphere. Describe these layers.** *Possible student answers are that the lithosphere is the uppermost part of the mantle and the asthenosphere is directly below the lithosphere (correct). May flip the asthenosphere location with lithosphere location.*
 - **Hypothesize why you think the outer core is a liquid and the inner core is a solid.** *Possible student answers may vary because it's a hypothesis, but they may say because of pressure of the layers above it, the material becomes a solid.*
6. Additional questions that can be asked as part of class discussion or as probing questions:
 - **Which layer is the thinnest?** *Possible student answers Possible student answers are the crust (correct), or any of the other layers if they got the thicknesses incorrect in the chart.*
 - **What is the composition of the inner and outer cores?** *Possible student answers iron and nickel (correct) or another composition if they got the chart incorrect.*
 - **Which layer do you think all of the heat comes from?** *Possible student answers inner core (correct), or any other layer if they got the temperatures wrong in the chart.*
 - **What would be a good model to use for the mantle?** *Possible student answers playdoh, honey oatmeal. Anything that is considered a semi solid.*
 - **Why would it be impossible to travel to the center of the Earth?** *Possible student answers temperature is too hot, pressure is too intense, Take too long because the layers are too thick, no technology available.*
 - **What did you learn that was new about the Earth's interior?** *Possible student answers will vary because it's a reflection.*

Expand

1. Students will complete, label, and color a diagram of the Earth's layers.

Evaluate

FORMAL EVALUTION

- Blackline Master #4: Earth's Layers Check for Understanding

INFORMAL or OPTIONAL EVALUTIONS

- Students can turn in their lab activity or their expand activity to be reviewed as an informal evaluation.

WRAP UP.

- Bring the lesson to a conclusion by having the students share with each other what they have learned from the activity and the teacher can address any misconceptions.

Supplementary Resources**Interactive look at Earth's Layers-7th grade**

Earth's Structure. (n.d.). Retrieved September 21, 2016, from
<http://interactivesites.weebly.com/earths-structure.html>

Interactive look at Earth's Layers-7th grade

Journey to the Center of the Earth. (n.d.). Retrieved September 21, 2016, from
<http://www.cpalms.org/Public/PreviewResourceStudentTutorial/Preview/119030>

CITATION OF SOURCES.

Bartee, K. (2017). Drawing of cross-section of earth.

Halldin, M. (2006). Image of Earth's Layers Model. Retrieved from
https://commons.wikimedia.org/wiki/File:Earth_layers_model.png

N.A.. (2005). *Sciencesaurus: A student handbook*. Wilmington, MA: Great Source Education Group/Houghton Mifflin.

Yes, I cited all materials and resources used in this lesson.

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Lesson author signature

Blackline Master #1 Earth's Layers Lab

Earth's Layers Student Lab Sheet

Take your Layered candy bar and cut it in half, keep one half and give the other to your partner. Observe the candy bar and answer the following questions:

1. Label and draw what you see on the inside of the Layered candy bar.

2. What do you observe about each of the layers? _____

3. How do you think this relates to the Earth? _____

4. What are the benefits and limitations of using the Layered to model the layers of the Earth?

**** Once questions are answered you may eat your candy bar****

Earth's Layers Observations:

1. Take the bags of different materials and observe them. Do not open the bags!
2. Make some observations in the table below. 3 for each bag.

	Bag A	Bag B	Bag C	Bag D
Qualitative Observations 3 for each bag				
Solid, Liquid, Semi-Solid				
Name of Earth's Layer				

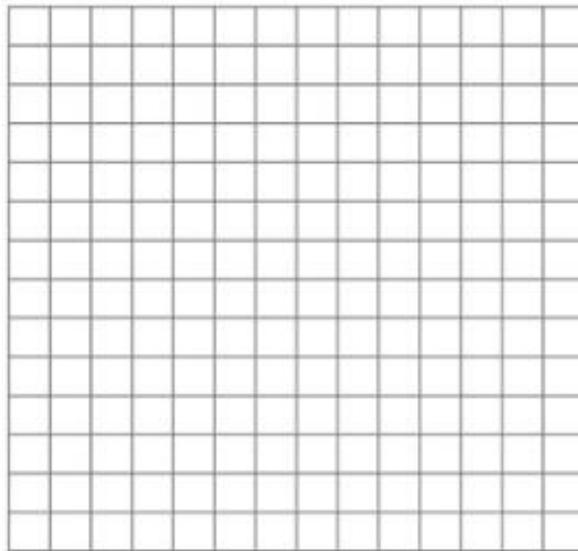
After you have observed the bags, use the cards to figure out which bag represents each layer and put its name on the data table.

1. What do you observe about the composition of each layer? How are they similar or different?

Four horizontal lines for writing an answer.

Graph:

Using the information on the index cards, create a **bar graph** of the highest temperature of each layer. Color each bar a different color to represent each layer of the Earth.



1. Looking at your graph, how is the temperature of layer related to the location of the layer?

Two horizontal lines for writing an answer.

2. Hypothesize why you think the temperatures are different for each layer. _____

Two horizontal lines for writing an answer.

3. Describe the relationship between a layer's composition and its temperature. _____

Two horizontal lines for writing an answer.

Characteristics of Layers:

Using your textbook or digital resources, fill in the chart below about each layer.

Characteristics	Crust	Mantle	Outer Core	Inner Core
Composition				
Temperature				
Thickness				
Solid or Liquid				

1. Which layer is the thickest? _____

2. Which layer is the hottest? _____

3. Between the mantle and the crust there are 2 sub-layers called the lithosphere and asthenosphere. Describe these layers. _____

4. Hypothesize why you think the outer core is a liquid and the inner core is a solid.

Earth's Layers Student Lab Sheet **ANSWER KEY**

Take your Layered candy bar and cut it in half, keep one half and give the other to your partner. Observe the candy bar and answer the following questions:

1. Label and draw what you see on the inside of the Layered candy bar.

Answers will vary.

2. What do you observe about each of the layers? *Answers will vary but could include that each layer is very different and you can easily tell them apart. There is an outer shell of chocolate, a layer of squishy caramel, and a layer of nougat and nuts.*

3. How do you think this relates to the Earth? *Answers will vary but could include that each layer relates to the layers within the Earth. At this point, students probably won't know the names of the different layers to align them with the layers of the candy bar.*

4. What are the benefits and limitations of using the Layered to model the layers of the Earth? *Answers will vary but could include that a benefit is that it shows the distinct layers like are in the Earth. A limitation could include that the model is not to scale, the layers are not the correct size (to scale), there are only 3 layers and there are 4 layers of the Earth.*

**** Once questions are answered you may eat your candy bar****

Earth's Layers Observations:

1. Take the bags of different materials and observe them. Do not open the bags!
2. Make some observations in the table below. 3 for each bag.

	Bag A	Bag B	Bag C	Bag D
Qualitative Observations 3 for each bag	<i>Answers will vary.</i>	<i>Answers will vary.</i>	<i>Answers will vary.</i>	<i>Answers will vary.</i>
Solid, Liquid, Semi-Solid	<i>Liquid</i>	<i>Semi-Solid</i>	<i>Solid</i>	<i>Solid</i>
Name of Earth's Layer	<i>Outer Core.</i>	<i>Mantle</i>	<i>Crust</i>	<i>Inner Core</i>

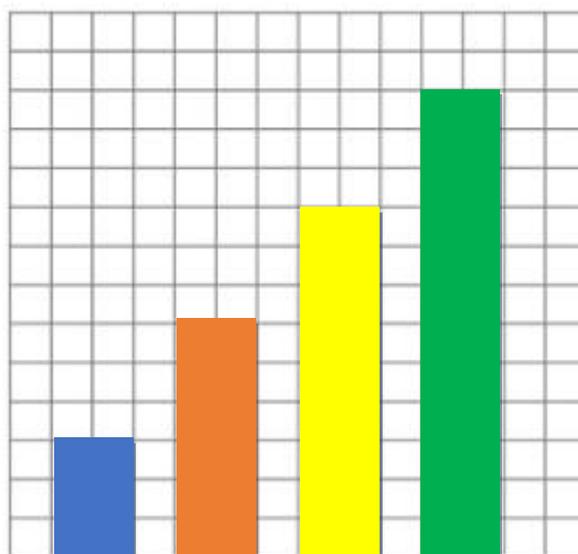
After you have observed the bags use the cards to figure out which bag represents each layer and put its name on the data table.

1. What do you observe about the composition of each layer? How are they similar or different?

Answers will vary.

Graph:

Using the information on the index cards, create a **bar graph** of the highest temperature of each layer. Color each bar a different color to represent each layer of the Earth.



Crust Mantle Outer Core Inner Core

These are graphing approximations to show the general pattern of graphing.

1. Looking at your graph, how is the temperature of layer related to the location of the layer?

Answers will vary. The deeper the layer, the higher the temperature.

2. Hypothesize why you think the temperatures are different for each layer. Answers will vary.

Students may hypothesize that as the layer gets closer to the center of the Earth, it gets hotter.

3. Describe the relationship between a layer's composition and its temperature. Answers will

vary. Hotter temperatures results in a more liquid layer. Students will likely not understand why the inner core is a solid and how that relates to pressure.

Characteristics of Layers:

Using your textbook or digital resources, fill in the chart below about each layer.

Characteristics	Crust	Mantle	Outer Core	Inner Core
Composition	rock	molten rock	liquid metal	solid metal
Temperature	0-400°C	3,200°C	5,000°C	6000°C
Thickness	0-60 km	2,900 km	2,300 km	1,220 km
Solid or Liquid	solid	semi-solid	liquid	solid

1. Which layer is the thickest? The mantle

2. Which layer is the hottest? The inner core

3. Between the mantle and the crust there are 2 sub-layers called the lithosphere and asthenosphere. Describe these layers. _____

4. Hypothesize why you think the outer core is a liquid and the inner core is a solid.

Blackline Master #2 Earth's Layer's Diagram

Earth's Layers Diagram

1. Label and color each layer.

** Use information from your lab and your text or digital resources**

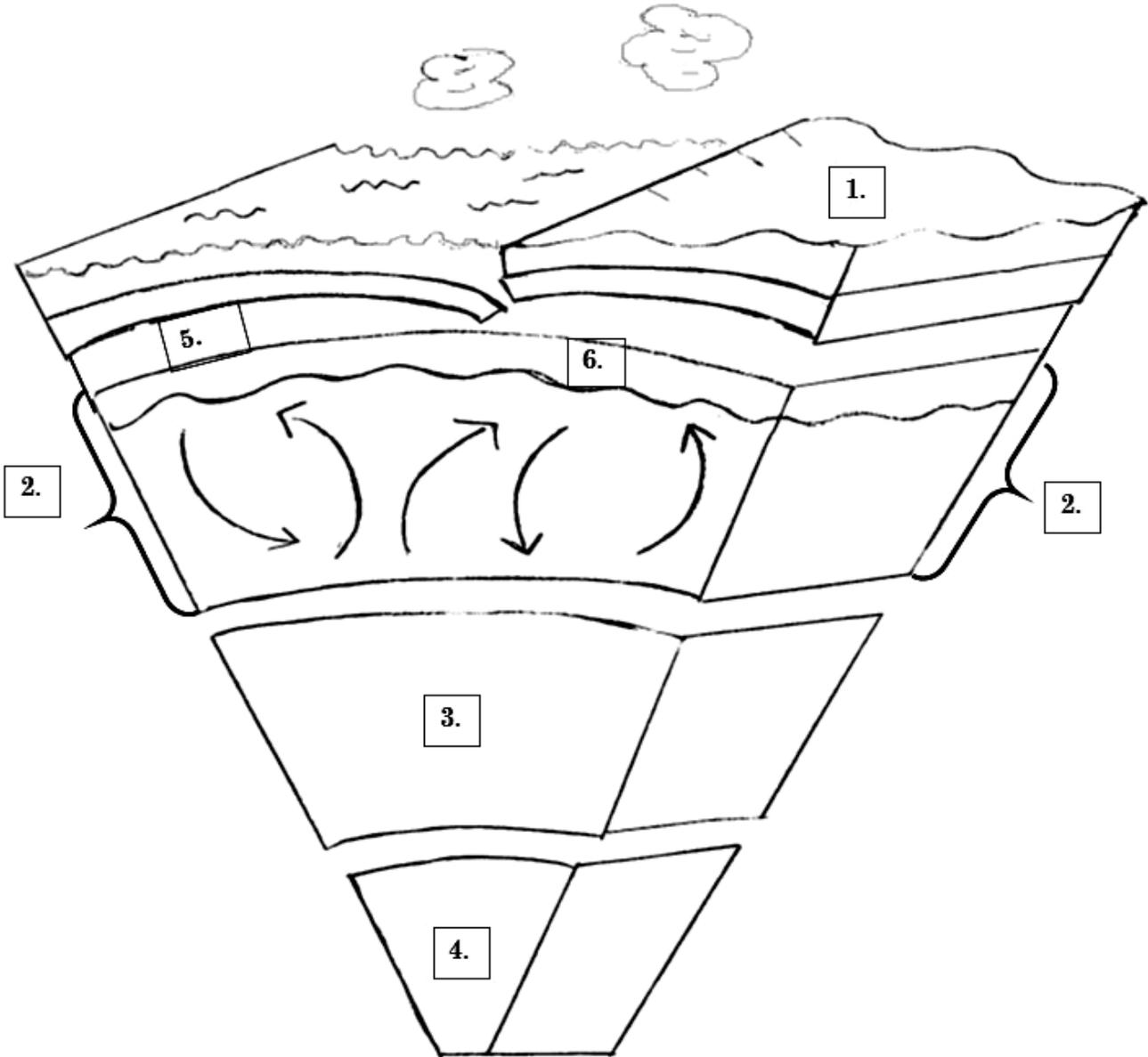


Image drawn and labeled by Kristin Bartee, 2017.

What are the benefits and limitations of this model of Earth's layers? _____

Earth's Layers Diagram ANSWER KEY

1. Label and color each layer.

** Use information from your lab and your text or digital resources**

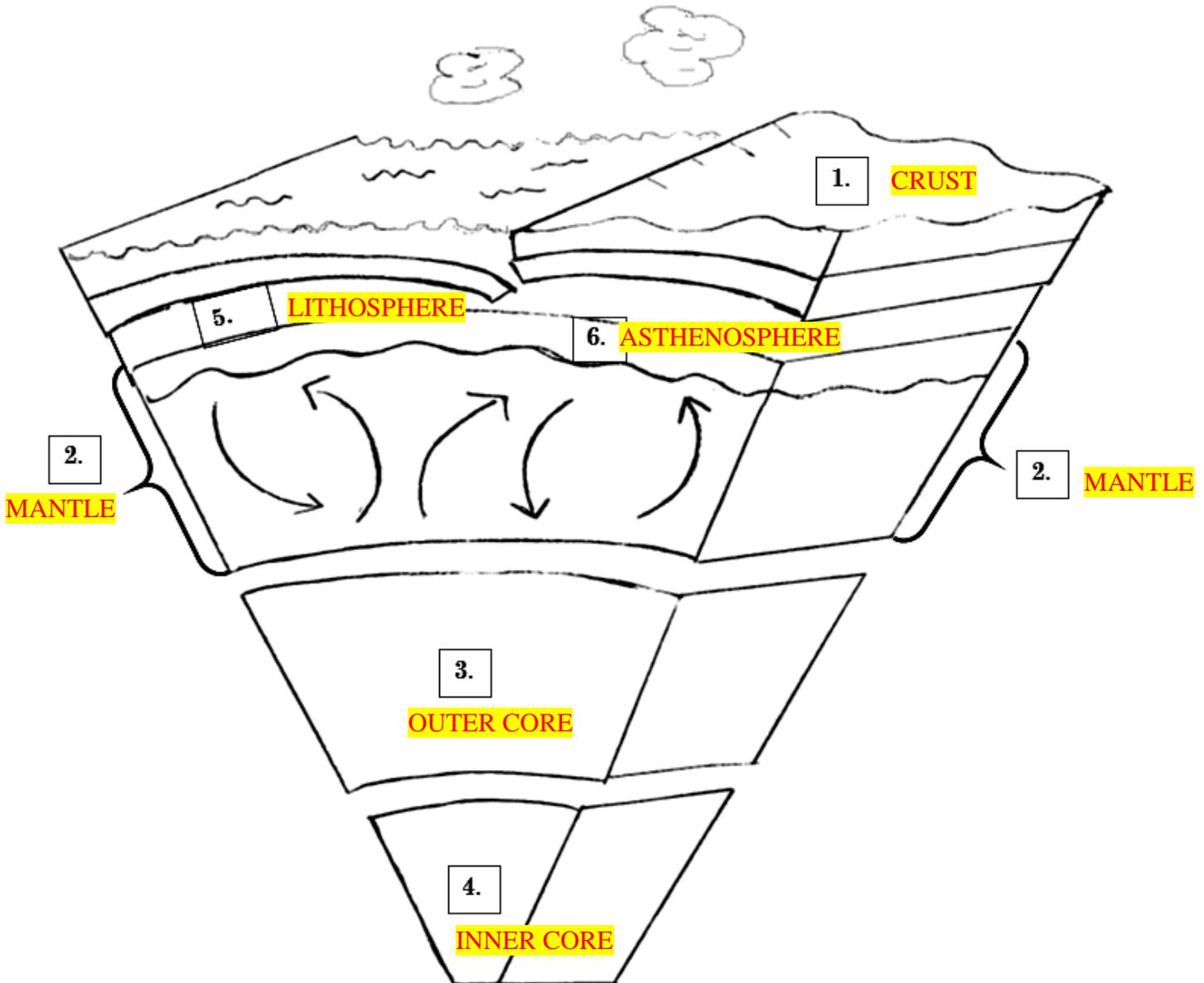


Image drawn and labeled by Kristin Bartee, 2017.

What are the benefits and limitations of this model of Earth's layers? Answers will vary but could include that a benefit is that you can easily see all of the layers of the Earth and how they relate to one another. A limitation is that it is not drawn to scale, shows very limited information in terms of temperature and pressure, you can't tell what type of material the layers are made of.

Blackline Master #3 Earth's Layers Cards

Earth's Layers Cards

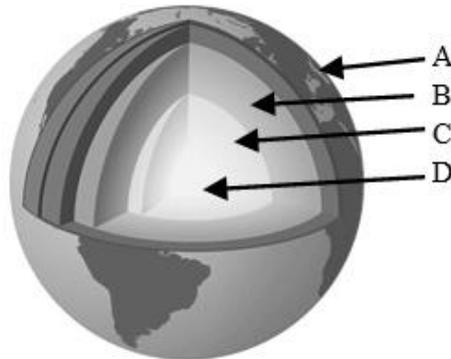
<p><u>Outer Core</u></p> <p>Liquid</p> <p>5,000°C</p>	<p><u>Inner Core</u></p> <p>Solid</p> <p>6,000°C</p>
<p><u>Crust</u></p> <p>Rocky, very thin</p> <p>400°C</p>	<p><u>Mantle</u></p> <p>Semisolid, moves slowly</p> <p>3,200°C</p>

Blackline Master #4 Earth's Layer's Assessment

Layers of the Earth Check for Understanding

1. Which statement below **best** describes how temperature changes in the Earth's interior as you travel deeper into the Earth? *SC.7.E.6.1*

- The temperature constantly decreases
- The temperature constantly increases
- The temperature constantly decreases then increases
- The temperature constantly increases then decreases



2. In the diagram above, what does **letter C** represent? *SC.7.E.6.1*

- Crust
- Inner Core
- Mantle
- Outer Core

3. In the diagram above, what does **letter A** represent? *SC.7.E.6.1*

- Crust
- Inner Core
- Mantle
- Outer Core

4. In the diagram above, what does **letter D** represent? *SC.7.E.6.1*

- Crust
- Inner Core
- Mantle
- Outer Core

5. In the diagram above, what does **letter B** represent? *SC.7.E.6.1*

- Crust
- Inner Core
- Mantle
- Outer Core

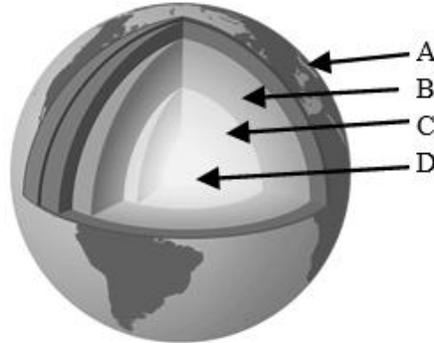
6. Which of the following is a limitation of the model of Earth's layers as seen in the diagram above? *SC.7.N.3.2*

- The model cannot show the proper order of Earth's layers.
- The model cannot show the 3-dimensional nature of Earth's layers.
- The model cannot show the proper relative thickness of Earth's layers.
- The model cannot show the proper relative temperatures of Earth's layers.

Layers of the Earth Check for Understanding **ANSWER KEY**

1. Which statement below **best** describes how temperature changes in the Earth's interior as you travel deeper into the Earth? *SC.7.E.6.1*

- a. The temperature constantly decreases
- b. The temperature constantly increases**
- c. The temperature constantly decreases then increases
- d. The temperature constantly increases then decreases



2. In the diagram what does **letter C** represent? *SC.7.E.6.1*

- a. Crust
- b. Inner Core
- c. Mantle
- d. Outer Core**

3. In the diagram what does **letter A** represent? *SC.7.E.6.1*

- a. Crust**
- b. Inner Core
- c. Mantle
- d. Outer Core

4. In the diagram what does **letter D** represent? *SC.7.E.6.1*

- b. Inner Core**
- a. Crust
- c. Mantle
- d. Outer Core

5. In the diagram what does **letter B** represent? *SC.7.E.6.1*

- a. Crust
- b. Inner Core
- c. Mantle**
- d. Outer Core

6. Which of the following is a limitation of the model of Earth's layers as seen in the diagram above? *SC.7.N.3.2*

- a. The model cannot show the proper order of Earth's layers.
- b. The model cannot show the 3-dimensional nature of Earth's layers.
- c. The model cannot show the proper relative thickness of Earth's layers.
- d. The model cannot show the proper relative temperatures of Earth's layers.**