



Oceanic Crust and Age

Diagram reading practice and reading comprehension

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Background

The ocean crust is much younger than the continental crust, however both form the tectonic plates that cover the Earth. The main reason that oceanic crust does not get to be as old is due to density - tectonic plates mainly formed of oceanic crust are heavier, and so sink beneath continental crust at subduction boundaries, where it melts as it sinks, and gets recycled into the mantle. Meanwhile new crust forms at divergent boundaries, where tectonic plates move away from each other providing a space for magma to rise up, cool and harden into new crust. Diagrams are used a lot in geosciences and other sciences as a way to visualize scientific concepts, models, and theories. Learning how to understand them is critical to someone's knowledge and skills in the real world.

Additional Resources

- *Introducing the International Ocean Discovery Program*
 - <https://www.youtube.com/watch?v=0nydKlpZdIU&list=PLroDmZEKRHPMctFMzix-Zg7plqnlqWMjl&index=2&t=242s>
- *How Science Works*
 - <https://www.youtube.com/watch?v=i9tsdAQBcfM&list=PLroDmZEKRHPMctFMzix-Zg7plqnlqWMjl&index=3&t=0s>
- *PNN Special Report Life on Board*
 - <https://www.youtube.com/watch?v=n0bcloALDFg&list=PLroDmZEKRHPMctFMzix-Zg7plqnlqWMjl&index=4&t=341s>

Activity Summary

Students will be able to break down the tools used to make diagrams so informative, and thus use diagrams as a way to improve their learning in the sciences. Students will also be given an article to read that will connect to the two diagrams they have already discussed and try to apply what they learned from the diagram and article in a discussion at the end.

Next Generation Science Standards

HS- Evaluate evidence of the past and current movements of continental and oceanic crust
ESS1-5. and the theory of plate tectonics to explain the ages of crustal rocks

College and Career Readiness Standards for Adult Education



CCR Anchor 2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

CCR Anchor 4: Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate

CCR Anchor 6: Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering a word or phrase important to comprehension or expression

Skills

- Making observations
- Interpreting data
- Communicating observations
- Reading comprehension

Target Audience

Adult English Language learners in Science/ELA classes

Time Required

~2 hours

Materials Needed

Accompanying reading: <https://www.sciencenewsforstudents.org/article/explainer-understanding-plate-tectonics>

Video of a lava lamp for the reading: https://www.youtube.com/watch?v=h_IQ2tMgLVM
(Make sure to turn off the sound for the video.)—The Laval lamp is referenced in the reading so this video is useful in case someone doesn't know what it is.

Assessment

- Diagram reading
- Article Reading

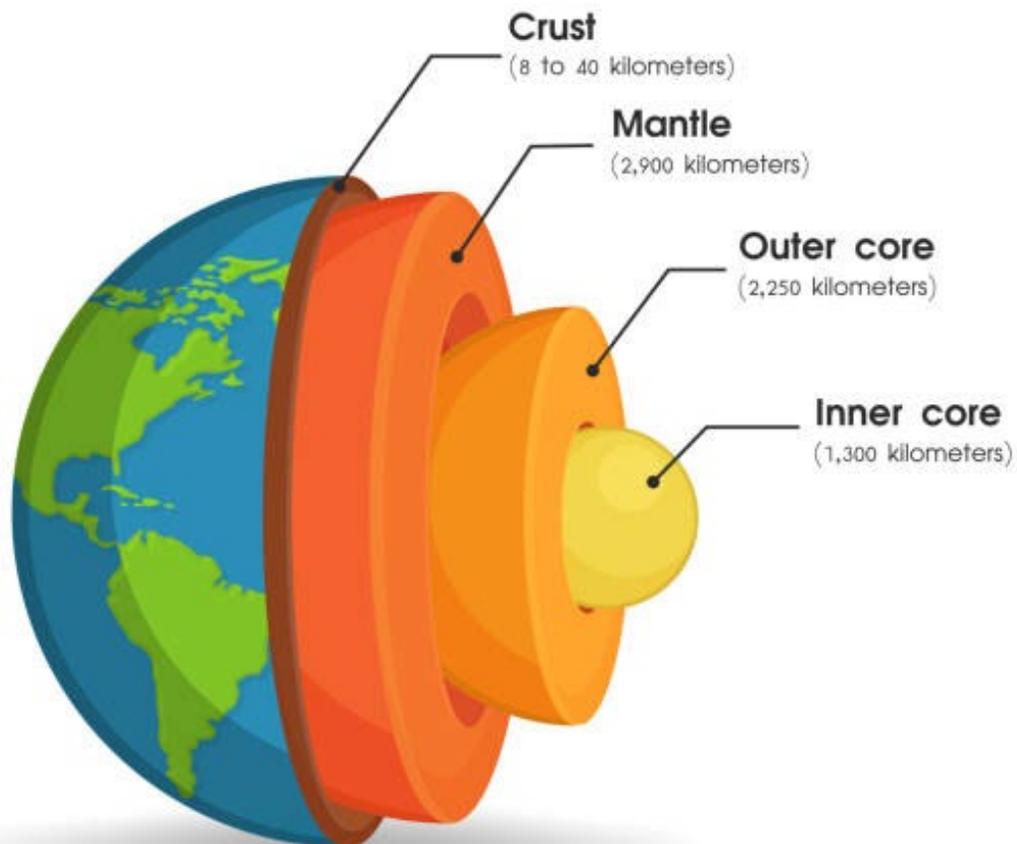
Activity Description

First go over what students know about diagrams. Then ask, “Where do you see diagrams, and what are they?”

Discuss that, *Diagrams are images used to convey information meant to be informative about a subject matter. Diagrams are used a lot in science because they give you a visual representation of the original thing so that people who cannot see the original in real life have a reference they can use.*

Take a look at this image and tell me what you notice about this diagram.:

STRUCTURE OF THE EARTH



You should hopefully get answers about the colors, labels, distance in parentheses, recognizable features of Earth, layers of Earth, etc.



Ask them *what they are learning from this diagram* (should get around to the fact Earth has layers that are different depths).

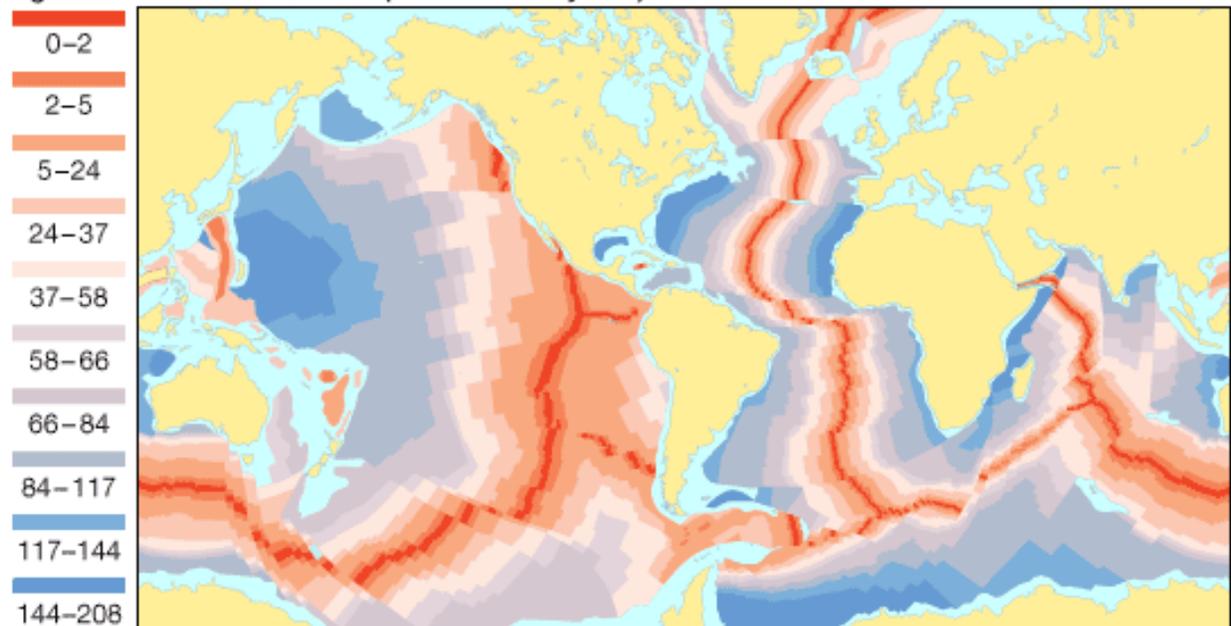
So, we have learned that Earth has layers with different names, that they have certain depths, and the closest one to us is called the crust! Science diagrams are pictures that teach us about a certain topic. Here we learned about Earth's layers.

- If students have more questions, you can use this reading:

<https://www.sciencenewsforstudents.org/article/explainer-earth-layer-layer>

Now let's try with another diagram that tells us more about the ocean crust. Make sure to pass a printout of this diagram to everyone. Give students a few minutes to write down or circle what they notice.

Age of Earth's oceanic crust (in millions of years)



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<https://www.britannica.com/science/oceanic-crust/Marine-magnetic-anomalies>

After everyone has a chance making observations on their own, then discuss what the students have observed. Have a bigger version of this diagram up on a projector (if you have one) or a big printout taped on a board so you can highlight, underline, or circle everyone's observations as they share them.

Hopefully, you are hearing about colors, continent shapes, a key on the left side providing numbers to a color, a title, etc.

Now ask, *"What are we learning from this diagram?"*



You should hopefully get to the main point that this diagram shows where the ocean crust is younger and older throughout Earth. You can say, *“So, this diagram shows us that there are parts of the ocean crust that look like big red lines. Where it is bright red the crust is very young (0-2 million years of age → point at the label of age and point back to the red lines). If we look at other parts of the ocean floor we see they are older, up to 208 million years of age (point to the other labels and have students find a spot on the map that matches the color and say the age of that spot).”*

Now ask: *“How do you think we get young crust (the 0-2 million years old)? and why do you think the crust only gets as old as 208 million years old when the actual age of the Earth is more than 4.5 billion years old?”*

After a discussion, read the accompanying article to learn about tectonic plates and the boundaries that represent where crust is formed and recycled.

Pass out printouts of the reading so everyone has their own copy. Before reading the article, spend some time on the list of power words. Read each word and its definition and see if you can use it in a sentence with the students.

Then begin reading the article, taking time to check which vocabulary words are unknown to students. Look them up to provide background to what the sentence is saying.

- If a word is unknown, look up the definition, share the definition with the students, then try to replace the word in the article with the definition so they can see how it is applied in context.
- For example if an unknown word was “cluster” from the sentence “the butterflies cluster together on sunny days”. Then look up the definition for cluster (a group of similar things closely put together) then you would rewrite the sentence as “ the butterflies group closely together”

After reading the article once, look at the diagram that shows how plates move (the diagram credited to Jose F Vigil Wikimedia commons).

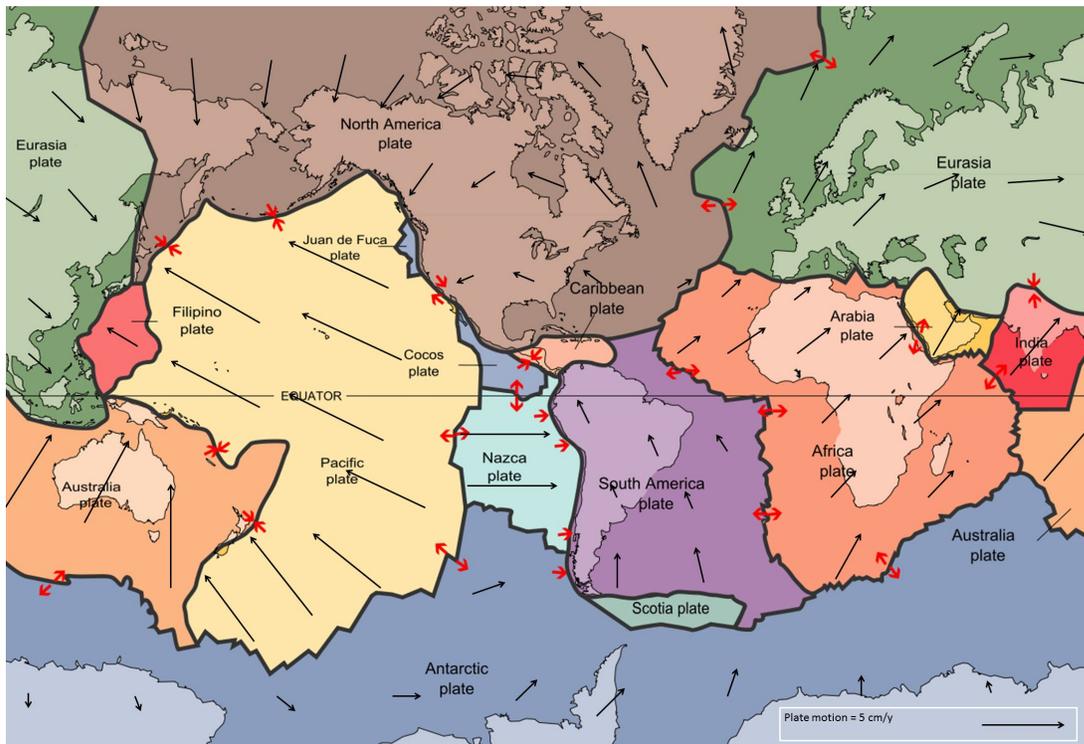
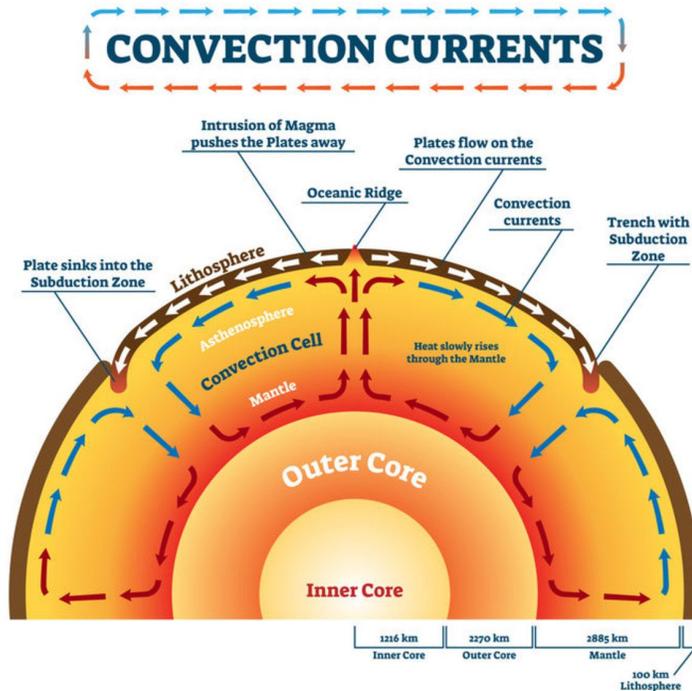


Image credit: <https://opentextbc.ca/geology/chapter/10-4-plates-plate-motions-and-plate-boundary-processes/>

- Ask students: *What do you notice about this image?* (Point out colors, arrows, and hard lines dividing the pieces.)
- *Where do the continents and the seafloor share the same plate?* (South American plate, African plate, Australian plate...etc.) *Where on the map is there is no continent sharing the same plate?* (Pacific Plate, Nazca Plate—there may be small islands on these plates, but for size comparison we will say there aren't big continents.)
- *If the map is showing us the pieces of rock that we call plates, what do you think the arrows are showing us?* (Hopefully, you get answers of movement, direction.)
 - o *The arrows are showing us the movement of the plates! They are always moving because the inside of the Earth is like a **big** bowl of hot rock soup being stirred!*
Show image below.
- *The center of the Earth is what you can think of has a big bowl of hot rock soup. It is so hot we get liquid rocks that are called magma. It is what you can think of that comes out of Volcanoes. That magma started out inside the Earth and when it comes out of the Volcano it is called lava.*



- Show the above image. *The movement of the plates is due to the magma under the layer of rocks moving and pulling the plates along the surface. The plates are a part of something called the Lithosphere (the part of Earth that is rock). Take your time to observe this image. What do you notice about colors, arrows, and labels?*
 - o They should see different colors arrows (blue for cooler magma, and red for hotter magma), they should see labels for each part, distance of each layer..etc
 - o For question about convection : Convection is defined as the flow of fluid where cooler parts of the fluid will sink and warmer parts will rise causing it to circulate in the are (we see this when we boil water).
 - o The Asthenosphere is just a science word for “ upper mantle”
 - o Take your time walking the students through this image emphasizing the lithosphere is moving in the same direction as the cooler magma moves.
- Focus in on what is happening to the lithosphere. Ask *what do the labels say about the lithosphere?*
 - o Subduction: a heavier plate will sink under a lighter plate causing it to melt and be recycled into the mantle as magma. A lighter plate is less dense.
- Then focus in on what is happening to another part of the lithosphere. Ask “*what do you think is happening at the Oceanic Ridge?*”
 - o Oceanic ridge is where the plates are moving away from each other creating a space for magma to escape. This creates new fresh crust.
- Then on the world map, find where there is a subduction zone between two plates. Find where there is an oceanic ridge. Ask students *where they think a subduction zone is and an oceanic ridge is* (Pay attention to the arrows of the lithosphere and the plates.)
 - o Should point out mid-Atlantic Ridge, and a subduction zone between the Australian plate and Pacific plate.



- Then ask them, *“What is the diagram teaching us?” Is the article easier to understand because of the diagrams?*

- You should hear that the diagram shows how plates can move and create different things (such as volcanoes and mountains) or subduct.

Also ask, *“Where did we see something that visualizes the mantle? ...The first diagram we looked at!*

- *“So, based on this reading, what is the mantle?”*

Now ask: *“If we look at the ocean crust diagram, we see red lines in the middle of the oceans. These represent very young crust. Now we know about tectonic plates, what direction of movement is happening between plates at those areas where it is red?”*

- In this moment, have the tectonic plate map visible, so they can compare where the ocean crust red lines are to where plates meet.
- You should get answers about the tectonic plates moving away from each other.

Therefore, if the two plates are moving away from each other, magma is rising from the middle of the mantle to the crust layer to form new crust as it cools down. Our mantle creates new and young crust.

So, what happens when the crust gets old? This was mentioned in the reading, but you can also use the diagram from Jose F Vigil Wikimedia commons.

- *It sinks under one of the plates back into the mantle! ...Then recycles as new ocean crust or as lava from volcanoes.*

To end the lesson, pass out 2–3 sticky notes for each person and ask them to write down what they have learned. If they can only think of one thing, that is fine. Then have them put it on a common space (big white board, poster board, table, etc.). Once everyone puts something down, read through each of the notes to summarize the main points.

Main take-aways:

- The Earth’s crust is broken up into pieces called Tectonic Plates
- Oceanic crust is young compared to continental crust (only up to 208 million years old)
- Diagrams are meant to be informative and use color, labels, and images to educate about the original thing.
- It is best to take your time to understand a diagram to learn from it.
- The Earth has layers.