Evidence for Plate Tectonics

LESSON OBJECTIVE
- Understand evidence of plate tectonics and use the geologic time scale

GRADE
- 7

STANDARDS
- Earth and Space Science

TIME REQUIRED
- 60-120 min

VOCABULARY
- Plate tectonics
- Continental drift
- Pangaea
- Divergent
- Convergent
- Transform

MATERIALS
- This packet
- Glue sticks
- Scissors

RECOMMENDED ASSESSMENT
- Student will complete worksheets and an optional crossword puzzle

introduction

Students will look at global fossil evidence of plants and animals and put together the "puzzle" of continents that makes up Pangaea. Students will explore other evidence for plate tectonics and then complete a crossword puzzle to assess their understanding of the topic.

State Standards

MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
MS-ESS2-3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.

Lesson Plan

Background Knowledge –
Teachers should review plate tectonics and the types of plate boundaries with their students. An excellent method for reviewing plate boundaries with Oreos is cited below.

Activity –
1. Review the main ideas of plate tectonics:
Just over a century ago, in 1915, a young German scientist named Alfred Wegener, published his theory of continental drift. This theory stemmed from a simple, but astonishing observation of a world map: the coastlines of South America and Africa seemed to fit together like the pieces of a puzzle. To Wegener, this suggested that the continents had once been part of one supercontinent but had somehow broken and drifted apart. Motivated by this observation, Wegener went digging for more information. Luckily for him, it didn't take long before he found fossil, rock, and climate data that also supported his idea of a supercontinent. After putting all this information together, he formally developed his theory of continental drift. Unfortunately, Wegener couldn't explain how continents moved, so he wasn't taken seriously by the geologists of his time. He died never knowing that his theory was eventually accepted and supported (explained) by the theory of plate tectonics.

2. Print out the student packets and pass them out (pages 12-18).

3. Have students look at the last page of their packet and work on question #1. Wegener's theory stated that the presence of plant and

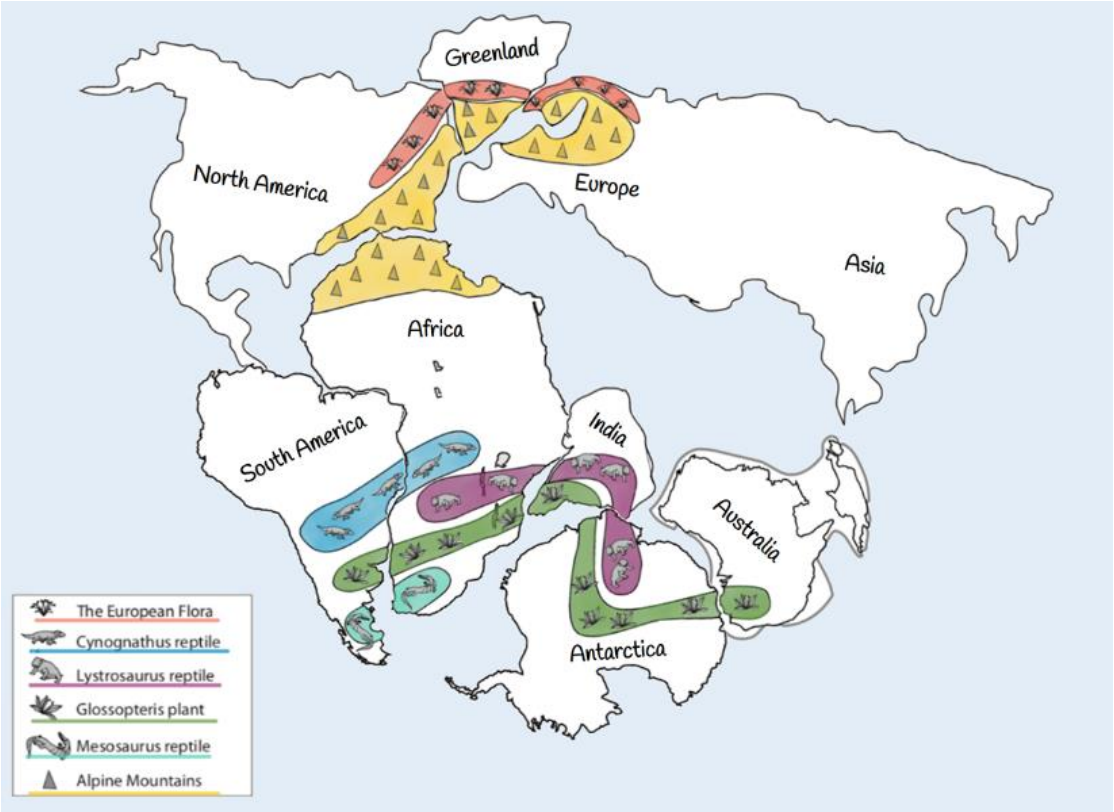
animal fossils across oceans means that those landmasses must have been touching at some point in time. Let's see if we can reassemble Pangaea using what he found.

a. Have students cut out the continents and put together the puzzle by using the clues and lining up the evidence to match across oceans.
b. Glue or tape the pieces together on the first page of the handout under #1 to create Pangaea.

4. While the students are working on their puzzle, set up "research stations" around the room, with different maps at each station to look at the evidence that both supports and explains Wegener's theory of continental drift. You will set up 4 stations:
   a. Locations of earthquakes and volcanoes (2 maps: earthquakes and volcanoes, tectonic plate boundaries)
   b. The ages of rocks in the oceans (ages of oceanic crust + geologic time scale)
   c. Locations of specific rock types (rock types map + geologic time scale)
   d. Pangaea to present map

5. Have students move around the room and explore each station.

6. If students finish at a station before the time to switch is up, students can be working on the plate tectonic crossword puzzle.



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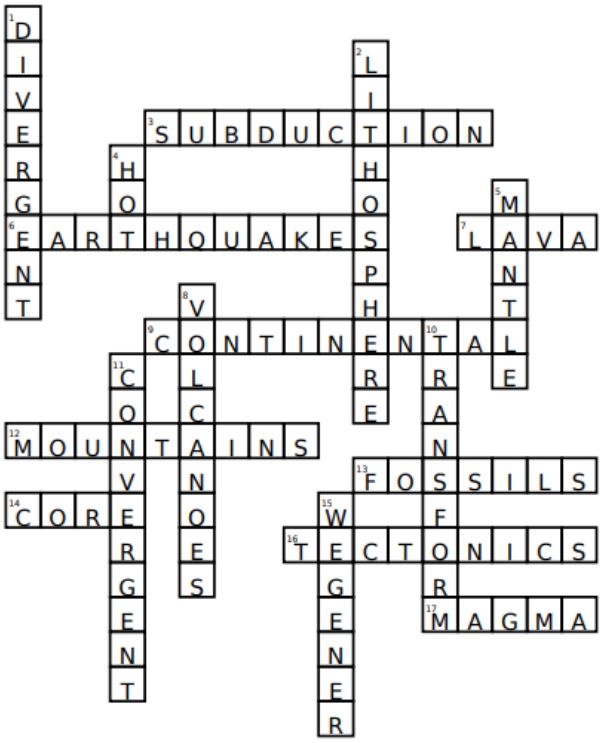

Discover Further

Extending the Lesson –

Try Oreo Plate Tectonics to better understand the different types of tectonic boundaries!
https://www.gtansw.org.au/wp-content/uploads/2021/06/GTA-Bulletin-Issue-2_2021-pdf.io_-14.pdf

Learn the Tectonic Shuffle (or create your own) and make a TikTok or video of it.
https://vimeo.com/162826666

Research an animal that is known as a "living fossil". Some examples, such as red pandas. Goblin sharks, elephant shrews, platypus, Komodo dragons, pygmy right whale, aardvark, comb jellies, and frilled sharks can be found by using a search engine and typing in "living fossil animals".

- Why is your animal considered a "living fossil"? How long has it been around for?
- Where did it originate? Has it spread to new locations over time? Will it spread further in the future?

Learn More –

Isn't it cool to think about how some species of animals exist where they are because of how the plates have moved over time? Millions of years ago, Indiana was underwater and was a tropical coral reef! Come and see the zoo's coral reef animals and imagine what Indiana might look like millions of years from now if we end up underwater again!

Evidence for Plate Tectonics

A California Paleontologist created an interactive map that lets you see where your hometown was on the Earth millions of years ago. You can select the geologic time period and type in a location to see it come up on the globe: https://dinosaurpictures.org/ancient-earth#470

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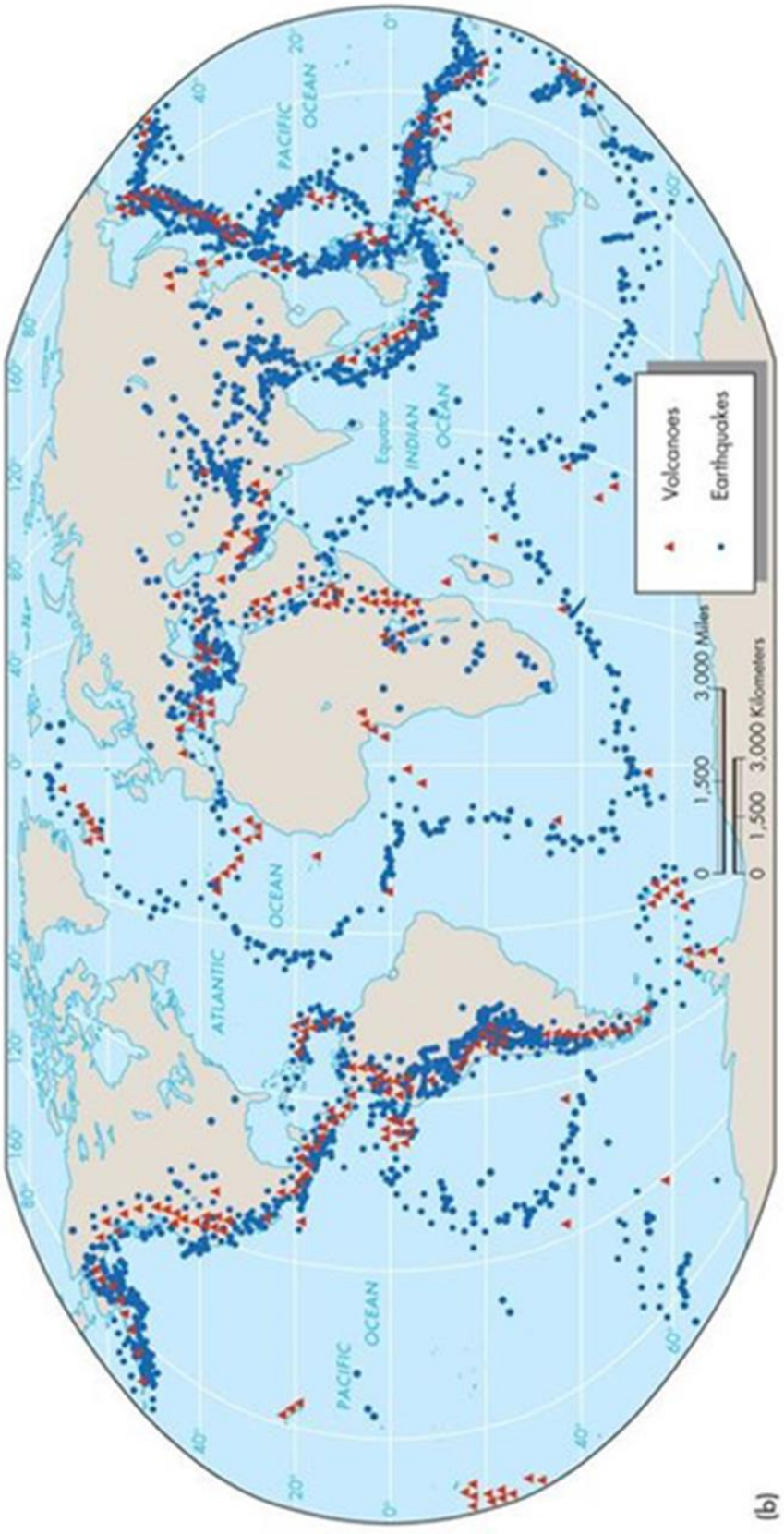
Evidence for Plate Tectonics

Map A: Earthquakes and Volcanoes



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Map A: Tectonic Plate Boundaries

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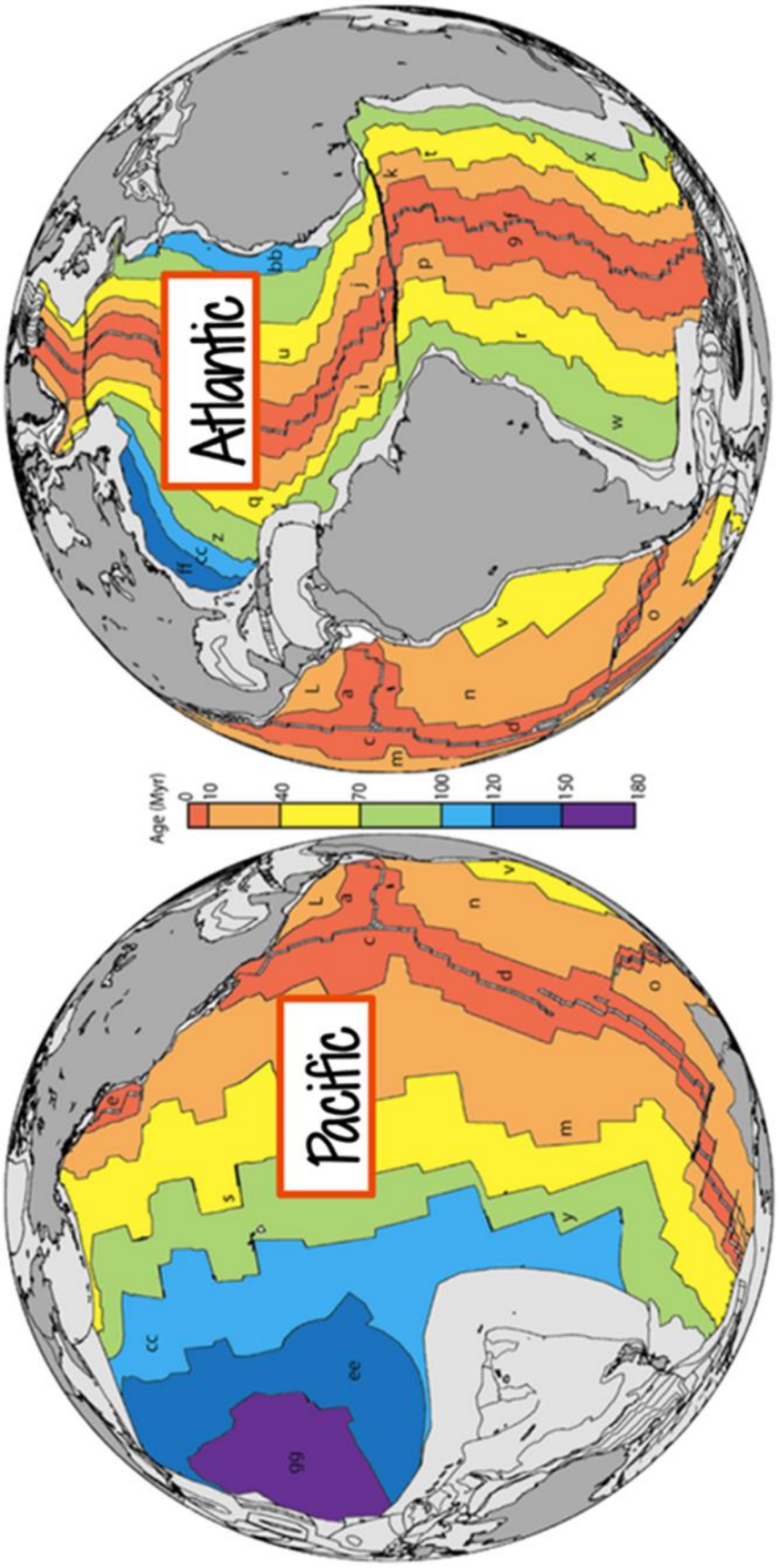
Map B: Ages of Oceanic Crust



Connecting kids and animals, strengthening families, and inspiring people to care.

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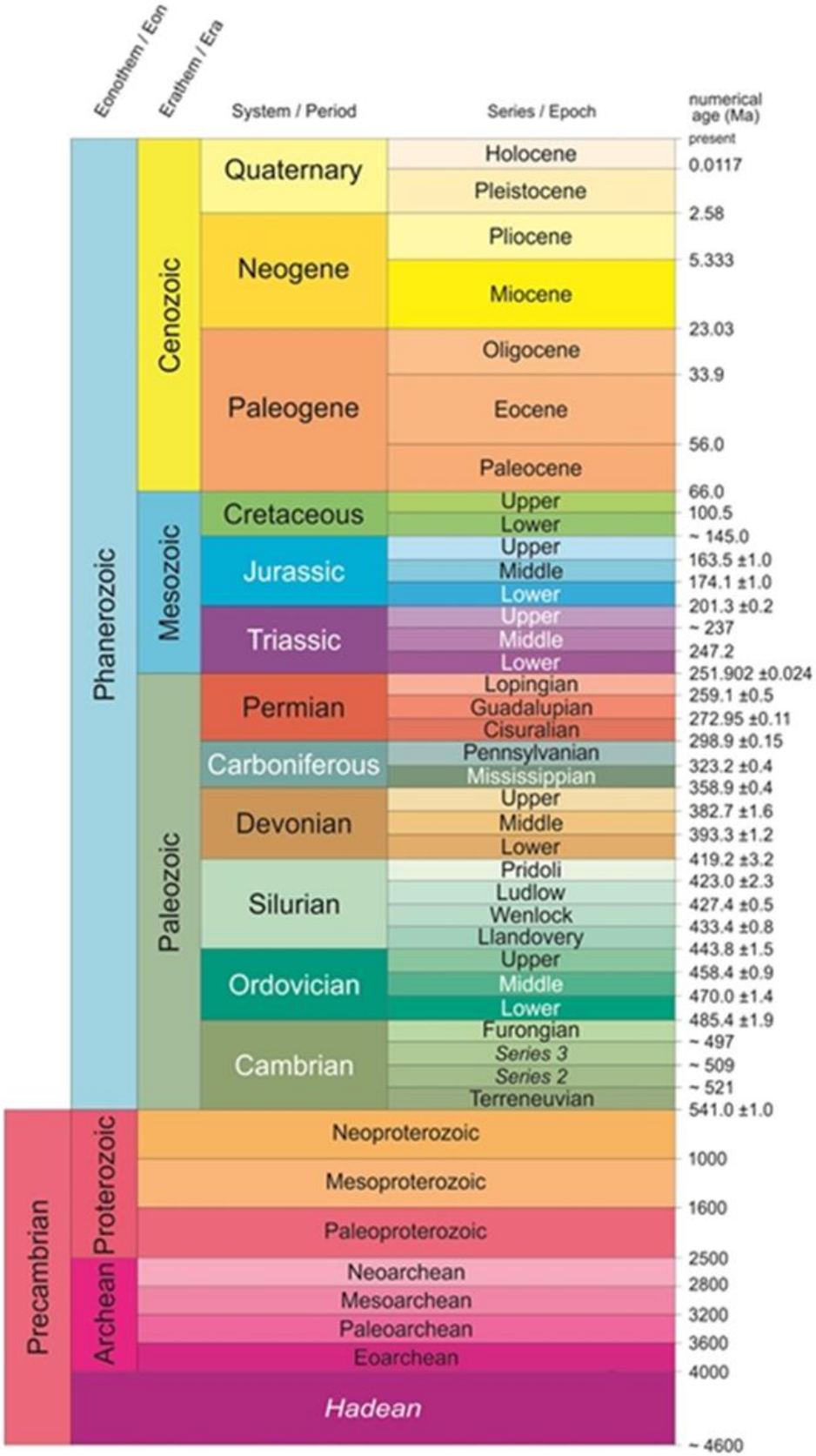
Evidence for Plate Tectonics

Geologic Time Scale



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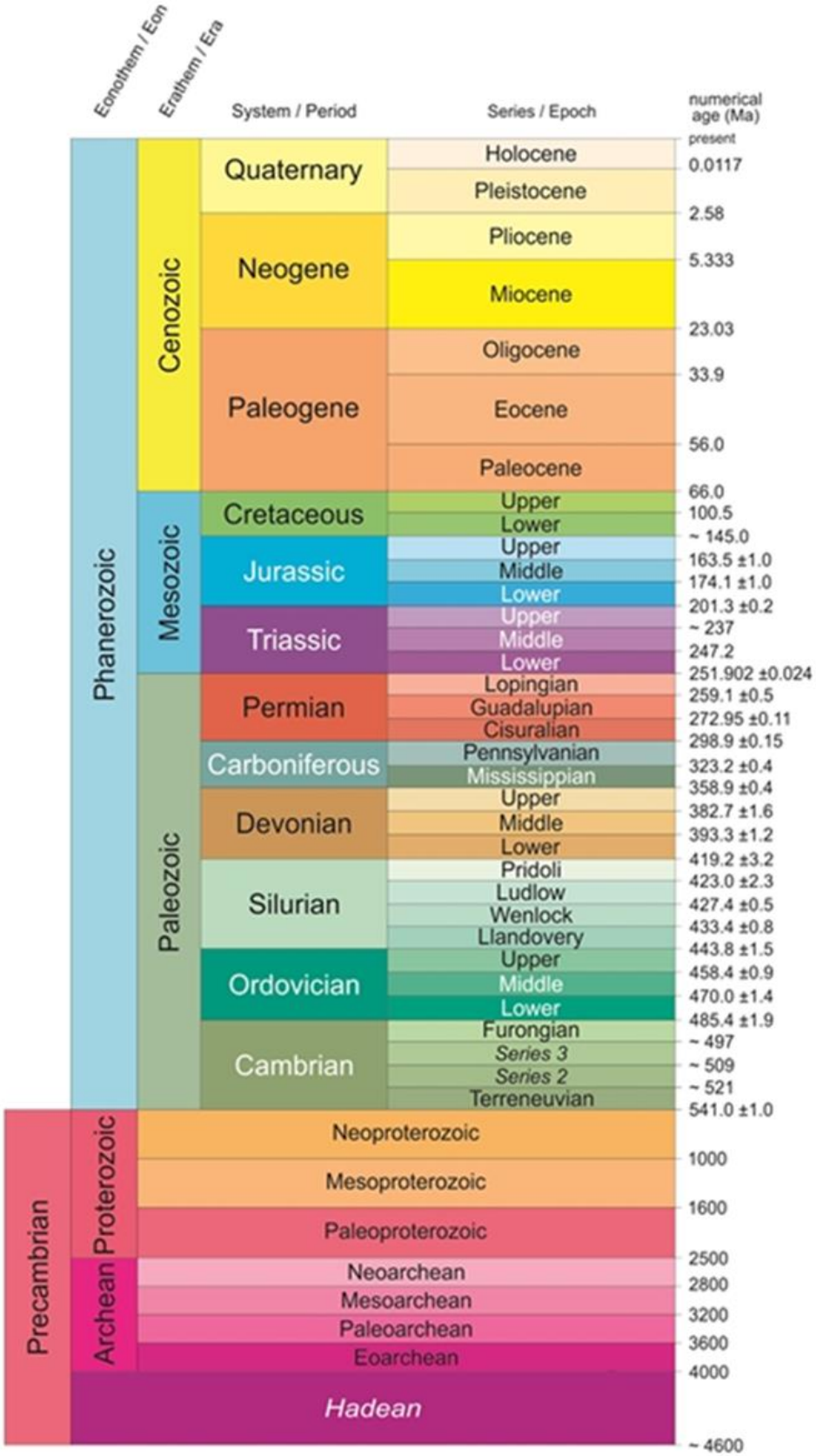
Geologic Time Scale



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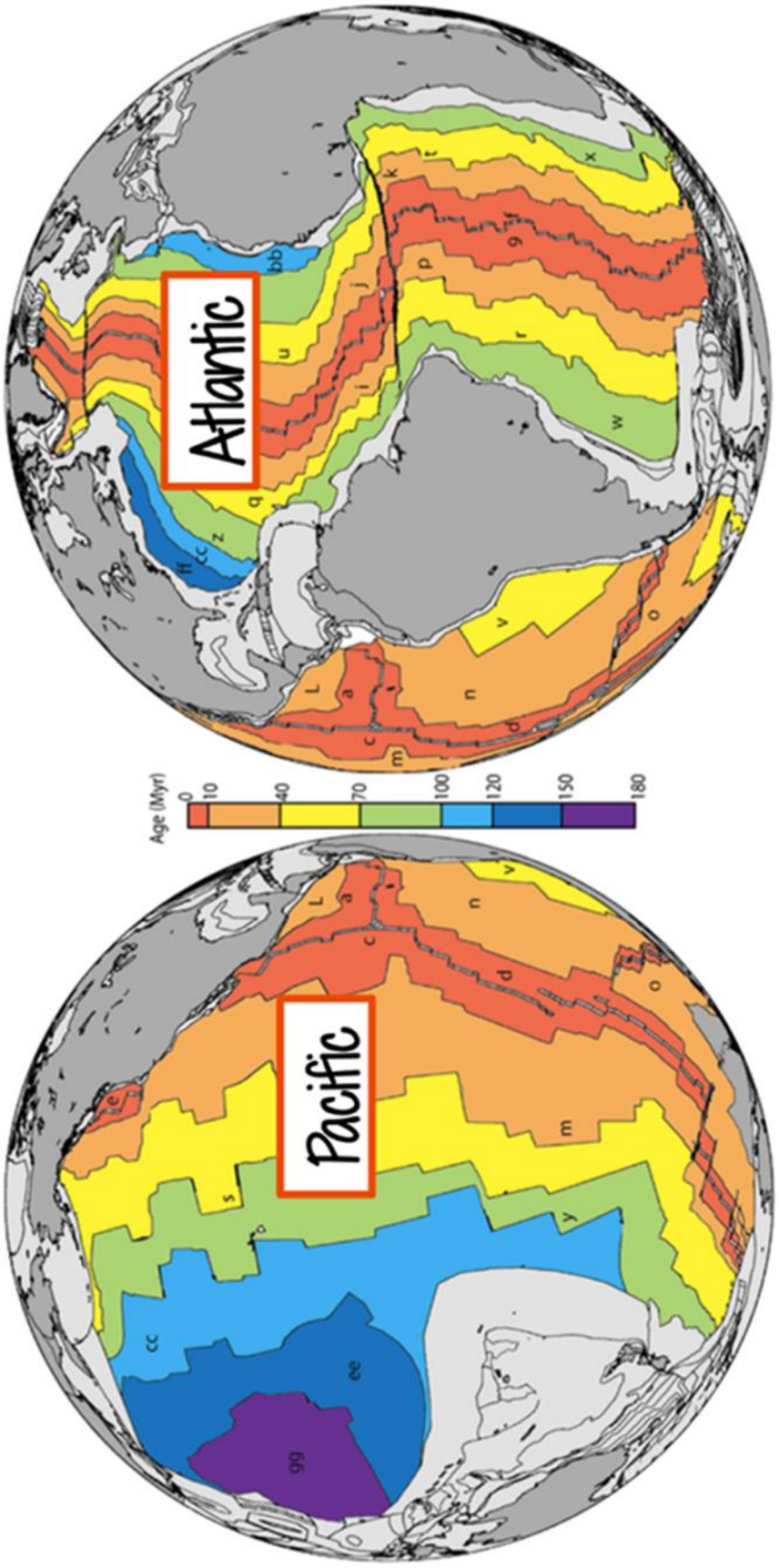
Map B: Ages of Oceanic Crust



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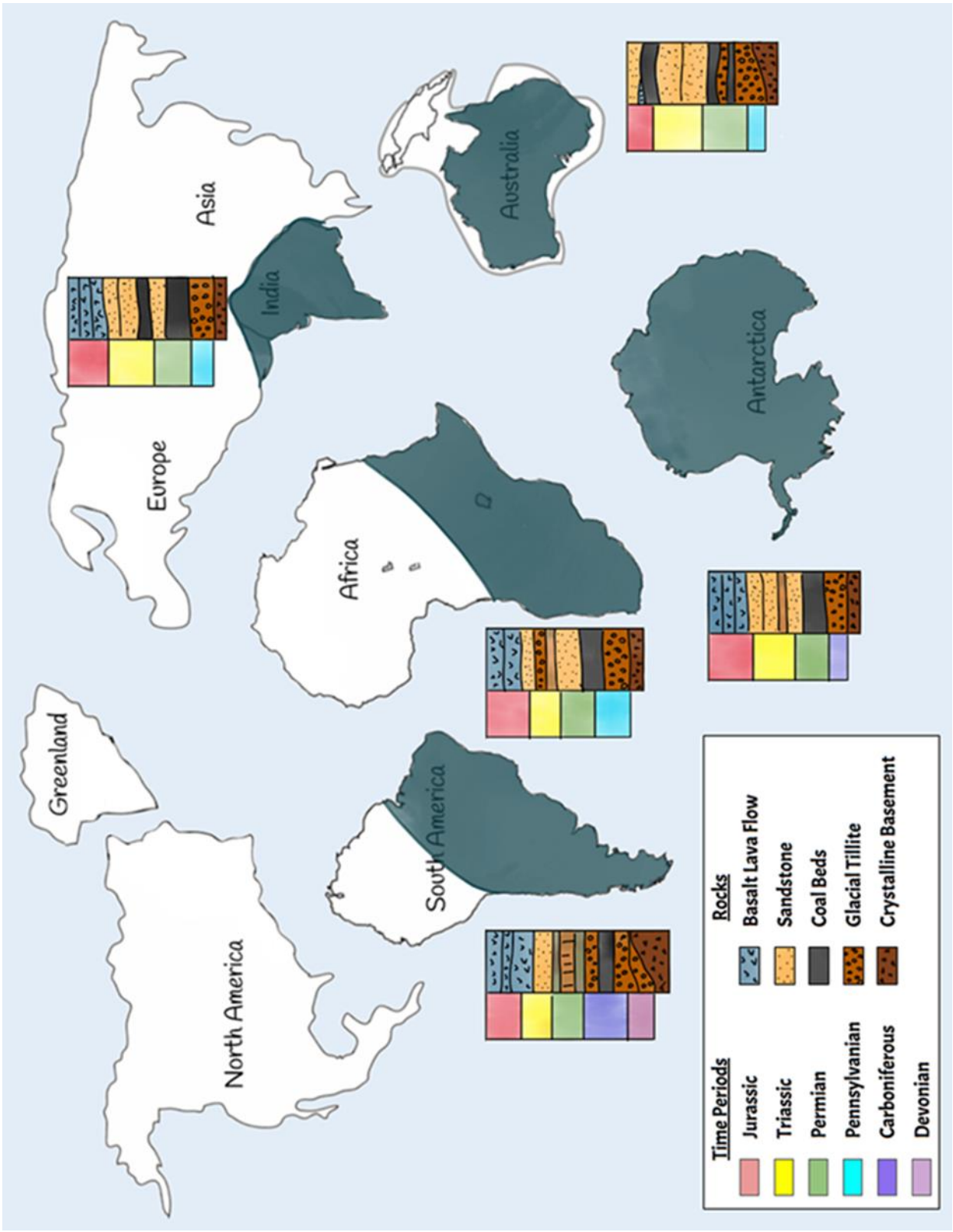
Map C: Rock Types



Map D: Pangaea to Present

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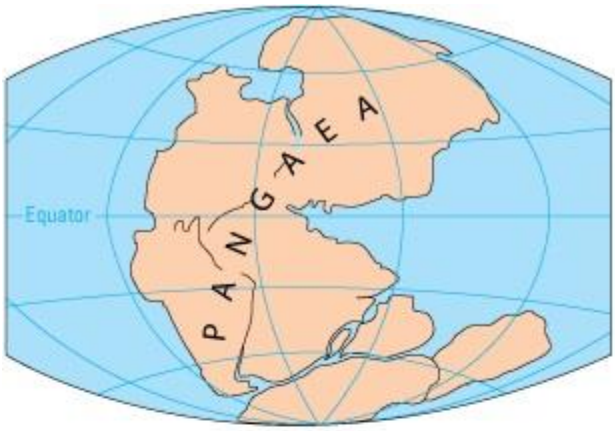
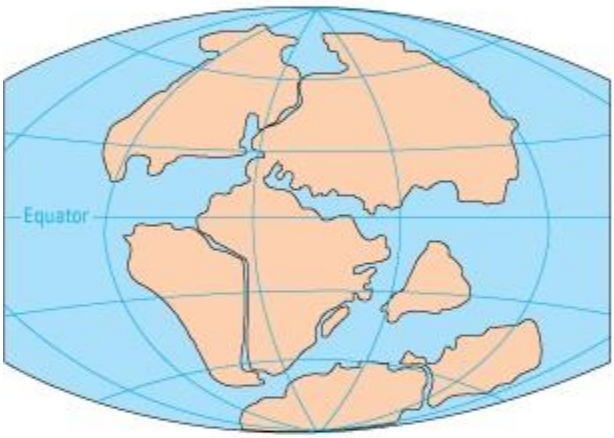
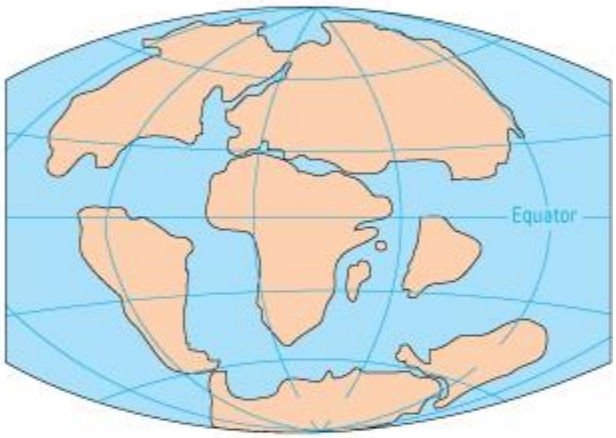


PERMIAN
225 million years ago

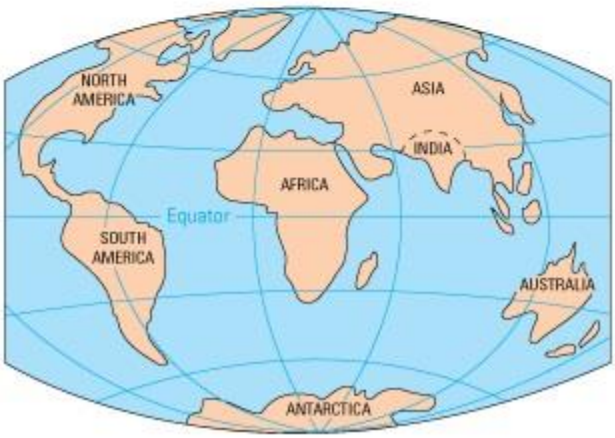
TRIASSIC
200 million years ago



JURASSIC
150 million years ago



CRETACEOUS
65 million years ago



PRESENT DAY

Connecting kids and animals, strengthening families, and inspiring people to care.

Evidence for Plate Tectonics

NAME: _____

1. Glue your model of Pangaea here:

2. Explain how these plants and animals were able to cross entire oceans. How is it that a plant found in Antarctica (a frozen tundra) is also found in Africa (a tropical continent with rainforests and deserts)?

   _____

   _____

   _____

   _____

Evidence for Plate Tectonics

3. MAP A: EARTHQUAKES AND VOLCANOES. MAP A: TECTONIC PLATE BOUNDARIES.
   Is there a pattern to the distribution of earthquakes and volcanoes? Where do most earthquakes and volcanoes happen?

   _____

   _____

   _____

4. Why do they happen there? What is the mechanism causing earthquake and volcanoes?

   _____

   _____

   _____

   _____

5. MAP B: AGES OF OCEANIC CRUST.
   New rock is formed and pushed outward at what type of plate boundary?

   _____

6. The youngest rock shown on this map is colored red. How old is it (Hint: "Myr" means "millions of years")?

   _____

7. The oldest rock is colored purple. How old is it?

   _____

8. What geologic time periods would that equate to on the geologic time scale (what is the age range of the oceanic crust)?

   _____

Evidence for Plate Tectonics

_____

9. Our world looks the way it does because the tectonic plates have been moving over time and leaving behind evidence that they were there! Various landforms can be left behind from the collision and separation of tectonic plates. List two:

_____

_____

10. MAP: ROCK TYPES.
Large sections of South America, India, Africa, Australia, and Antarctica all have similar rock strata (layers of rock). The types and depths of rock strata are determined by environmental conditions. For example, coal forms when dead plant matter submerged in swamp environments is subjected to geologic heat and pressure over hundreds of millions of years. With coal being so widespread on this map, what does that tell us about the continents?

_____

_____

11. The map shows us the time periods that coal was formed in each of those continents. When was Antarctica a swamp that would have produced that coal?

_____

12. Was Antarctica always covered in snow? How do you know?

_____

_____

_____

13. Antarctica is in a cold spot on the planet. How could it have once been a swamp?

_____

_____

_____

Evidence for Plate Tectonics

14. Using the geologic time scale, list the 5 regions in the chronological order they were "swampy" and write the dates of when they were warm and wet.

_____

_____

_____

_____

_____

15. Bring it all together: The cool part about looking at layers of rocks (and dating those rocks to a specific time period) is that we can determine WHEN specific continents were in specific places for those rocks to be formed. Fossils in rocks are often the biggest piece of the puzzle. Most of Indiana's bedrock is limestone from the Ordovician-Carboniferous age. Limestone is formed in the ocean when shells and shell fragments from a tropical coral reef build up on the sea floor. What does that tell us about what Indiana was 485-300 million years ago?

_____

_____

_____

_____

16. MAP: PANGAEA TO PRESENT.
This map shows the locations of the continents throughout the last 225 million years. What has been the general motion of North America? (Where has it been moving?)

_____

17. Giant Tortoises have been around for 200 million years, and they are not swimmers. If we know they exist in Africa today, where else could we expect to find them (given what we know about where the continents were 200 million years ago)?

_____

_____

18. Where would we definitely NOT find Giant Tortoises today?

_____

_____

_____

19. Indiana has a species of salamander called the hellbender (sometimes called "snot otters"). It is a large, fully aquatic amphibian that lives in freshwater streams. Hellbenders evolved and have been in Indiana for about 65 million years. Explain why we wouldn't find hellbenders in Australia.

_____

_____

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_____

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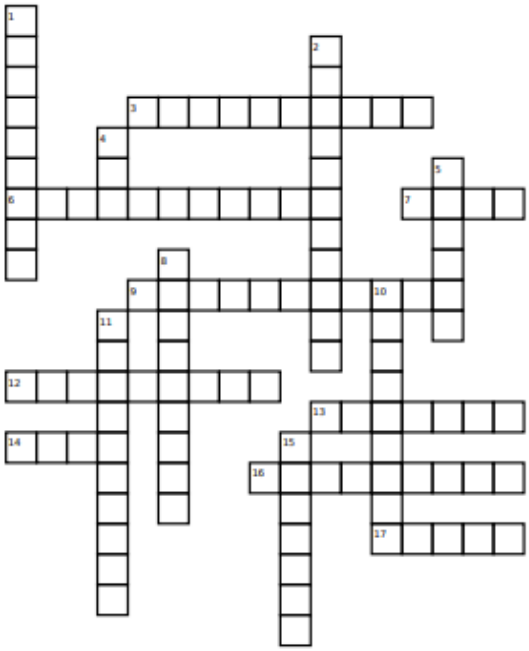
Plate Tectonics Crossword



Down:

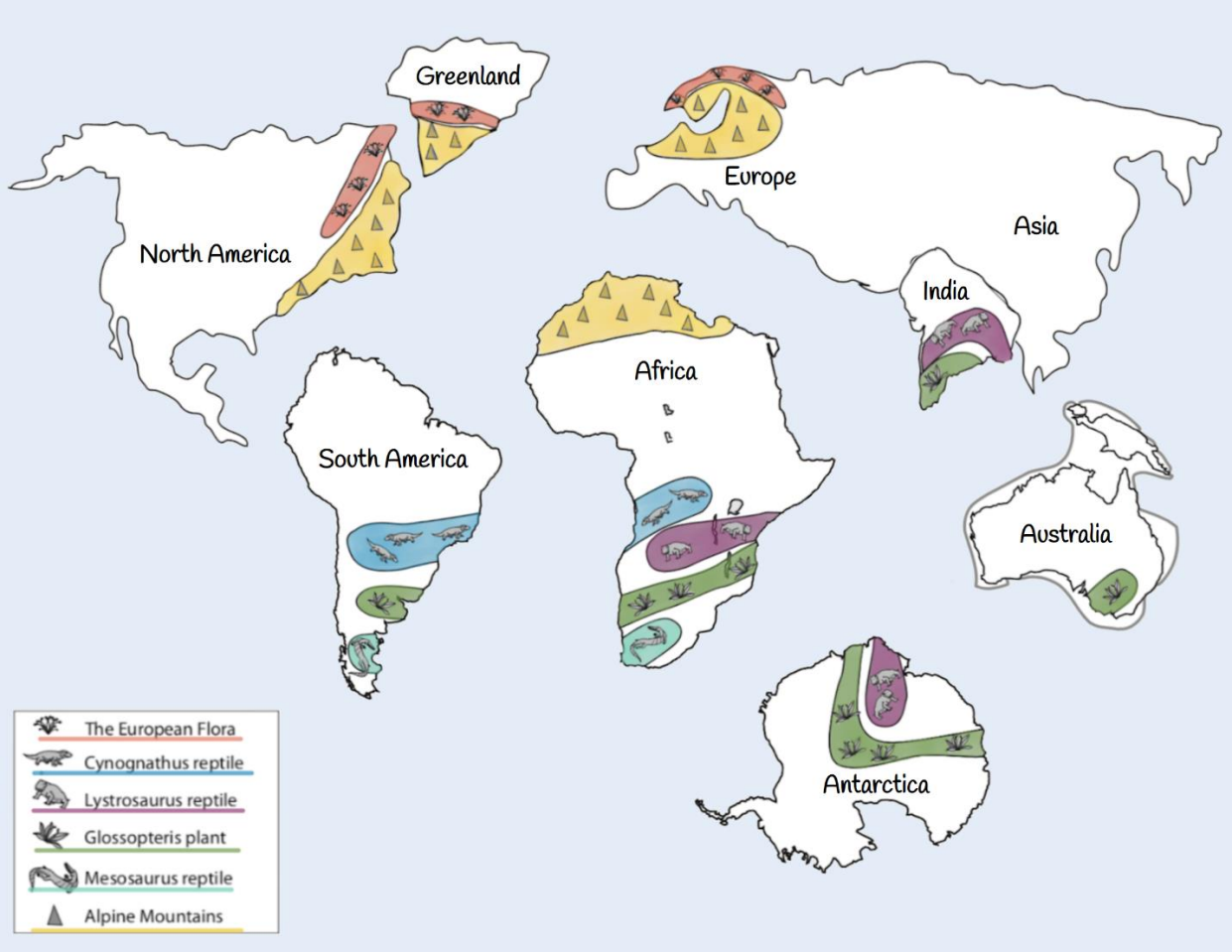
1. When 2 tectonic plates move away from each other
2. The crust + the top part of the mantle
4. The mantle and core are very, very, _____
5. The thickest layer of the Earth
8. Often formed when one plate is subducted under another
10. When 2 tectonic plates slide side-by-side
11. When 2 tectonic plates move toward each other
15. The last name of the man who first came up with the idea of plate tectonics

Across:

3. When one tectonic plate is tucked or pushed under another
6. Caused by the slipping of tectonic plates
7. Melted rock that has erupted out of a volcano onto the crust
9. Drift when continents move because of plate tectonics
12. Formed when 2 tectonic plates push into each other
13. Evidence found in the ground that shows animals existed across continents
14. Has 2 parts and is responsible for the Earth's magnetic field
16. Wegener's theory of plate _____
17. Melted rock inside the mantle

Evidence for Plate Tectonics

Cut out the continents and use the fossil data to reassemble Pangaea, the supercontinent that existed about 300-200 million years ago! Use the information below to help you decide where each piece of the puzzle should go.



PLANT FOSSILS

- The European flora (pink) is a group of plants that lived about 300 million years ago (MYA).
- The Glossopteris plant (green) was a fern-like plant with large, heavy seeds that wouldn't have been carried far by wind or water.

ANIMAL FOSSILS

- The Cynognathus reptile (blue) lived about 230 MYA and was approximately 10 feet long (3 meters). It was a weak swimmer that lived primarily on land.
- The Lystrosaurus reptile (purple) lived around the same time as the Cynognathus and were also poor swimmers who lived on land.
- The Mesosaurus reptile (blue-green) lived about 250 MYA. This reptile was about 1.5 feet long (0.5 meters) and lived on both land and in fresh water (rivers and lakes).