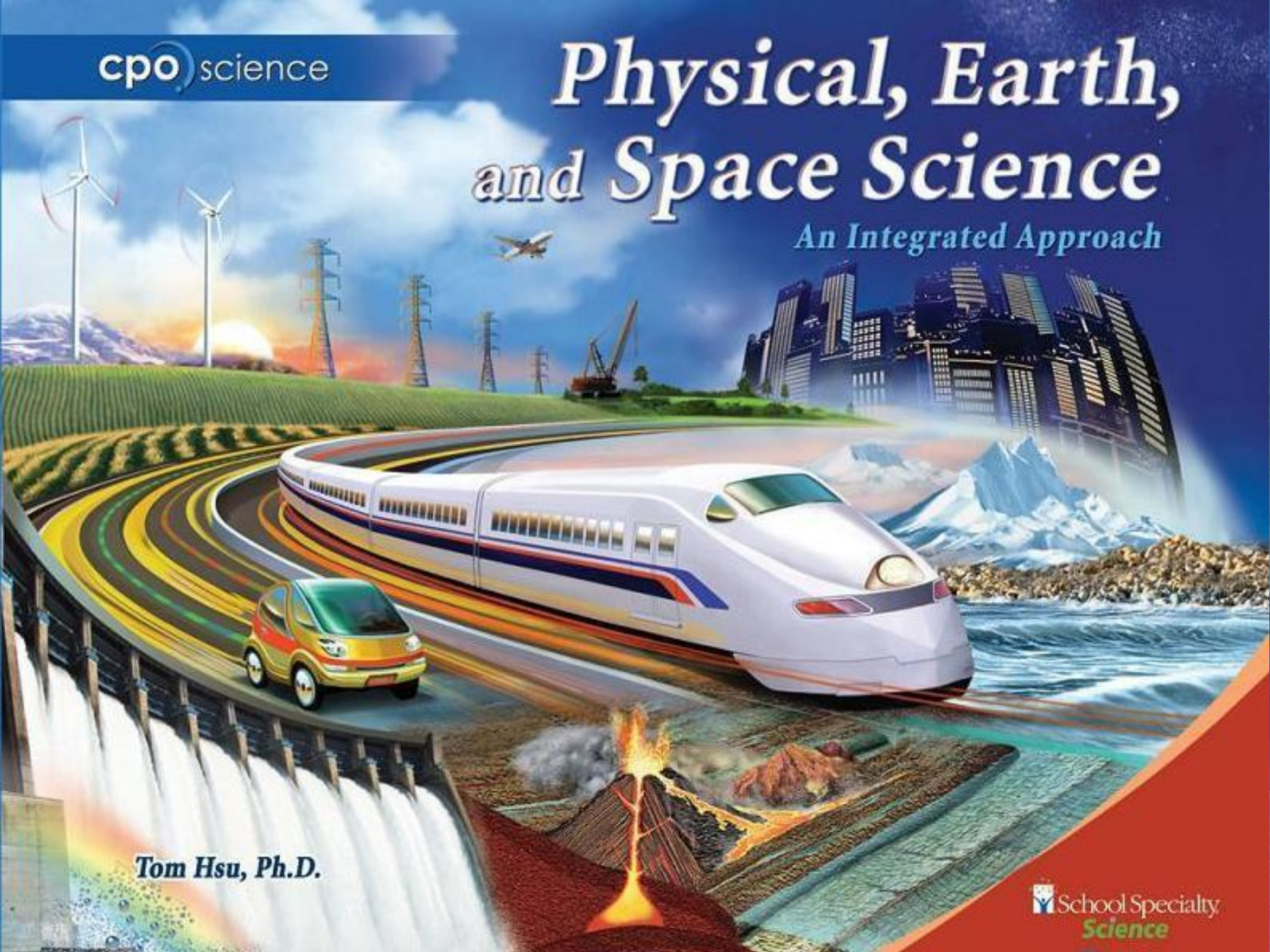
cpo science

Physical, Earth, and Space Science

An Integrated Approach

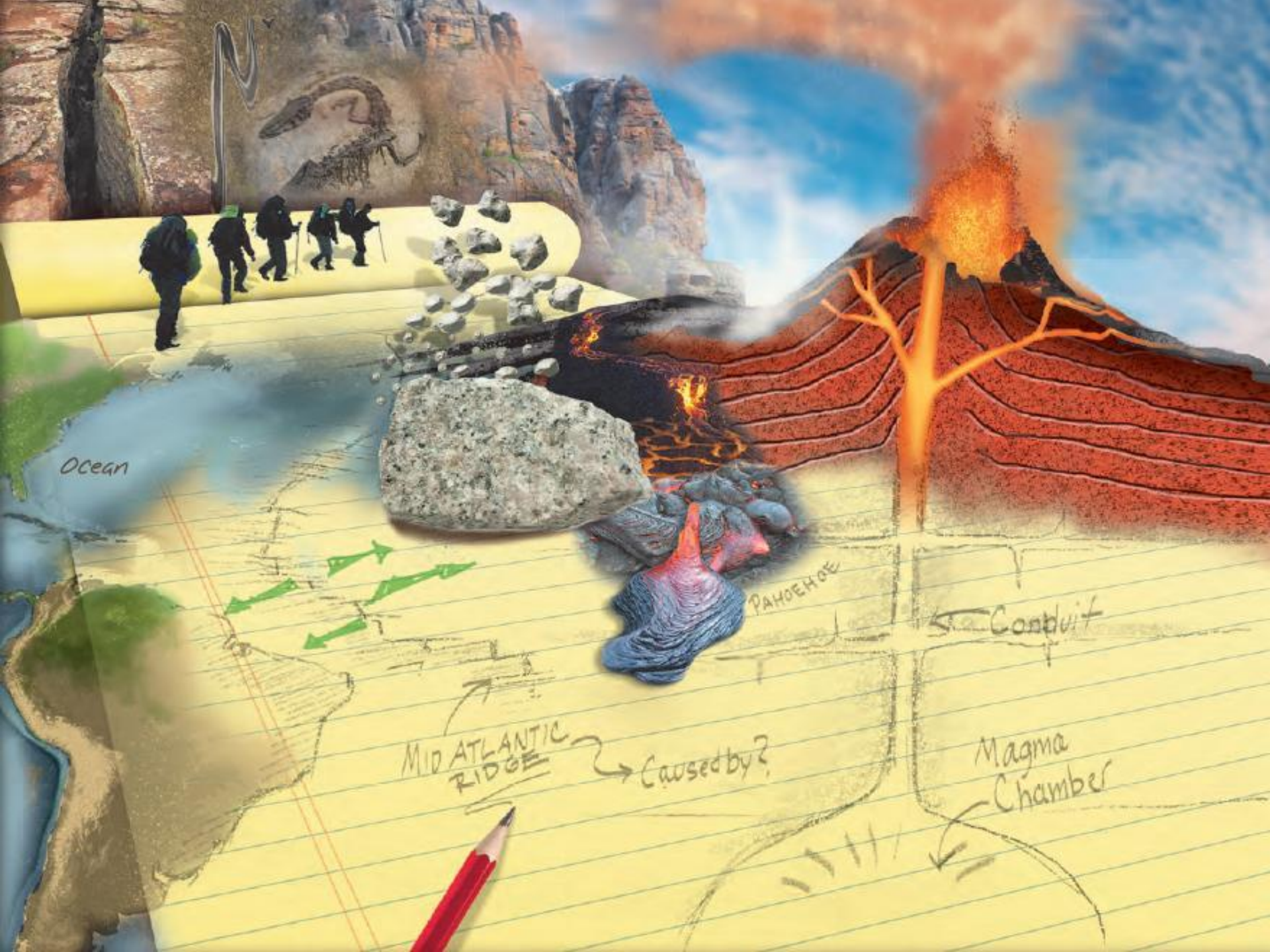


Tom Hsu, Ph.D.

School Specialty Science

UNIT SIX: Earth's Structure

- Chapter 18 Earth's History and Rocks
- Chapter 19 Changing Earth
- Chapter 20 Earthquakes and Volcanoes


Ocean
PAHOEHOE
Conduit
MID ATLANTIC RIDGE
Caused by?
Magma Chamber

Chapter Nineteen: Changing Earth

- 19.1 Inside Earth
- 19.2 Plate Tectonics
- 19.3 Plate Boundaries
- 19.4 Metamorphic Rocks

19.1 Learning Goals

- Explain how seismic waves are used to study Earth's interior.
- Describe the characteristics of layers inside Earth.
- Apply existing knowledge of density and convection to describe Earth's interior layers.

Investigation 19A

All Cracked up

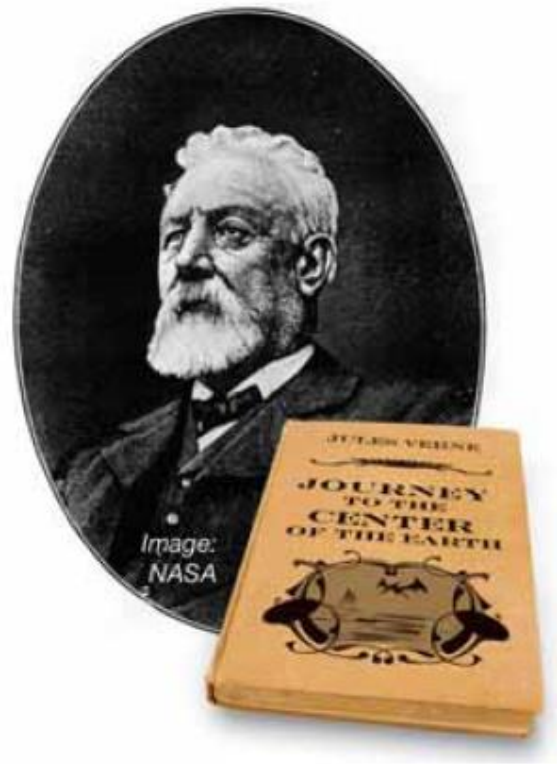
- ***Key Question:***
  - *What is a good way to model Earth?*

Table I: Evaluating your models

Model	Strengths	Weaknesses

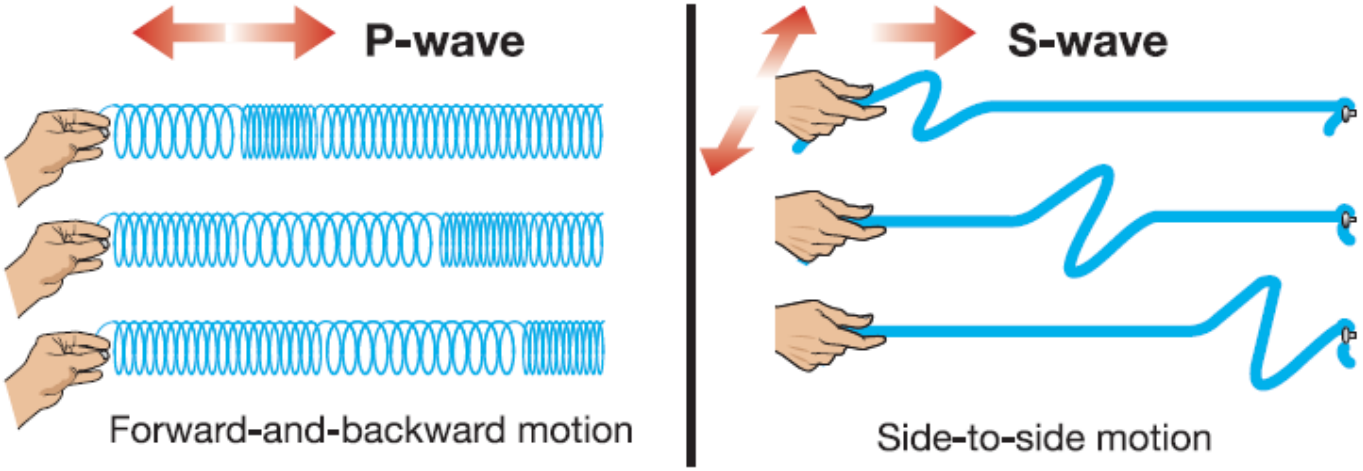
19.1 Waves inside earth

- **In 1864, Jules Verne wrote *A Journey to the Center of the Earth*.**
- **Scientists began to study special vibrations that travel through earth.**
- *** These vibrations, called *seismic waves*, revealed the structure of Earth's interior.**



19.1 Wave motion

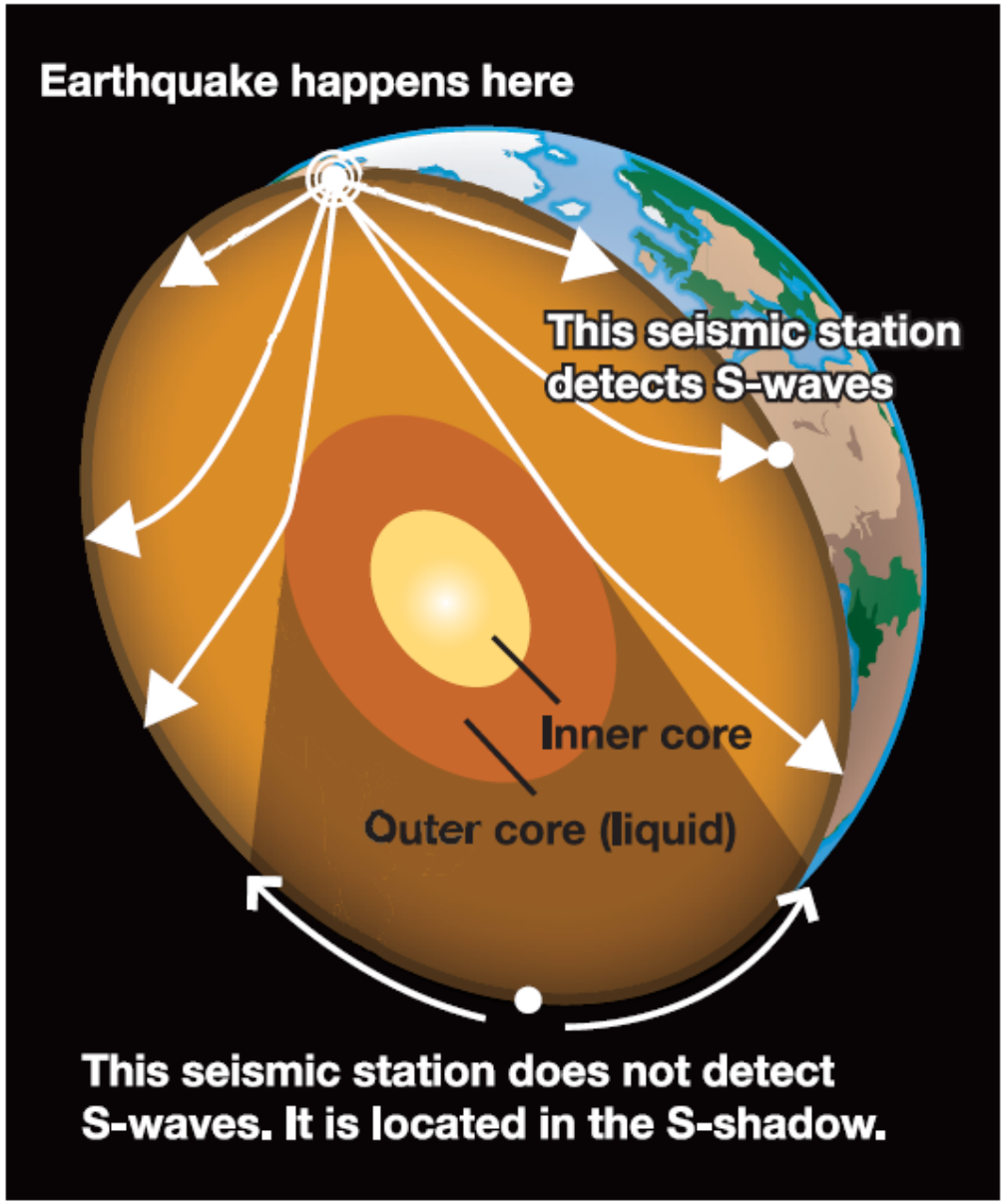
- *Two type of seismic waves that are important are primary and secondary waves.
- * *P-waves* travel faster than *S-waves* and move with a forward-and-backward motion.
- Slower S-waves travel with a side-to- side motion.



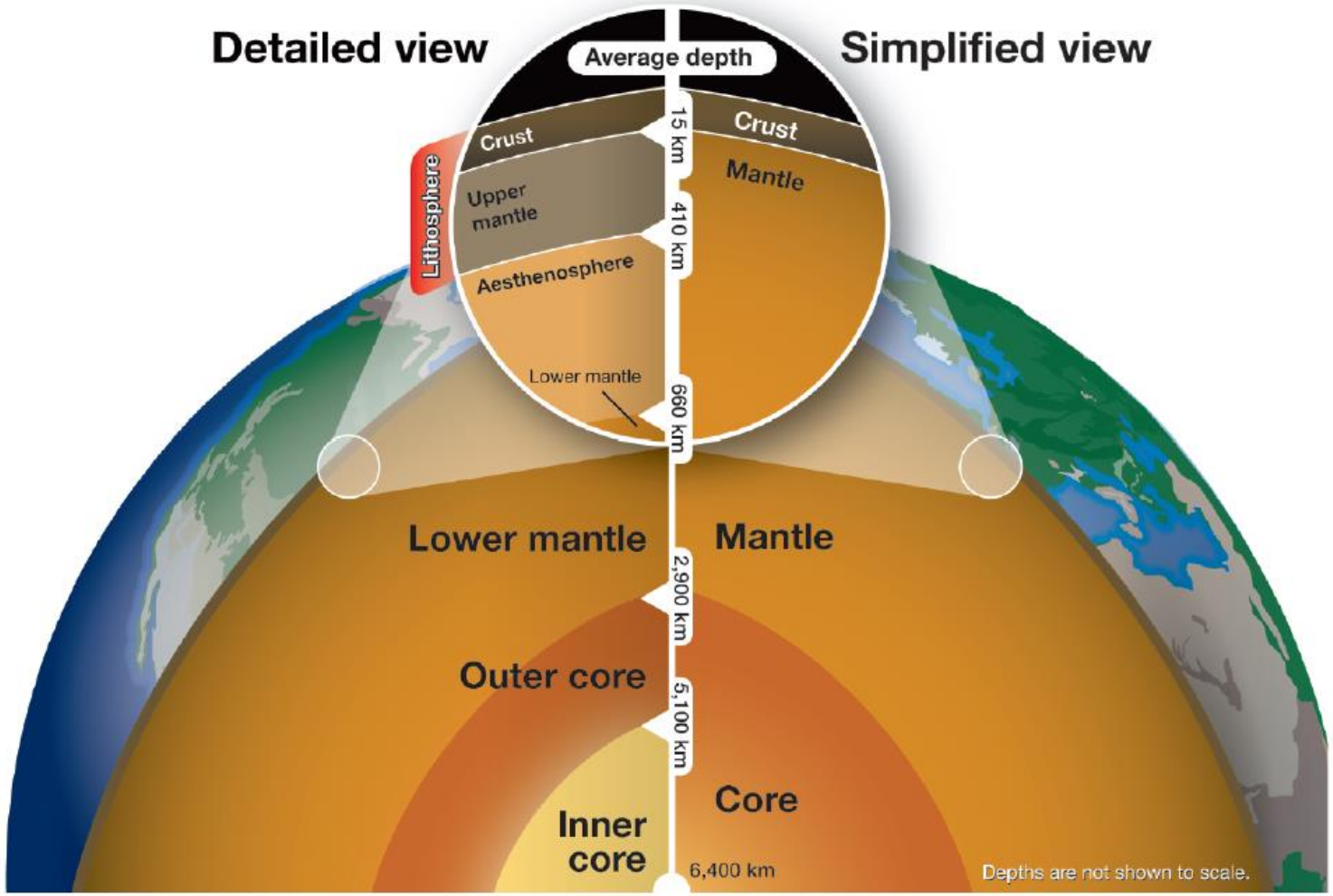
19.1 Wave motion

- By studying what happens to the waves on their path through Earth, scientists are able to make detailed maps of Earth's interior…
  1. When S-waves are produced on one side of Earth due to an earthquake, there is a large area on the other side where the waves can't be detected.
  2. Scientists know that secondary waves do not pass through liquids.
  3. With this fact and these observations, they realized that the outer core of Earth must be liquid.

S-Waves and S-Shadow

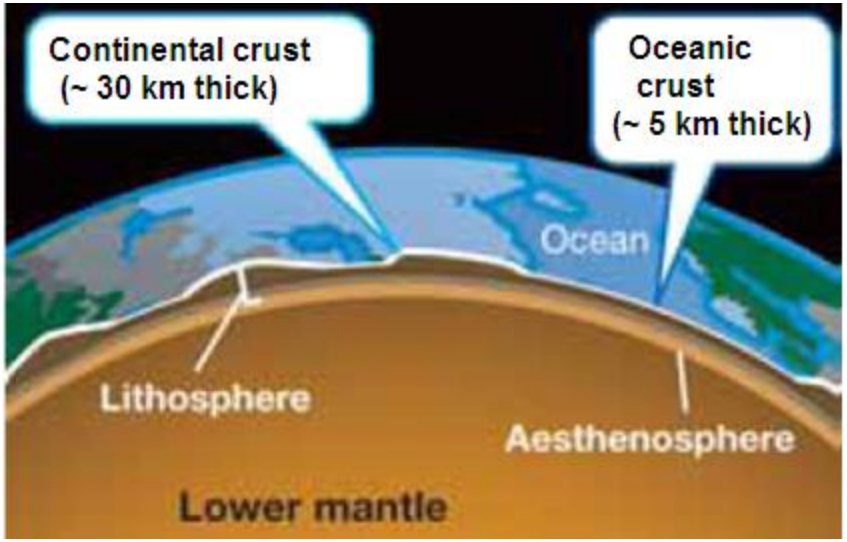


Earth's Interior



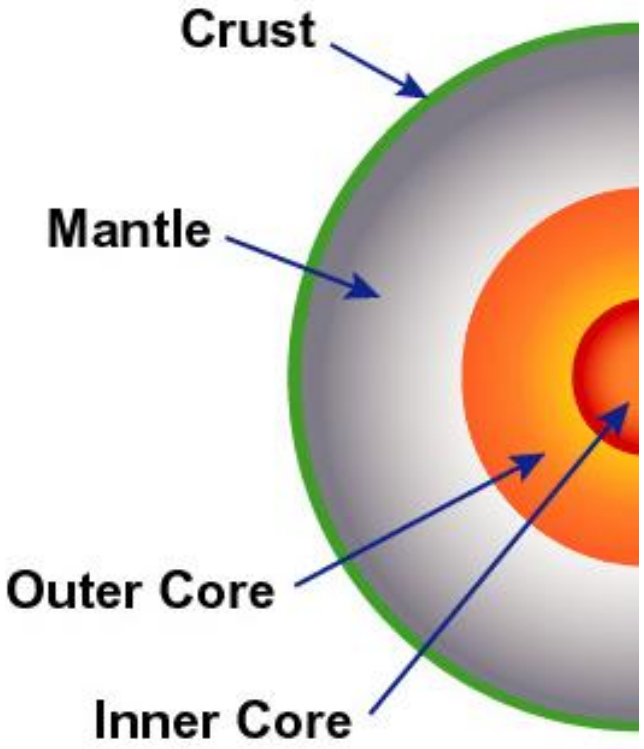
19.1 Layers inside Earth

- * The *crust* is the outermost surface of Earth.
- * Oceanic crust lies under the oceans and is thin.



What is below the crust?

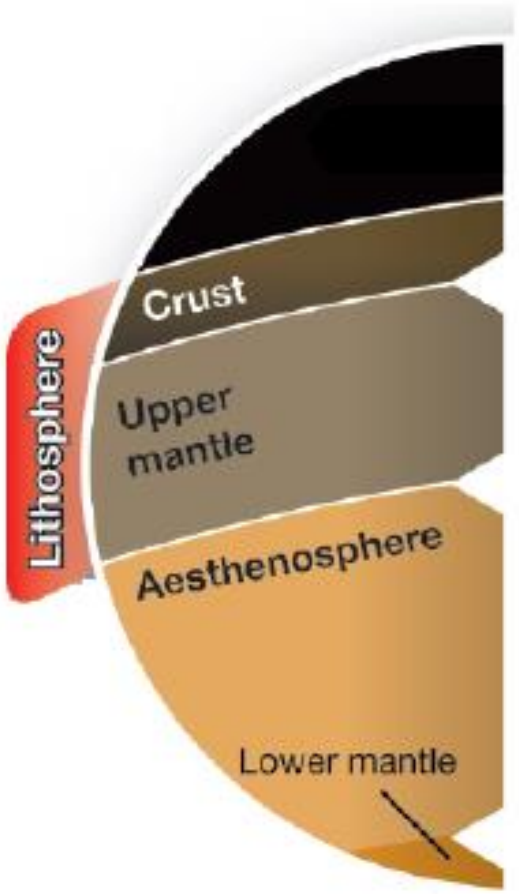
19.1 Layers inside Earth



- * In a simplified view of Earth, the *mantle* includes everything below the crust and above the core.

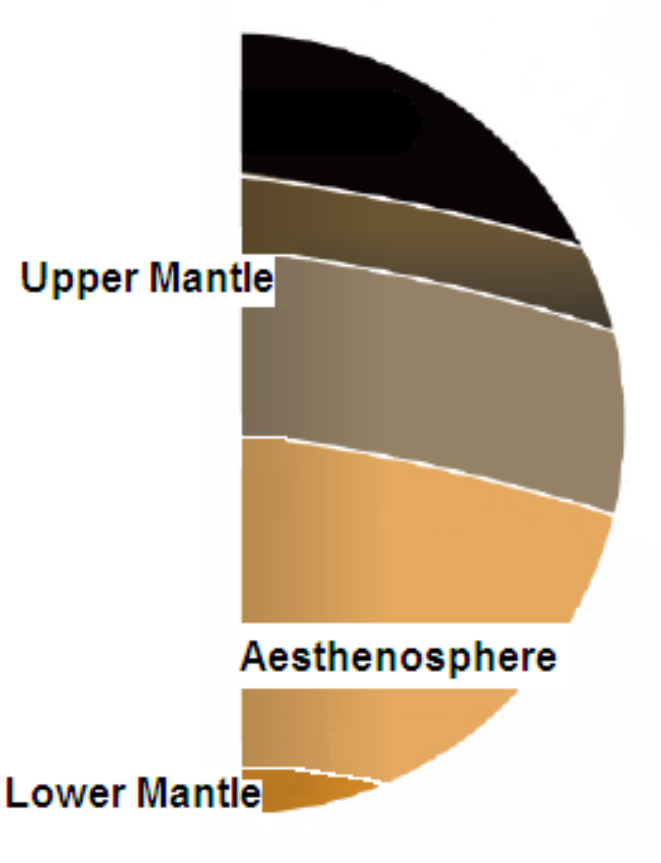
19.1 Layers inside Earth

- **** The lithosphere*** **<u>includes</u> the crust and a thin part of the mantle.**



What lies above the lithosphere?

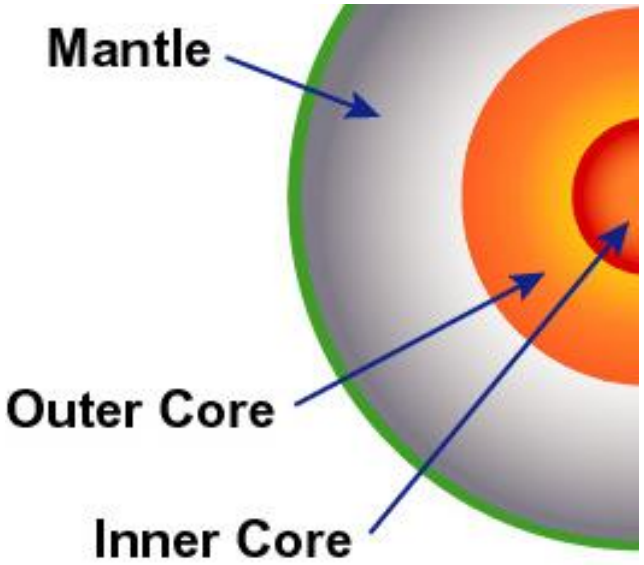
19.1 Layers inside Earth



- * The *aesthenosphere* lies just under the lithosphere and is the outermost part of the lower mantle.
- * This is a slushy zone of hot rock with a small amount of melted rock.

19.1 Layers inside Earth

- * The *core* is the name for the center of Earth.
  - The outer core is made mostly of iron, and is so hot the iron is melted.
  - The inner core is also made mostly of iron, but it is solid.



Why is the inner core solid?

19.1 Density and Earth's materials

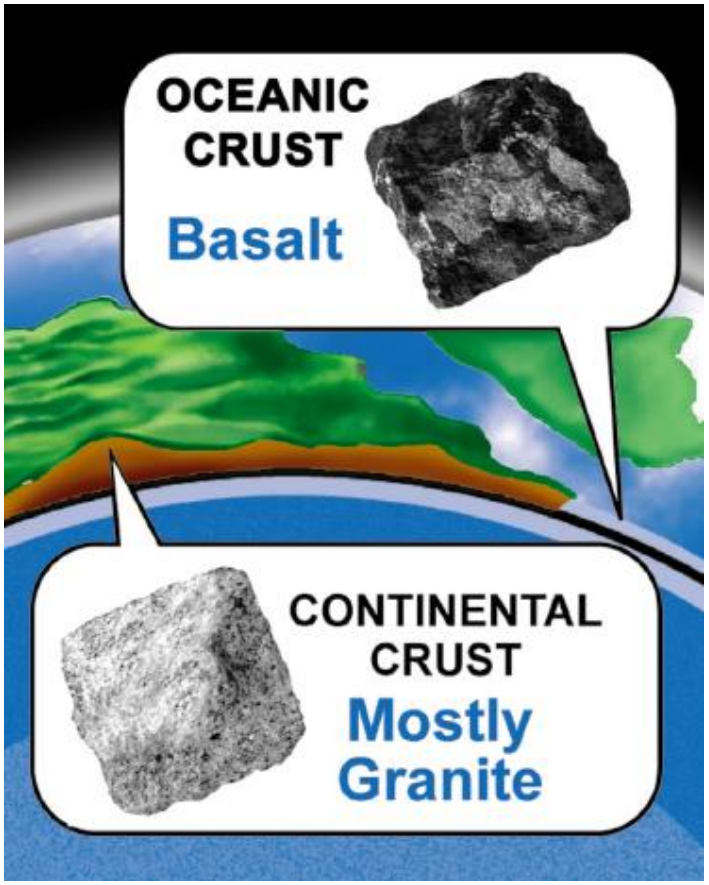
- * Scientists conclude that Earth formed from the gas and dust that surrounded our young sun.
- * At first, Earth's surface was made of the same materials as its center.
- * Later, the materials melted and became fluid.
- * More dense materials settle toward the center.
- * Less dense materials rose toward the surface.

19.1 Density and Earth's materials

- Today aluminum and silicon, which have low densities, are common in Earth's crust.
- * Earth's inner and outer cores are composed mostly of very dense iron.

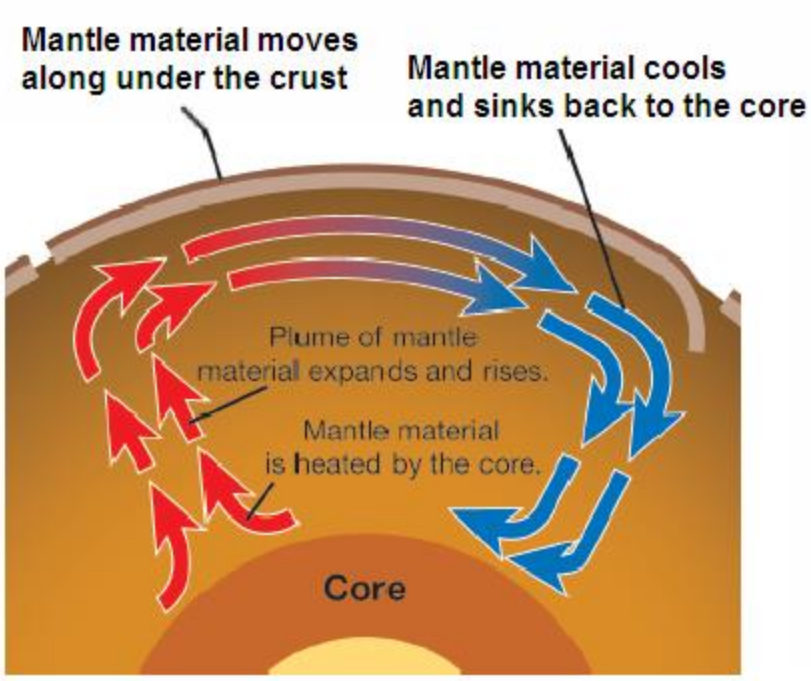
Substance	Density (g/cm^3)
aluminum	2.7
silicon	2.3
iron	7.9
water	1.0

19.1 Density and Earth's materials



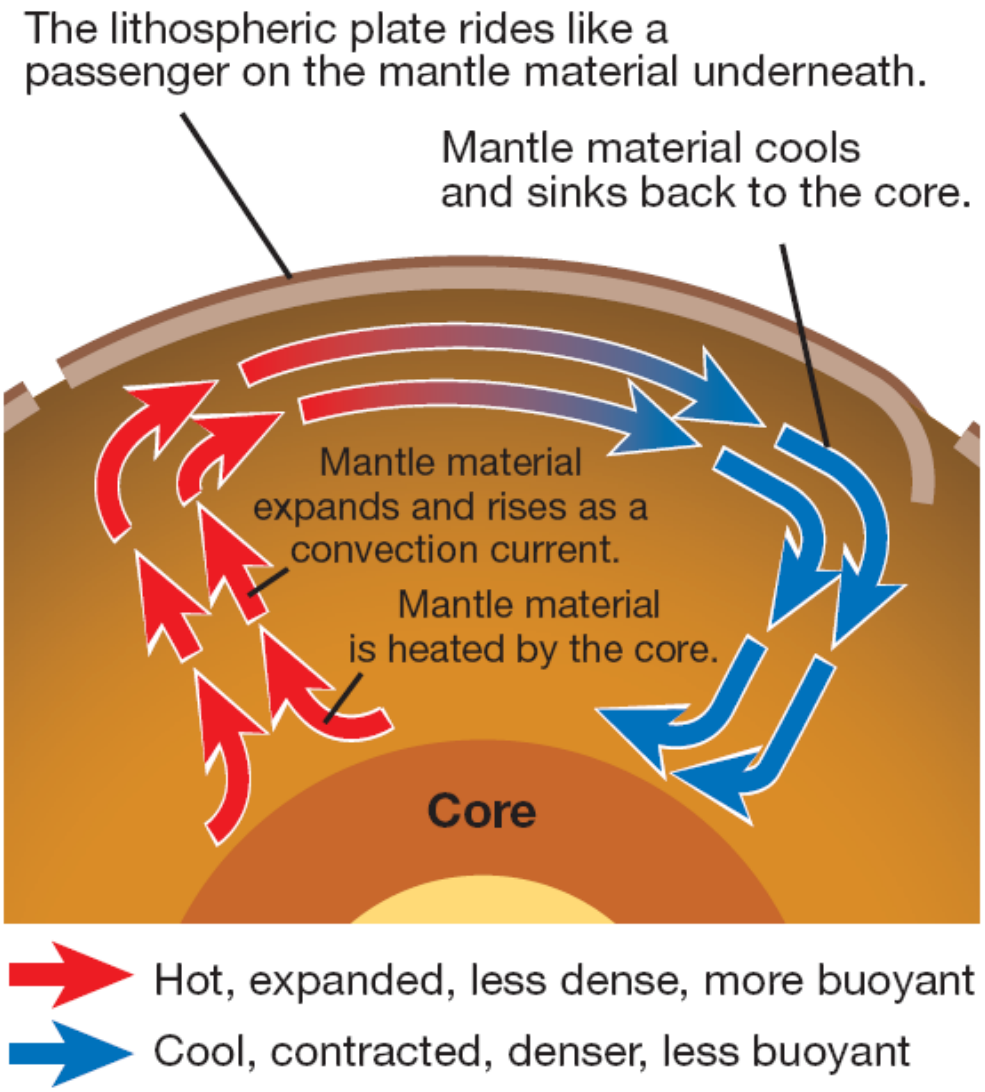
- * The oceanic crust is made mostly of basalt.
- * The continental crust is made mostly of andesite and granite.

19.1 Density and Earth's materials



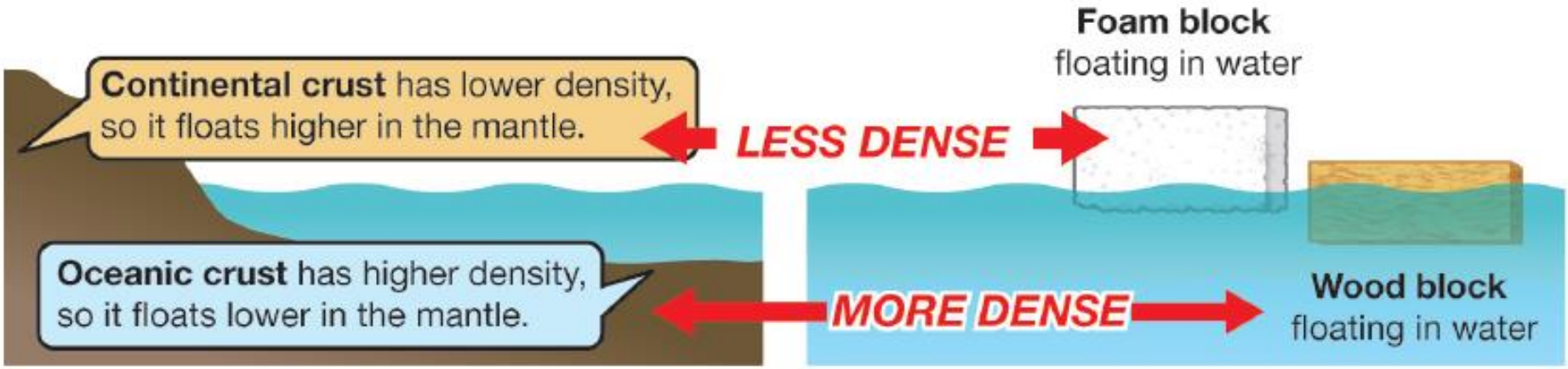
- * Heating the lower mantle causes the material to expand.
- * Since less dense materials float on more dense materials, a convection current develops.

Mantle Convection



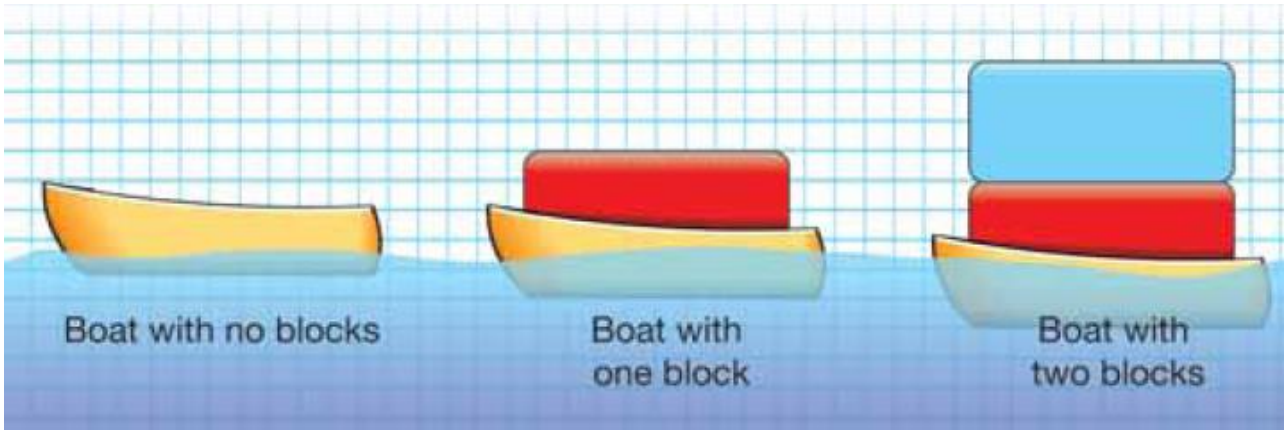
19.1 Floating continents

- * Earth's crust is made of different types of rock that are less dense than the mantle.
- It's hard to imagine rocks floating on other rocks, but this is what happens inside Earth!



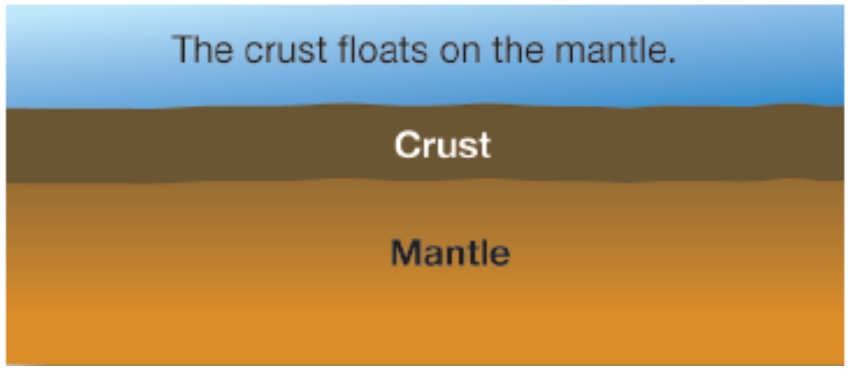
Because continental crust is less dense than oceanic crust, it floats higher on Earth's mantle. Blocks of foam and wood floating in water demonstrate this phenomenon.

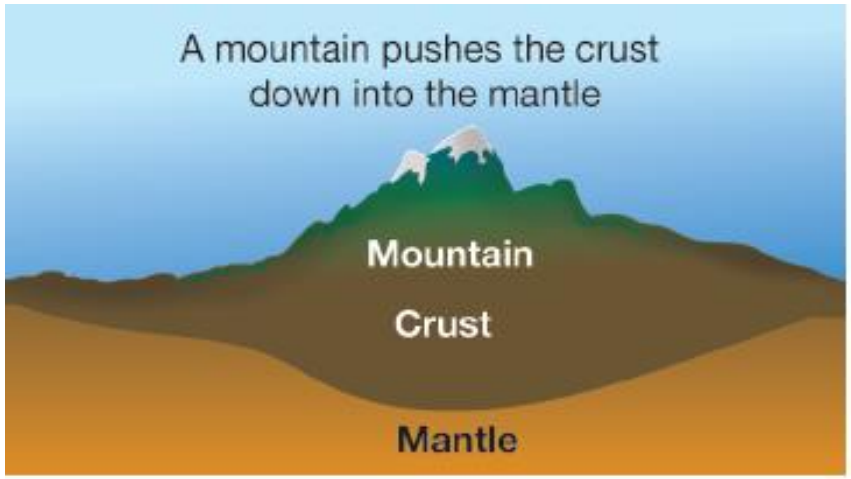
19.1 Floating continents



- * Earth's crust floats on the mantle just like the boat.
- * A mountain on land is just like the stack of blocks.
- * Crust with a mountain sticks down into the mantle.

19.1 Floating continents

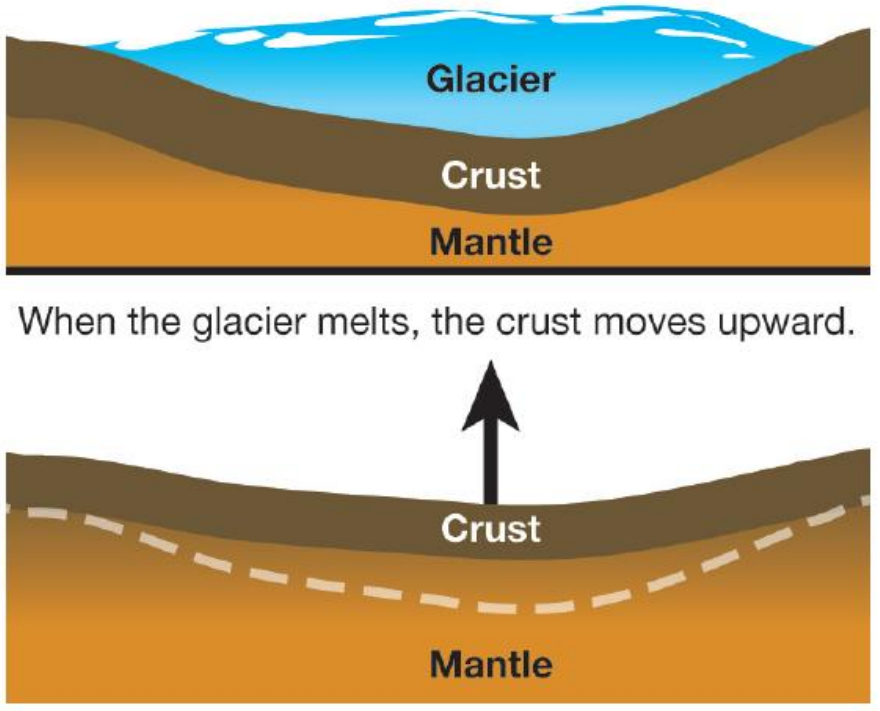




- * The average thickness of continental crust is 30 kilometers.
- * A combination of a mountain and its bulge underneath may make the crust as thick as 70 kilometers.

19.1 Floating continents

- * A *glacier* affects the crust with up and down movements.
  - During an ice age, the weight of glacial ice presses down the crust just like a mountain.
  - After the ice age ends and the glacier melts, the crust springs back up again.

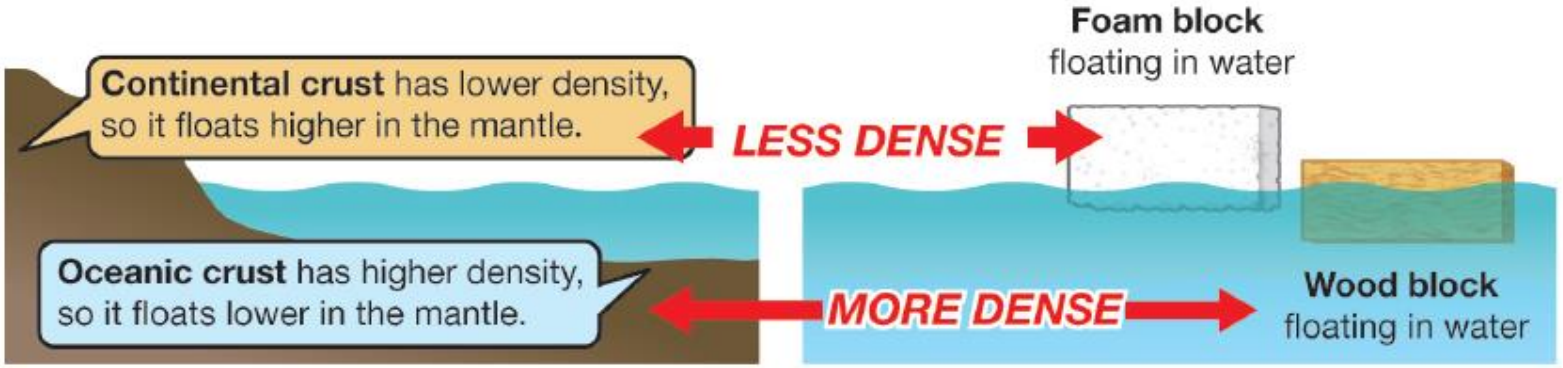


19.1 Layers of Earth

- **Compare and contrast the details of the different layers of the Earth.**

Layers of Earth		Average Depth (km)	Appoximate Temperature (°C)	Description
Lithosphere	Crust	15	0	The uppermost layer
	Upper mantle	410	870	The lower part of the lithosphere
	Asthenosphere	660		Zone where mantle rock is most fluid
	Lower mantle	2900	3700	Largest part of Earth's interior
Core	Outer core	5100	3700	Liquid iron
	Inner core	6400	5000	Solid iron

Temperature increases with depth



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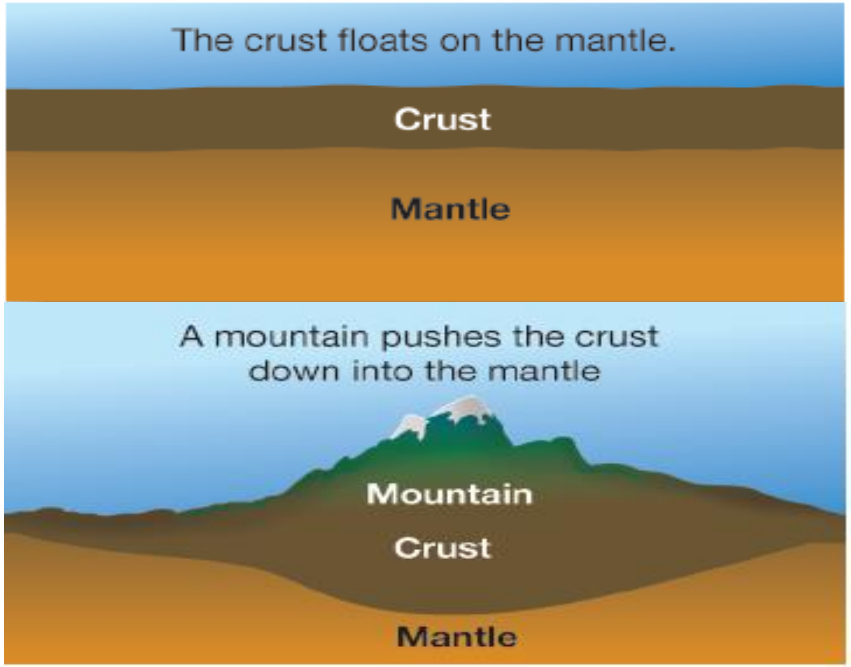

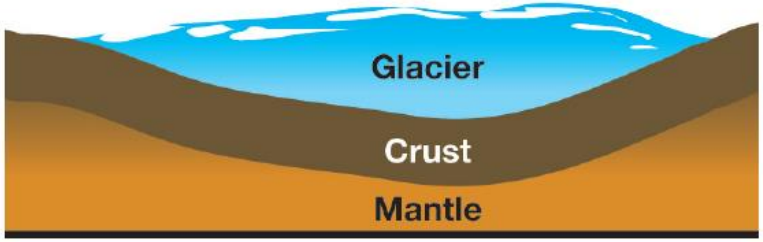

When the glacier melts, the crust moves upward.