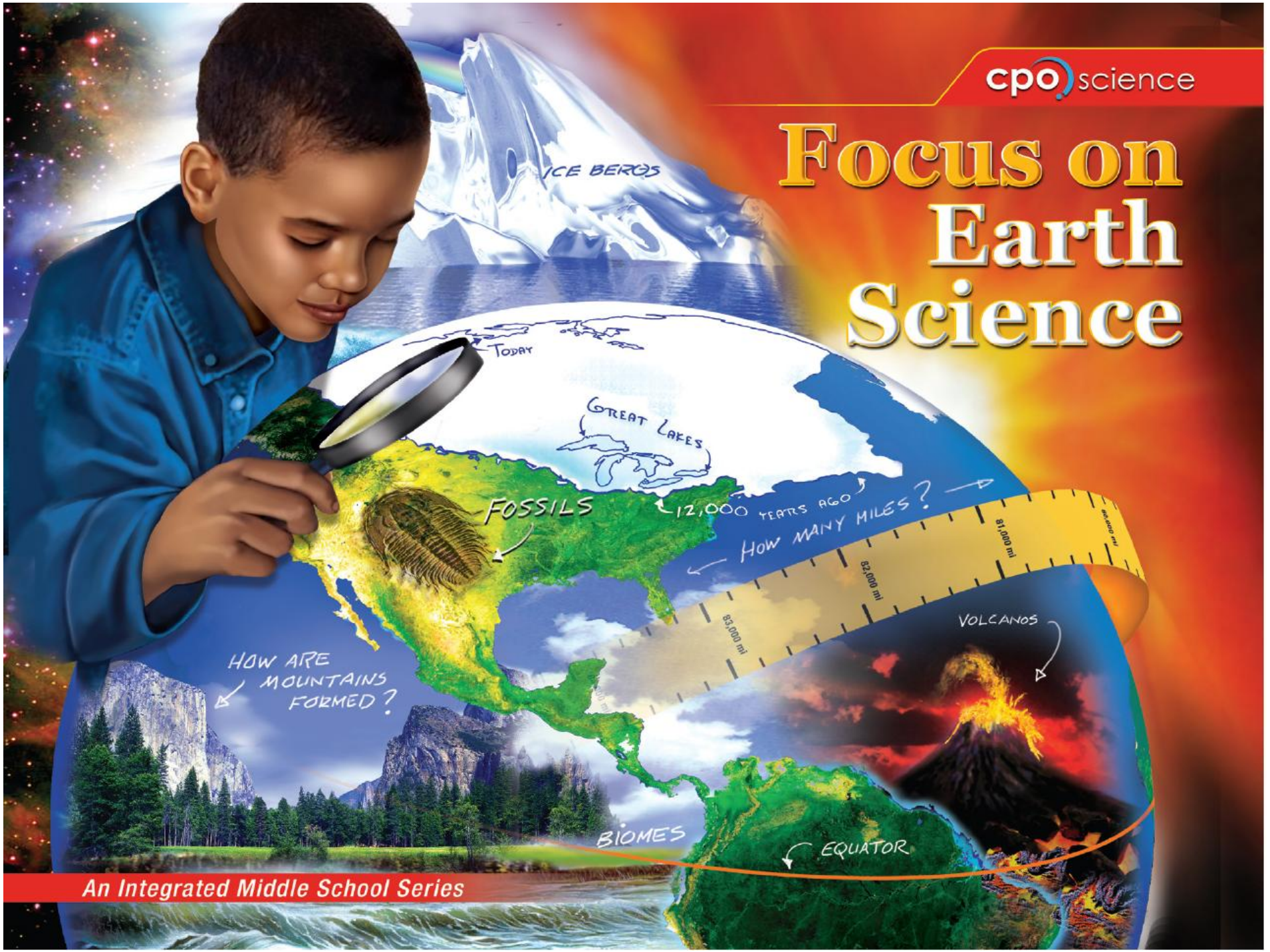

cpo science
Focus on Earth Science
ICE BERGS
TODAY
GREAT LAKES
FOSSILS
12,000 YEARS AGO
HOW MANY MILES?
81,000 mi
82,000 mi
83,000 mi
VOLCANOS
HOW ARE MOUNTAINS FORMED?
BIOMES
EQUATOR
An Integrated Middle School Series

Chapter Seven: Heat Inside the Earth

- 7.1 Sensing the Interior of the Earth
- 7.2 Earth's Interior
- 7.3 Density and Buoyancy Inside the Earth

Investigation 7A

All Cracked up

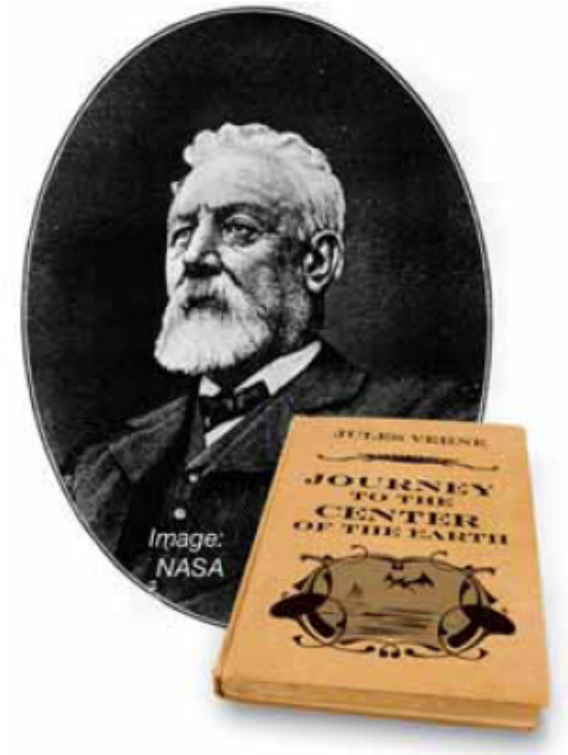
- *What is a good way to model Earth?*

Table 1: Evaluating your models

Model	Strengths	Weaknesses

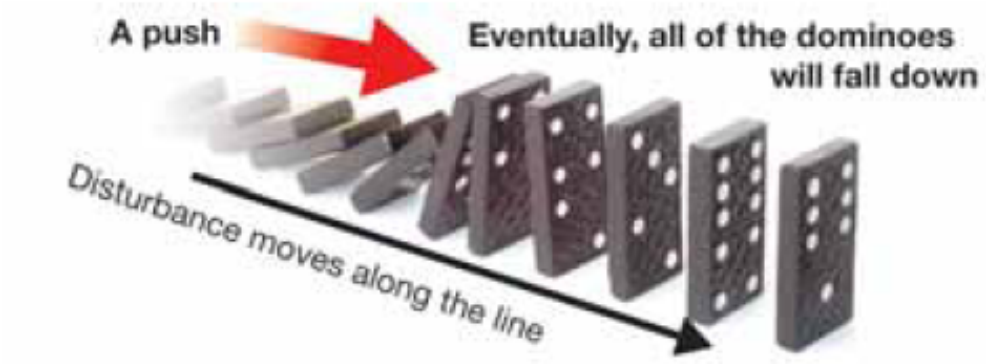
7.1 Ideas from the past

- 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.

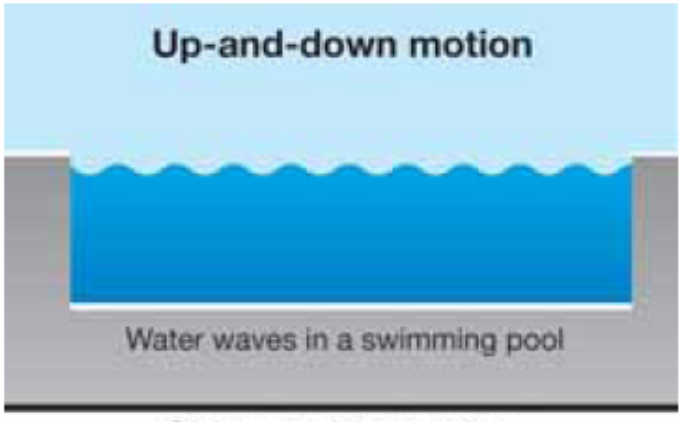


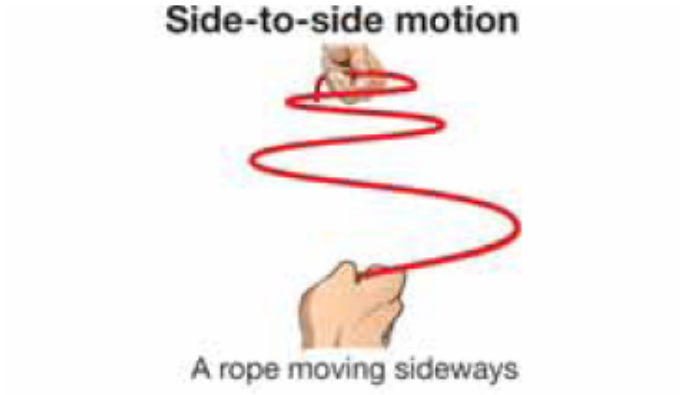
7.1 Wave Motion

- A line of dominoes illustrates how wave energy can travel.



7.1 Wave Motion

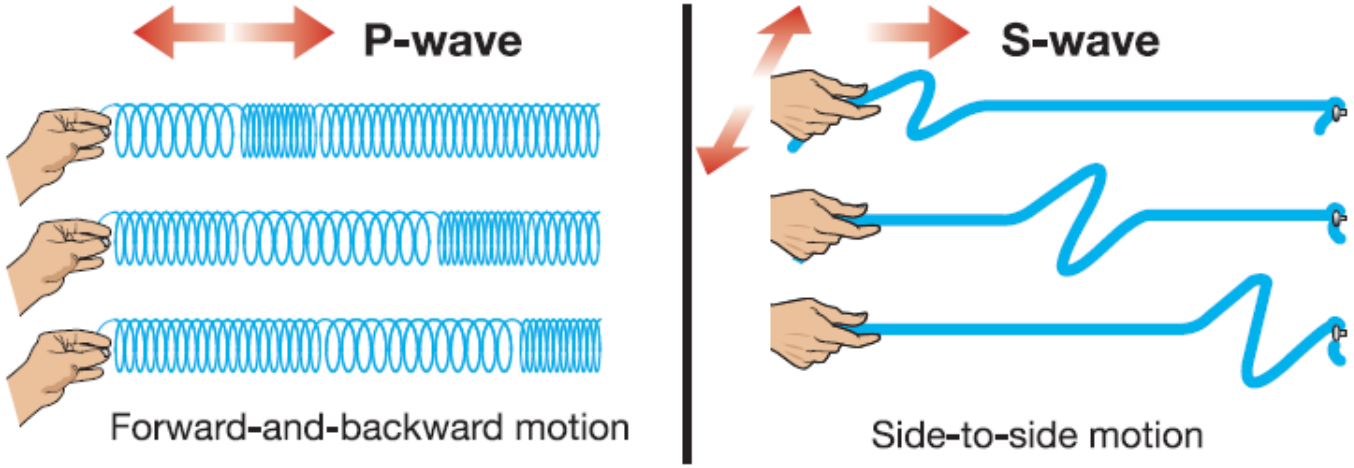




- You are probably familiar with the up-and down motion of water waves in a pool.
- We can demonstrate side-to-side wave motion by wiggling a rope.

7.1 Wave Motion

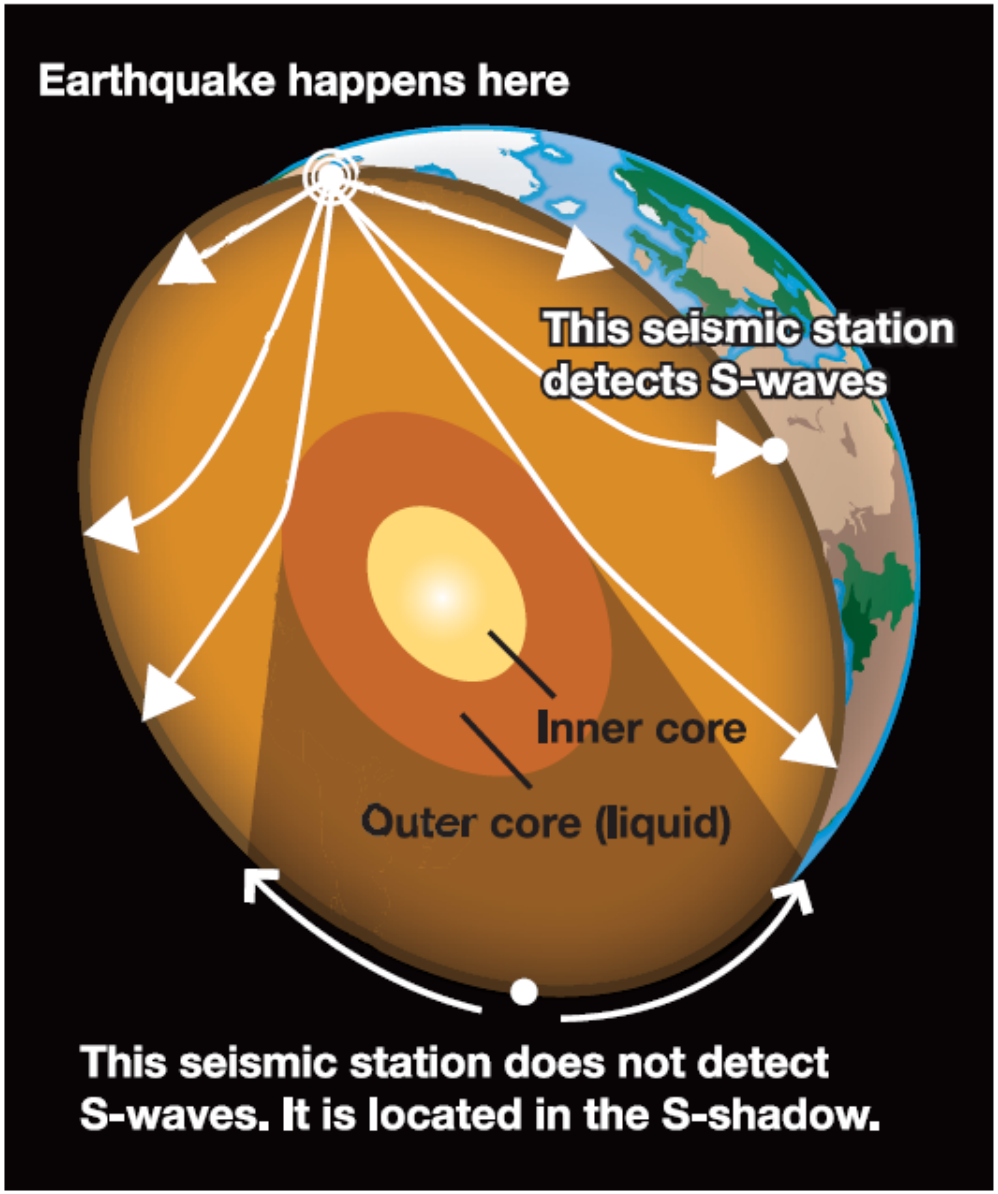
- Two type of seismic waves that are important are **p**rimary and **s**econdary waves.
- **P-waves** travel faster than S-waves and move with a forward-and-backward motion.
- Slower **S-waves** travel with a side-to- side motion.



7.1 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.

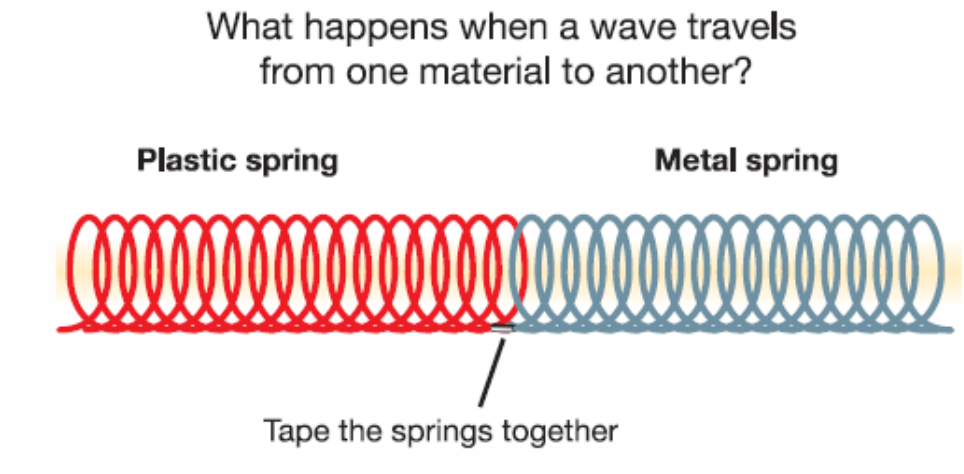
S-Waves and S-Shadow



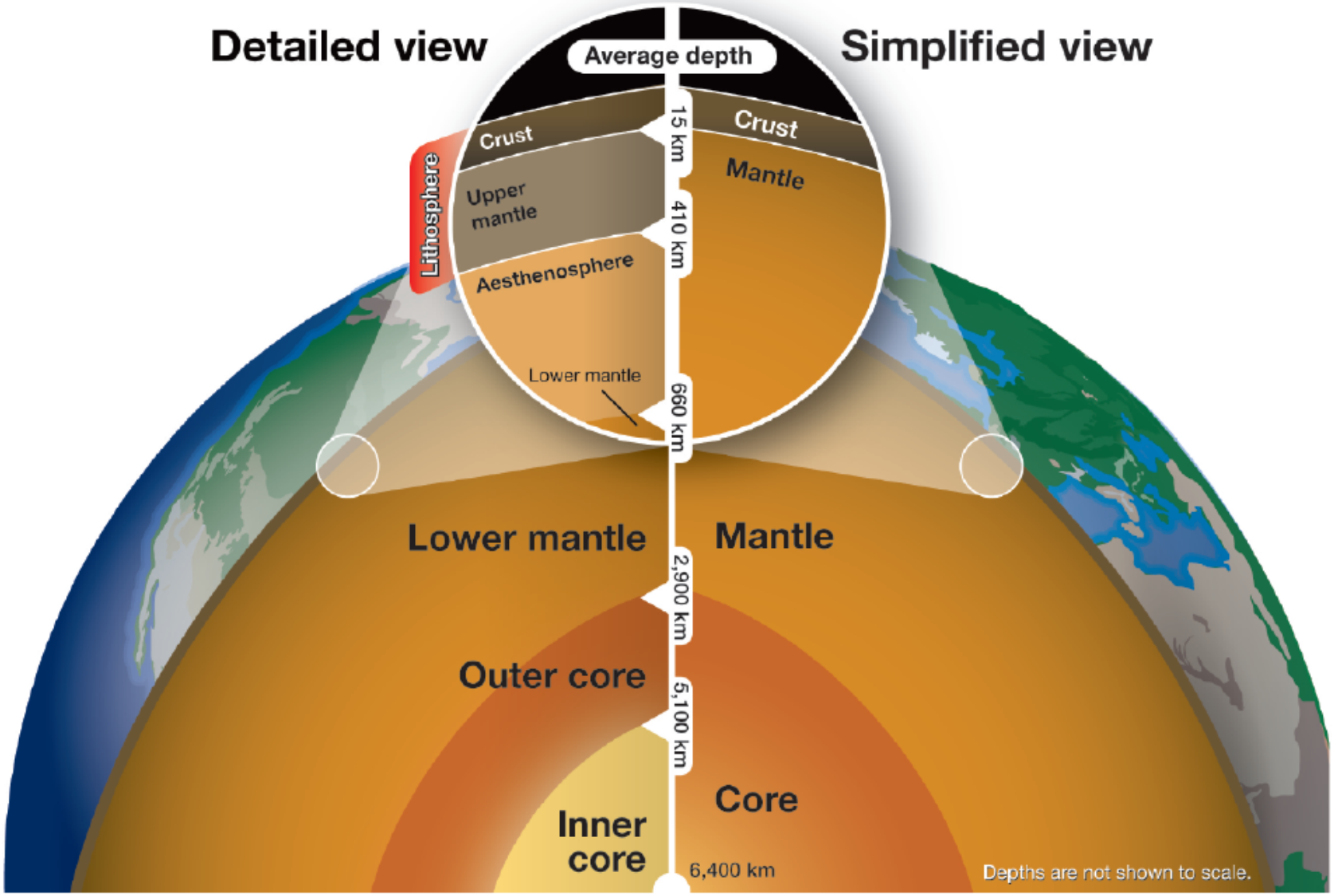
Activity

Modeling Wave Motion

- In this activity, you will be observing wave motion, the movement of primary and secondary waves, and the change in behavior of a wave as it passes from one material to another.

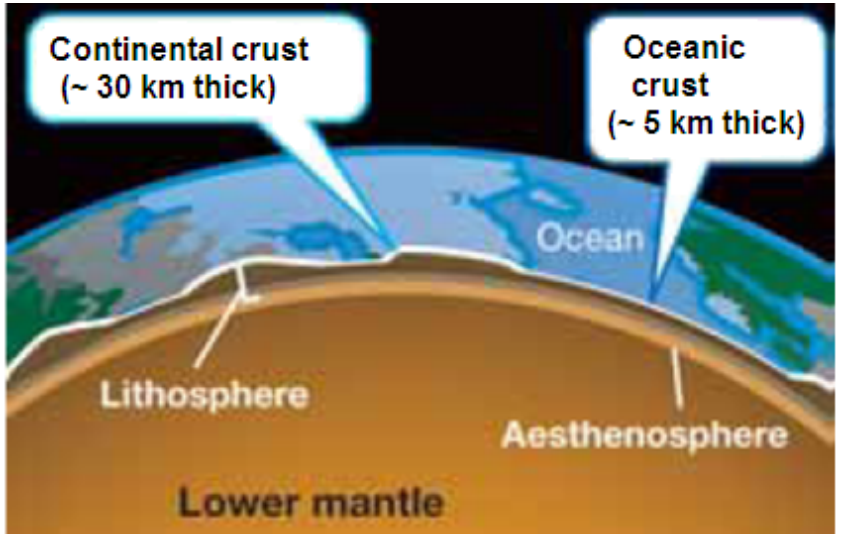


Earth's Interior



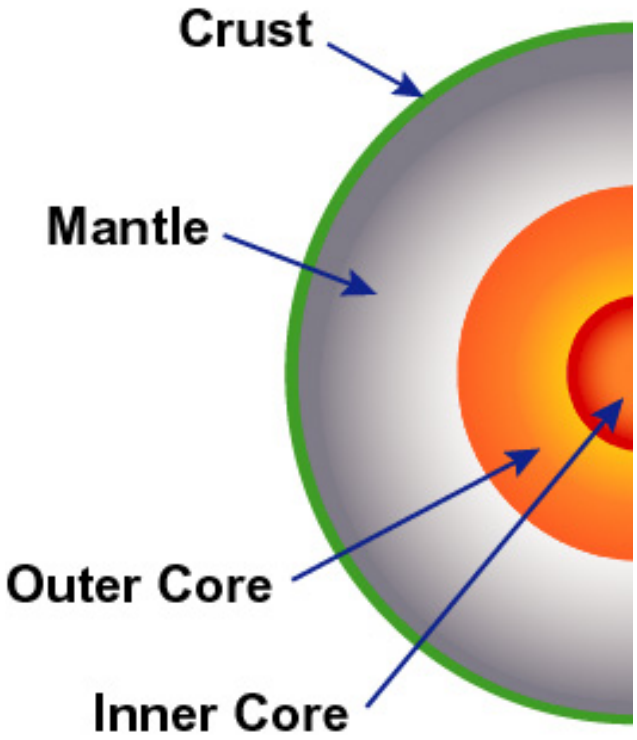
7.2 The Earth's Interior

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



What is below the crust?

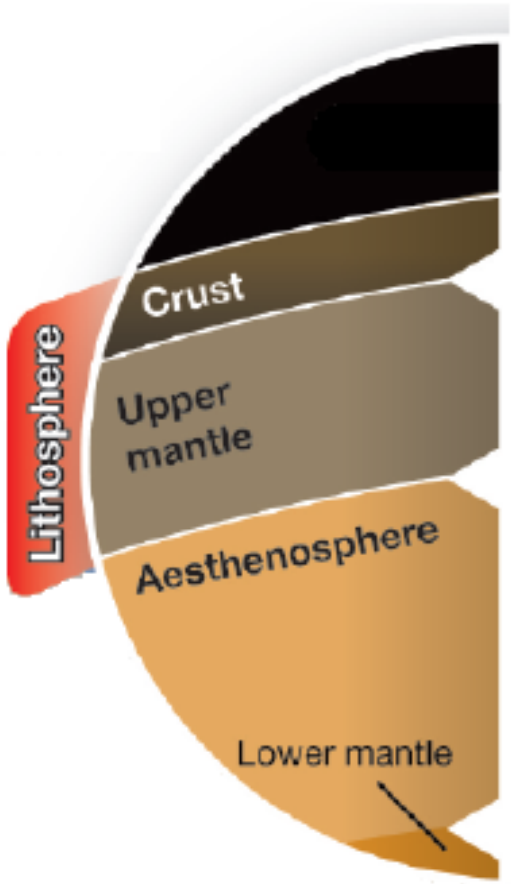
7.2 The crust and the mantle



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

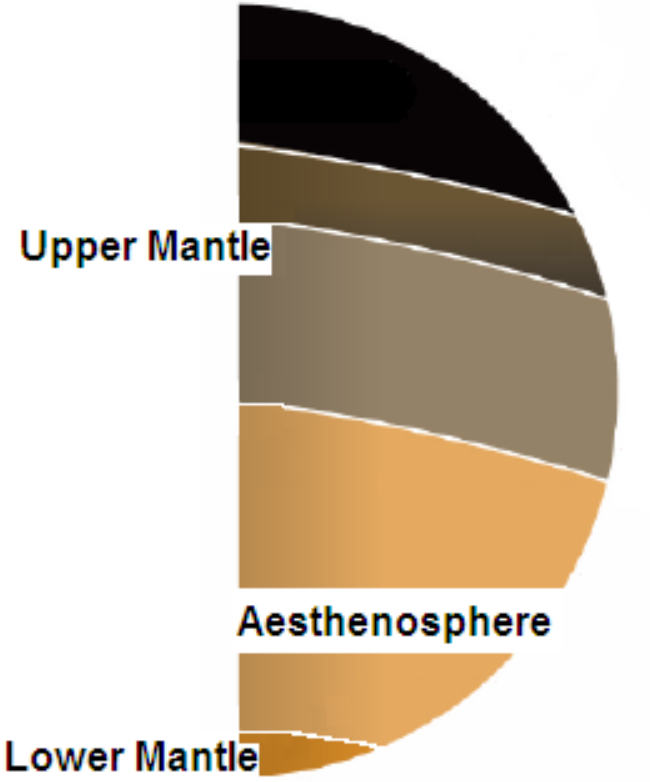
7.2 The crust and the mantle

- The **lithosphere** includes the crust and a thin part of the mantle.



What lies above the lithosphere?

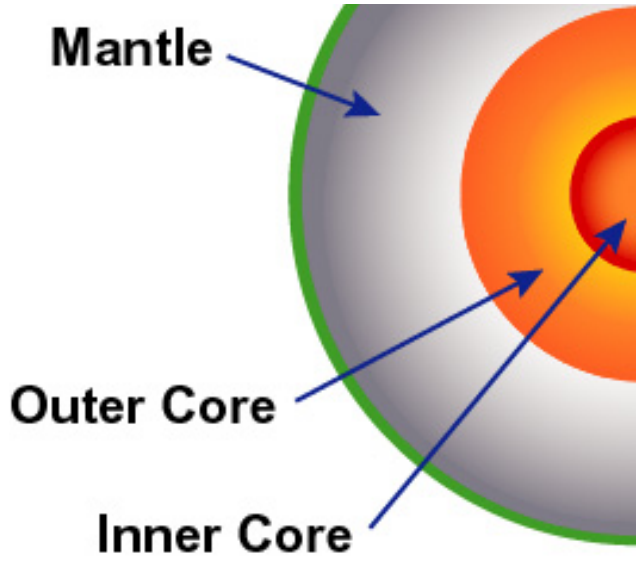
7.2 The crust and mantle



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

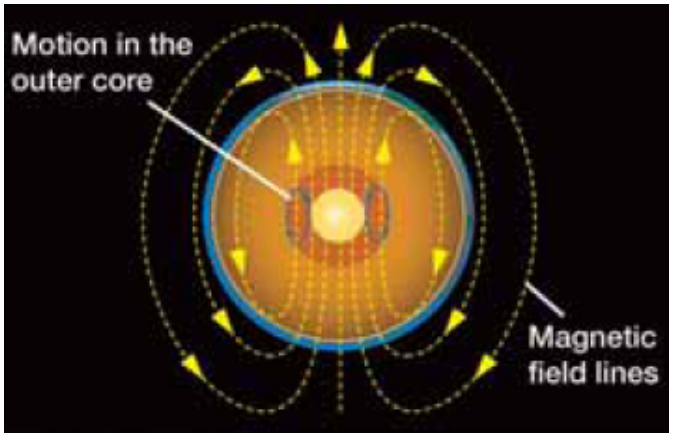
7.2 The Earth's Interior

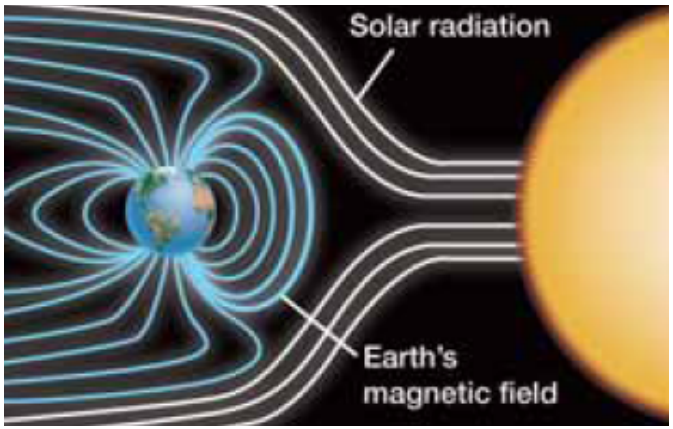
- The **core** is the name for the center of Earth.
  - The outer core is made mostly of iron, and is so hot the iron is melted.
  - The inner core is also made mostly of iron, but it is solid.



Why is the inner core solid?

7.2 The crust and mantle





- Earth's **magnetic field** is created by the motion of liquid iron in Earth's outer core.
- Earth's magnetic field protects the planet from harmful radiation from the Sun.

7.2 Layers of Earth

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

Layers of Earth		Average depth (km)	Relative temperature (°C)	Description
Lithosphere	Crust	15	0	The uppermost layer
	Upper mantle	410	870	
	Aesthenosphere	660		The surface of the lower mantle on which lithospheric plates slide.
	Lower mantle	2900	3700	Largest part of Earth's interior
Core	Outer core	5100	4300	Liquid
	Inner core	6400	7200	Solid (hotter than the surface of the Sun)

Temperature increases with depth

Research Connection

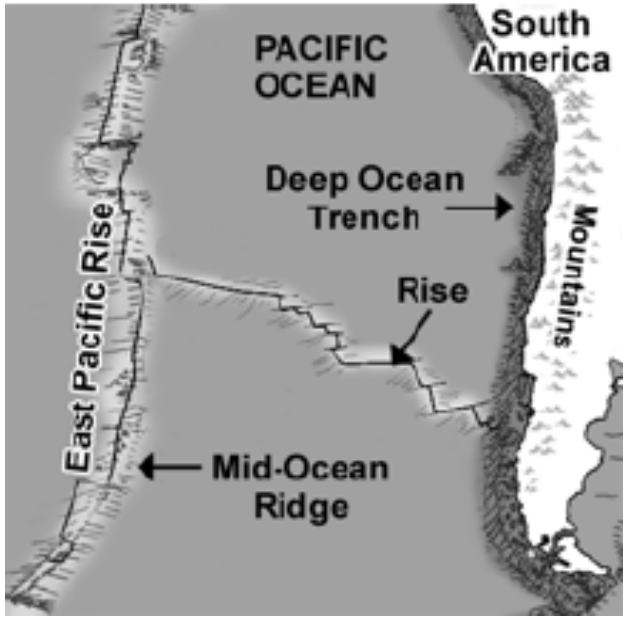
Drilling to the Earth's Core

- If we could somehow reach Earth's core, from the center every direction would be "up."
- Getting through the planet's outer layer is a huge job: eight weeks of drilling a hole in the ocean floor.

Investigation 7B

Moving Around on Earth's Surface

- *What is plate tectonics?*



7.3 Earth's materials sorted by density

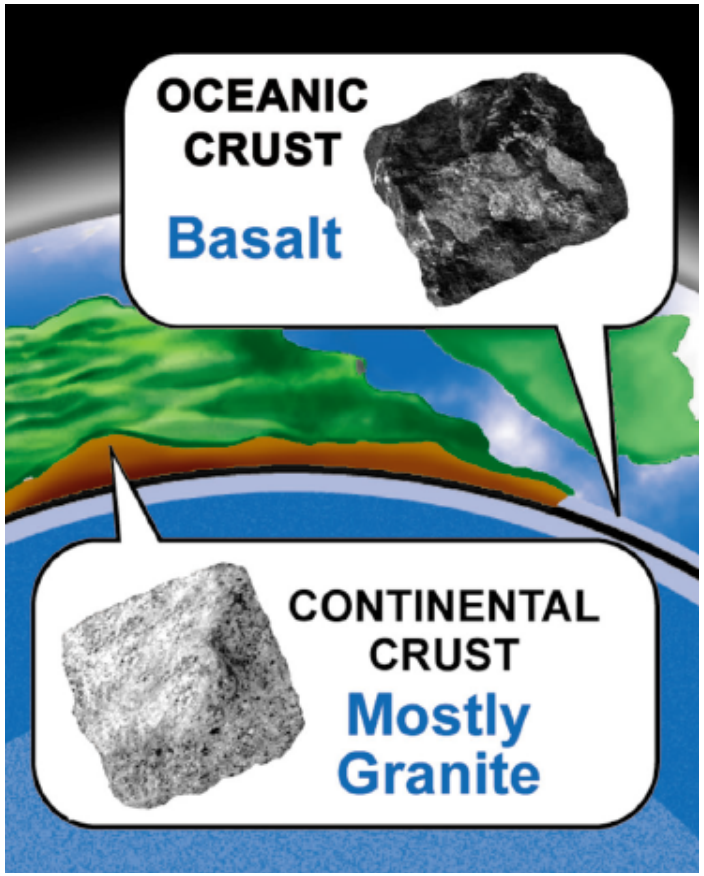
- Scientists believe that Earth formed from the gas and dust that surrounded our young sun.
- At first, Earth's surface was made of the same materials as its center.
- Later, the materials melted and became fluid.
- More dense materials settle toward the center.
- Less dense materials rose toward the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

7.3 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.

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

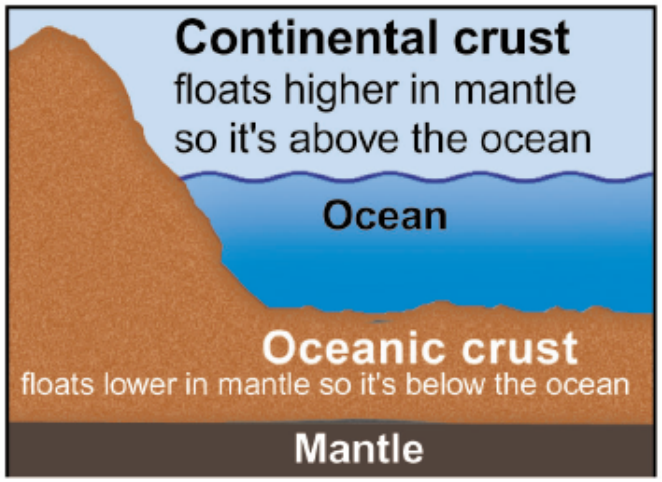
7.3 Earth's materials

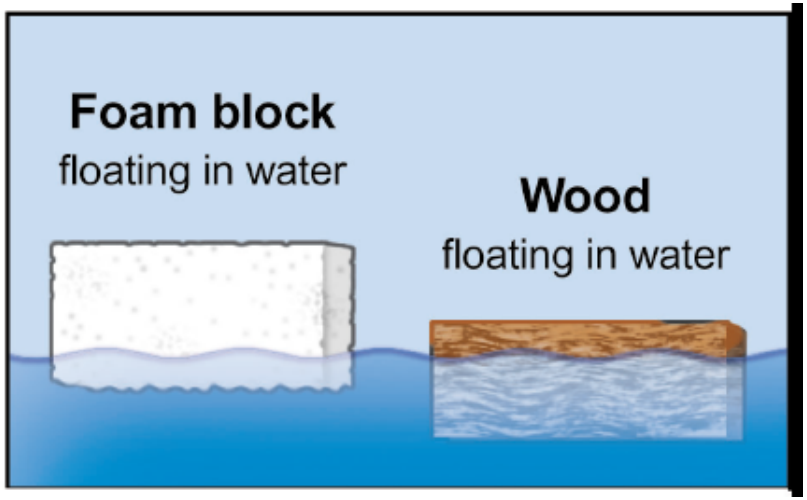


- The oceanic crust is made mostly of basalt.
- The continental crust is made mostly of andesite and granite.

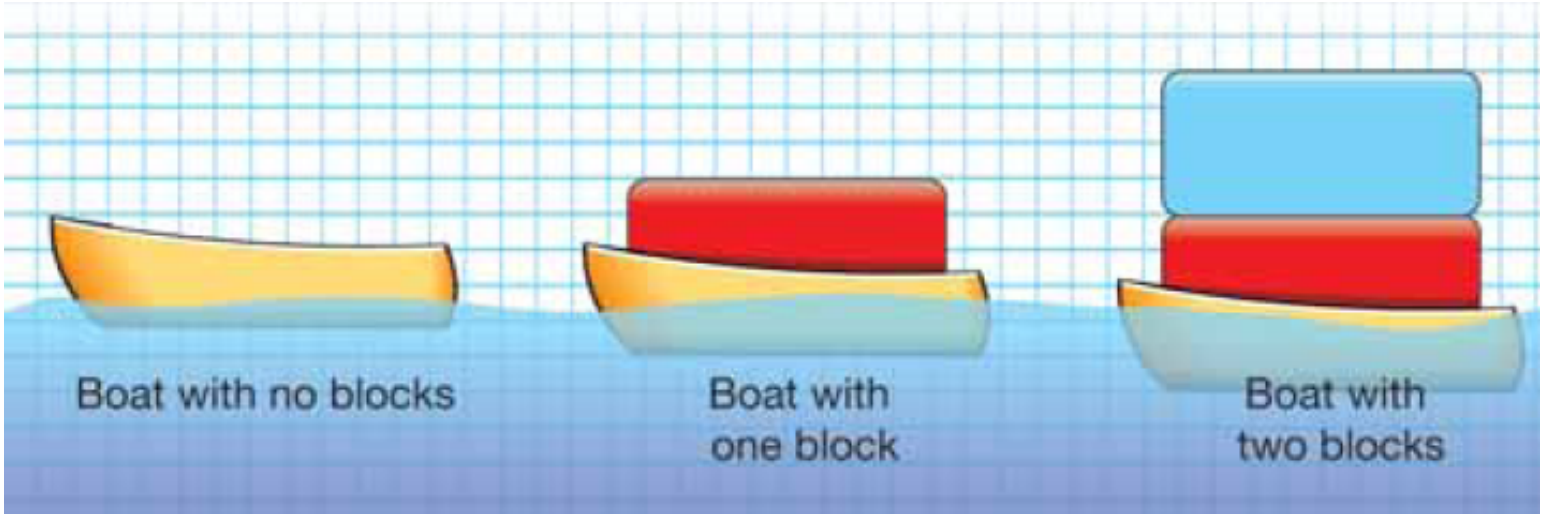
7.3 Rocks float on rocks!

- 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!



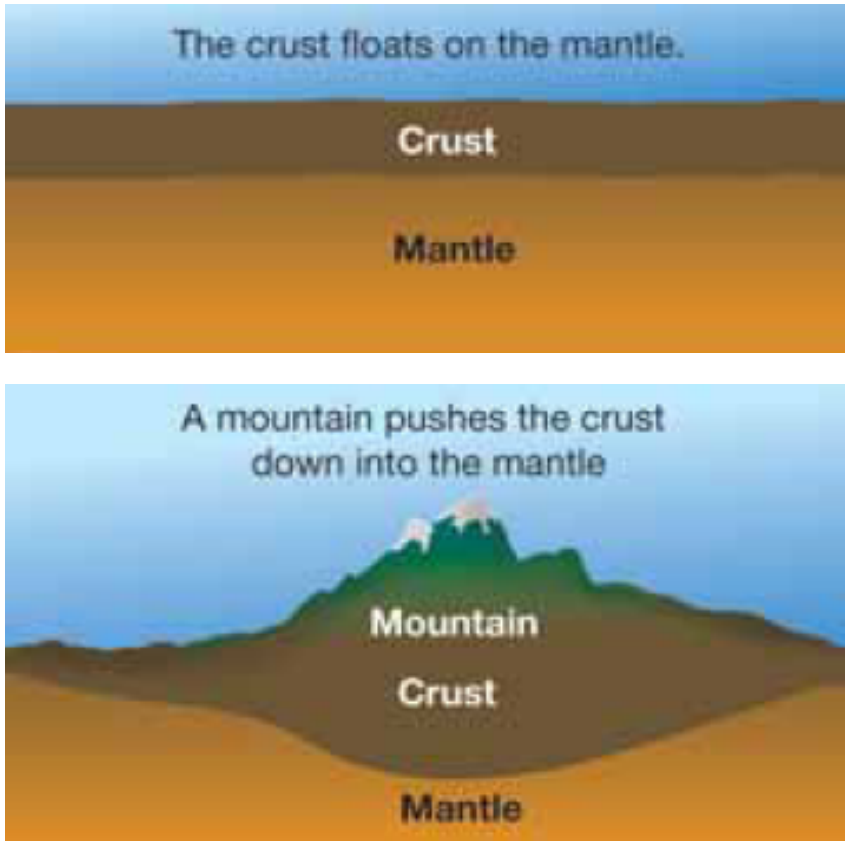


7.3 Floating continents



- 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.

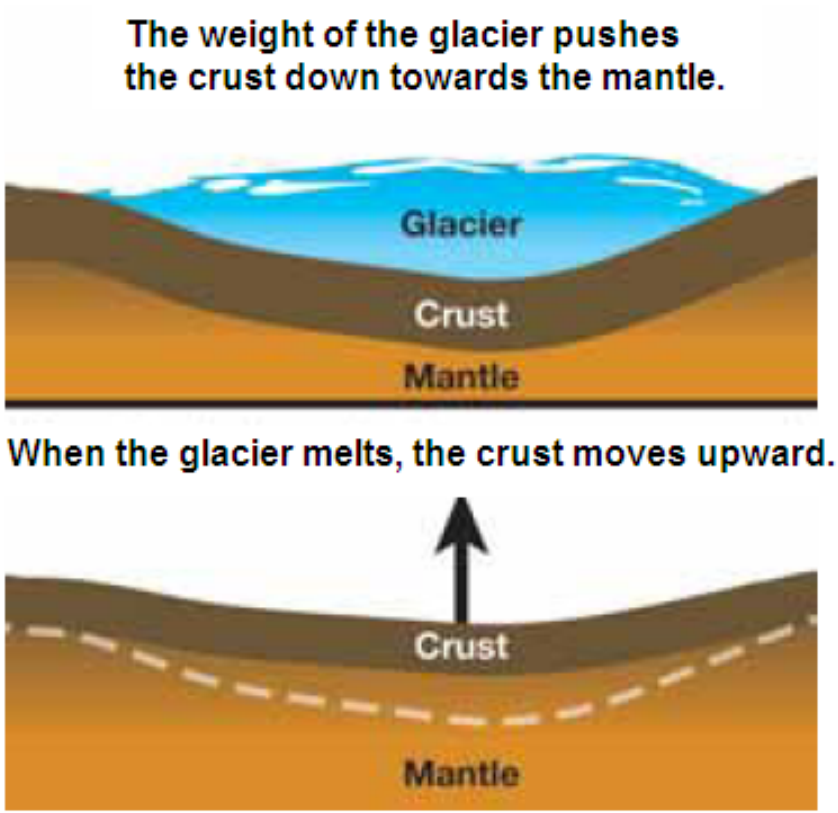
7.3 Floating continents



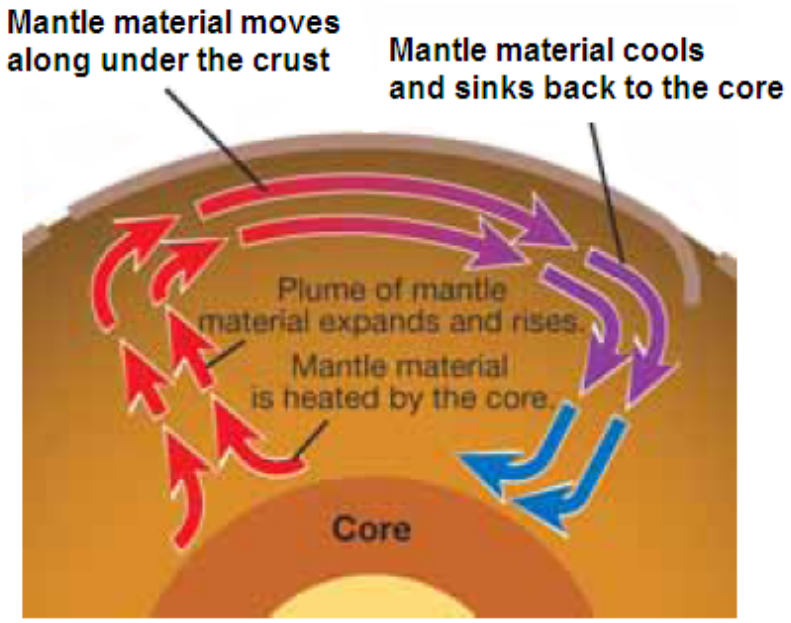
- The average thickness of continental crust is 30 kilometers.
- A combination of a mountain and its bulge underneath may make the crust as thick as 70 kilometers.

7.3 Glacier effects

- 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.

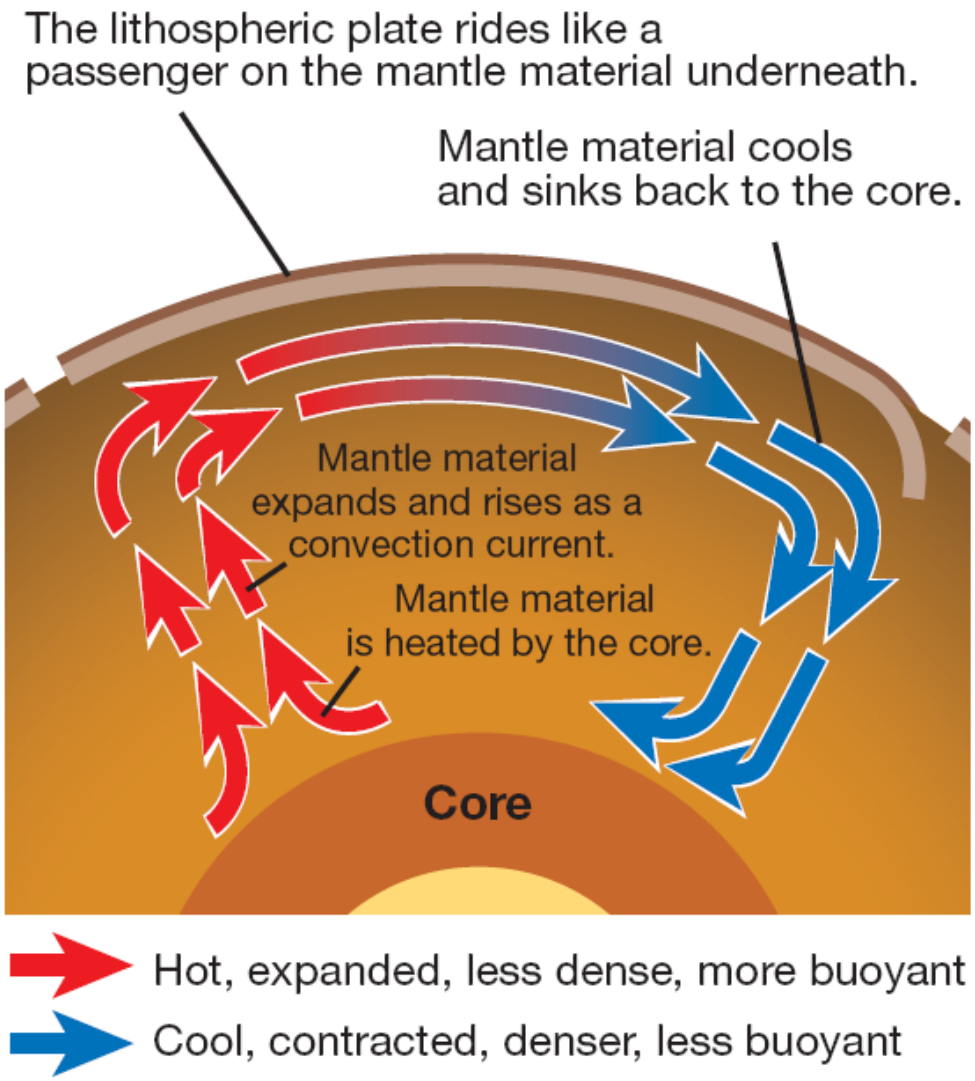


7.3 Convection cells



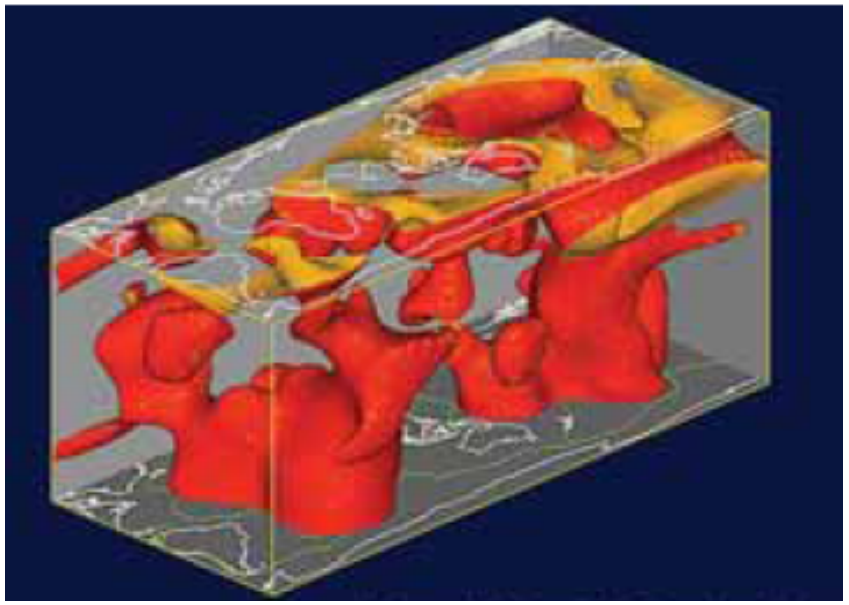
- Heating the lower mantle causes the material to expand.
- The result is a plume of hot lower mantle material rising up from near the core toward the lithosphere.

Mantle Convection



7.3 Convection cells

- **Seismic tomography** uses seismic waves collected from all over the world and combined on a computer to create a 3-D image of Earth's interior.



The red blobs in the image are convection currents of mantle rising toward Earth's surface from the core.