WARM-UP

QUESTION:

Can we drill to the center of the earth? Why or why not?

WARM-UP

QUESTION:

Can we drill to the center of the earth? Why or why not?

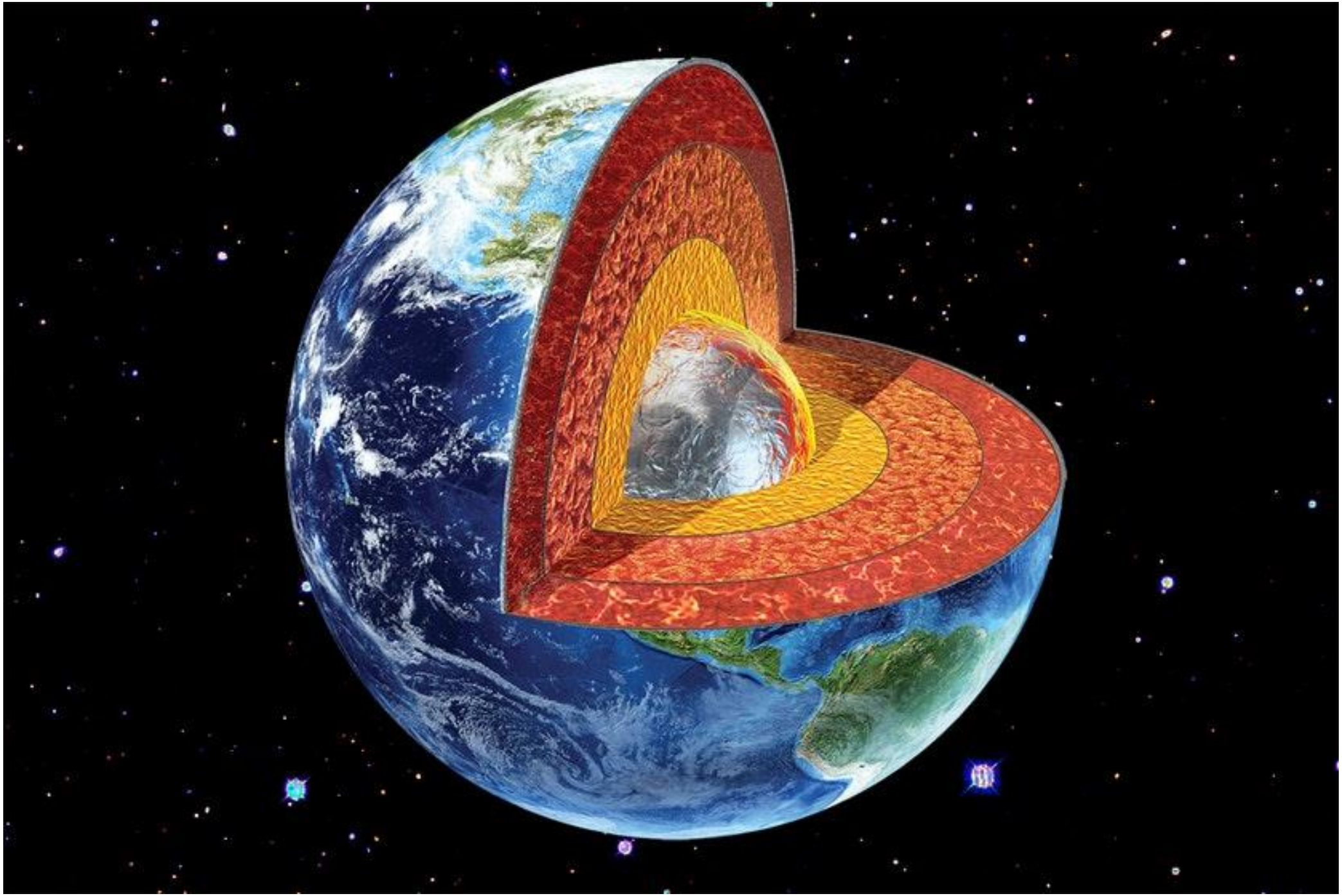
ANSWER:

No, the heat and pressure is too great as you approach the mantle which is molten rock.

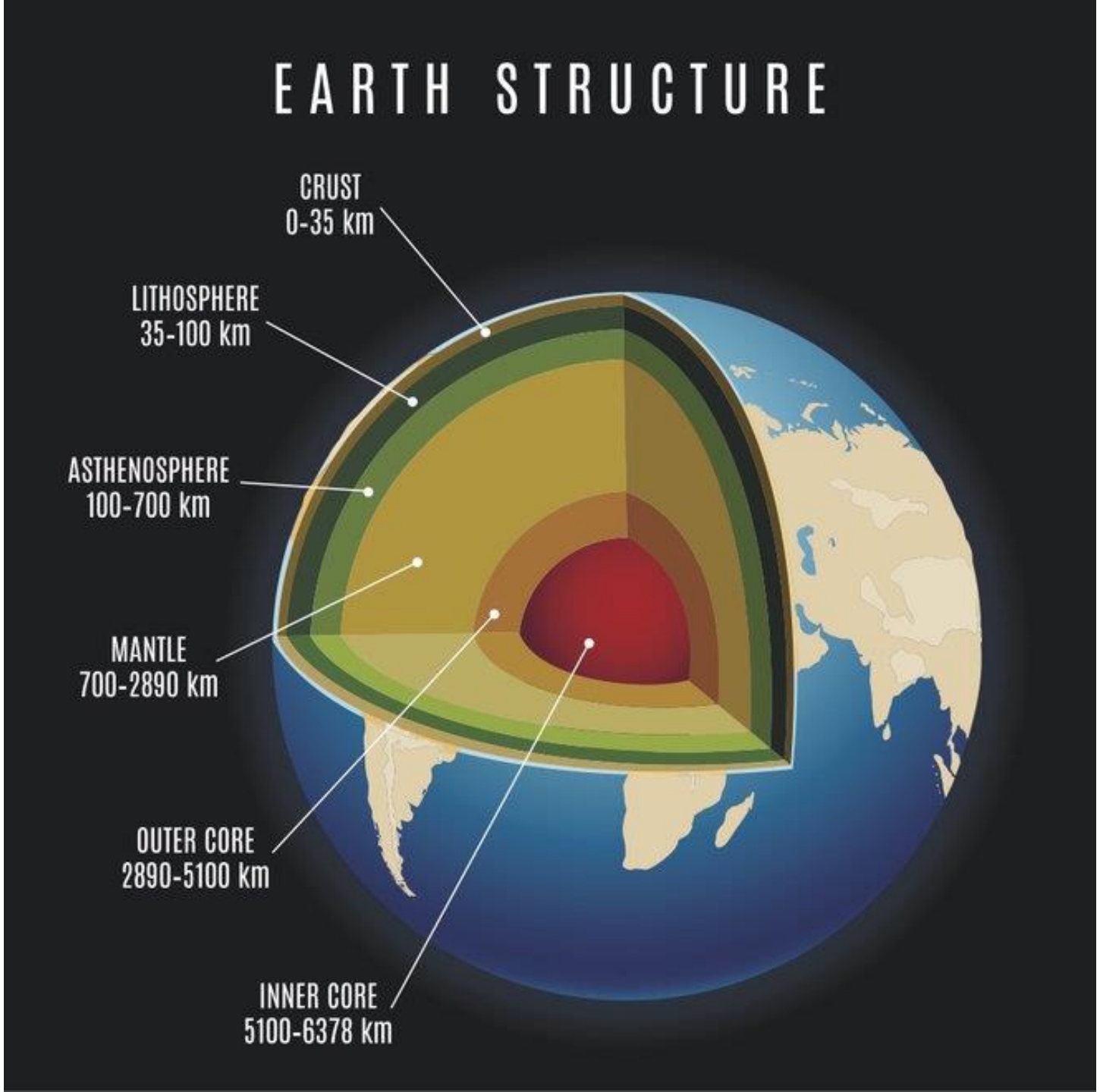
Deepest Hole ever Drilled?

- From 1970 to 1994, Russian geologists drilled on the Kola Peninsula and chipped slowly away to create an Earth-shattering record: the **deepest hole in the world**.

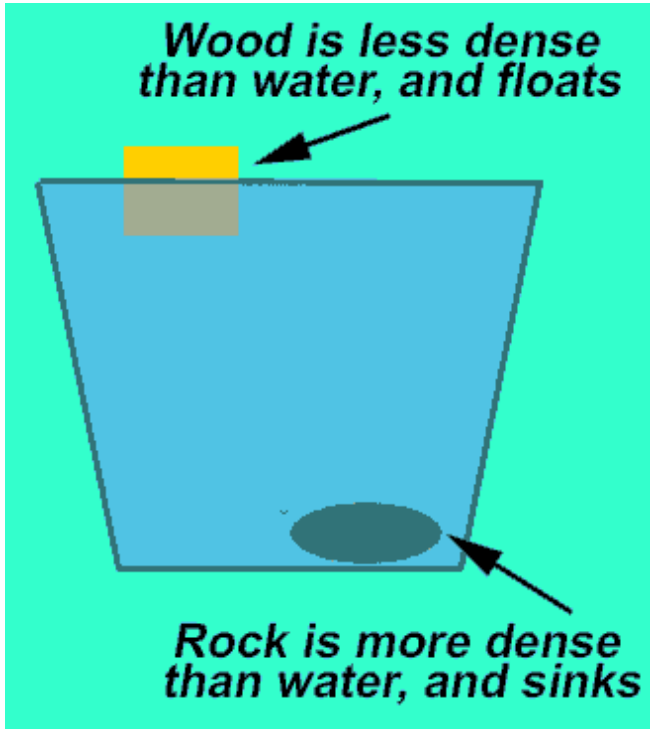
- The **Kola** Superdeep Borehole is just 9 inches in diameter, but very deep: 40,230 feet / 12,262 meters / 7.6 miles.
- Click here to watch video



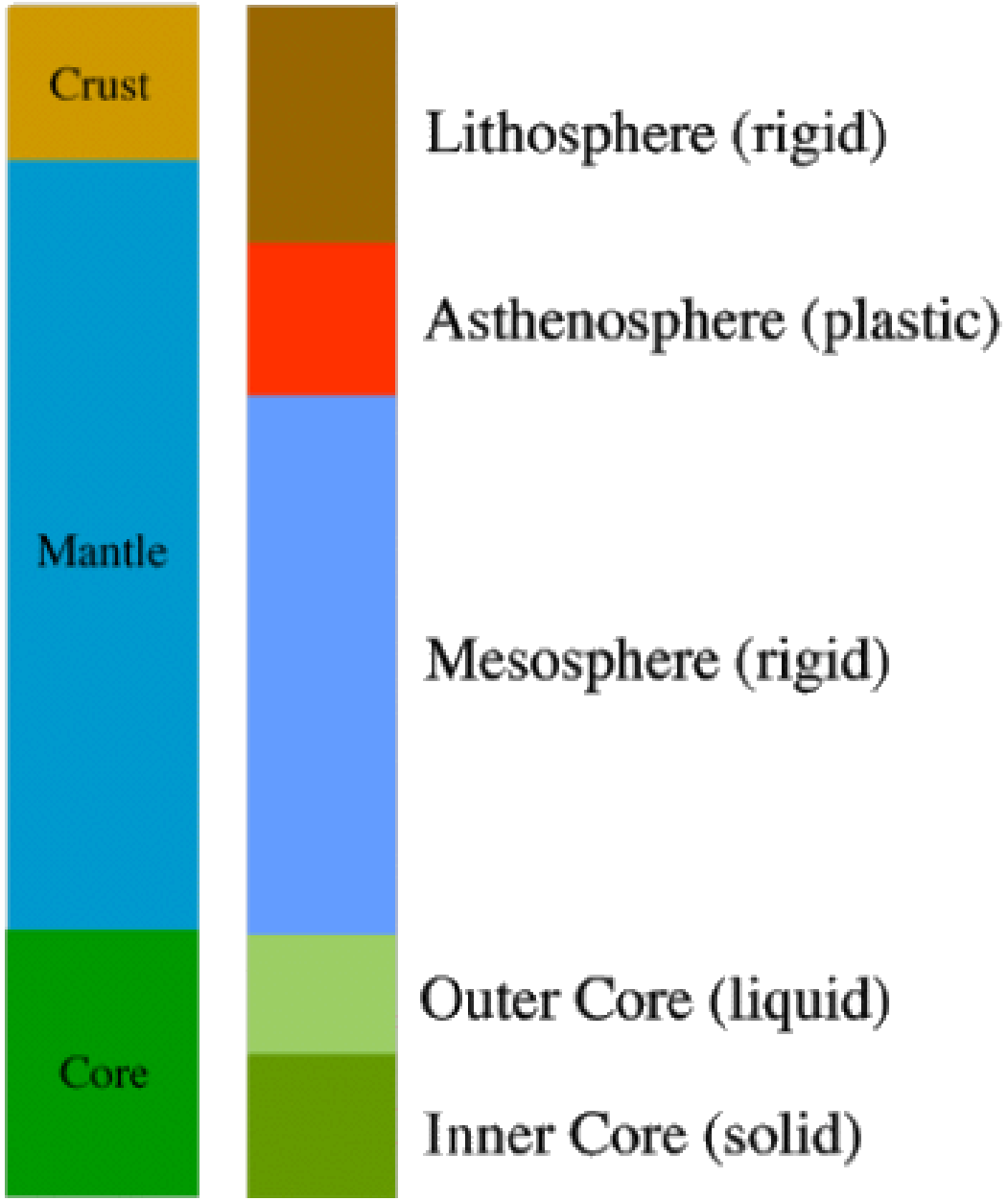
EARTH STRUCTURE



Some Things Float... Some Things Sink...

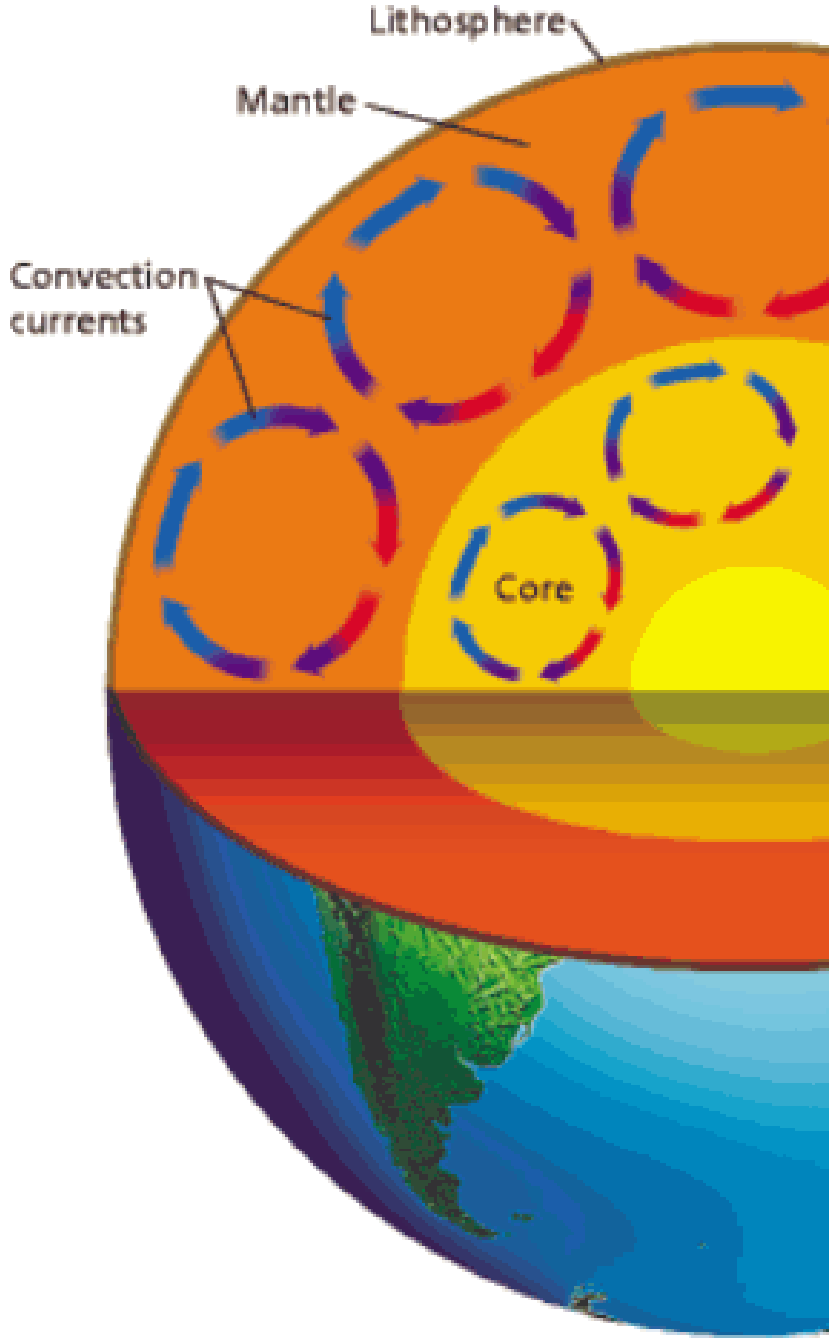


- More dense sinks, less dense rises
- Heat rises while cold sinks.



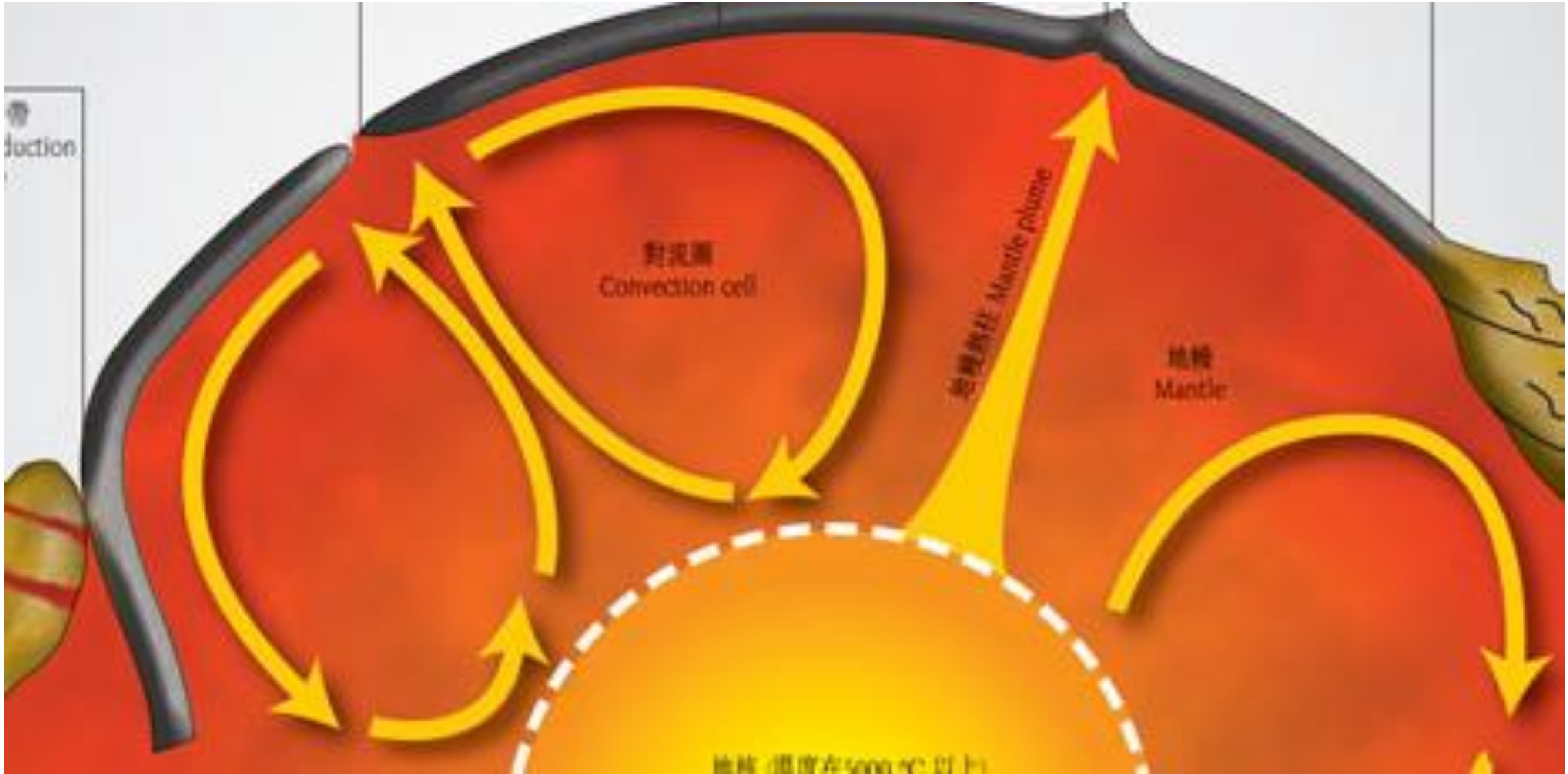
- Continental Crust (Rigid 2-30km):
  - Silicates and Granites; 2.2 g/cm^3
- Oceanic Crust (Rigid 5-10km):
  - Andesite and Basalt; 2.9 g/cm^3
- Asthenosphere (Plastic 720km):
  - Olivine and Pyroxene; 4.0 g/cm^3
- Mesosphere (Rigid 2200km):
  - Magnesium and Silicon Oxides; 5.0 g/cm^3
- Outer Core (Liquid 2300km):
  - Iron, Sulfur and Nickel; 11.0 g/cm^3
- Inner Core (Solid 1200km):
  - Iron, Sulfur and Nickel; 13.0 g/cm^3


P waves only
No S waves
No P or S waves
P and S waves seen
Shadow zone
P and S waves
P waves
Outer core
Inner core
Earthquake



Heat Transfer and Convection Currents

CONVECTION AND THE MANTLE



TYPES OF HEAT TRANSFER

- Heat always moves from warm to cold

Example: Holding an ice cube

  - Your hand begins to feel cold
  - Is the coldness from the ice moving to your hand? No
  - Cold is the absence of heat
  - Heat from your hand is moving to the ice cube.

- This is ONE of the three ways heat is transferred.

TYPES OF HEAT TRANSFER

There are three types of heat transfer:

- Radiation
- Conduction
- Convection

Radiation…

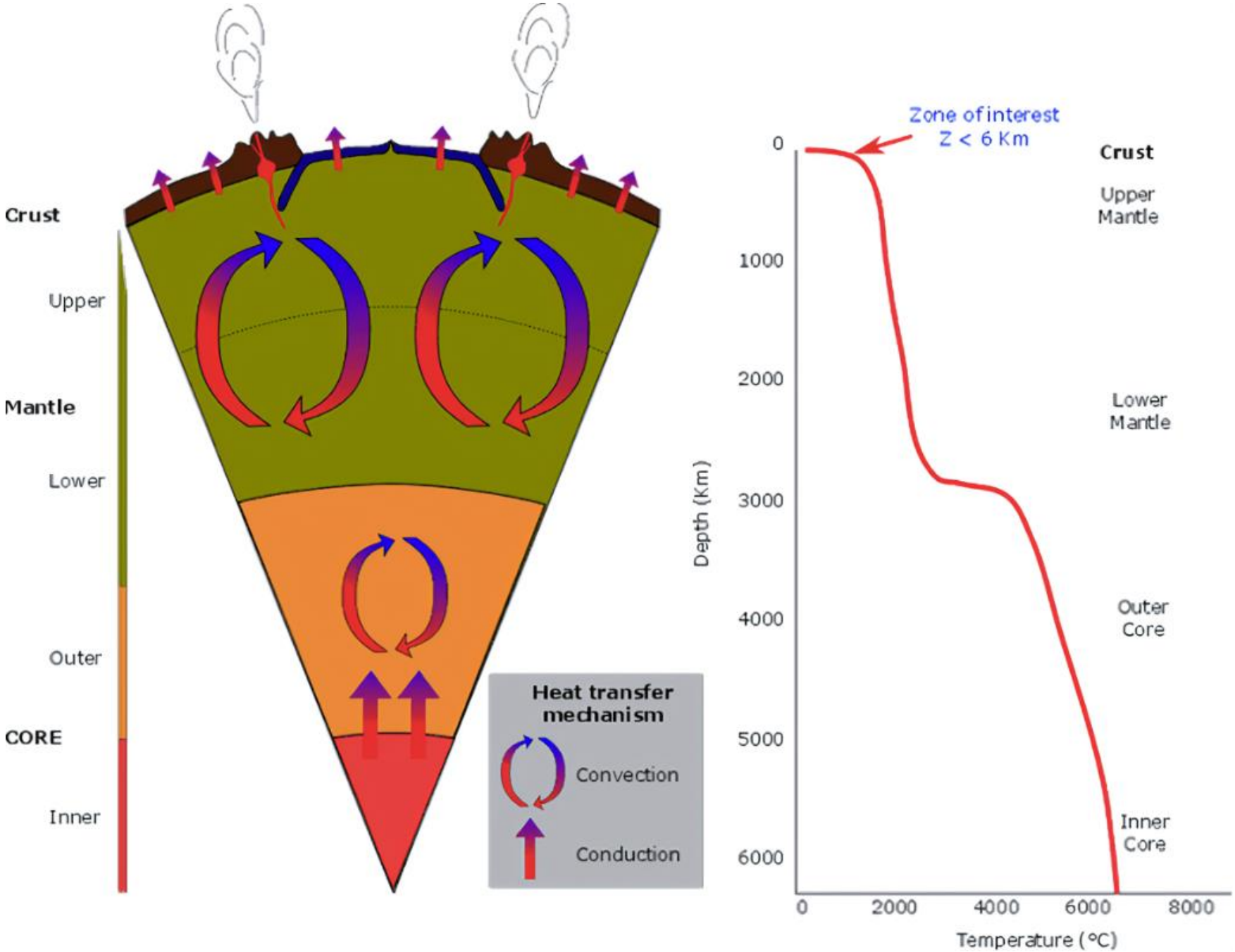
- The transfer of heat through space
- No direct contact between heat source and an object
- Example: heat from sunlight, heat from open fire…
- Crust to Atmosphere to Space

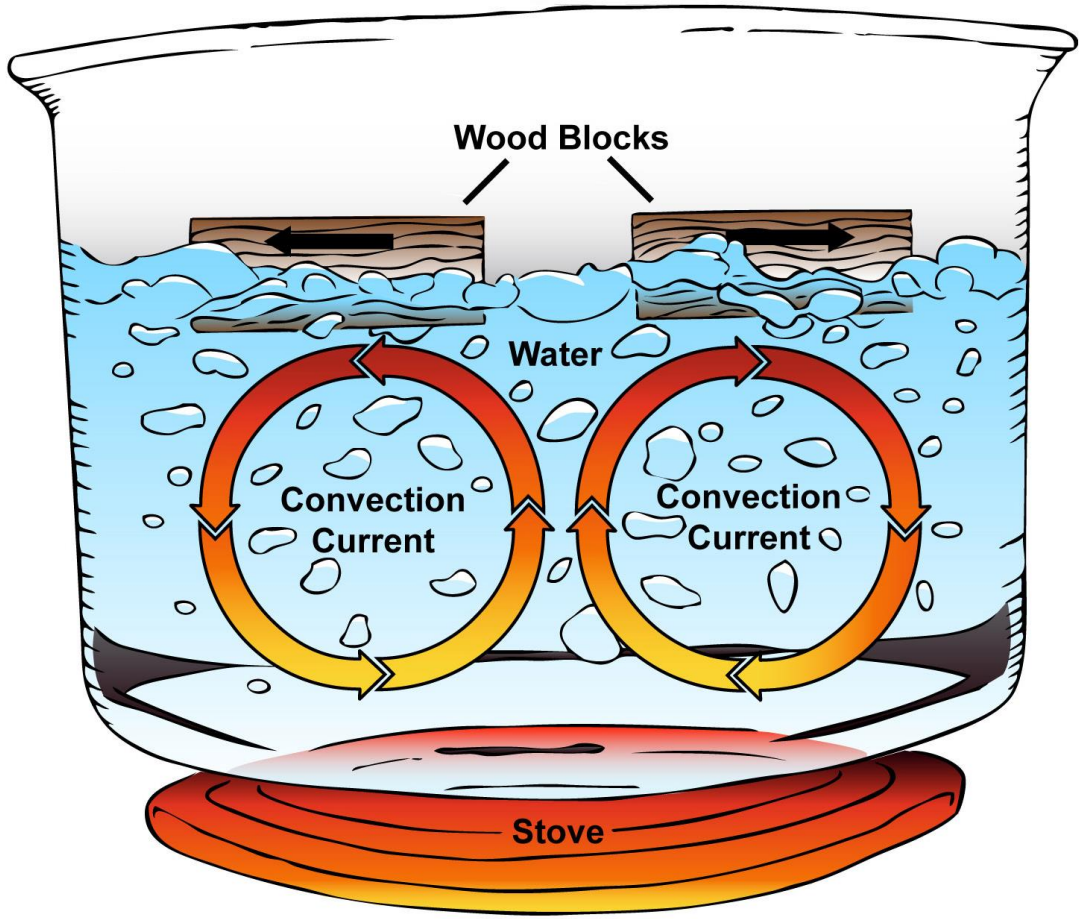
Conduction…

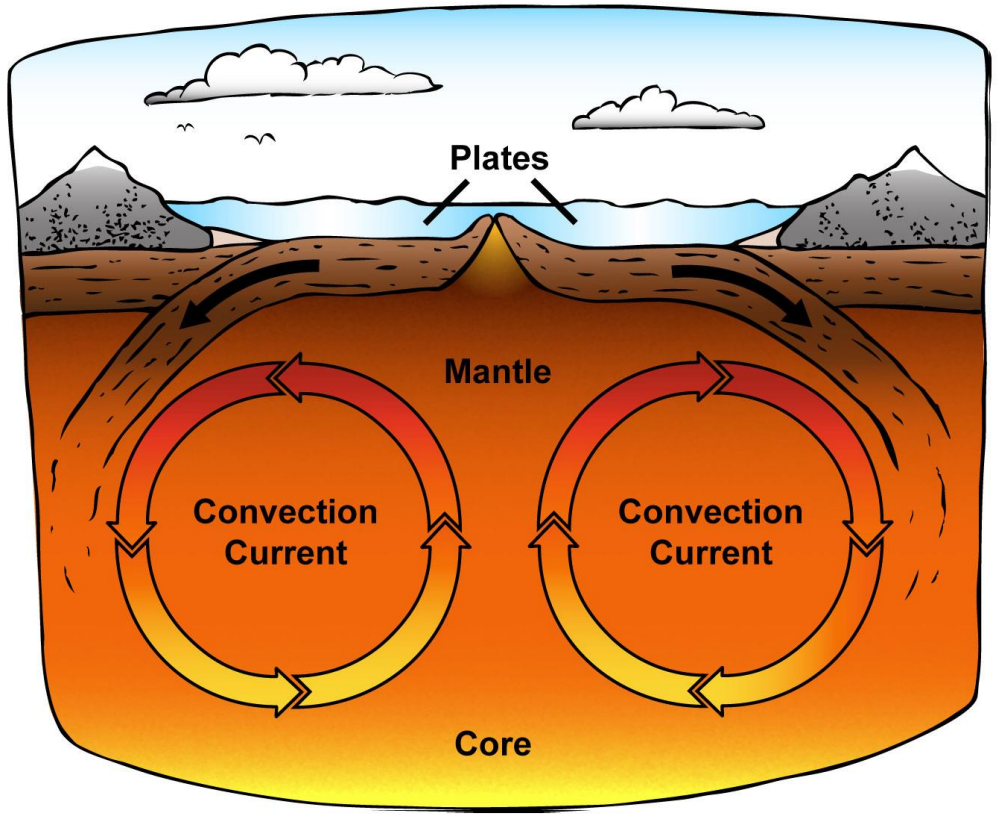
- Heat transfer within a material or between materials
- Must be touching
- Example:
  - hot spoon in soup heats up
  - Burn your tongue on the spoon
- <u>Layer-to-layer contact</u>

Convection…

- The transfer of heat within fluids
- Heat moves atoms apart creating a lower density
- Heat rises while cold sinks
- Density affects:
  - Weather
  - Ocean Currents
  - Volcanic Eruptions, and
  - Earth's Layers

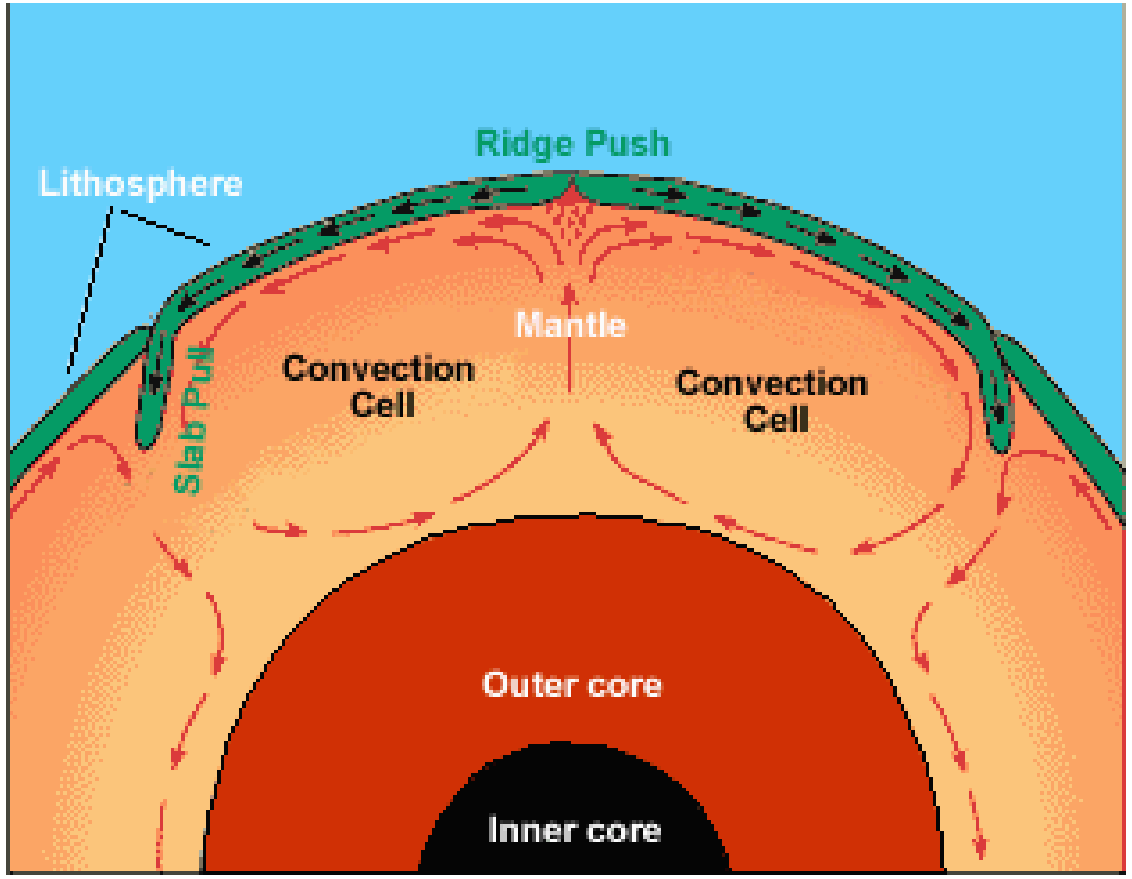

Crust
Upper
Mantle
Lower
Outer
CORE
Inner
Heat transfer mechanism
Convection
Conduction
Zone of interest
Z < 6 Km
Crust
Upper Mantle
Lower Mantle
Outer Core
Inner Core
Depth (Km)
0
1000
2000
3000
4000
5000
6000
0
2000
4000
6000
8000
Temperature (°C)


Wood Blocks
Water
Convection Current
Convection Current
Stove


Plates
Mantle
Convection Current
Convection Current
Core

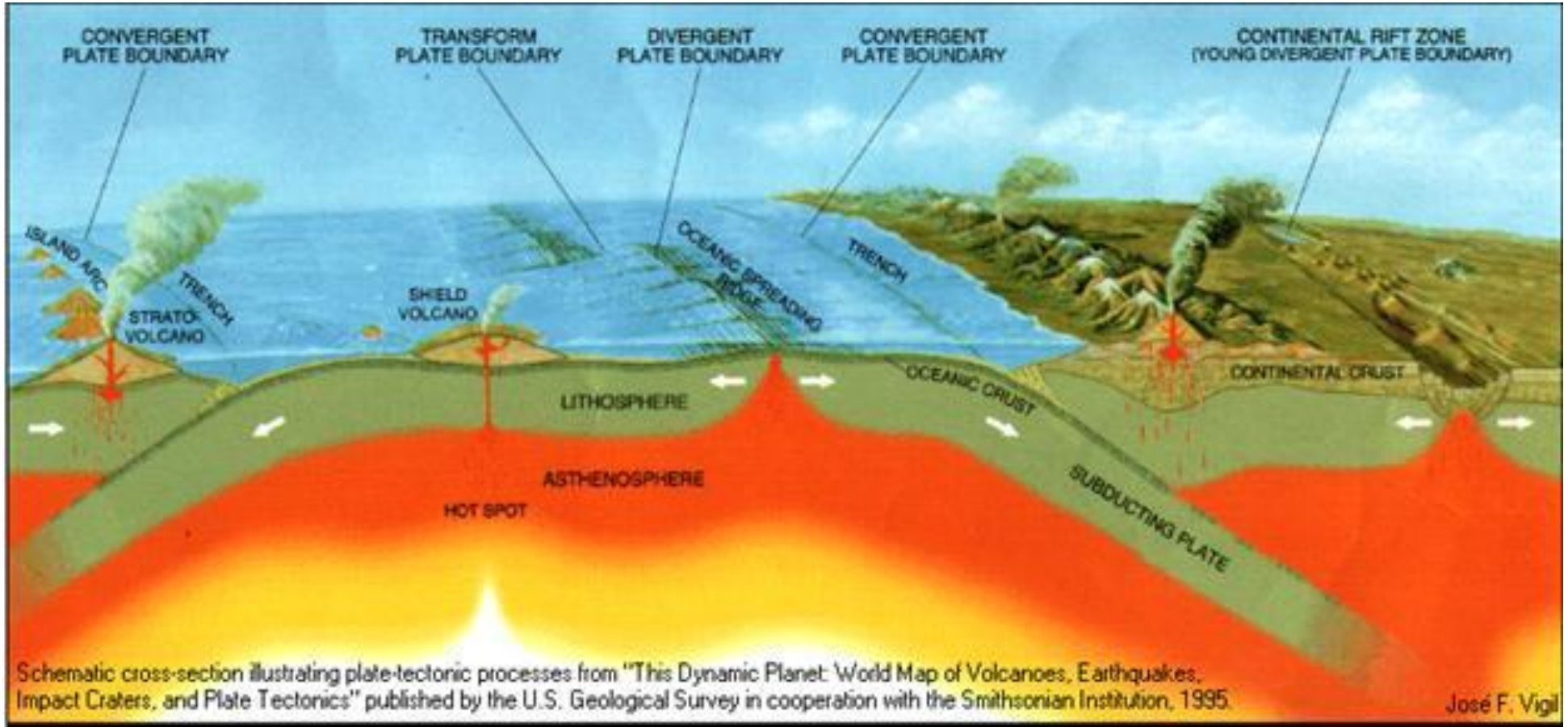
Convection Currents in Earth's Mantle

- Hot core and cold space
- Upper mantle cooled
  - Conduction with crust
- Lower mantle heated by core
- Convection currents flow in the mantle
  - Less dense floats; More dense sinks
- Friction causes the mantle to move the crust.



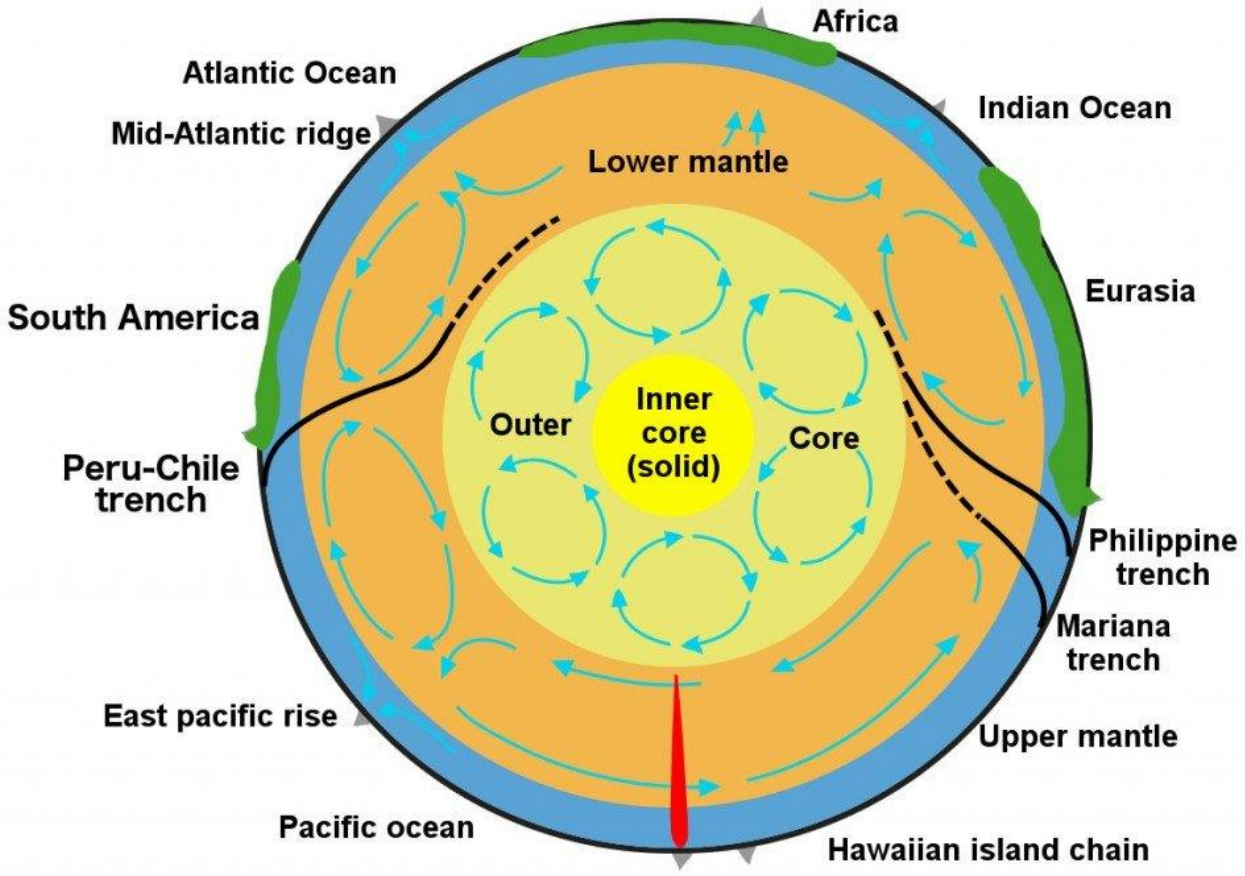
The Lithosphere

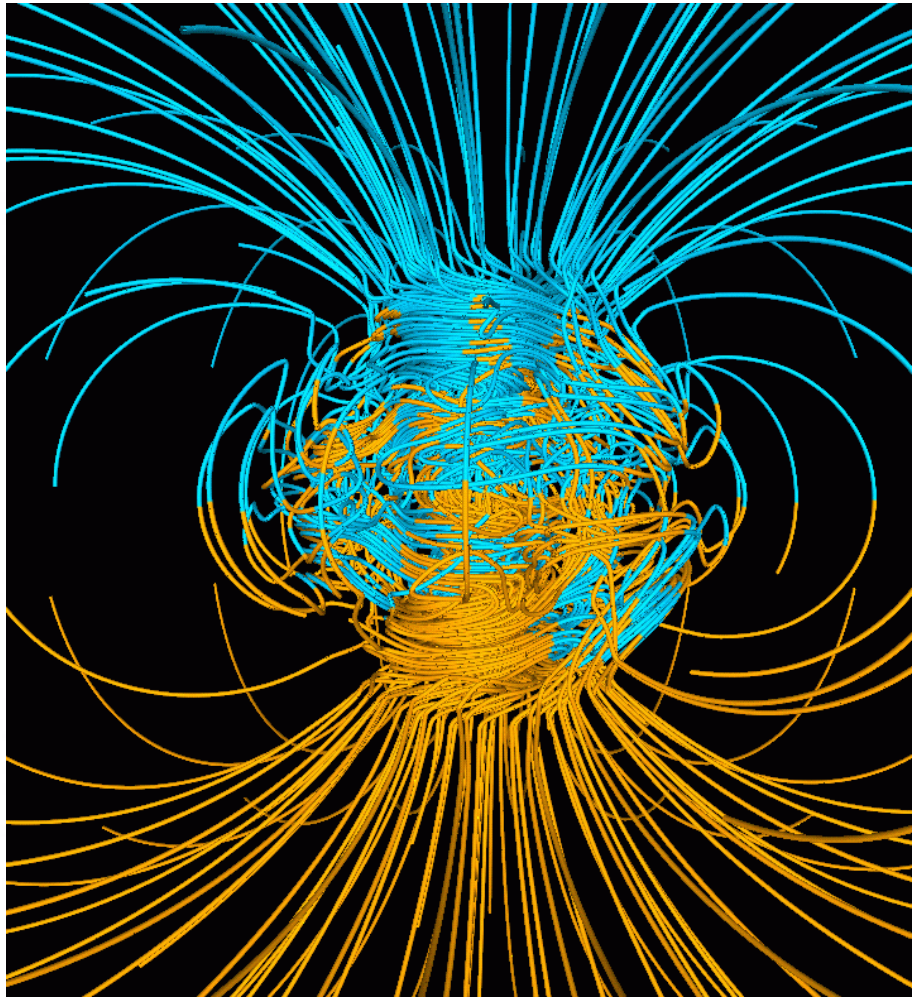
- The Crust is divided into <u>separate plates</u>
  - This is the <u>Lithosphere</u>
- <u>Each</u> <u>moves</u> very slowly on convection currents (Asthenosphere)

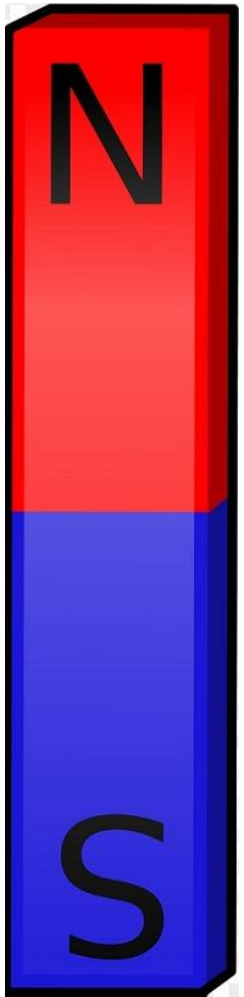


Convection in the Outer Core

- These convection currents cause Earth's magnetic field.







So Why Does Earth Have Layers that Move?

- Differentiation:
  - Planet warm enough to melt elements
  - Gravity and density differences formed layers

- Transfer of Heat
  - Movement of Heat through Radiation, Conduction and Convection
  - Outer layers Cool (Heat to Space)
  - Heating causes density differences in the inner layers
  - Convection causes layers to flow (Mantle)
  - Friction causes adjacent layers to move (Crust)

Let’s hear from a student