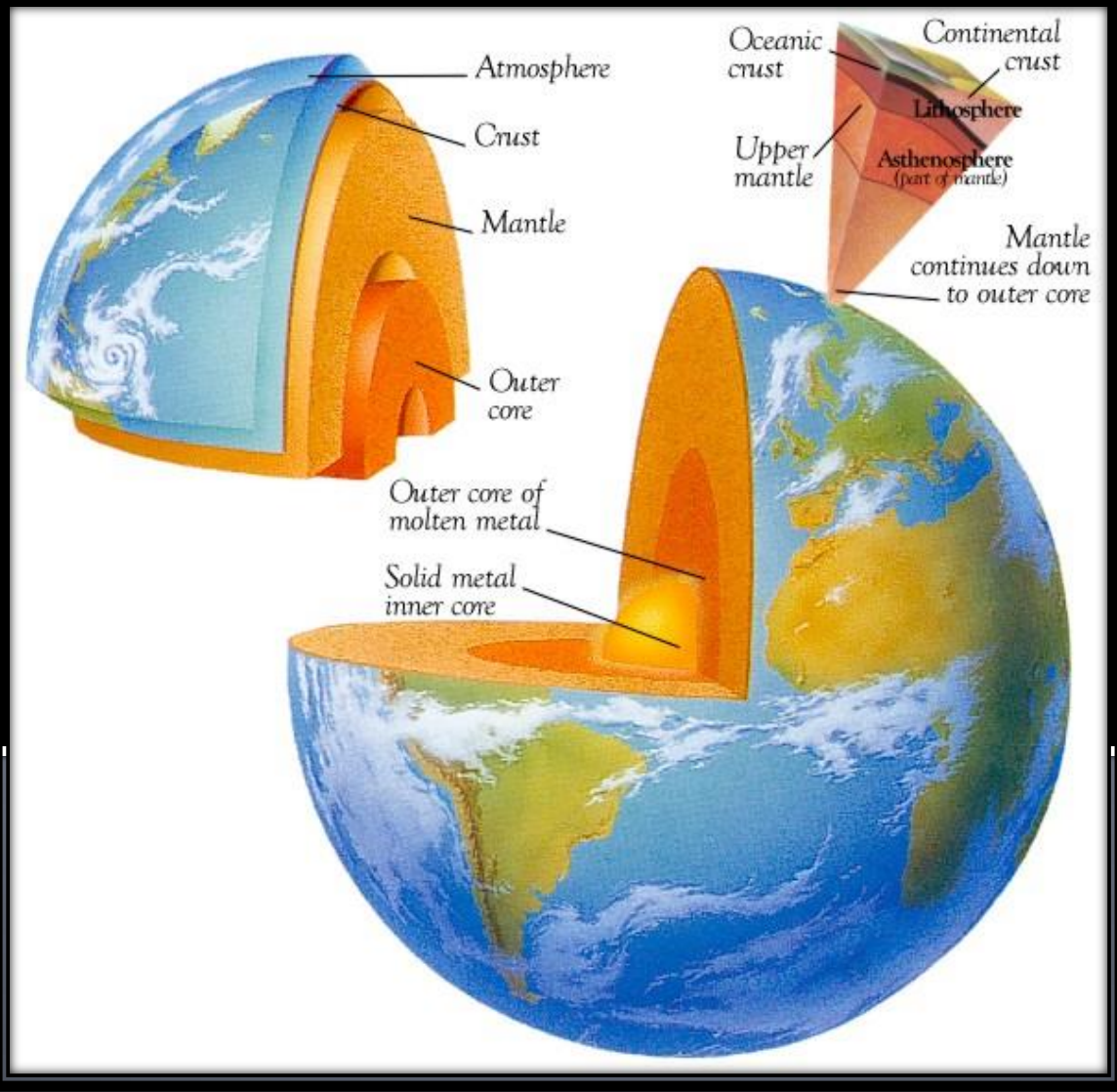
Welcome to Earth



[Cool Video Clip](#) 1.
2.

Image Source: Google

Part 1: What does the word STRUCTURE mean?

What does the word STRUCTURE mean?

- The theme for Seventh Grade Science is **structure.**
- **Structure** is how things are built. It often refers to the physical characteristics of something.

How is structure a part of what we learn in 7th Grade Science?

- All substances are made of smaller parts and are themselves parts of larger wholes. Each part has an important function towards the success of the whole.
  - MLMS term 1: **Classification of Living Things**
    - **Structure** is used to classify plants, animals, rocks, stars, and other things.
  - MLMS term 2: **Structure of Matter**
    - **Structure** is used to explain matter. Matter is composed of molecules, compounds, atoms and sub-atomic particles
  - MLMS term 3: **Structure of Earth**
    - The Earth has **structure**. It is divided into layers.
    - Density is responsible for the sorting and distribution of matter on the Earth.
  - MLMS term 4: **Structure of Cells and Organisms**
    - Living organisms have **structure**. The levels of organization and **structure** within a complex multi-cellular organisms include cells, tissues, organs, organ systems.
    - Cellular **structures** called organelles do the work within the cell.
  - MLMS term 5 : **Heredity and Adaptations of Organisms**
    - Inherited traits are carried on **structures** called genes.

Part 2: Why haven't we explored the inside of the Earth?

Why haven't we explored the inside of the Earth?

- We have explored outer space much more extensively than we have explored the inside of our own planet.
- Why haven't we explored the inside of our planet more completely?
- There are 4 major reasons: (See next slides)

Image Source: Google

Reason 1 – Heat

- **Heat**
  - The Earth gets hotter as it gets deeper.
  - The Earth gets up to

9000 degrees F in the inner core.

  - Crust = 0 -1598 F
  - Mantle = 1598 F – 3992 F
  - Outer Core = 3992 – 9032 F
  - Inner Core = 9032 F+
  - The Kola peninsula drilling project well (in Russia) reached 356 f, and they weren't even halfway through the crust!
    - Food cooks well at 350 degrees F.
- Discuss Temperature Scale
  - http://www.mathsisfun.com/temperature-conversion.html

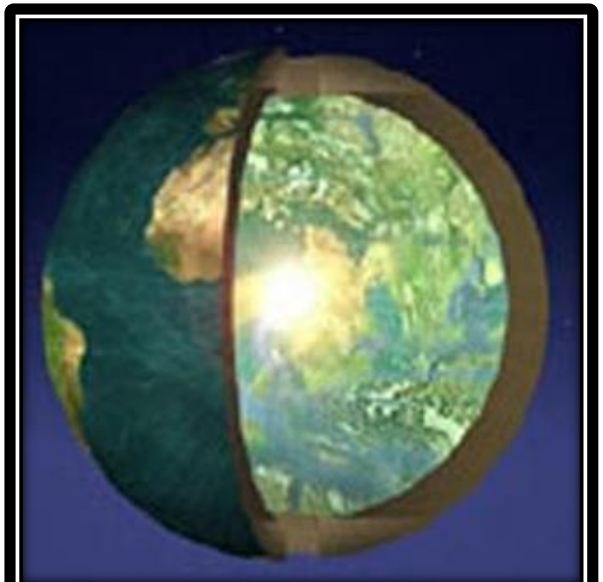


Image Source: Google

Reason 2 – Earth is not Accessible

- Getting *into* the earth is very difficult because of tremendous **heat** and **pressure**.
- The Kola peninsula drilling project well (in Russia) was the deepest well ever drilled into the Earth. It took 24 years, and it is less than 13 kilometers (about 7.6 miles) deep.
- This is less than halfway through Earth's **crust**.
- The furthest humans have traveled is 3.5 km (**about 2.2 miles**) in mines in South Africa to extract gold. (see www.en.m.wikipedia.org

- Mine Link

Image Source: Google

Reason 3 - Pressure

- The pressure increases as depth increases in the Earth.
- The inner core is being squished by all of the other layers and matter on top of it.
- Just 30 miles down into the Earth the pressure reaches pressures of around 200,000 psi. Your bike tire only hold around 32 psi. (psi = pounds per square inch). It could be up to 4,000 miles to the inner core.
- **Pressure** = Continuous force applied to a gas, liquid, or solid by another, gas, liquid or solid.

Image Source: Google

Reason 3 – Pressure (Continued)

- The pressure at the center of the earth is estimated at around 5 million times atmospheric pressure (the 15 pounds/square inch that we breathe and live in).

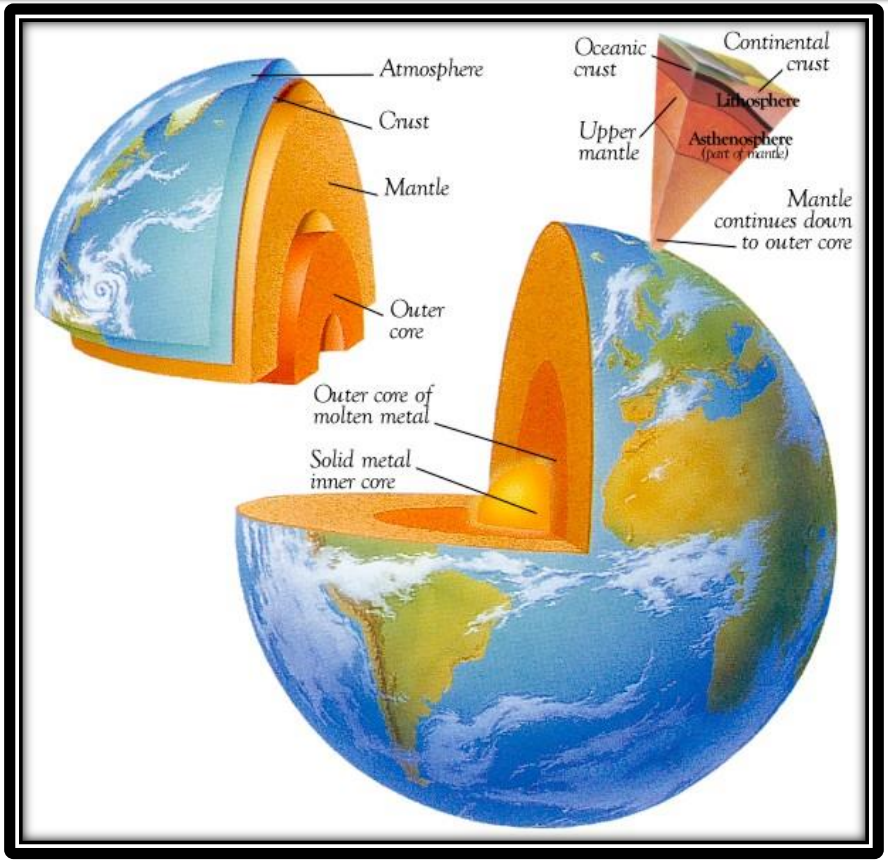


Image Source: Google

Reason 4 - Density

- Three centuries ago, the English scientist Isaac Newton calculated the density of the inside layers of the Earth as twice that of surface rocks.
- Our knowledge of what's inside the Earth has improved immensely since Newton's time, but his estimate of the density remains essentially unchanged.
- Look at the chart at right. You can see that the density of Earth materials increase as depth increases.
- The matter in the Earth is simply too compact to be able to work through.

Layer	and Overall Thickness	Layer is Made of?	Density of the Layer
Inner Core	5150-6500 km 3200 – 4000 miles	**Solid** Iron and Nickel	**13.0**g/cm3
Outer Core	2900-5150 km 1800 – 3200 miles	**Liquid** Iron and Nickel	**11.5**g/cm3
Mantle	32-2900 km 20 – 1800 miles	Si, O2,Fe,Mg Upper layer is mostly rocks Lower Layer is more iron and nickel	**4.5**g/cm3
Crust	0-32 km 0-20 miles	Si, O2, Al, Ca, Fe, Na, K, Mg Mostly rocks	**2.7- 3.0**g/cm3

Part 3: Learning about the structure of the Earth.

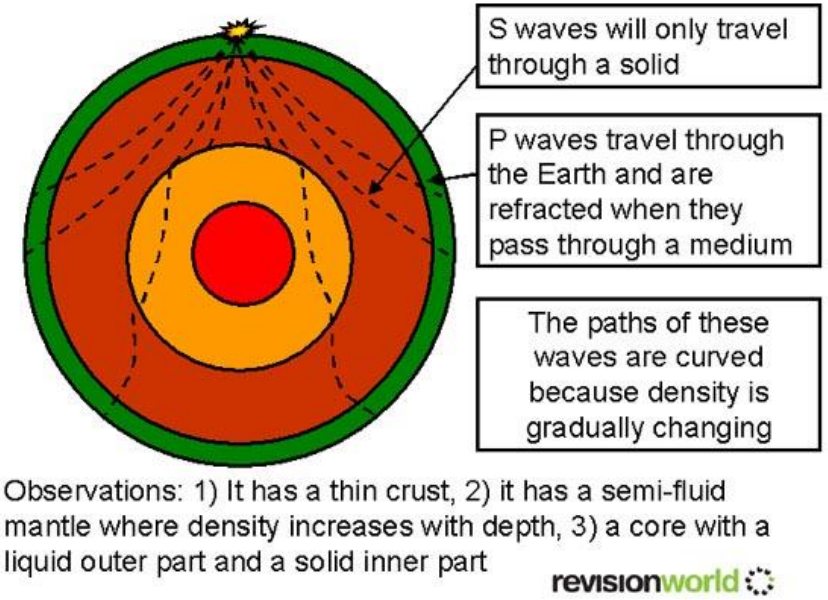
Learning about the structure of Earth

- Most of the information that scientists have been able to learn about the Earth's interior has come from shock waves produced by **earthquakes**.

Image Source: Google

Learning about the structure of the Earth

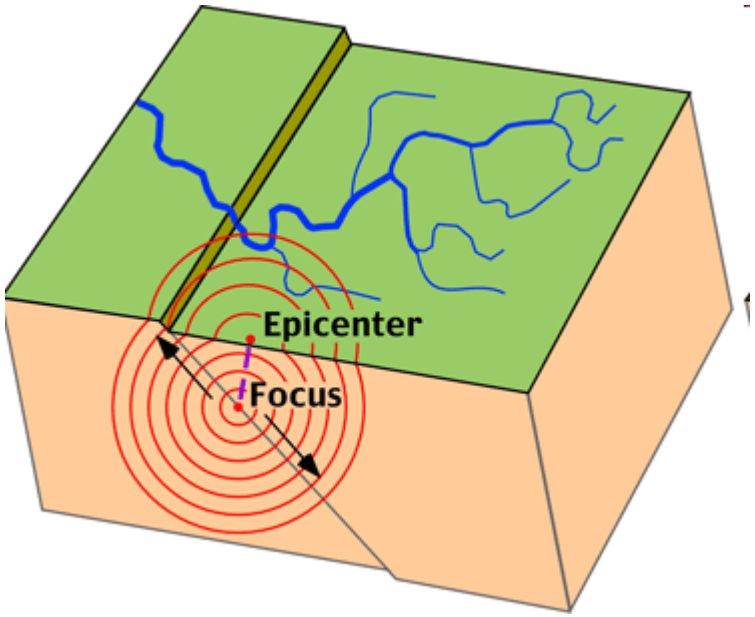
- Earthquakes have taught us most everything we know about the structure of the Earth.



Source: Google Images

Learning about the Structure of the Earth

- Earthquakes are produced when the earth's uppermost **layer** moves suddenly.
- Earthquakes produce shock waves that travel through the earth.
- Another name for **shock waves** is **seismic waves**.



Source: Google Images

Learning about the Earth

- Seismic waves always start from their point of origin, and travel outward like ripples on a pond.
- Scientists learn about the inside of the earth by studying the speed and direction of these waves.
  - Video (click and watch)

Image Source: Google

Learning about the Earth

- The two types of seismic waves that have been most helpful to scientists are called **S waves** and **P waves**.
  - Video (click and watch)
  - S and P Wave Video
  - Website Information
  - Good Khan Video on Waves

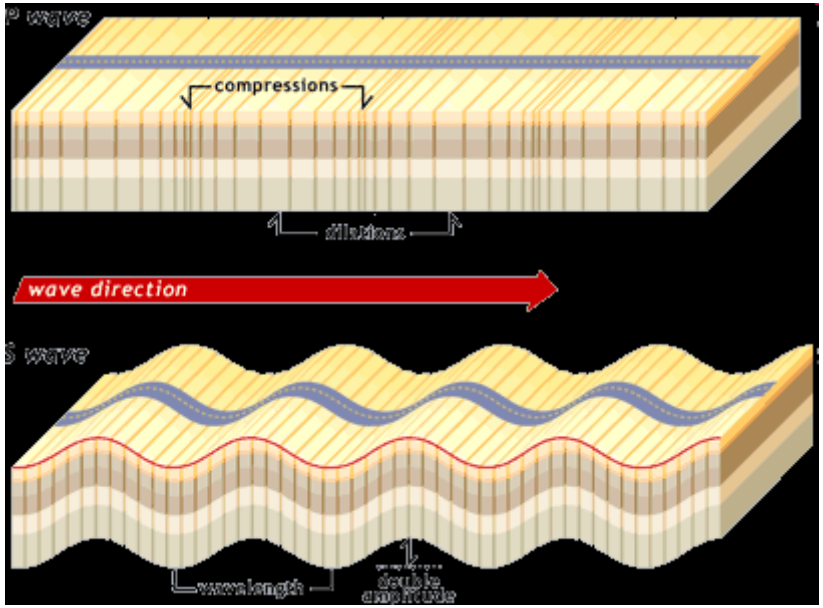


Image Source: Google

Learning about the structure of Earth

- **P waves** don't travel well through **liquid**, and **S waves** don't travel at all through liquid. Neither wave will travel through a **gas**.
- Using this knowledge, scientists have been able to develop a **model** of what the inside of the earth may look like.

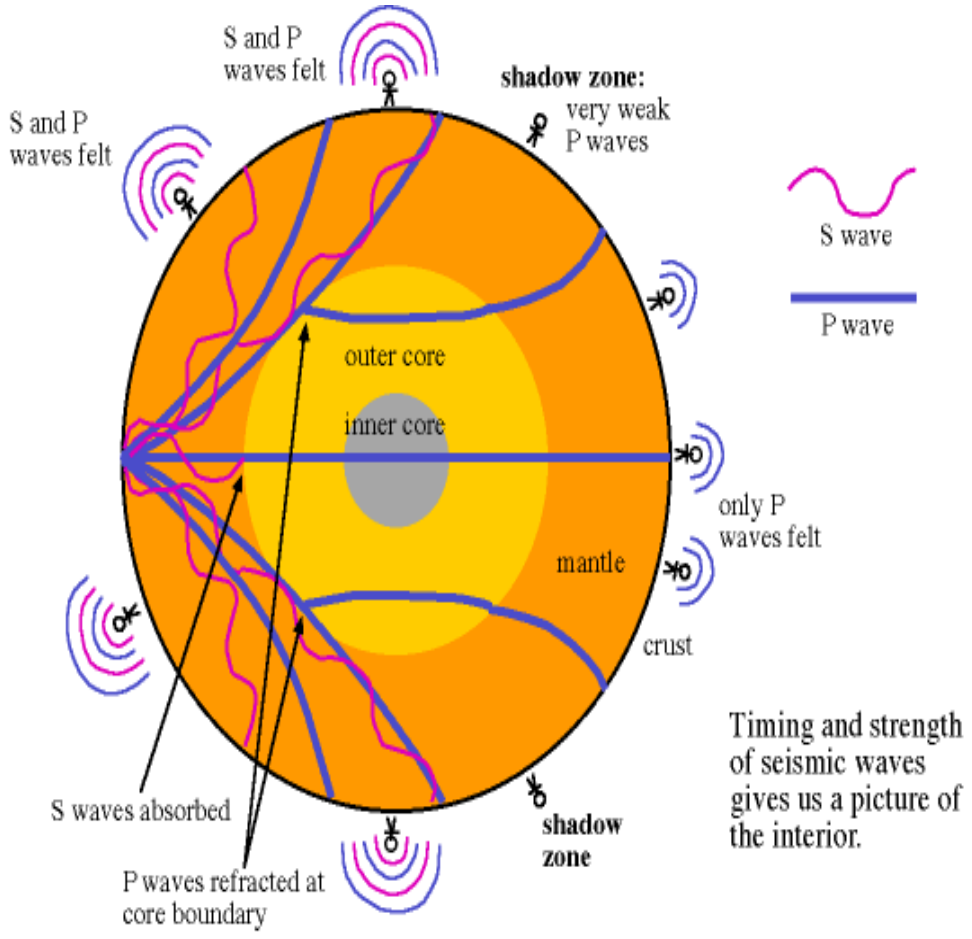


Image Source: Google

Part 4: The Earth's Inner Core

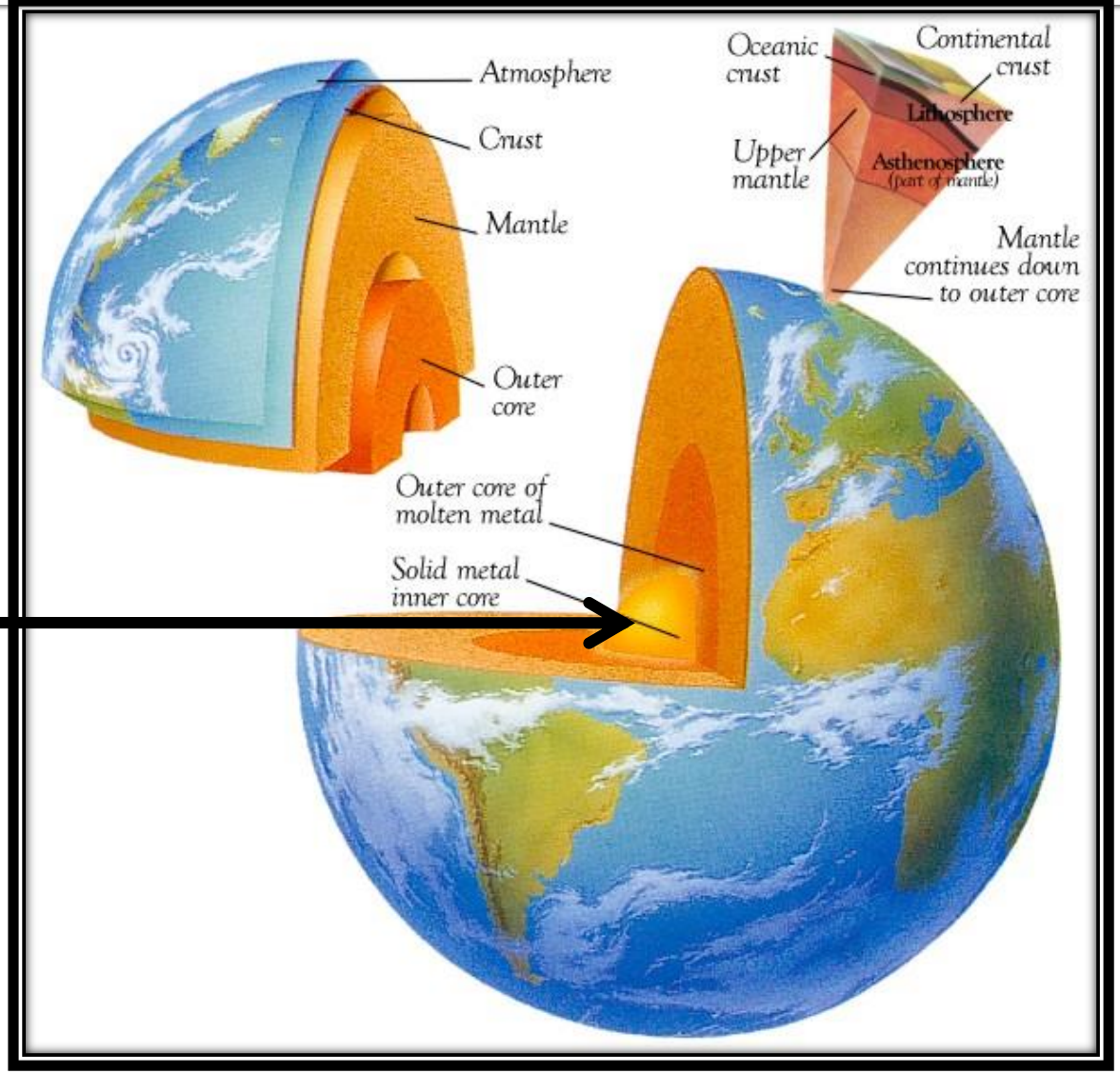


Image Source: Google

The Earth's Core – Inner Core

- At 5150 km below the earth's surface, the P waves speed up again.
- This indicates that there is a **solid** section called **the inner core that begins 5150 km** beneath the earth's surface.

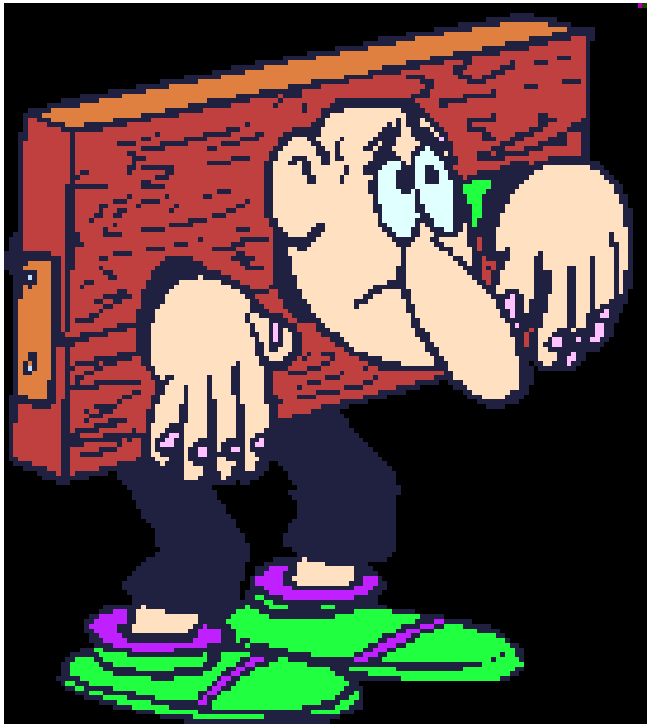


Image Source: Google

This is a picture from The Hunchback of Notre Dame. This guy breaks out of these stocks and he says "I'm Free" several times and keeps getting trapped again. The waves change speed several times throughout the Earth. They may feel like they are free when traveling through solids.

The Earth's Core – Inner Core

- The inner core is hottest, deepest, and most dense layer of the Earth. It also has the greatest pressure because of all the other layers of matter and Earth above it. The temperature of the inner core is nearly equal to the surface of the sun.
- The inner core is made of **solid iron and nickel** because of the high pressure

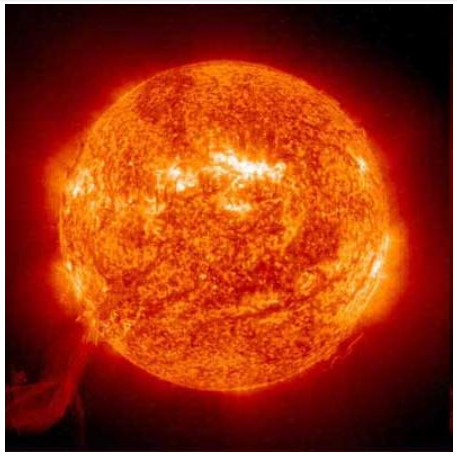


Image Source: Google

Inner Core - Fact

Composition: Iron and Nickel

Depth Range: 5150 – 6500km (3200 - 4039 mi)

State of matter: Solid

Temperature: 5000 - 6000 c (9032 – 10,832)

Density: 13g/cm3

The Earth's Core – Inner Core

- … the extreme **pressure** from all the other layers of the earth pushing in on the inner core cause the **atoms** to move very closely together.
- This causes the inner core to be a solid rather than a liquid.

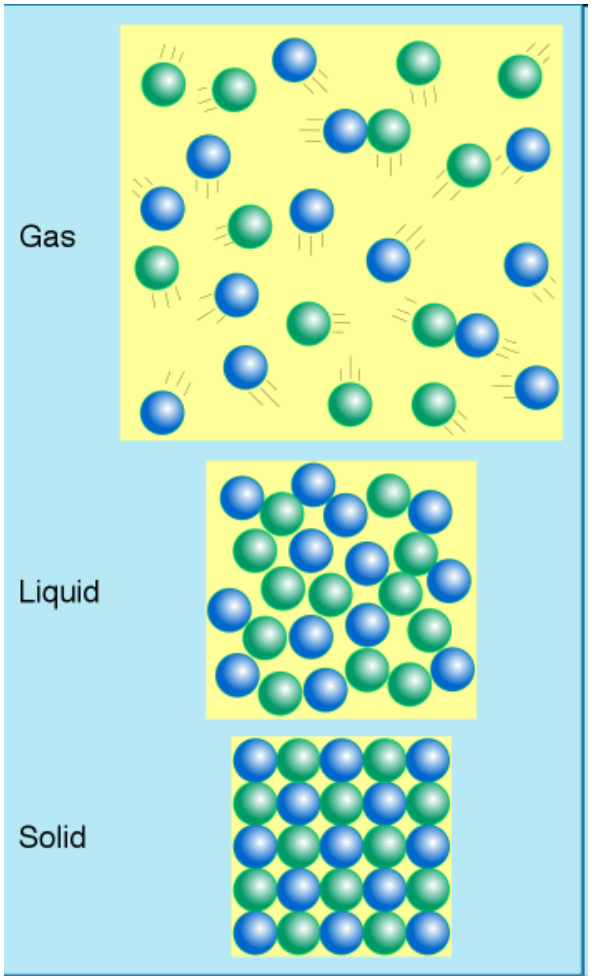


Image Source: Google

The Earth's Core – Inner Core

- The inner core begins at a **depth** of about 5150 Km (3200 miles) below the earth's surface, and has a ***radius*** of about 1300 Km (about 807 miles)!
- From here to Disneyland is about 639 miles.

Image Source: Google

Radius = the length of a line segment between the center and circumference of a circle or sphere.
The distance across the US is about 2973 miles. So the distance from the crust to the center of the Earth is a little more than the distance across the USA.

Radius =

- Image Source: Google

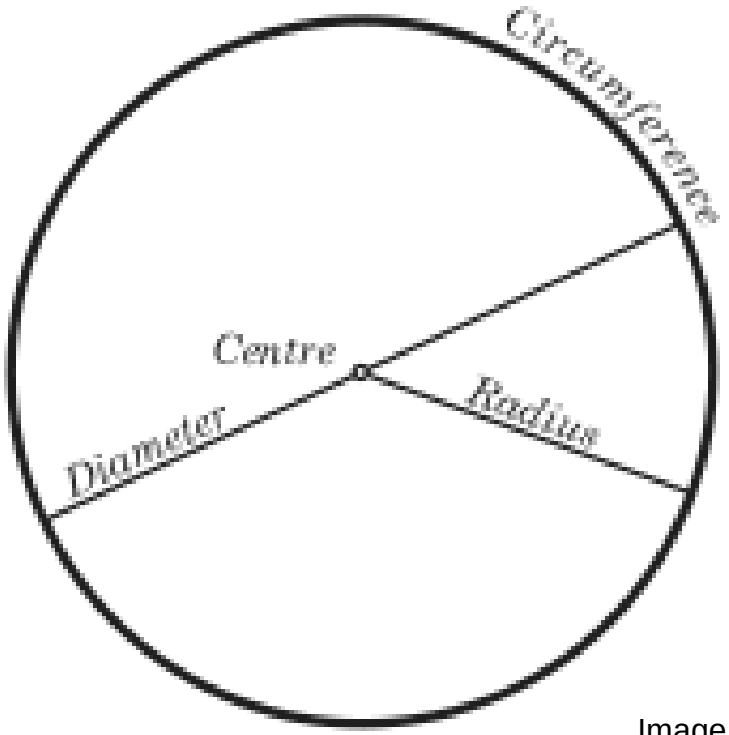


Image Source: Google

Part 5: The Earth's Outer Core

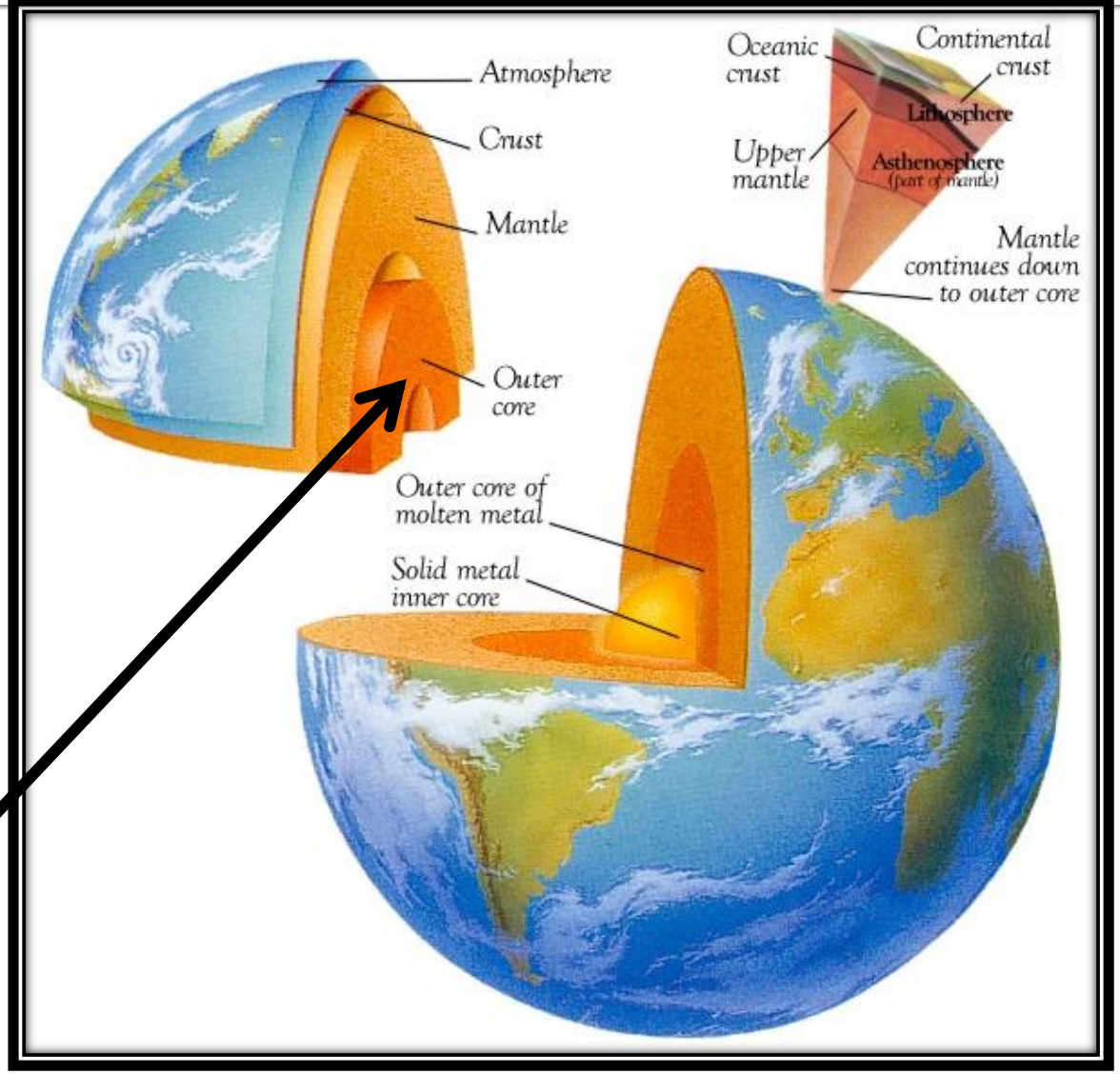


Image Source: Google

The Earth's Core – Outer Core

- At 2,900 **kilometers** below the earth's surface, the P waves slow down, and the S waves disappear.
- This indicates that there is a liquid section that begins 2,900 km beneath the earth's surface.

Image Source: Google

This tiger picture represents how we travel fast through gas, slow through liquid and not at all through solids. The opposite is true for P waves. We know that the Earth is not hollow because the P waves would most likely not travel at all through the Earth if it was hollow.

The Earth's Core – Outer Core

- The outer core is the layer of the earth that surrounds the inner core.
- The outer core is made of **liquid iron and nickel**
- The outer core is said to be liquid iron and nickel spinning around the inner core causing the Earth's magnetism.
- Watch Video: How core was discovered.

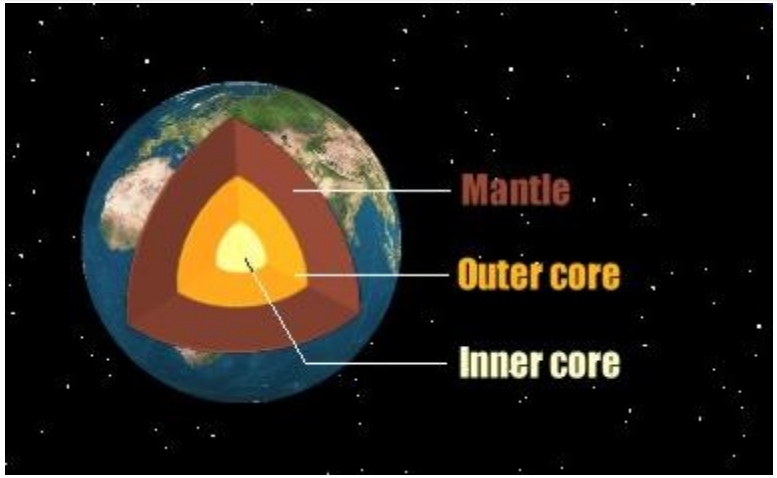


Image Source: Google

Outer Core - Fact

Composition: Iron and Nickel

Depth Range: 2900 – 5150 km (1801- 3200 mi)

State of matter: Liquid

Temperature: 2200 -5000 c (3992 -9032 f)

Density: 11.5 g cm

Part 6: The Earth's Mantle

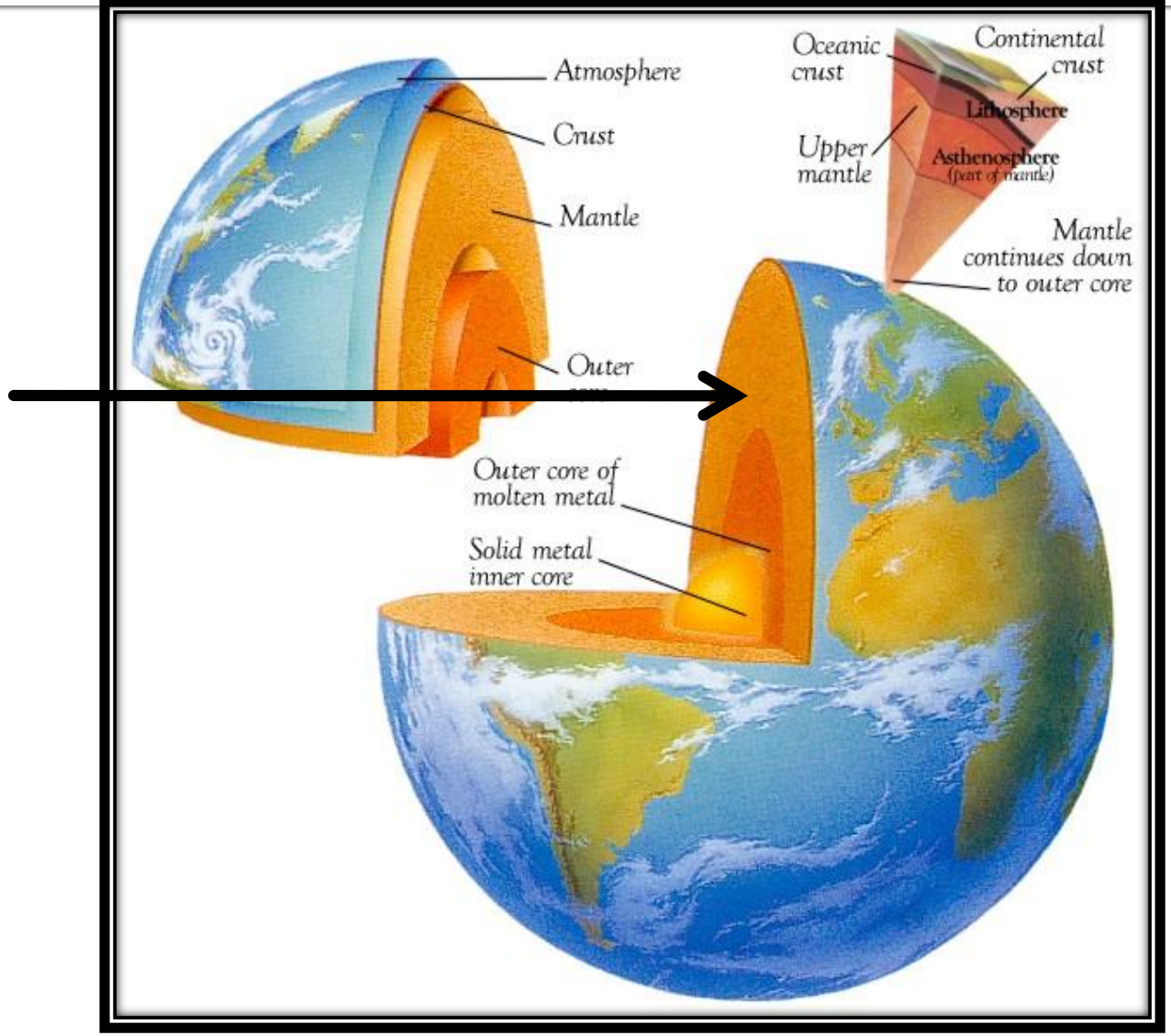


Image Source: Google

Part 6: The Earth's Mantle

- The Earth's **mantle** is located above the outer core.
- This is the **thickest and largest** layer of the earth. It takes up about 82% of the total volume of Earth.

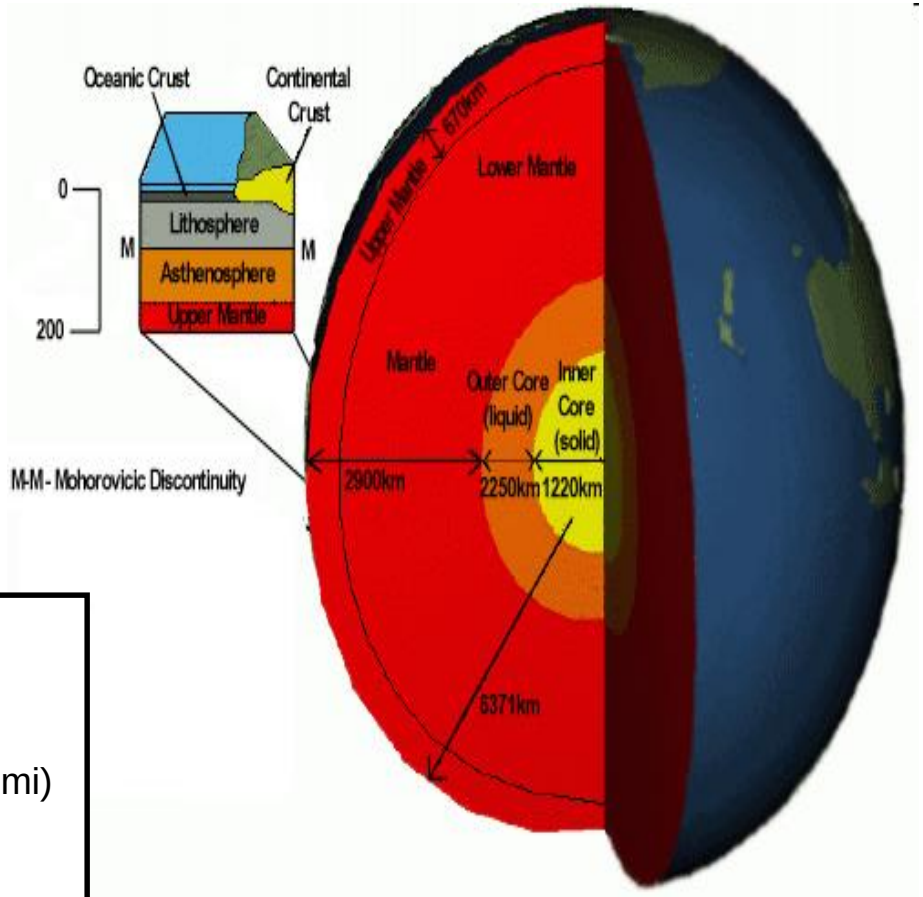


Image Source: Google

Mantle - Fact

Composition: Si, Mg, Fe (iron)

Depth Range: 32 – 2900 km (20 mi – 1801 mi)

State of matter : Solid

Temperature: 870 -2200c (1598-3992 f)

Density: 4.5 g/cm3

The Earth's Mantle

- The boundary between the crust and mantle is called the "**Moho**"
- The Moho, or Mohorovicic Boundary, was named after the Yugoslav scientist who first observed a change in wave speeds as they moved 32-64 Km below Earth's surface.

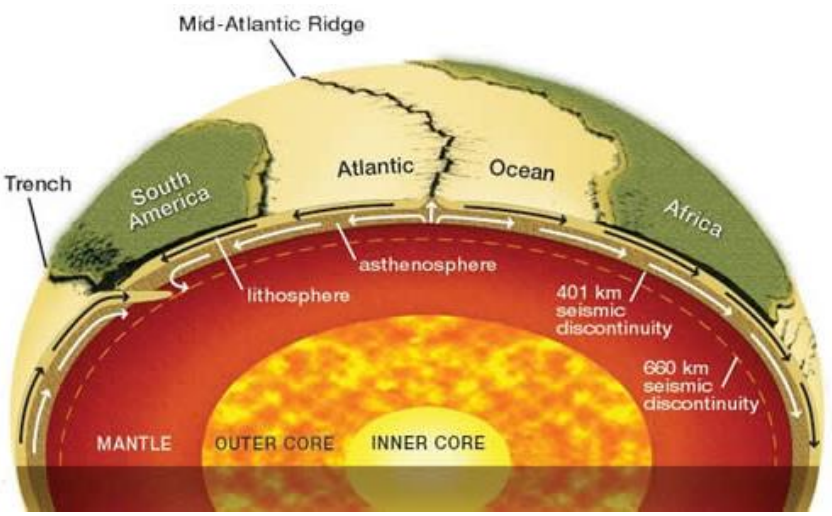


Image Source: Google

The Earth's Mantle

- The mantle is made mostly from **Silicon** (Si), **Oxygen** (O), **Magnesium** (Mg), and **Iron** (Fe) rocks.

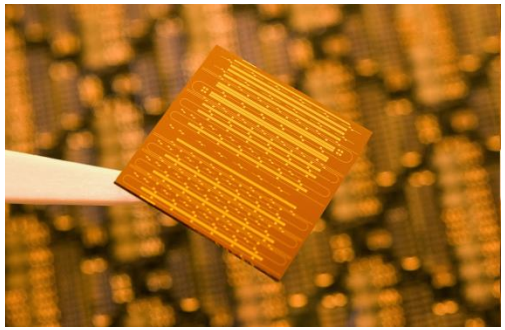


Image Source: Google

The Earth's Mantle

- The deeper you go through the mantle, the greater the **density** is.
  - This is because there are greater amounts of Iron and less rock deeper in the mantle.

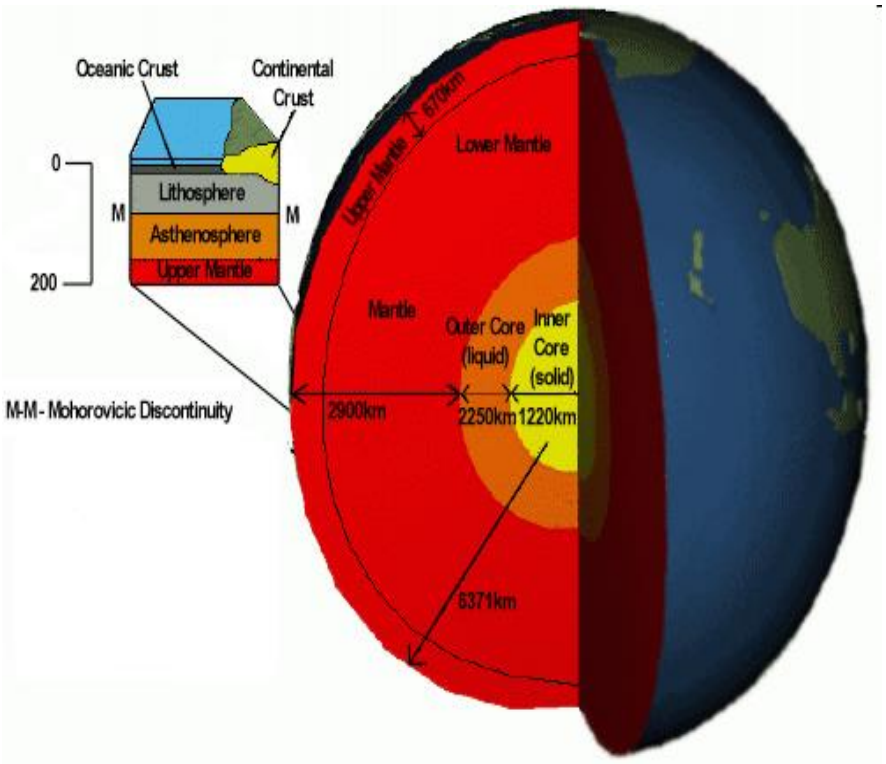


Image Source: Google

The Earth's Mantle

- The temperature and pressure of the mantle increase as you move further down.

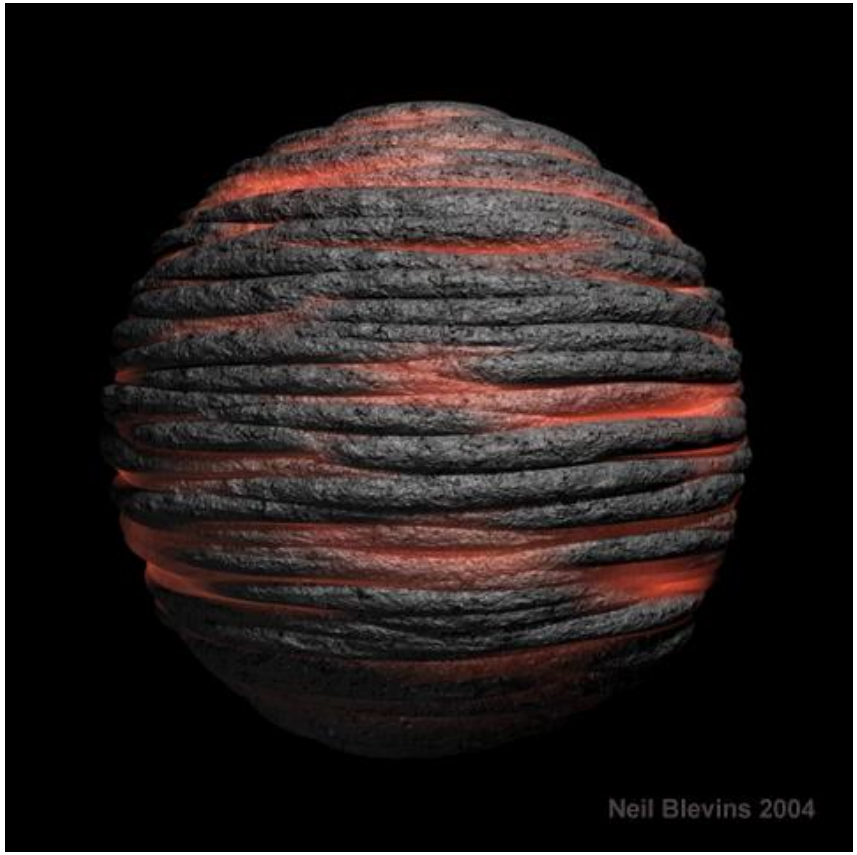


Image Source: Google

Part 7: The Earth's crust

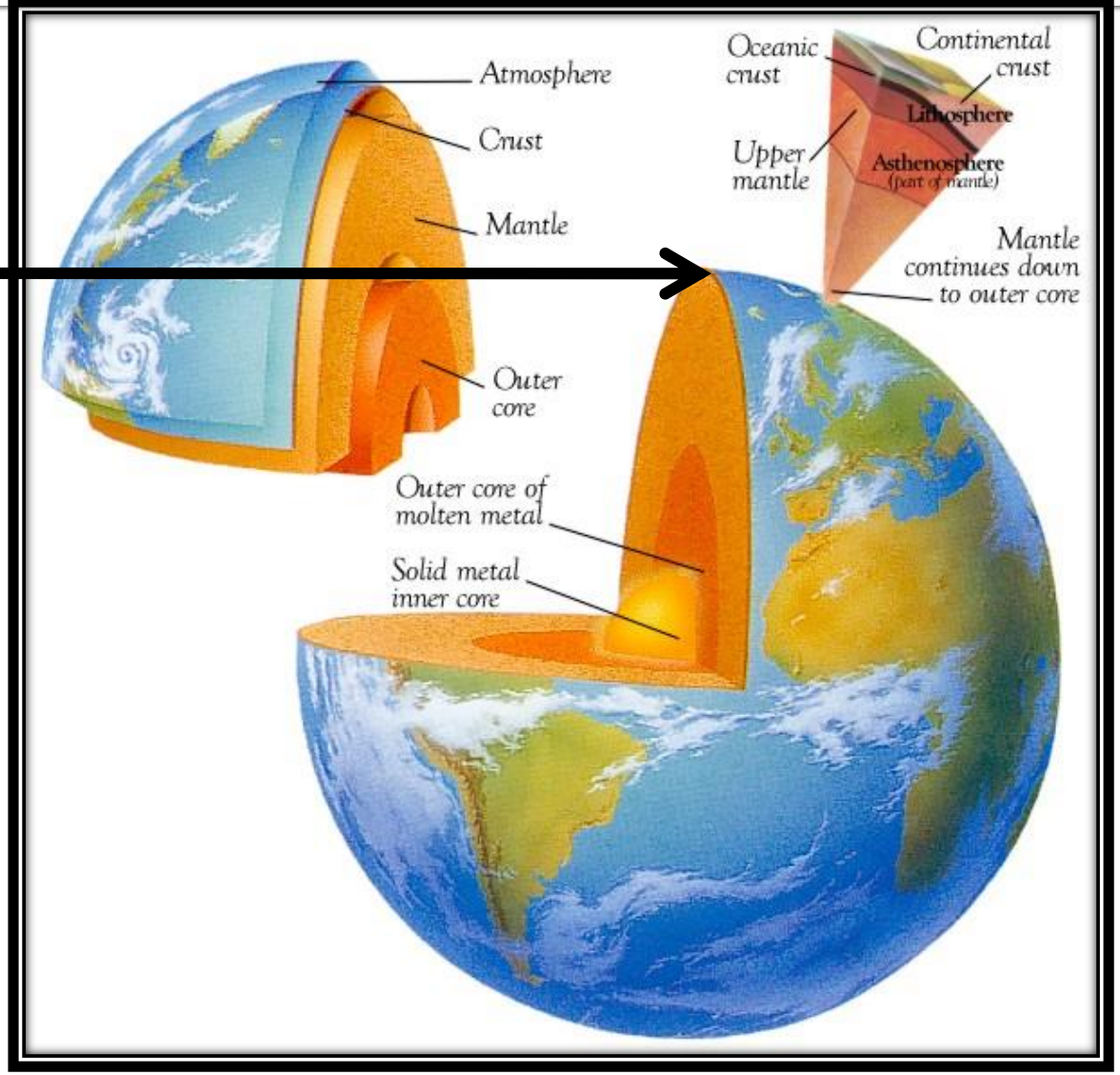


Image Source: Google

Part 7: The Earth's crust

- The Earth's **crust** is it's thin, outermost layer and is not far below the dirt, rocks and stuff in which we are living on.
- The crust is much thinner than the mantle or the inner or outer cores.
- The crust floats on the softer and more dense mantle. The crust is made of rock.
- There are two types of crust; Oceanic and Continental.

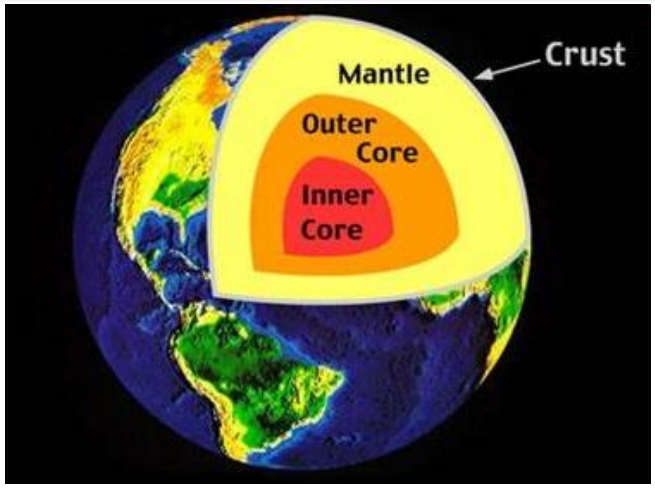


Image Source: Google

Crust

Composition: Granite (continental), Basalt (ocean)

Depth Range: 0 -32 km (0 -20 mi)

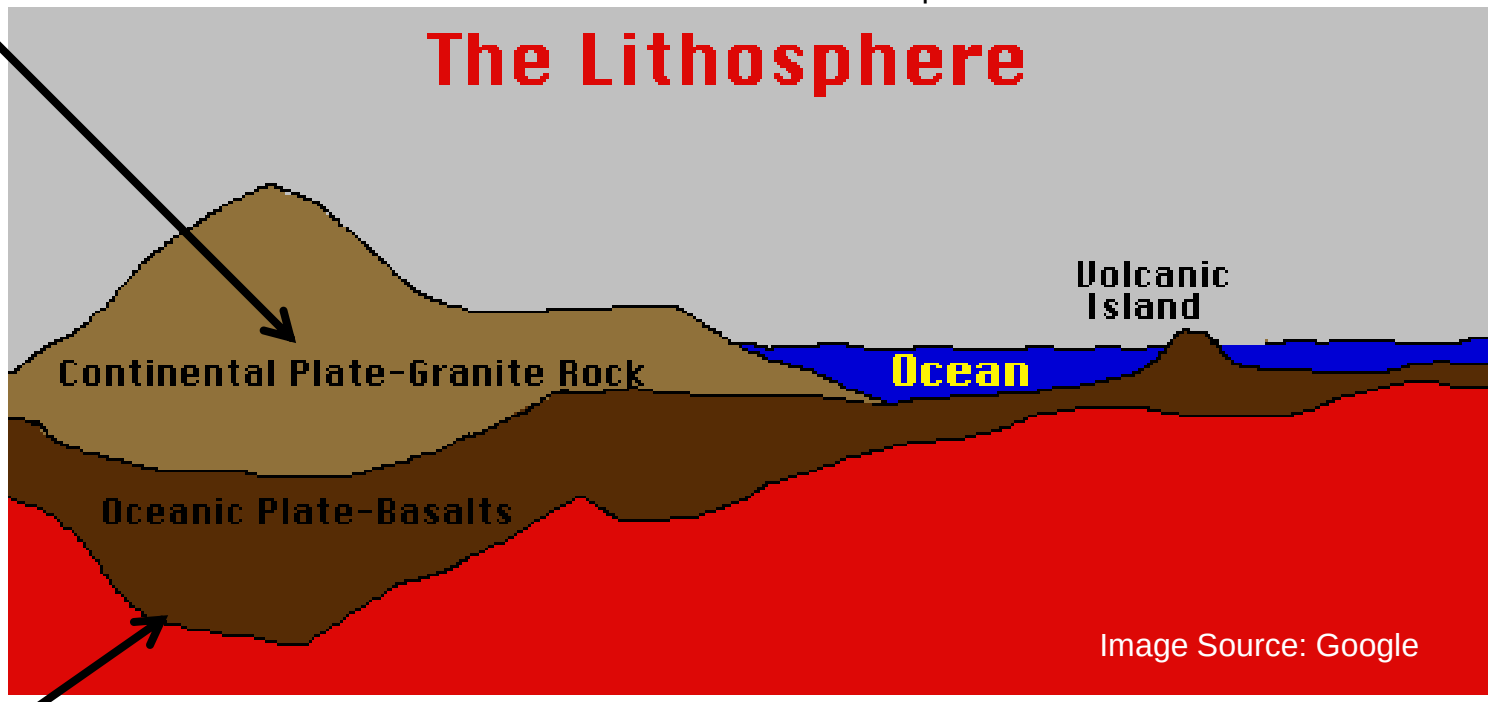
State of matter: Solid

Temperature: -17.7 – 870 c (0 -1598 f)

Density: 2.7 (cont.) – 3.0 (ocean)

The Earth's crust

Continental crust makes up the continents and rests on top of oceanic crust. **Continental crust consists of less dense rock such as granite**. Even though Continental crust is less dense **(2.7 g/cm^3)** it is much thicker than oceanic crust because it consists of the rocks that make up the continents.



Oceanic crust is a thin layer found under the oceans. Even though it is relatively thin it is the densest type of crust **(3.0 g/cm^3)** and is made up of a metamorphic rock called basalt.

The Earth's crust

- The three main types of rocks found in Earth's crust are:
  - Sedimentary rocks
  - Igneous rocks
  - Metamorphic rocks
- We can know what the crust is made of by studying rocks.

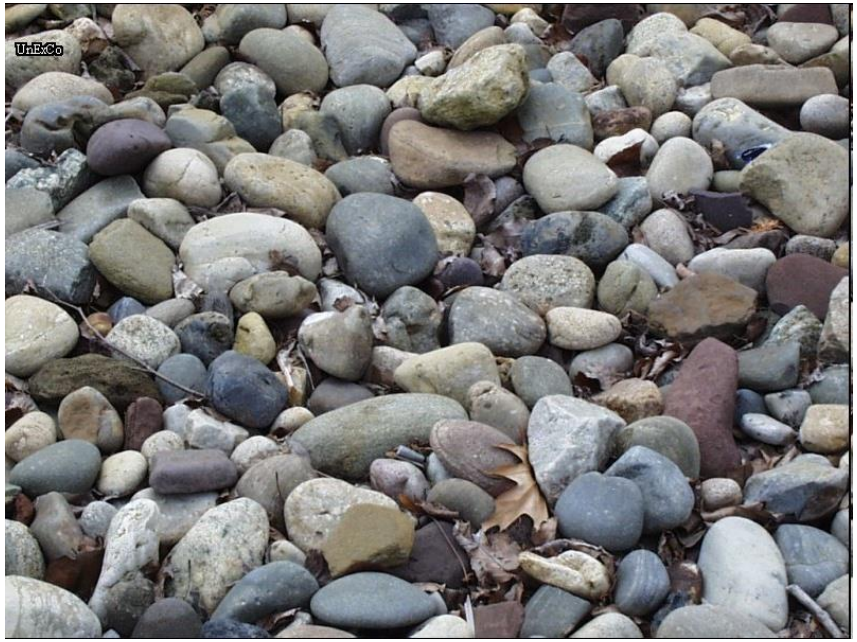


Image Source: Google

The Earth's crust

- Sedimentary rocks make up 75-80% of the crust of the earth.
- Sedimentary rocks are made of small particles that are smashed together to form rocks.
- Sedimentary rocks are common on a beach.
- Limestone and Sandstone are sedimentary rocks.

Image Source: Google

The Earth's crust

- Igneous rocks form from magma (melted rocks) that cool and become solid.
- Igneous rocks would be common around an old volcano.
- Flint, obsidian, and granite are examples of igneous rocks.

Image Source: Google

The Earth's crust

- Metamorphic rocks form when one type of rock is exposed to extreme temperatures, and changes into another type of rock.
- Marble and Quartzite are metamorphic rocks.

Image Source: Google

The Earth's crust

- The thickness of the earth's crust varies depending on location.
- The crust at the bottom of the ocean (oceanic crust) is about 10 Km (6.2 miles) thick, but the crust below the continents, (continental crust) is about 32 Km (19.2) thick. The crust is the thickest under mountains. (70Km or 43 miles).

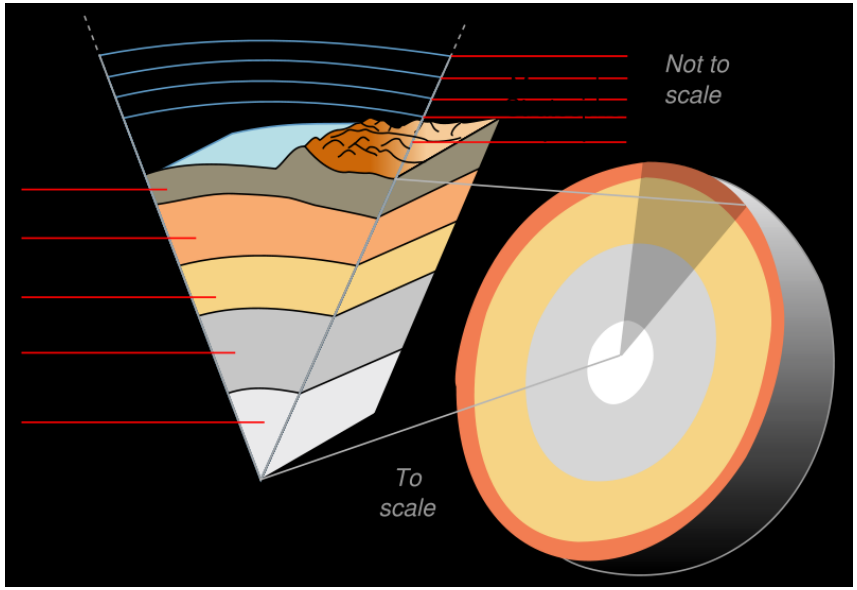


Image Source: Google

What is the crust made of?

- The Earth's crust is covered with soil, rock and water.
- The Earth's crust is made of….
  - Oxygen 46.6 %
  - Silicon 27.7%
  - Aluminum 8.13%
  - Iron 5.0%
  - Calcium 3.63 %
  - Sodium 2.83 %
  - Potassium 2.59 %
  - Magnesium 2.09%
  - Titanium 0.40 %
  - Hydrogen 0.14%

  Total = 99.13% (some rounding error)

Part 8: The Earth's Atmosphere

Image Source: Google

The Earth's atmosphere

- The **atmosphere** is the air that surrounds the earth. It rests on top of the crust.
- The atmosphere is made of the following gasses:
  - 78% Nitrogen
  - 21% Oxygen
  - 1% Argon, Carbon Dioxide, and other trace gases.

Image Source: Google

Atmosphere

Composition: N_2, O_2, Ar, CO_2

Depth Range: 0 -100 km (62 miles)

State of matter: Gas

Temperature: -90 c – 2000 c (-130-3632 f)

Density: .0013g/cm3

The Earth's atmosphere

- The earth's atmosphere goes about 800 Km (497 miles) above the earth, but ¾ of the atmosphere's mass is within 11 Km of the earth.
- Atmospheric pressure at sea level is about 14.7 psi.
- Recent information Mission from Stratosphere to Earth

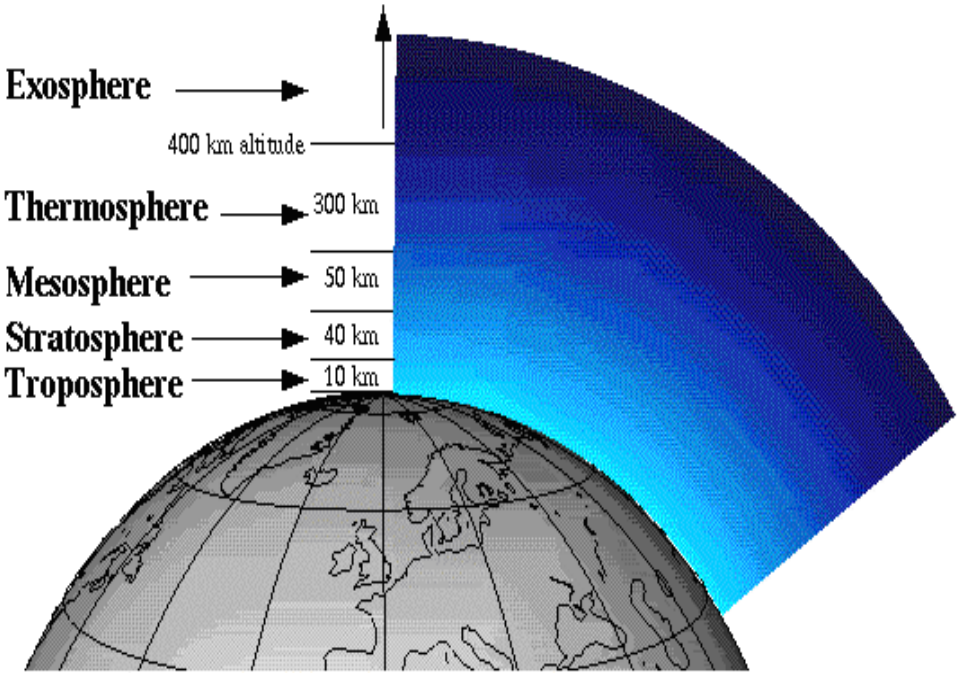


Image Source: Google

Part 9: Structure of Earth Review

Image Source: Microsoft clip art

Structure of Earth Review

- Models of the Earth
  - If the Earth were an atom, which parts would be each section of the Earth?

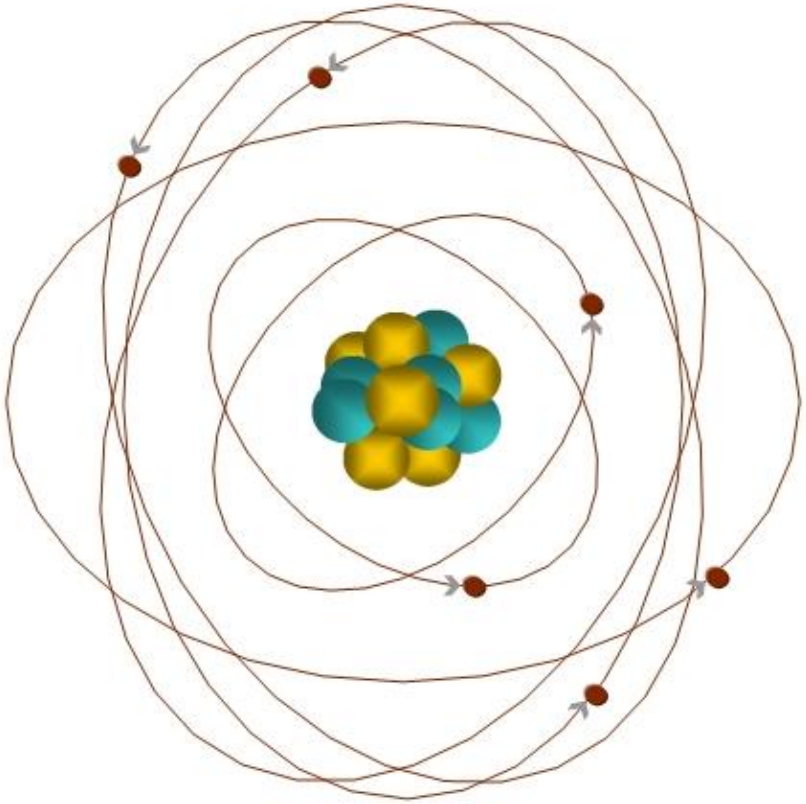


Image Source: Google

Structure of Earth Review

- Models of the Earth
  - If the Earth were a cell, which parts would be each section of the Earth?

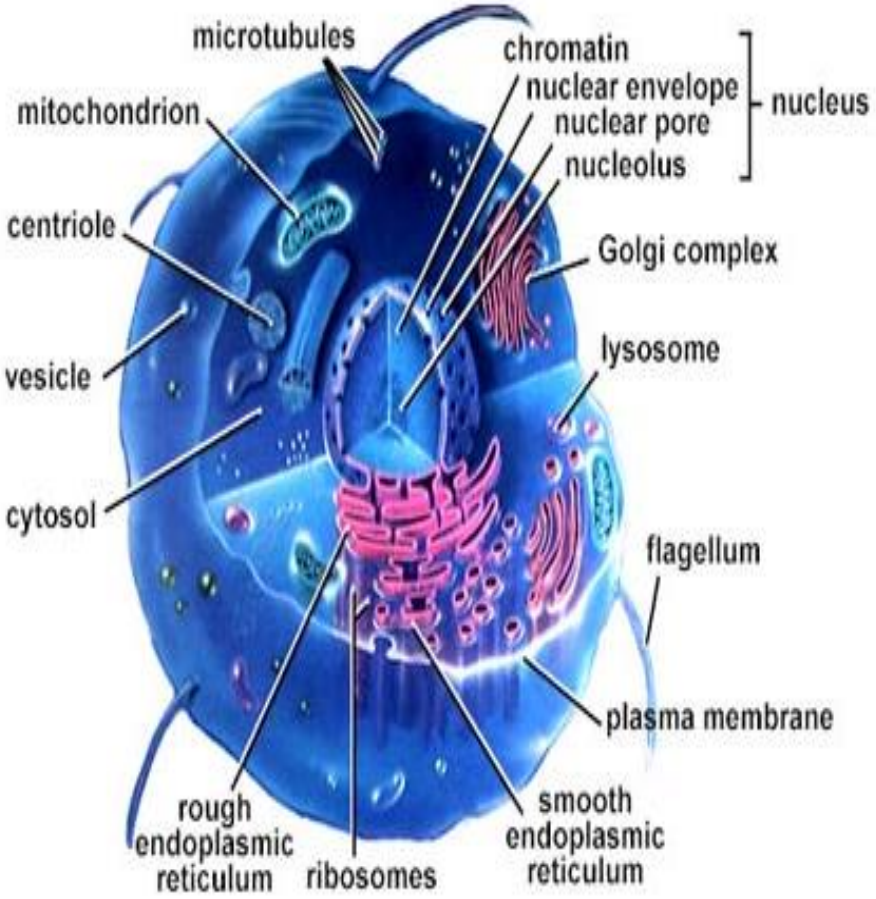


Image Source: Google

Structure of Earth Review

- Models of the Earth
  - If the Earth were a peach, which parts would be each section of the Earth?

Image Source: Google

Structure of Earth Review

- Models of the Earth
  - If the earth were an egg, which parts would be each section of the earth?

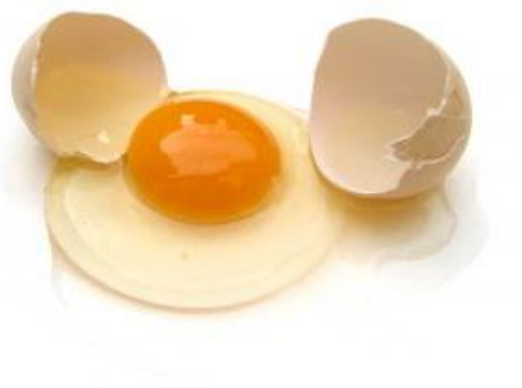


Image Source: Google

Structure of Earth: Review

Crust

Composition: Granite (continental), Basalt (ocean)

Depth Range: 0 -32 km (0 -20 mi)

State of matter: Solid

Temperature: -17.7 – 870 c (0 -1598 f)

Density: 2.7 (cont.) – 3.0 (ocean)

Mantle - Fact

Composition: Si, Mg, Fe (iron)

Depth Range: 32 – 2900 km (20 mi – 1801 mi)

State of matter : Solid

Temperature: 870 -2200c (1598-3992 f)

Density: 4.5 g/cm3

Outer Core - Fact

Composition: Iron and Nickel

Depth Range: 2900 – 5150 km (1801- 3200 mi)

State of matter: Liquid

Temperature: 2200 -5000 c (3992 -9032 f)

Density: 11.5 g cm

Inner Core - Fact

Composition: Iron and Nickel

Depth Range: 5150 – 6500km (3200 - 4039 mi)

State of matter: Solid

Temperature: 5000 - 6000 c (9032 – 10,832)

Density: 13g/cm3

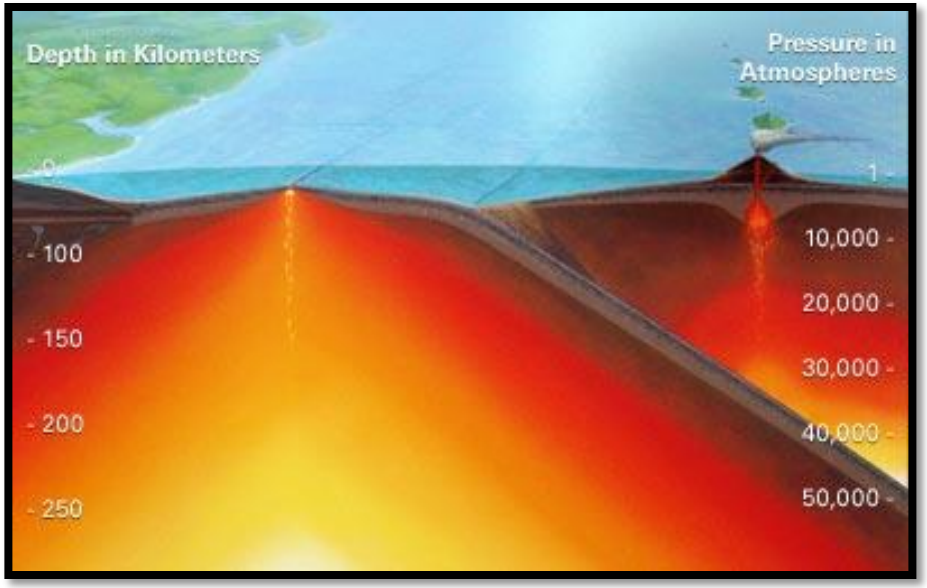
Structure of Earth – Atmosphere Review

- **Atmosphere**

- **Composition:** N_2, O_2, Ar, CO_2
- **Depth:** 0- 100 km (62 mi.) up from crust
- **State of matter:** Gas
- **Temperature:** -90 c – 2000 c (-130-3632 f)
- **Density:** .0013g/cm3

Extra Information

- "The deeper a rock is within the Earth, the hotter and denser it is. Both temperature and pressure increase with depth. With every kilometer in depth the temperature increases by about 25°C (45°F), and the pressure increases by about 250 atmospheres. (One atmosphere = 14.7 lb/sq in, the average pressure of the atmosphere at sea level".



- Heat, Pressure Information

Source: http://www.mnh.si.edu

Information and Image Sources

- **Sources:**
- The foldable: http://www.dinah.com
- http://www.visionlearning.com
- http://mediatheek.thinkquest.nl/~11125/en/struct/htm
- *Exploring Earth Science*. 2nd ed. Needham, Massachusetts: Prentice Hall, 1997. 191-198, 307-316. Print.
- http://www.metric-conversions.org/temperature/celsius-to-fahrenheit.htm
- http://www.metric-conversions.org/length/kilometers-to-miles.htm
- http://images.google.com