Name:_____ Points:___/10

SMITH - EARTH SPACE - 7TH PERIOD - OFF-SITE LEARNING PACKET DAY 2

Chapter 9 The Earthlike Planets
Lesson Two – Earth's Interior

Lesson Objectives

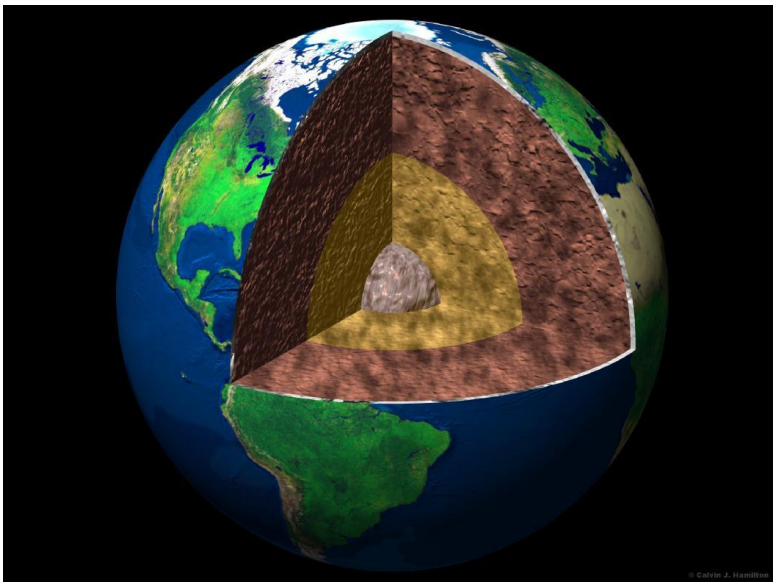
- **define today's bellwork vocabulary (orogeny, convergent boundary, divergent boundary, transform boundary)** with 100% accuracy
- **state the calculated average density of Earth as a whole and the experimentally known density of Earth's crust** with 100% accuracy
- **list the three layers of the Earth's interior** with 100% accuracy

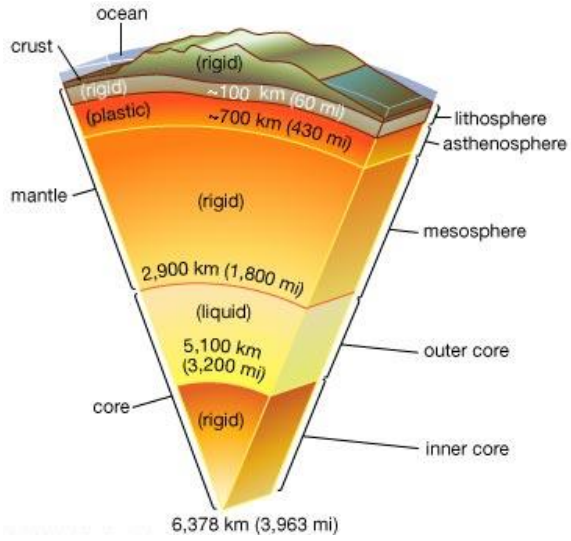
Data File Two - The Earth

Average distance from the sun	1.00 AU (1.495979×10^8 km)
Eccentricity of orbit	0.0167
Maximum distance from the sun	1.0167 AU (1.5210×10^8 km)
Minimum distance from the sun	0.9833 AU (1.4710×10^8 km)
Inclination of orbit to ecliptic	0^o
Average orbital velocity	29.79 km/sec
Orbital period	1.00 y (365.25 days)
Period of rotation (with respect to the sun)	$24^h00^m00^s$
Inclination of equator to orbit	$23^o27'$
Equatorial diameter	12,756 km
Mass	5.976×10^{14} kg
Average density	5.497 g/cm^3 (4.2 g/cm^3 uncompressed)
Surface gravity	1.0 Earth gravity
Escape velocity	11.2 km/sec
Surface temperature	-50^o to 50^o C (-60^o to 120^o F)
Average albedo*	0.39
Oblateness	0.0034

Associated Text:

Chapter 9 Lesson 2





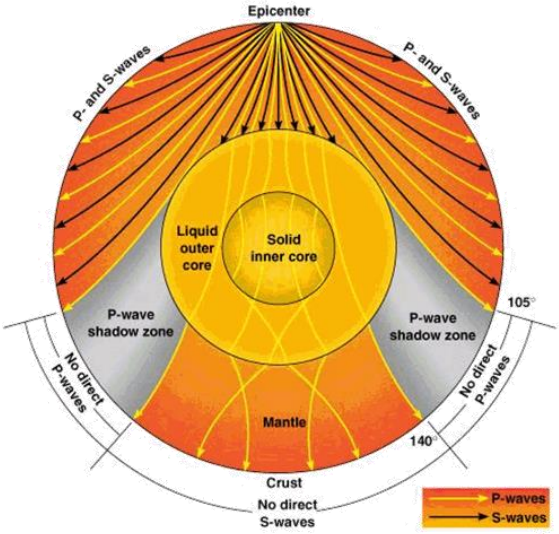
Cross sections of the Earth.

Earth's Interior

We expect that Earth differentiated, but what evidence do we have to tell us what the interior of Earth is really like?

Earth's mass divided by its volume tells us its average density, about 5.50 g/cm^3. But the density of Earth's rocky crust is only about half that. Clearly, a large part of Earth's interior must be made of material denser than rock.

Although the deepest wells extend only a few kilometers down, Earth scientists have clear proof that Earth did differentiate. Each time an earthquake occurs, seismic waves travel through the interior and register on seismographs all over the world. Analysis of these waves shows that Earth's interior is divided into a metallic core, a dense rocky mantle, and a thin, low-density crust.



Scientists have evidence of a differentiated Earth via earthquakes.

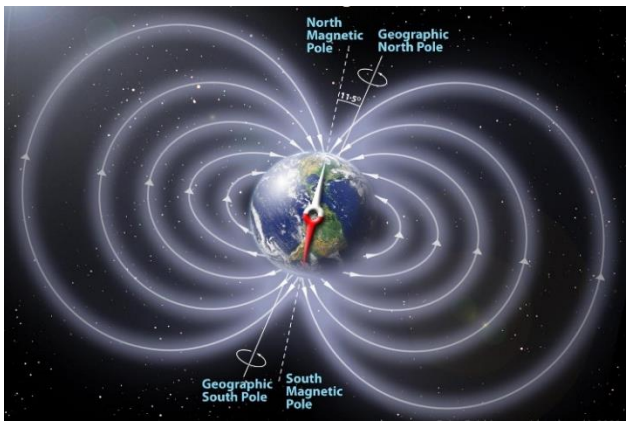
Earth's Core

The core has a density of 14 g/cm^3, denser than lead, and is believed to be composed of iron and nickel at a temperature of roughly 6000 K. In other words, the core of Earth is as hot as the surface of the sun, but the high pressure keeps the metal a solid near the middle of the core and a liquid in its outer parts.

Two kinds of seismic waves tell us the outer core is liquid. The P waves travel like sound waves, and they can penetrate a liquid; but S waves travel as a side-to-side vibration of particles like the jiggle in a bowl of jelly. S waves can't travel through a liquid, so Earth scientists can deduce the size of the liquid core by observing where S waves get through and where they don't. The outer boundary of the core lies just over halfway to the surface.

Earth's Magnetic Field

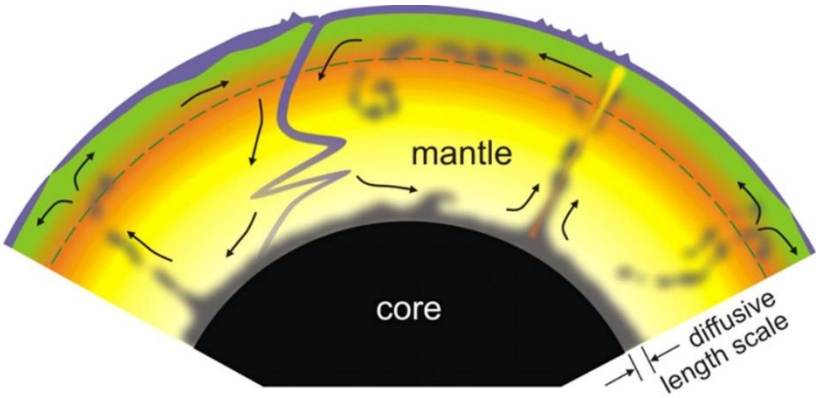
Earth's magnetism gives us further clues about the core. Convection currents stir the molten liquid; and, because it is a very good conductor of electricity and is rotating as Earth rotates, it generates a magnetic field through the dynamo effect-the same process that creates the sun's magnetic field. From traces of magnetic field retained by rocks that formed long ago, geologists conclude that Earth's magnetic field reverses itself every million years or so. Periodic reversals, though poorly understood, are a characteristic of the dynamo effect. Thus, the presence of a magnetic field is evidence that part of Earth's core is a liquid metal.



The rotation of the Earth on its axis and the molten iron core create Earth's magnetic field.

Earth's Mantle

The interior of Earth, similar to the other terrestrial planets, is divided into layers of different composition. The mantle is a layer between the crust and the outer core. Earth's mantle is a silicate rocky shell with an average thickness of 2,886 km (1,793 mi). The mantle makes up about 84% of Earth's volume. It is predominantly solid but in geological time it behaves as a very viscous fluid. The mantle material is a plastic, a material with the properties of a solid but capable of flowing under pressure. Asphalt used in paving roads is a common plastic; it shatters if struck with a sledgehammer, but it bends under the weight of a truck. Just below Earth's crust, where the pressure is less than at great depths, the mantle is most plastic.

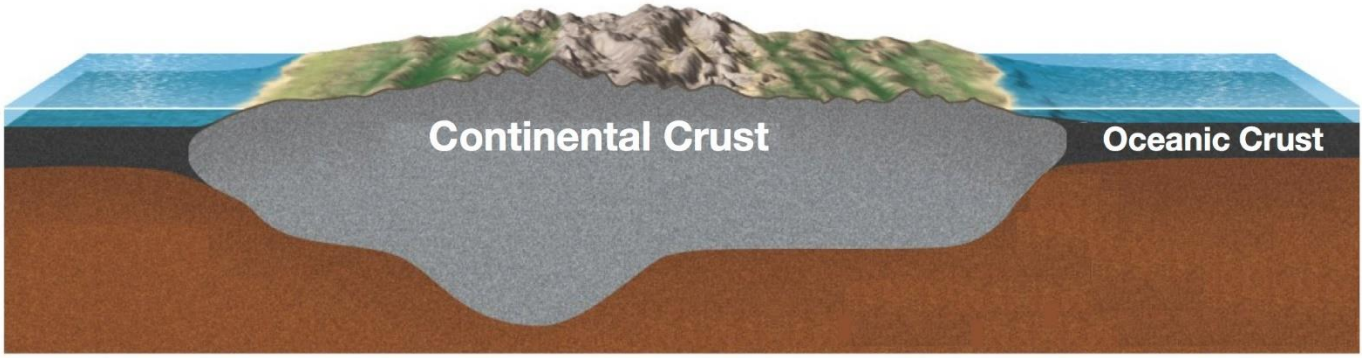


Earth's mantle has a plastic consistency.

Peridotite is the dominant rock of the upper part of the Earth's mantle.

Peridotite is the dominant rock of the upper part of the Earth's mantle. Peridotite is a dense, coarse-grained igneous rock consisting mostly of the minerals olivine and pyroxene.

In the mantle, temperatures range between 900 °C at the upper boundary with the crust; to over 4,000 °C at the boundary with the core. Although the higher temperatures far exceed the melting points of the mantle rocks at the surface the mantle is almost exclusively solid. The enormous pressure exerted on the mantle prevents melting.



Earth's crust has two distinct types, continental and oceanic.

Earth's Crust

The crusts of Earth, Moon, Mercury, Venus, Mars, Io, and other planetary bodies formed via igneous processes, and were later modified by erosion, impact cratering, volcanism, and sedimentation.

Earth has two distinct types of crust: continental crust and oceanic crust. These two types have different chemical compositions and physical properties, and were formed by different geological processes. The Earth's rocky crust is made up of low-density rocks and floats on the denser mantle. The crust is thickest under the continents, up to 60 km thick, and thinnest under the oceans where it is only about 10 km thick. The continental crust is deepest in mountainous areas. Both the continental and oceanic crusts are bonded to the mantle. As the mantle moves, the crustal plates are dragged along with them, this is the basis for plate tectonics.

Oceanic: crust is composed primarily of dense rocks, such as basalt. Continental crust is composed primarily of less dense rocks, such as granite.

Granite

Basalt

Picture URLs

http://d1jqu7g1y74ds1.cloudfront.net/wp-content/uploads/2008/10/earth_interior.jpg
http://geophile.net/Lessons/PlateTectonics/images/bodywavesthroughearth.fw.png
http://www.britannica.com.ph/article_images/73583.jpg
http://www.nasa.gov/images/content/607968main_geomagnetic-field-orig_full.jpg
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http://hmxearthscience.com/Sammartano/DYNAMIC%20CRUST%2013/Earth's%20Interior%20STUDENT.key/Data/Crust.jpg
http://www.pitt.edu/~cejones/GeoImages/1Minerals/1IgneousMineralz/Olivine/Peridotite.jpg
https://flexiblelearning.auckland.ac.nz/rocks_minerals/rocks/images/basalt2.jpg
http://cdn3.kidsdiscover.com/wp-content/uploads/2013/08/8_1.jpg

Guided Reading Questions: **(10 pts.)**

Use the above text and class notes to answer the following questions

Earth's Interior

1. What is the average density of the Earth?

2. What is the average density of Earth's crust?

3. What is the average density of Earth's core?
4. How does the temperature of Earth's core compare to the surface of the sun?

5. What type of seismic wave is similar to sound waves?

6. What type of seismic wave is side-to-side motion?

7. Which type of seismic wave cannot travel through liquid?

8. How far does the liquid core extend from center of the Earth?

9. How do scientists know that the Earth's magnetic field has reversed itself every million years or so?

10. What does the mantle consist of?

11. What does it mean that the mantle behaves like a plastic? What familiar example does the text give?

12. What is Earth's crust made up of?

13. How thick is Earth's crust under the continents?

14. How thick is Earth's crust under the oceans?

Lesson Notes

Earth's Interior

- average density ~ 5.5 g/cm^3
- crustal density ~ 2.7 g/cm^3

Seismic Wave Evidence

- seismic wave evidences that Earth's interior has three distinct layers
  - metallic core
  - dense rocky mantle
  - thin, low-density crust

Earth's Core

- average density ~ 14 g/cm^3
- 6000 K
- solid center
- liquid outer

Seismic Waves

- two kinds of seismic waves
- p-waves
  - travel like sound waves
  - can go thru liquid
- s-waves
  - travel side-to- side
  - cannot go thru liquid
- Earth's core's boundary ½ way to surface

Earth's Magnetism

- called geo-magnetism
- offers further evidence of a liquid outer core
- produced by the dynamo effect
- has periodic reversals approximately every 1,000,000 years

Earth's Mantle

- middle layer, between core and crust
- dense rock and metal oxides
- plastic flow

Earth's Crust

- low density rocks
- floats on mantle
- thicker under continents (~ 60 km thick)
- oceanic crust (denser) (~ 20 km thick)

Vocabulary:

Orogeny - the building of a mountain, either by volcanic or tectonic means
Convergent boundary – where lithospheric plates move toward each other
Divergent boundary – where lithospheric plates move away from each other
Transform boundary – where lithospheric plates slide past each