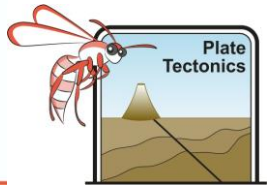
Planetary Differentiation – Student Activities



Planetary differentiation - A theory supported by scientific data

DEFINITION A scientific theory is an hypothesis supported by data.

Data must be

O_____

M _____

and R _____

before it is R_____

We will be dealing with mixtures and compounds. What is the difference between a mixture and a compound?

A ***mixture*** is _____

_____

A ***compound*** is _____

_____

Our planet has an atmosphere, a hydrosphere, a biosphere and a lithosphere. Is our planet a mixture or a compound? Explain your answer.

_____

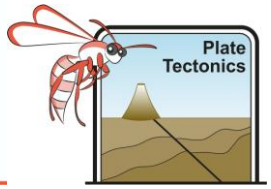
_____

_____

Early scientists realized that rocks below the Earth's surface must be denser because the estimated density of the planet was 5.52g/cm^3 this was very much larger than rocks found on its surface (2.67g/cm^3).

They hypothesised that:

1. During the first 300million years the planet was much hotter than it is at present and rocks would be molten
2. Gasses would be driven upwards to form our atmosphere
3. Denser materials would be pulled by gravity towards the center of the Earth



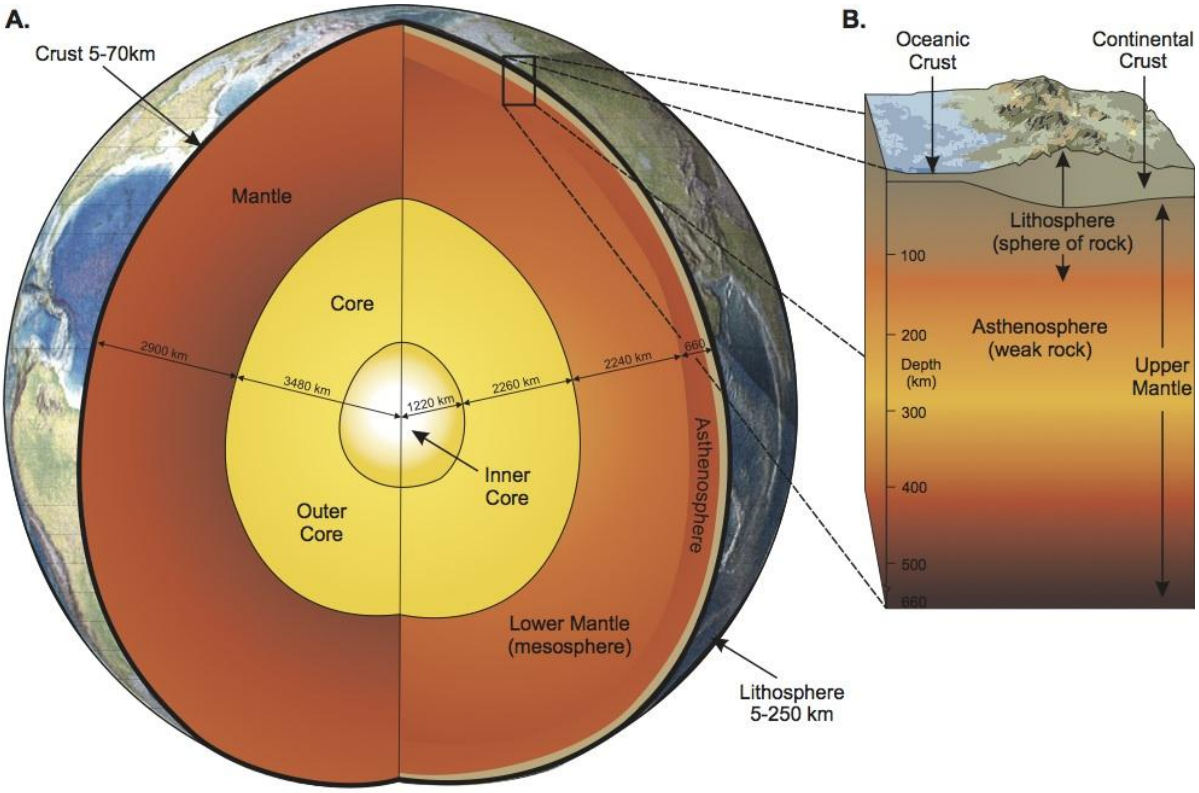
4. Five layers of increasing density would be created

We will be testing the hypothesis that planetary differentiation (core, mantle and crust) could result from density separation.

Your teacher will demonstrate an activity

Did this activity scientifically support the hypothesis that planetary differentiation is the result of density separation?

_____



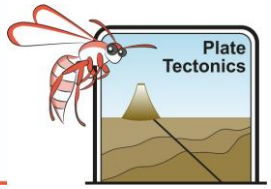
Composition of the Earth (Tompkins, 2010)

You will now collect scientific data that is observable, measureable and repeatable.

<u>AIM</u> To collect scientific data to support the hypothesis that planetary differentiation could be the result of density separation in the early molten Earth.

Materials per student or group

- One measuring cylinder
- Sufficient water or glycerin to 2/3 fill the container
- A teaspoonful, or prepared equal volumes of clean dry sand, iron filings and lead shot or equivalent.
- Teaspoon or spatula



- Stop watch or equivalent
- Swarf or cotton wool
- Graph paper, pencil and ruler

You will be experimenting to see what happens when a mixture of sand, iron filings and lead shot falls through the column of water or glycerol. The solids represent minerals of different densities and the glycerine or water represents early molten Earth.

HYPOTHESIS: Make a scientific guess or estimate of what will happen when the mixture you have been given falls through the liquid.

_____

_____

METHOD:

1. Gently sprinkle the mixture onto the top of the liquid in the test tube
2. Measure the time it takes for each component of the mixture to reach the bottom of the water.
3. Clean your equipment as directed by your teacher and repeat your measurements twice more.

Your teacher will tell you the density of the components after you have collected your data. This is primary data (data you have collected yourself).

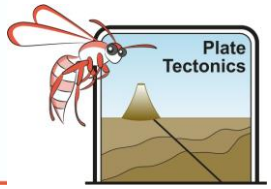
Observations

Component	Time taken to reach bottom (seconds)				Density of component (g/cm^3)
	First test	Second test	Third test	Average	
Gold	_____	_____	_____		19.30

Your teacher will inform you of the density of the materials you used.

Why did we require three tests? _____

What did you observe? _____



Did the data support your hypothesis? _____

_____

How could this experiment be improved to provide better data? _____

_____

_____

What force caused the mixture to move to the bottom of the container? _____

Write the density of each component into the final column

Draw a graph comparing the density of the component with the speed it took to reach the bottom.

HINTS

1. What should the title of the graph be?

   _____

2. What should the X-axis be labeled? …… in which units?

   _____

3. What should the Y-axis be labeled? …. in which units?

   _____

4. What type of graph should it be? _____

Using this data, is there a correspondence between density and rate of falling (gravitational pull)?

_____

An inference is a judgement made from the evidence provided. Can you infer the time it would take for gold to reach the bottom?

_____

Density separation is used in mining to separate denser minerals from crushed rock. Gemstones can also be classified by dropping them into viscous liquids. The rate of movement through the liquid reflects the density and chemistry of the gemstone.

Cubic zirconium is commonly cut to look like diamond. A simple test in liquid will prove which stone has been used

Conclusion

How does this experiment help to explain how early earth became layered into crust, mantle and core?

_____

_____

_____

Did the experiment prove this hypothesis? _____

_____

Some scientists call this movement of iron towards the core “The GREAT IRON CATASTROPHE” or “THE GREAT IRON EVENT”. Movement was restricted when heat from the original collapse of planetary dust to form Earth was lost into space.