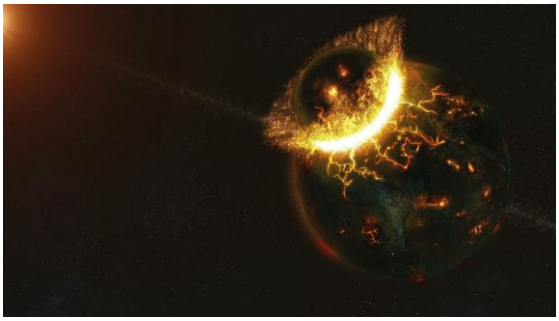
Origin of the Universe, Earth and Life



Stars and Seas

- To understand the ocean, we need to understand how it formed and evolved through time.
- Because the world ocean is the largest feature of Earth's surface, scientists believe the origin of the ocean is linked to Earth's origin.

The Earth Was Formed of Material in Stars

- The origin of Earth is linked to that of the solar system and the galaxies.

Earth Was Formed of Material Made in Stars

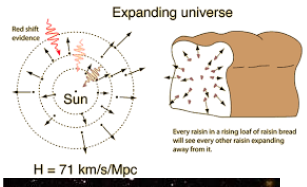
- The universe apparently had a beginning called the **big bang** that occurred ~1_____ billion years ago.
- All of the mass and energy of the universe was concentrated at a _____ _____at the beginning of space and time, the moment when the expansion of the universe began.
- We don't know what initiated the expansion, but it continues today and will probably continue for billions of years, perhaps forever.

The Big Bang Theory

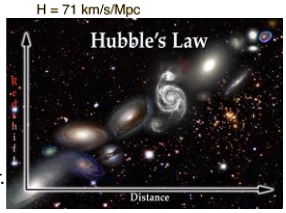
- The universe began with the **"big bang**" _____ billion years ago.
- All of the condensed matter in the universe was concentrated in _____and then exploded outward.
- The expansion away from the center continues today.
- As it expands, it cools; various atoms are formed.

Evidence for the theory?

- Hubble's Law:
- considered the first observational basis for the _____ _____and today serves as one of the pieces of evidence most often cited in support of the _____ _____ model.
- the more _____ ones moving ____ away from us, observed by their "___ shift" color.



H = 71 km/s/Mpc



Stars and Planets Are Contained within Galaxies

- What do stars have to do with the ocean?
- Most of the substance of Earth, its ocean, and all living things, was formed _____.
- Every chemical element _____was manufactured and released into space by stars.
- Our sun, like all normal stars, is powered by _____.

Galaxies, Stars, and Solar Systems

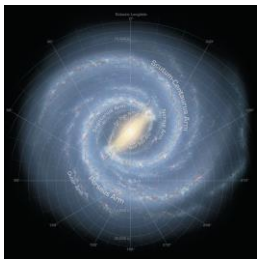
•A _____ is a huge rotating mass of gas, dust, stars, and planets held together by gravity.

•Our galaxy is called the _____.

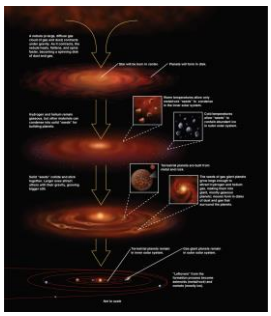
•**Stars** are mostly made of _____ & _____.

•_____- formation of planets by the _____ of smaller materials into larger ones.

•Our sun and its planets make up the _____.

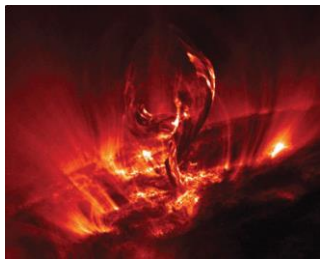


Stars Make Heavy Elements from Lighter Ones



The origin of a solar system in the spiral arm of a galaxy. Our sun and its family of planets were formed in this way about _____ years ago.

Stars and Planets Are Contained within Galaxies



A filament of hot gas erupts from the face of our sun. Like all normal stars, the sun is powered by nuclear fusion – the welding together of small atoms to make larger ones. The entire Earth could easily fit into this filament's outstretched arms.

The life of a star

A _____ (gas cloud) flattens and becomes a **Protostar** .

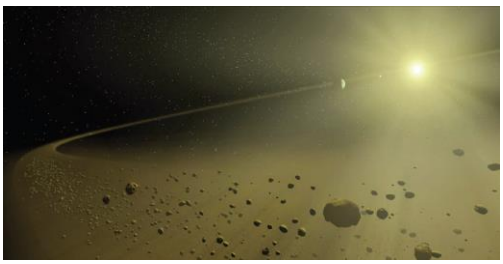
Further shrinkage leads to a **Star.**

Towards the end of a star's life it depletes its supply of _____, heats up and explodes in a **_____.**

This provides matter for new planets**.**

b

Solar Systems Form by _____



Planet-building in progress. Accretion of planets occurs when small particles clump into large masses.

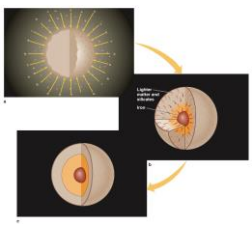
How old is the Earth?

- Our sun and its family of planets were formed in in the spiral arm of a galaxy about ____ _____billion years ago.
- The estimated age of Earth is about ____billion years (plus or minus a few hundred million!)

Earth Accumulated in Layers Sorted by Density

- _____ pulls the heavier materials to the center, lighter materials remain to the exterior.
- This is the idea behind _____ _____.
- The atmosphere formed from the _____ of Earth.
- Further _____ led to millions of years of _____.
- This led to the formation of the oceans.

Earth Accumulated in Layers Sorted by Density



(top) The planet grew by the aggregation of particles. Meteors and asteroids bombarded the surface, heating the new planet and adding to its growing mass. At the time, Earth was composed of a homogeneous mixture of materials.

(middle) Earth lost volume because of gravitational compression. High temperatures in the interior turned the inner Earth into a semisolid mass; dense iron (red drops) fell toward the center to form the core, while less dense silicates move outward. Friction generated by this movement heated Earth even more.

(bottom) The result of density stratification is evident in the formation of an inner and outer core, a mantle, and the crust.

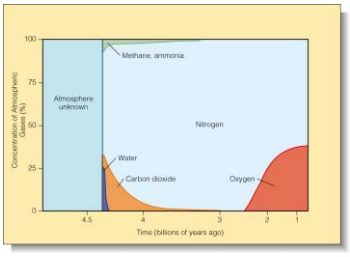
Earth Accumulated in Layers Sorted by Density

- How did water and water vapor form on early Earth?
- The Sun stripped away Earth's first atmosphere
- Gases, including water vapor, released by the process of out-gassing, replaced the first atmosphere.
- Water vapor in the atmosphere condensed into clouds.
- Eventually, the surface cooled enough for water to collect in basins.

Earth Accumulated in Layers Sorted by Density

Comets may have delivered some of Earth's surface water. Intense bombardment of the early Earth by large bodies – comets and asteroids – probably lasted until about 3.8 billion years ago.

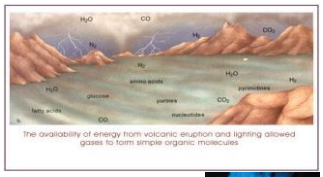
Earth Accumulated in Layers Sorted by Density

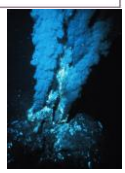


The early atmosphere was very different from the atmosphere today.

Where was the Origin of Life?

- Life began in the ocean from the building blocks of life.
- _____- the theory that life arose from simple _____ _____.
- Fossils found, suggest life began over ____billion years ago.

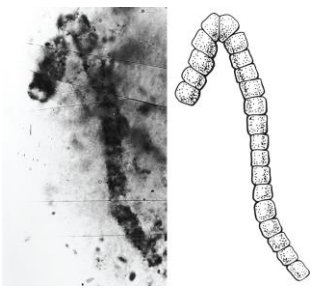




Life Probably Originated in the Ocean

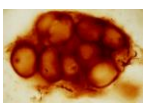
Fossil of a bacteria-like organism (with an artist's reconstruction) that photosynthesized and released oxygen into the atmosphere.

Among the oldest fossils ever discovered, this microscopic filament from northwestern Australia is about 3.5 billion years old.



Did life originate in the oceans?

- Fossil records indicate that life on Earth originated in the oceans.
- Fossils of _____ (photosynthetic bacteria) have been dated 3.5 billion years ago (that is 3,500,000,000 years!!).



- _____ fossil dated at _____ million years ago

Frank T. Cheshire of www.fossils.com.au

A Cambropaulas trilibite

http://bcs.whfreeman.com/thelifewire/content/chp03/0302001.html

Trilobites are remarkable, hard-shelled, segmented creatures that existed over 300 million years ago in the Earth's ancient seas. They went extinct before dinosaurs even came into existence…
http://www.trilobites.info/trilobite.htm

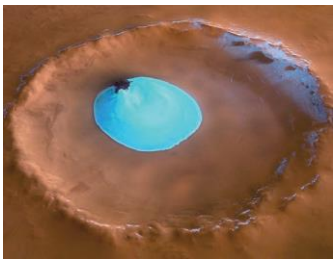
What Will Be the Future of Earth?

- How long can Earth exist?
- Our Sun will begin to die in 5 billion years.
- 6 billion years from now the sun will enter the red giant phase and will engulf the inner planets.
- At that time, Earth will probably be recycled into component atoms.
- See Figure 1.8 for a timeline of Earth.

Are There Other Ocean Worlds?

- Where have scientists found evidence of water?
- _____
  - The gravitational pull of Jupiter twists Europa, cracking the ice crust and warming the interior.
  - In some areas the ice has broken into large pieces that have shifted away from one another but fit together like a jigsaw puzzle.
  - This suggests the ice crust is lubricated by slush or water. A global ocean greater in volume than Earth's ocean may lie beneath the movable crust. It may also be salty - salinity has been detected by *Galileo's* magnetometers.

Are There Other Ocean Worlds?

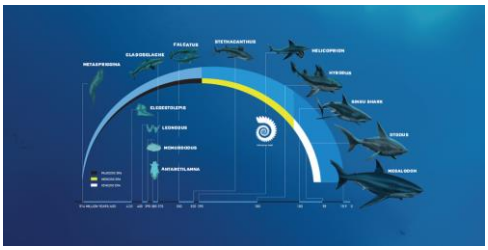


In 2005, Europe's Mars Express orbiter imaged a glacier in an unnamed crater in the vast plains of northern Mars. This 200 meter (656 foot) thick remnant of a larger ice sheet is shielded by the frosty shade of the crater walls.

Are There Other Ocean Worlds?

- Where have scientists found evidence of water?
- _____– Saturn's largest _____, may have an ocean of hydrocarbons.
- _____
  - Early in its history, Mars may have had a thick atmosphere of carbon-dioxide, much like the atmosphere of the early Earth.
  - An _____ may have existed on Mars about _____years ago.
  - Over the eons, rocks on the Martian surface absorbed the carbon dioxide and the atmosphere grew thin and cold and the ocean disappeared

How old are sharks?



Answer:_____