Origin of the Earth

Big Bang – 14 BYA

>Everything began very hot, and as it expanded, it cooled

Galaxy – huge rotating aggregation of stars, dust , and other debris held together by gravity

Stars-massive spheres of gases

>Our star (the sun) is a typical star

Solar System- Sun and family of planets

Condensation Theory – Sun Formation (and its parts too)

It all begins with a Nebula (dust cloud)

1) Collapsing or Accretion Stage: formation of protostar

>During this stage, the first materials to solidify were the substances with high boiling points, such as metals. Further out, lighter things condensed.

*Mercury is composed of mostly iron

*Outer planets are mostly gassy

(This is a form of Density Stratification)

2) Flattening Stage: As it begins to rotate

While these stages are occurring, the protostar will shrink and continue to accrete new material into its center. Eventually, the temperature will reach about 10 million degrees Celsius, and A STAR IS BORN.

>Once fusion occurs, the star becomes stable

Eventually, the Hydrogen becomes depleted, and Helium begins to condense and form heavier elements

Up to Fe in the biggest stars

Bigger stars, bigger elements

The bigger stars will Supernova (infalling stuff can no longer be compressed, and the whole thing expands violently). All of our heaviest elements were formed in this way by ancient novas and supernovas.

Our Solar System probably began to take shape ≈5 BYA, with an initial solar nebula composition of 75% H, 23% He, 2% other

The Earth began to develop a surface about 4.6 BYA (beginning the geologic time scale for the Earth).

Geologic Time Scale>>>Eon>>Era>>Period>>Epoch>>Age

Oldest Eon: **Hadean** (4.0 to 4.55 BYA)

>Density stratification (of the Earth this time)– densest in the center less dense outward

>The Earth separated into the layers of Crust, Mantle and Core (add the pretty drawing here)

>Early atmosphere formed from volcanic outgassing: H_20, CO_2, CH_4, and NH_3

>25 MY of rain, recondensing and more rain

The Earth's crust was kept thin due to heating caused by:
Internal heat from radioactive elements
heat of friction from gravity collapse
external heat from meteorite impacts

Next Eon: **Archaen Eon** (2.5 BYA to 4.0 BYA)
"age of bacteria", first life (NW Australia, Akilia Island)
First Life forms: All life unicellular
Oldest rocks found on the planet
Final stages of Earth cooling and formation of the crust
Radioactivity kept continental crust thin and unstable
Continued out gassing, outside impacts causing Earth to accumulate H_2O, which would become our ocean(s).

So, our oceans are thought to have come from two sources:
1) Inside Out: Volcanic Outgassing
2) Outside In: Comets and Meteors

Then, **Proterozoic Eon** (543 MYA to 2.5 BYA)
Oldest sedimentary rocks (~2.5 BYA)
Formation of ozone layer
cyanobacteria-- photosynthetic bacteria
First multicellular organisms (late 600-700MYA)
Jellyfish - 670 MYA
The "Prototypes of Life"

Phanerozoic Eon (543 MYA to Present): Everything else

Our Fate: In another 5 BY or so, our Hydrogen will run out, and our sun will swell to Red Giant size (swallowing the Earth-poof, that's all folks).

<u>Origin of Life</u>
It all begins with simple carbon compounds, which were more than likely transported to Earth via comets, meteors, asteroids, interstellar dust, etc.

But we need to *biosynthesize:* that is, create life from these simple building blocks.
1953: Miller and Urey-The Shock Treatment-they tried to do it, but no luck
2002: Bada and Lascano-Life began under the ice that was probably here due to the fact that our sun was probably a little dimmer earlier in its life.
>Supported to some degree from data obtained via the Martian studies
Could it be that it all began in hydrothermal vents?

Other Interesting Places
Europa and Ganymede: satellites of Jupiter, lots of ice
Mars: lots of evidence of water flow
Titan: Hydrocarbon Ocean?
Planets outside our Solar System: 100 by 2003, and now 2 per month