Rhiannon Rasmussen-Silverstein Astrobiology Class Notes

Monday September 27th, 2010

**Introduction to Astrobiology and the Solar System**

Astrobiology is an interdisciplinary science that covers biology, chemistry, geology, physics, and mathematics. Questions that astrobiology addresses include:

How small can life be and still be alive?

How do mats of bacteria fossilize?

What conditions can life be created and survive under?

Ranges from the search for extraterrestrial life and civilizations (SETI, the Fermi Paradox, the Drake Equation) to extraterrestrial life in any form (what is life, how does it form, what conditions does it need: habitable planets and extremophile life on Earth. Mars, Europa, Titan.)

Earthlike planets: spectra, extrasolar planets, planet formation models, stellar lifecycles, where do elements come from?

Life surviving dormant in interstellar space (for possibly millions of years until reactivated by water): cosmochemistry, from nanometers to light years.

**Our Solar System** is the input to all of our models and the system that we have the most access to/know the most about by far.

Definition of solar system: All of the material that is gravitationally bound to our Sun (the star Sol.) Other systems are known as extrasolar or stellar systems.

Star: A gaseous sphere that produces enough heat in its interior (by nuclear fusion) to withstand the force of gravity.

Planet: From a Greek word meaning “wanderer.” Originally, little points of light that moved through the constellations. Now, reasonably large objects that orbit the Sun (or a star).

The planets orbit the Sun on a plane (more or less) and all in the same direction. There are four interior terrestrial planets (Mercury, Earth, Venus, Mars) ringed by an asteroid belt, and then four Jovian (gas giant) planets (Jupiter, Saturn, Uranus, Neptune). Past the Jovian planets are the Kupier Belt Objects and comets.

Rejected definitions of planet: “a object in orbit around the sun sufficiently large enough that gravity shapes it into a spherical form” (too broad) and “gravitationally clears it space of other large objects” (would exclude Jupiter due to asteroids at its LaGrangean points)

Terrestrial Planets: Mercury, Venus, Earth (with the Moon, technically a binary planet), Mars. The Moon and Mercury are very similar – both “dead” world, no atmosphere, similar makeup. Earth and Venus are also very similar, but Venus lacks water and is completely inhospitiable (too close to the Sun- the “evil twin.”)

Mars is the only other *planet* in the Solar System on which there might be life. However, unlike the Earth, Mars lacks a magnetic field (currently; it used to have one).

Asteroids: An unassembled, rocky or metallic object in orbit around the Sun. There are several classes (elemental makeups) of asteroids, and a wide variety of sizes and shapes. Asteroids are survivors of the planetary formation/”sweep-up” process- unaccreted material. They are concentrated in three main places:

The Main Belt – between Mars and Jupiter

Near-Earth Asteroids (NEA) – planet-crossing, travelling through the system

Trojan Asteroids – in Jupiter’s orbit, LaGrangean points.