

LIFE IN THE UNIVERSE EXAM 2 REVIEW SHEET

FORMATION OF THE SOLAR SYSTEM

Jovian vs. Terrestrial Planets – characteristics, location, reasons for differences

Asteroid Belt, Kuiper Belt, Oort Cloud – what & where they are

Nebular model of the formation of the solar system – refractories, volatiles, “snow/frost line”

Asteroids as source of meteorites (stony, iron, stony-iron) - some stony ones contain organics

Kuiper Belt – beyond orbit of Neptune in flattened plane – source of some comets – Pluto is
actually a KBO (and not even the largest one at that!)

Oort Cloud – larger & spherical– source of some comets

Comets – ices (which sublime into gases), dust (CHON, silicates, etc.)

“Special” comets: Hale-Bopp, Tempel 1, Wild 2, (Shoemaker-Levy 9), Schwassmann-Wachmann 3

(Comet naming convention in next chapter’s notes)

IMPACTS & EXTINCTIONS

Early Heavy Bombardment Period

Impacts – the bigger they are, the less frequent

Tunguska – 1908 – multi megaton with death & destruction

SL9 & Jupiter – 1994 – our first opportunity to observe an impact in detail

1980 – Luis & Walter Alvarez link KT layer to impacting asteroid - Chicxulub Crater!

VENUS

Cannot see surface in visible – radar mapping

Lack of ability to see surface – led to “endless” speculation about its surface

Atmosphere – Mostly CO₂, very high pressure, clouds of sulfuric acid

Surface - ~750 K, evidence of impacts & volcanism, but not water

Greenhouse Effect – understand how it works

Why so different than Earth? – lack of liquid water prevented removal of CO₂ via Urey Reaction

MARS

Lowell's Canals & influence on our "understanding" of Mars (or lack thereof)

Seasonal changes caused by something – some thought vegetation

Mariner 4 (1964) – Wakeup Call – Mars looked as lifeless as the Moon. Mariner 6 & 7 ditto

Mariner 9 – first orbiter – canyons, water-carved channels, volcanoes

Viking 1 & 2 – Orbiters & Landers

Orbiters – more detailed mapping, more evidence of water-carved surface, polar caps

Lander – gas chromatograph mass spectrometer – "heavy molecule detector" – *negative*

Lander Biology Experiments – gas exchange, labeled release, pyrolytic release – *negative*

Water locked in polar caps, permafrost

Atmosphere – thin CO₂ – much lost to impact erosion

Early Mars was different – liquid water – atmosphere must have been more extensive in past

Post-Viking Projects

Mars Global Surveyor – first mega-mapper & first success since Viking 20 years earlier

Mars Pathfinder – first rover on Mars

Mars Odyssey – First detailed infrared mapper & spectrometer (minerals from orbit)

Mars Exploration Rovers – Spirit & Opportunity

Sites chosen based on water-related criteria (Gusev Crater & Meridiani Planum)

Imagers & spectrometers can do “mineralogy” – hematite, sulfates, some surface features

(rock shapes, “blueberries”) indicate liquid water present *in the past*

Mars Express – stereoscopic imaging

Mars Climate Orbiter – latest arrival – data deluge to follow!

JOVIAN PLANETS & MOONS

Planets

Jupiter & Saturn

Mostly H, He, with traces of water, ammonia, methane, rock

Atmospheres ideal for production of organics like that of Miller-Urey Experiment

Uranus & Neptune – less well-endowed with H, He – higher densities than J&S

Colored clouds require contaminants – organics?

Any possible organisms likely cannot survive convection to hot deep regions

Moons

Jupiter (Galileo spacecraft) – Io, Europa, Ganymede, Callisto – Last 3 may have liquid water;

Europa best candidate for a mission to look for life?

Saturn (Cassini spacecraft) – Enceladus has water geysers? Possibly better than Europa?

- Titan has atmosphere, “prebiotic chemistry lab”? Visited by Huygens probe