Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Notes: What makes a planet habitable?**

**Circumstellar Habitable Zone (CHZ)** “Goldilocks Zone”– is the region around a star within which planetary-mass objects with sufficient atmospheric pressure can support liquid water at their surfaces.

***Not too hot, not too cold (Temperature):***

 Liquid water is needed to exist on the surface of a planet.

 Too Close – Water boils off the surface

 Too far – Water is frozen, not allowing for molecules to mix and interact

 Our solar system has one planet in the Goldilocks Zone (0.9-1.2 AU)

 Earth (But Mars had liquid water at one time)

 Extended habitable zone (0.75-3.0 AU-extended to Ceres)

 Could Venus’s atmosphere be thinned to allow liquid water to exist?

***Not to big not too small (size)***

 Planets need to have sufficient size to hold onto its atmosphere, Mars lost most of its atmosphere. If planet is too big, gravity could limit the development of life.

***What type of star is it?***

 To determine the habitable zone you need to know total radiation a star emits.

 OBAFGKM- Our star is G-class

 Massive stars- hotter, blaze with radiation, zone is further out.

 Live for short time, not enough time for life to evolve

 Smaller stars- tighter belts than our sun, closer to the star

 Live for longer time, more chance for life to evolve.

 Ex. Kepler-62f, takes 267 days to complete an orbit

 Best stars to search are F-M class, O-A don’t live long enough



***Is that star stable?***

 Solar eruption from a star could bathe a planet in radiation.

 New stars/old stars- variations in radiation

 Middle-aged star – radiation tends to be constant

 Liquid water- absorbs high amount of radiation, could protect life underwater

***A planet’s chemistry?***

 A planet’s atmosphere will absorb a certain amount of energy from starlight and radiate the rest back out.

Atmosphere- Tends to trap heat, more CO2 or methane can increase the greenhouse effect and extent the zone.

 Energy that is trapped- difference between turquoise sea vs. erupting volcanoes

 Atmosphere- look for oxygen, water, carbon dioxide and methane (could indicate life).

**CHZ Controversy**- Other ways for liquid water -tidal heating, radioactive decay, or pressurized by other non-atmospheric means, and basic conditions of life in interstellar space on rogue planets or their moons. Non-water solvents to hypothetical life based on alternative biochemistries.

**Galactic Habitable Zone :** Area in a galaxy where life has the best chance of occurring.

 Too close to the center, star density increases, greater chance of being taken out by a supernova explosion.

 Too far out, less stars to generate the heavier elements necessary for planets and life to form.



<http://astro.unl.edu/naap/habitablezones/animations/stellarHabitableZone.html>

<http://www.post-gazette.com/opinion/editorials/2013/11/07/Planet-Goldilocks/stories/201311070205>

Article on planets in the goldilocks zone…short and good.