



HW#6 due tonight.

Next time Presentations:

**Rebecca Marcotte & Ryan Smoot
Trent Wright**

Music: *Earthbound*- Darin Drda

$$n_e = n_p \times f_s$$

n_p : number of planets suitable for life per planetary system

f_s : fraction of stars whose properties are suitable for life to develop on one of its planets

We can list 5 situations that will have an effect on f_s .



<http://mike.cecs.esub.edu/~kjlivio/Wallpapers/Planets%2001.jpg>

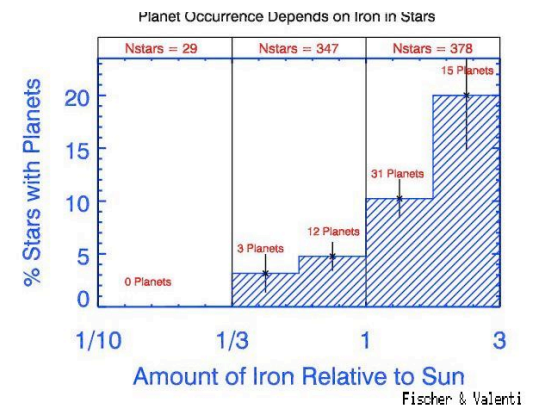


- **Mike McCarthy & Tim Nossem:** [Project Daedalus](#)
- **Max Schoenoff & Seth Kelter:** [The Anthropic Principle](#)

Differences of Stars to Life



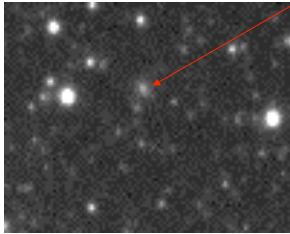
1. **Metal rich stars.** Stars with heavy elements, probably more likely to have planets. Suggested in the current planet searches. About 90% of all stars have metals.



Differences of Stars to Life



2. **Main sequence stars.** Need the brightness to stay as constant as possible. Otherwise the temperature changes dramatically on the planets. This is 99% of all stars.

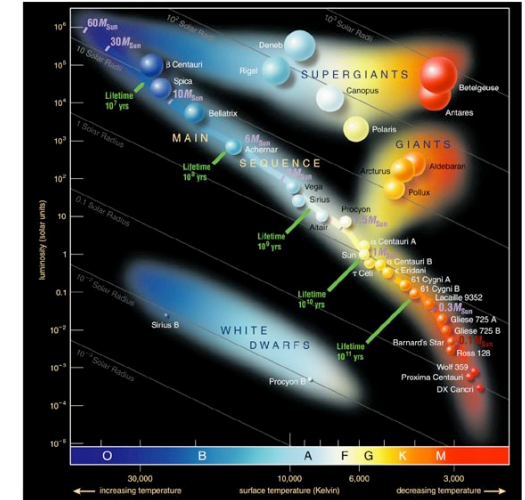


Differences of Stars to Life



3. **Length of time on the main sequence.**

We needed temperature stability for 5 billion years to get intelligence on Earth. This rules out stars more massive than 1.25 solar masses! 90% of all stars are less massive than that.

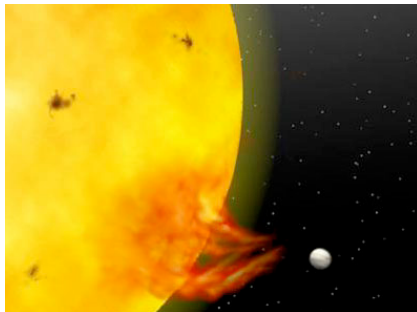


<http://mjbs.org/hr.jpg>

Differences of Stars to Life



4. **Minimum mass of star.** If ice exists close to the star, that would imply the formation of Jupiter-like planets not Earth-like planets. And, any life bearing planet would have to be closer to the star— and closer to stellar effects (e.g. tidal locking and more flares from low mass stars). That limits us to a minimum of 0.5 solar masses. 25% of all stars are more massive than that.

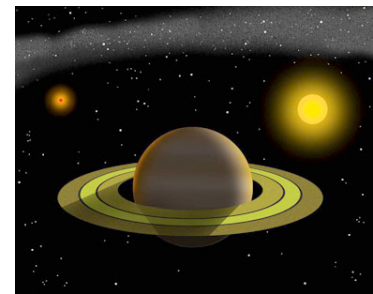


<http://spaceflightnow.com/news/n0401/19planet/planet.jpg>

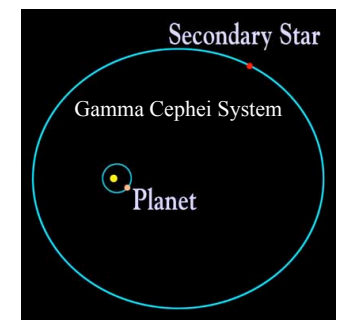
Differences of Stars to Life



5. **Binarity.** Planets may form. But they may have odd orbits unless the 2 stars are far enough apart or the planet orbits the pair. Only 30% of all stars are single stars. 50% of all stars are single stars or wide binary stars.



<http://spaceflightnow.com/news/n0210/11planet/>



Adding it all up



<i>Stellar Requirement</i>	<i>Mass Limit</i>	<i>Fraction OK</i>	<i>Cumulative Fraction</i>
✓ Heavy Elements	...	0.9	0.9
✓ Main Sequence	...	0.99	0.891
Main Sequence Lifetime	$M < 1.25 M_{\text{sun}}$	0.90	
Synchronous Rotation/ Flares	$M > 0.5 M_{\text{Sun}}$	0.25	
Not a Binary	...	0.30	0.267
✓ Wide Binary Separation	...	0.50	

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Not a Binary	...	0.30	
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f_s : fraction of stars that life can exist around



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Not a Binary	...	0.30	
Wide Binary Separation	...	0.50	

Value can range from ~ 0.06 to ?