

Astronomy 330



This class (Lecture 19):
Cultural Evolution

Jack Holzman
Steven Kallal

Next Class:
Evolution of World View
Jared Evans
Carol Regalbuto

Music: *Space Oddity* – David Bowie

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HW #6



- Yi: http://www.illuminati-news.com/ufos-and-aliens/html/area51_the_ufo_cover_up.htm
- Cheryl:
<http://www.nidsci.org/pdf/rullan.pdf>
- Allison:
<http://www.bltresearch.com/>

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Presentations



- **Jack Holzman** : [Inventing Science Fiction](#)
- **Steven Kallal** : [Life without the Sun](#)

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Outline



- What is f_i ?
- From intelligence to communication
- Will a civilization develop that has the appropriate **technology** and **worldview**?
- Requires knowledge of quantum mechanics and astronomy.

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Drake Equation



Frank Drake

That's 2.9 life systems/decade



$$N = R_* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

# of advanced civilizations we can contact in our Galaxy today	Star formation rate	Fraction of stars with planets	# of Earthlike planets per system	Fraction on which life arises	Fraction that evolve intelligence	Fraction that communicate	Lifetime of advanced civilizations
	19 stars/yr	0.4 systems/star	1.25 x 0.07 = 0.0875 planets/system	0.44 life/planet	intel./life	comm./intel.	yrs/comm.

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f_i Considerations



- Complexity leads to intelligence, but complexity seems to require a benign environment. Harsher environments tend to have simpler organisms.
- Perhaps life may exist on harsh planets, but more intelligent life?

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f_i Considerations



- Remember, human intelligence took 4.5 billion years.
- Systems very near the center of the galaxy are more likely to be hit with supernovae event in that time.
- 4.5 Byrs is about half the age of our Galaxy. Were we fast or slow? Fast: severely limits ETs. Slow: there can be multiple ETs.

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f_i Considerations



- Intelligent life is a very recent development on Earth with the emergence of the primates, hominids, and H. sapiens.
- Everyone agrees that this particular evolution will not occur on other planets.
- But, will the characteristics of H. sapiens be common to human-like intelligence?
 - Manipulative organs– hands
 - Walking upright?
 - Is tool use and larger brains associated with walking upright?
 - Pair bonding?
 - Human brains quadruple in size after birth compared to other primates which double.

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f_i Considerations



- How unique is our intelligence?
- Teaching sign language to chimps and gorillas have shown they are more intelligent than we thought.
- Don't forget Alex the parrot!



Alex (1976 - September 6, 2007)

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Dr. Patterson persuades Koko not to smoke. "Kitten hates it, Koko!"

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f_i Considerations



- Whales and dolphins are speculated to be of high intelligence.
- With all of this in hand, we are ready to make the next estimate in the Drake equation.
- This term is only intelligent life that can communicate abstract thought to each other, not technological able to communicate.



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What is f_i



- What is the fraction of life that forms human or better intelligence in less than about 4.5 billion years?
- If you think that it always does, then $f_i = 100\%$
- If you think that it is a statistical fluke or required supernatural invention then you could use 1/billion or $10^{-7}\%$.
- Anywhere in between is fair game.

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