



Extraterrestrial Life

THE FLAKE EQUATION:

$$P = W_P \times (C_R + M_z) \times T_K \times F_o \times F_i \times D_t \times A_w \approx 100,000$$

FRACTION OF PEOPLE WHO IMAGINE AN ALIEN ENCOUNTER BECAUSE THEY'RE CRAZY OR WANT TO FEEL SPECIAL (1,000,000,000)
 PROBABILITY THAT THEY'LL TELL SOMEONE (1/10,000)
 AVERAGE NUMBER OF PEOPLE EACH FRIEND TELLS THIS 'FIRSTHAND' ACCOUNT (1/10)
 FRACTION OF PEOPLE WITH THE MEANS AND MOTIVATION TO SHARE THE STORY WITH A WIDER AUDIENCE (BLOGS, FORUMS, REPORTERS) (1/100)
 FRACTION OF PEOPLE WHO MISINTERPRET A PHYSICAL OR PSYCHOLOGICAL EXPERIENCE AS AN ALIEN SIGHTING (1/10,000)
 AVERAGE NUMBER OF PEOPLE THEY TELL (10)
 PROBABILITY THAT ANY DETAILS NOT FITTING THE NARRATIVE WILL BE REVISED OR FORGOTTEN IN RETELLING (1/100)

EVEN WITH CONSERVATIVE GUESSES FOR THE VALUES OF THE VARIABLES, THIS SUGGESTS THERE MUST BE A HUGE NUMBER OF CREDIBLE- SOUNDING ALIEN SIGHTINGS OUT THERE, AVAILABLE TO ANYONE WHO WANTS TO BELIEVE!

This class (Lecture 23):

Evolution of Culture
Brandon Murchison

Next Class:

Evolution of Culture
Kevin Brenner
Connor Bailey

Music: E.T. – Katy Perry

Article Forum open— selection due April 21st

HW #2



Quinn Calvert

http://www.bibliotecapleyades.net/vida_alien/alien_contact04.htm

Frank Drake and Carl Sagan used the Arecibo telescope to send a message, and a reply came in the form of a "crop circle"

Zachary Brewer

<http://www.sherryshriner.com/sherry/reality.htm>

author of this website is claiming that all humans are secretly controlled by aliens. "Trust me. I know I'm right."

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Drake Equation

That's 9 life systems/year

Frank Drake



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

# 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
	30 stars/yr	0.8 systems/star	4 x 0.47 = 1.88 planets/system	0.2 life/planet	intel./life	comm./intel.	yrs/comm.

f_i Considerations



Benign Environment?

Diversity promotes complexity

Complexity promotes intelligence

Harsh environments dampen
development of intelligence?

Where do we
come from?



f_i Considerations



Long, stable environment?

We took ~4.5 billion years

Fast? **Slow?**

This is about half the age of
the Milky Way

Fast: Less ET life.

Slow: More ET life.



f_i Considerations



Intelligent life is **very recent**
development on **Earth**

emergence of primates and hominins

Our path **will not** occur elsewhere

Likely human traits common for
human-like intelligence?

manipulative organs (hands)

bipedal

→ tool use

→ larger brains

pair bonding

Note: Our brains **quadruple** in size from birth.
Other primates only **double**

f_i Considerations



How unique is our intelligence?



Can teach sign language to chimpanzees
Gorillas have shown higher intelligence than expected

f_i Considerations



How unique is our intelligence?



Alex (1976 - September 6, 2007)

1:24 Alex
1:33 Koko

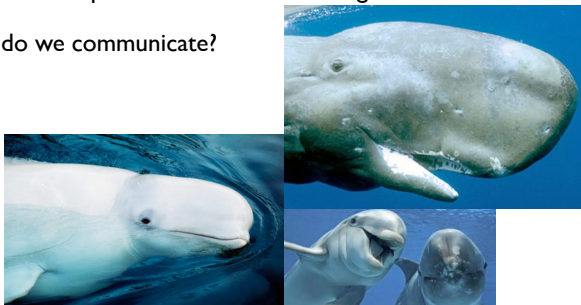
f_i Considerations



How unique is our intelligence?

Whales & Dolphins believed to be intelligent.

How do we communicate?



Whales and dolphins are speculated to be of high intelligence, but communicating is difficult.
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.

What is f_i



Fraction of intelligent life that can communicate abstract thoughts. No technology required now.



On Earth, this took about 4.5 billion years.

$f_i = 1$ if this will always occur

$f_i = 10^{-9}$ for a statistical fluke (or supernatural invention)

Drake Equation

That's 2.7 intelligent systems/year

Frank Drake



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

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
commu-
nicate

Lifetime of
advanced
civilizations

30
stars/
yr

0.8
systems/
star

4×0.47
 $= 1.88$
planets/
system

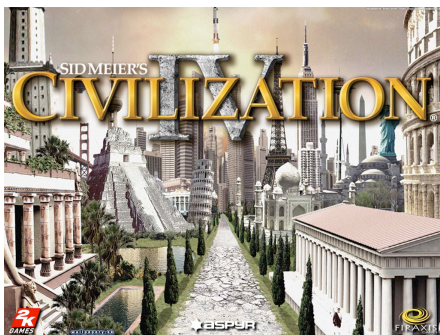
0.2
life/
planet

0.3
intel./
life

comm./
intel.

yrs/
comm.

Changing Gears





Backdrop



Homo Sapiens originated in *Africa* and spread out

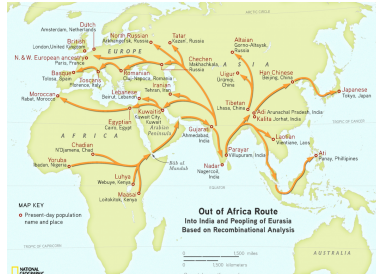
Common gene pool

Genetic drift & selection
Local Environments

Natural differences

Differences have little to do with race

The greatest genetic and linguistic variations are in Africa



genetic studies show
this is a meaningless
concept

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Cultural Evolution



Once *Homo Sapiens* had spread globally, new changes are driven primarily via *cultural* not *biological* evolution

Homo Sapiens into modern form about 100 kya

Modern behavior did not appear until about 40 kya

No significant biological evolution during this time.



El Castillo Cave: ~ 40 kya

Your brain is the same!

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Cultural Evolution



Cultural Evolution: *Hunter-Gathers* to *Twitter Nuts*



This transformation was fast



Is this needed for ET life?

Why would ET life communicate with us?

Need capability (technology)

Need interest (worldview)



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