Astronomy 330:

Extraterrestrial Life

TR 1300-1420
134 Astronomy Building

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Office Hours:
TR: 10:30-11:30 a.m.
or by appointment or email

This Class (Lecture 1):

Introductions

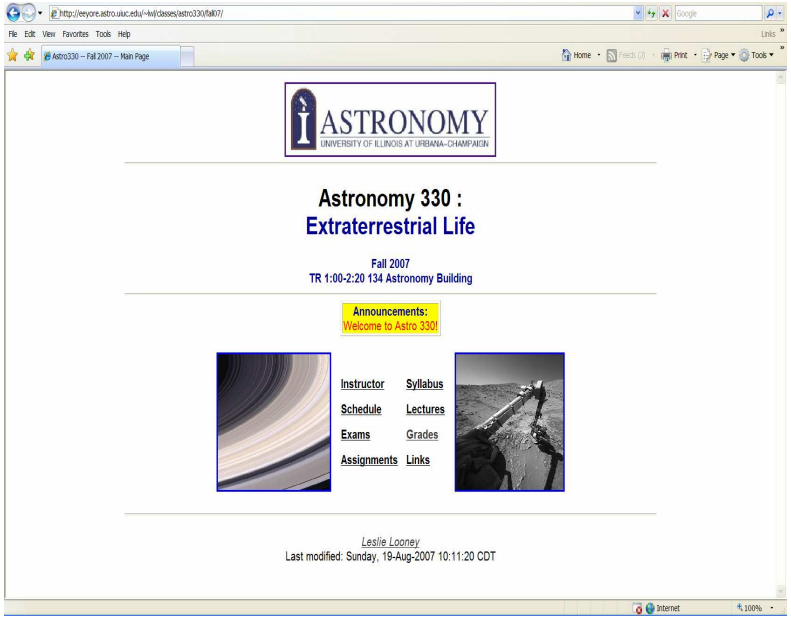
Next Class:

Size Scales & Cosmology

http://eeyore.astro.uiuc.edu/~lwl/classes/astro330/fall07/

Music: *Pets* – Porno for Pyros

Web Page



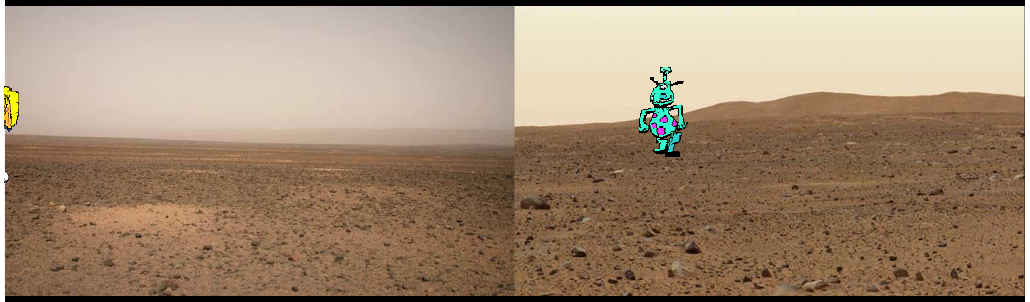
Outline

- Class Introductions
- Introduction of Extraterrestrial Life
- Class Goals
- Syllabus

Welcome to Astro 330

- It's a great time to take this course!
- In 1995, we knew of 9 planets. Now, in 2007, we know of over 200 planets around numerous suns.
- In the near future, NASA missions may find life on Titan or Europa, evidence of life of Mars, or image Earth-like planets around nearby stars.
- In this course, you will get an understanding of arguably the biggest astronomical question of all time:
  Are we alone?
- We will address this question with scientific methods, but also perhaps with some philosophy and science fiction thrown in too.

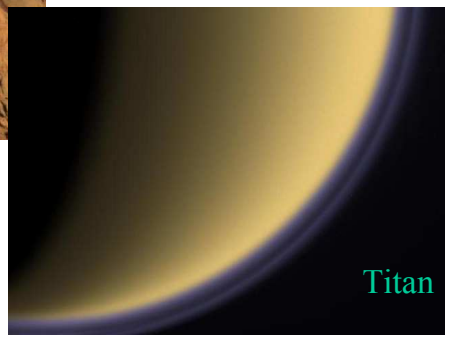
Which is Mars? Which is Earth?



Is There Anyone Out There?

Could there be life in a place like this?

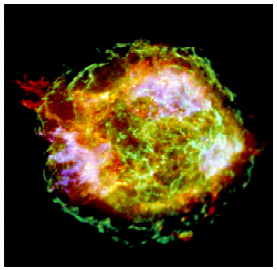
Or perhaps a place like this?



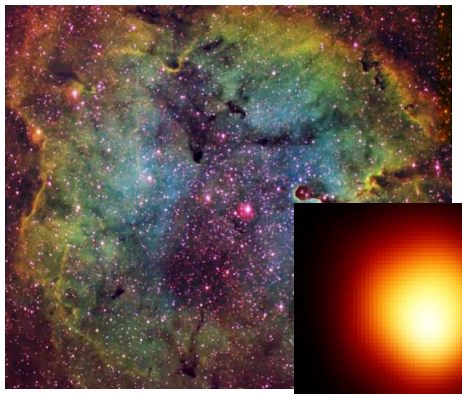
Should we be *AFRAID*?

- Will giant asteroids doom the earth?
- Will gamma-rays from an exploding star irradiate us?

- Will we be swallowed by a black hole?

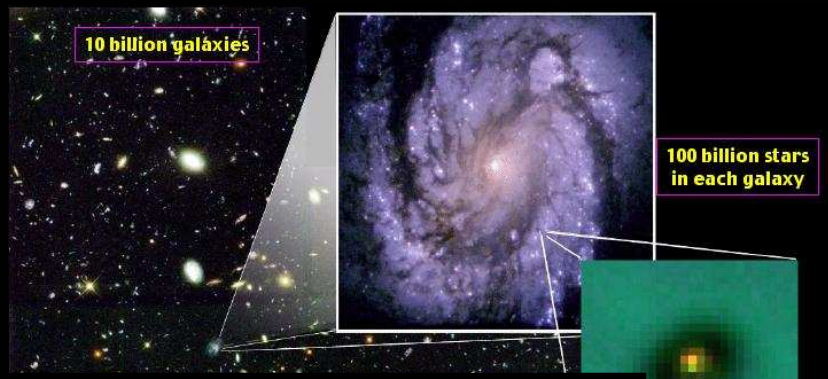


Where Do We Come From?



- How can clouds of gas and dust form stars, worlds - and us?
- … and where are we going?

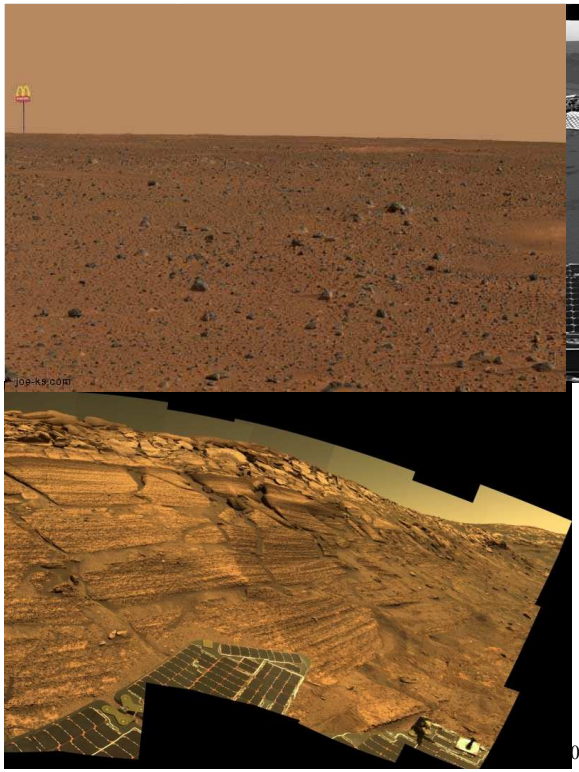
The Universe: Some Facts to Help you Live in it



"Tell a man that there are 100 billion stars in our Galaxy and he'll believe you. Tell him a bench has wet paint and he has to touch it."

http://astron.berkeley.edu/~kalas/disksite/learnframes.htm

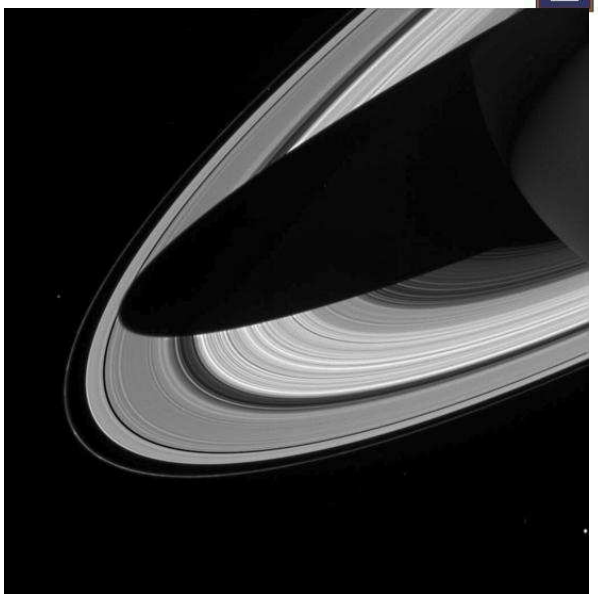
Roving on Mars



Roving on Mars:
Spirit and Opportunity find evidence of water

http://antwrp.gsfc.nasa.gov/apod/image/0403/emptynest_opportunity_big.jpg

Cassini Explores the Ring World

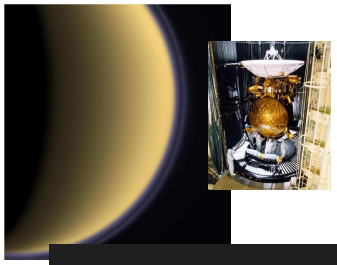


http://saturn.jpl.nasa.gov/cgi-bin/gs2.cgi?path=../multimedia/images/rings/images/PIA05417.jpg&type=image

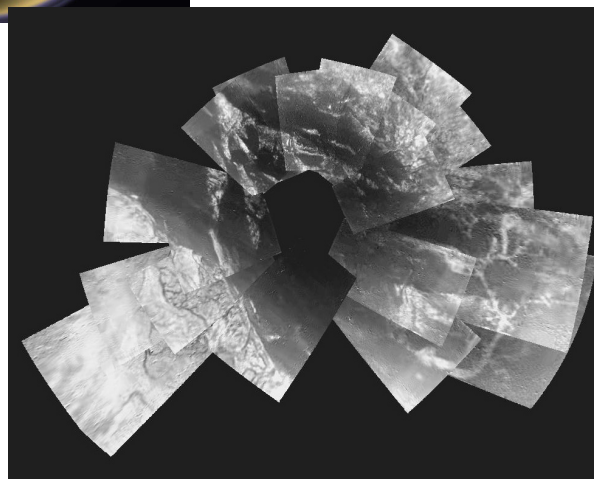
Cassini:
Life on Titan?

The Huygens probe touched down on Jan 14th 2005.

http://antwrp.gsfc.nasa.gov/apod/ap041220.html

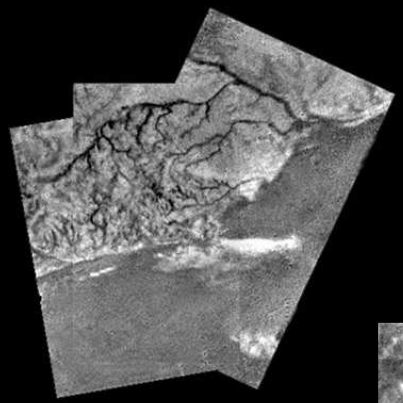


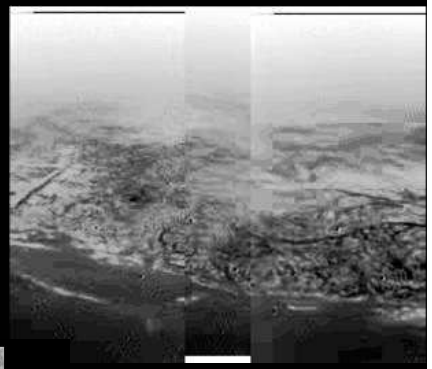
Cassini:
Images

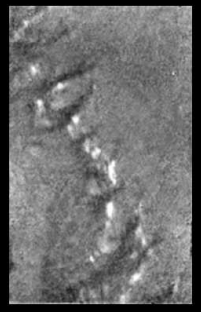


http://www.esa.int/SPECIALS/Cassini-Huygens/SEMC8Q71Y3E_0.html

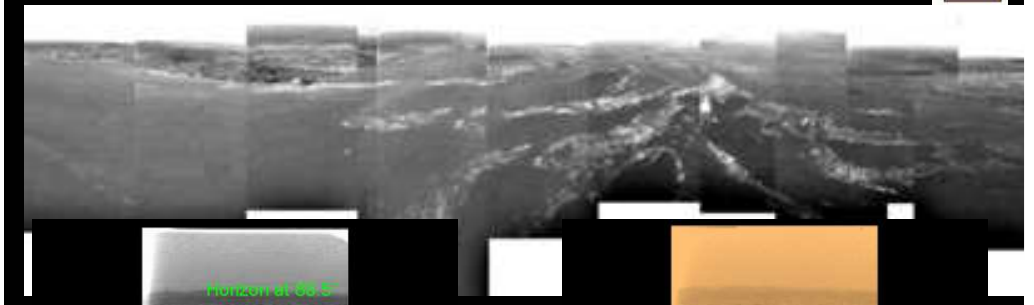
Mapping Titan

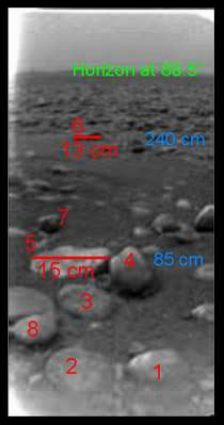






Mapping Titan





Astro 330: Sex in Space?

One of the neat aspects of this course is that we can address this cool subject with an open mind and scientific rigor.

Don't be scared of science. It is really just common sense and logic. Although not all scientist have those in any larger amounts than non-scientists.

Astro 230

In this class, we shall confront some of the ideas concerning the formation of life on this planet (origination of life), so we can apply it to extraterrestrial life. Remember, we only have a sample of one in the entire Universe!

BUT, we will not condemn anyone's beliefs (God, Gods, UFOs, etc.). So, we will examine life in the scientific sense.

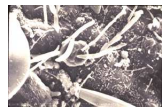
Life

- This examination may bring us to some very depressing conclusions
- What is life?
  - Just sunlight plus geochemistry?
- If we decide that intelligent life is common in the Universe, how will that make us feel?

http://www.ericweisstein.com/images/meaning-of-life.jpg

Class Facts

- Today, there is **no** evidence for ET life.
- And we don't even know how life happened on Earth.
- Earth's early geologic record (first 1/2 billion years) is GONE
  - Clues to early life formation are gone
  - Earth is about 5 billion years old



- But, we do have evidence for very early microbial life on Earth (about 3.5-4 billion yrs old).
- First multi-celled life about 1 billion years ago.

Class Facts

- Humans are NEW on Earth (about 5 Myrs ago)
- Keep in mind that faith is not science. Faith is fine, but we have to keep in mind that in this class, "I just KNOW it!" is not an acceptable answer.

- **We are investigating big questions scientifically.**

Be Careful of Science

- Sometimes people make big claims in the name of science.
  - Ancient world thought that the Earth was the center of the Universe.
  - Percival Lowell (~1913) thought he saw canals on Mars (optical illusion).
  - Eddington (~1940) tried to make the fine structure constant a rational number.
- We need to learn from these mistakes.

But Learn to Speculate

- The French Academy of Sciences once pronounced that meteorites were nonsense
  - EVIDENCE and REASON can produce just as many thrills as dogmatic faith-based belief
  - They were eventually just shown a a meteorite!
- The professors of Astronomy in the early 1600s, were probably teaching a geocentric solar system.
  - The Catholic church only forgave Galileo about his heliocentric solar system ideas in 1992!

Life on Earth

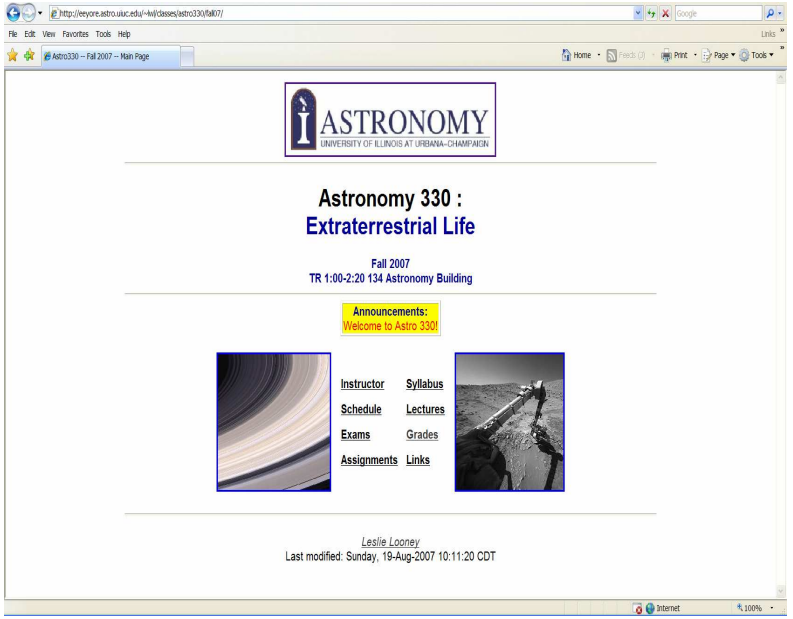
- A miracle?
- An accident?
- More-or-less inevitable given the laws of nature and chemistry with suitable conditions?
- **Principle of Mediocrity**: There's nothing terribly special about the astronomical, geological, physical and chemical circumstances on Earth; most likely nothing special about biology either

Major Premise of Course

The Universe is ***homogenous*** and ***isotropic***.

- The laws of nature are the same everywhere.
- So we can apply the lessons learned from life on Earth to extrapolate about life in space.
- Life probably should have repeated elsewhere, given the same circumstances.
- The Universe is freaky big!

Web Page



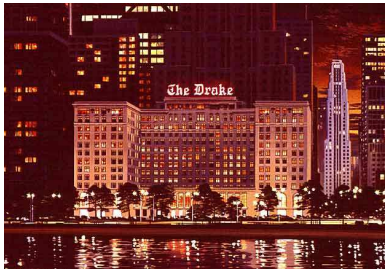
Course Goals

After this course one should be able to:

- Understand our current scientific view of life in the universe.
- Conceptualize the factors involved with the ultimate question.
- Propose what the future may hold for the field.
- Make informed decisions about science policies.
- Hold any "discovery" of extraterrestrial life to a personal scientific standard of proof.

Course Goals

- This class is designed to be fun.
- This course will revolve around the "Drake Equation".
- The Drake Equation *looks* like an attempt to calculate how many intelligent extraterrestrial civilizations exist with whom we *might* be able to communicate in our Galaxy.



- However, the equation actually helps us understand our ignorance about the subject and illuminates the various topics and issues worth thinking about when we ask the question, *"Are we alone?"*, with an open mind.

Course Outline

Topics:

- We will review some basic astronomy
- Planetary and solar system astronomy
- Biology and biochemistry
- Geology
- Paleontology
- Evolution
- History and the future of mankind on Earth
- Interstellar communication and travel, including UFO's.
- Take part of the journey, and let's enjoy the ride.

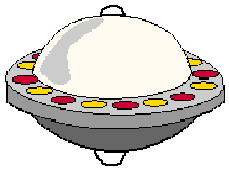
Aliens?

We have been bombarded by aliens in the media– all types.

No surprise that **close to half** of all Americans believe in aliens.

Have we been visited by ETs?

"Extraordinary Claims Require Extraordinary Evidence"

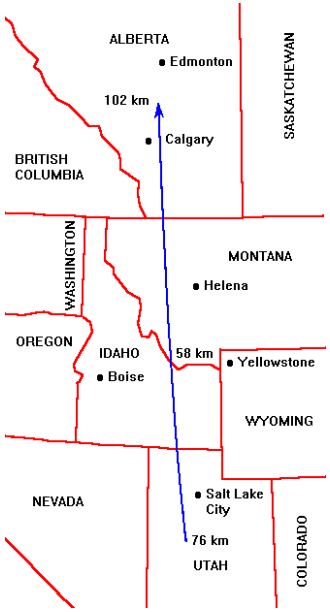


An Example: Meteor 1972

http://www.uwgb.edu/dutchs/

Yikes, a Near Miss

- A bus sized object entered atmosphere over Utah and exited over Canada
- Velocity of 15 km/sec
- Missed Earth by 58 km



But…

- Event was completely unexpected
- Crossed relatively sparsely-inhabited region
- Only visible for a *total* of 101 seconds
- Visible for no more than 30 seconds at any one spot

But…

- Nonetheless, we have dozens of clear photographs of this event
- Still, we have no comparable images of UFOs.
- And today digital cameras and camera phones should make unusual events even more seen.

Grades

Requirement	Percentage of Grade		Points
Class Participation (will drop 1 or 2)		8%	80
Presentation Synopsis		2%	20
Homework Assignments	10 out of 11	10%	100
Presentation		15%	150
Research Paper Draft		5%	50
Research Paper		10%	100
Midterm		20%	200
Final		30%	300
Total		**100%**	**1000**

Questions

1. Why did ***you*** take this course?
2. What are ***you*** interested in learning in this course?
3. Do ***you*** think extraterrestrial life exists?
4. How long ago do ***you*** think life on Earth occurred?
5. Do **you** think Pluto should be considered a planet or not, and does the question matter?

Oral Presentation

- Most students in this class come with a topic that is of interest to them.
- Student will build this interest into a research project. Logically, if one student is interested then other students will likely be interested in the topic too.
- This forum provides the opportunity to investigate issues that may not be explored or not explored in depth during class.

Oral Presentation Questions

1. How relevant is the topic to the search for extraterrestrial life or this class?
2. How interesting is the topic for the general class audience?
3. Rate the extent of the speakers knowledge on the topic?
4. Rate the quality of the overall presentation?
5. Does the research use enough solid scientific basis?

These questions are rated 1-10 out of 10 scale.

Presentation Examples

- Life without a planet
- Faces and pyramids on Mars
- Aliens in South Park: Satire, Silly, or Scientific
- Supernovae: Adding Heavy Elements to the Mix
- Panspermia: Life from the Stars
- Human Colonization of other Planets/Asteroids
- Terraforming Mars
- How to get to Mars
- Self-Replicating Space Probes: Explore the Galaxy on the Cheap.

Presentation Synopsis

Due on Sept 6th, the presentation synopsis.

- 1-2 paragraphs: describing the main idea behind the presentation
- 1-2 paragraphs: addressing the 5 questions directly
- A list of 5 or more references for the presentation / research paper. This is necessary to help you avoid some of the more questionable sources.

Research Paper

- You will be writing a research paper on the presentation topic.
- This paper must be 8 to 10 pages double-spaced 12-point font, not including references. A draft of the paper is due as listed on the website. It may be before your presentation.
- The final paper is due as listed for you on the website. Most points are usually lost for bad referencing or missing bibliography.

For examples on WWW reference, see the syllabus or contact me. Remember that I have access to google as much as you do. Academic honesty is vital!

Homework Assignments

- There will be 11 homework assignments given throughout the course (1 is dropped).
- These will be simple answer or short essay, and are meant to sharpen your thinking on the material covered in lecture, and to help prepare you for the exams.
- Homework is due at the beginning of class or at the announced time, after which the answers will be made available. **No late homework will be accepted.**

"Is the homework fresh?"

http://www.sas.upenn.edu/popcult/cartoons/anthropo/homework/homework.JPG

Yuck-- Exams

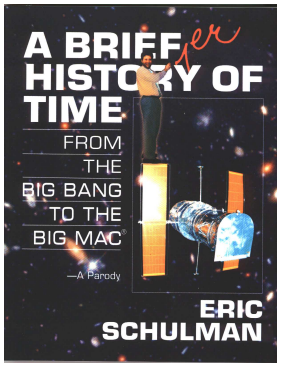
- There will be one midterm exam and a comprehensive final exam for this course. The exams will consist of short answer essay and multiple choice questions. Dates are as follows.

- **Hour Midterm Exam: In class Thursday, Oct 11th**
- **Final Exam: 1:30-4:30 pm Wednesday, Dec 12th**

Book 'em Danno

RECOMMENDED BOOK: *Extraterrestrial Life*, 5th edition, 2003 by Neal Evans

REQUIRED READING: A Briefer History of Time by Eric Schulman
http://members.bellatlantic.net/~vze3fs8i/bhtes/index.html



Drake Equation

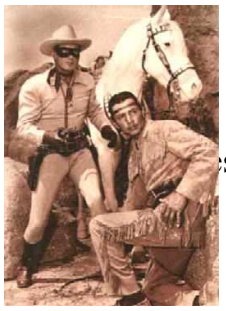
Frank Drake

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

- N: # of advanced civilizations we can contact in our Galaxy
- R_*: Rate of star formation
- f_p: Fraction of stars with planets
- n_e: # of Earthlike planets per system
- f_l: Fraction on which life arises
- f_i: Fraction that evolve intelligence
- f_c: Fraction that communicate
- L: Lifetime of advanced civilizations

Perhaps we shouldn't look for Aliens?

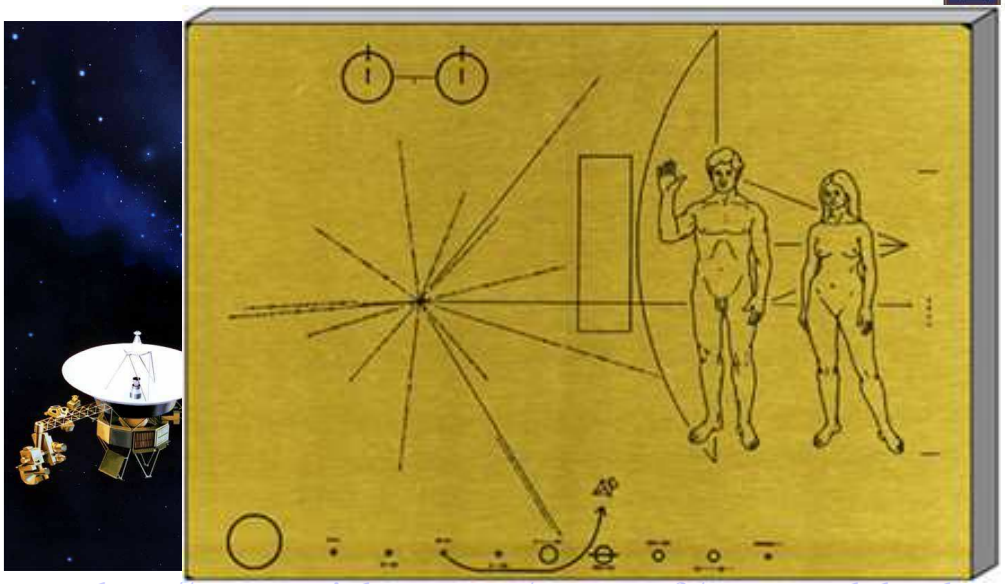
- But we've been broadcasting our presence on Earth for the last 65 years now!
- At the present time, the Earth is brighter in radio than the Sun.
- Is anyone out there watching TV right now?
- Also there have been intentional



SETI

- Communications via radio signal
  - 18–21 cm wavelength range good for interstellar communication
- SETI search is ongoing
  - SETI
  - **http://www.seti.org**
- If they exist, should we contact them?

Voyager– the message is out.



http://voyager.jpl.nasa.gov/spacecraft/sceneearth.html