

Astronomy 330:
Extraterrestrial Life

TR 1230-1350
Astronomy 134



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Office Hours:

W: 11:00-11:59 a.m.

or by appointment or email

This Class (Lecture 1):

Introductions

Next Class:

Size Scales & Cosmology

<http://eeyore.astro.uiuc.edu/~lwl/classes/astro330h/spring10/>

Music: *Pets* – Porno for Pyros

Outline



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

Class Web Page



Astronomy 330 :
Extraterrestrial Life

Spring 2010
TR 10:00-10:50
Noyes Laboratory 217

Announcements:
Welcome to ET life!

Instructor	Syllabus
Schedule	Lectures
Exams	Grades
Homeworks	Links

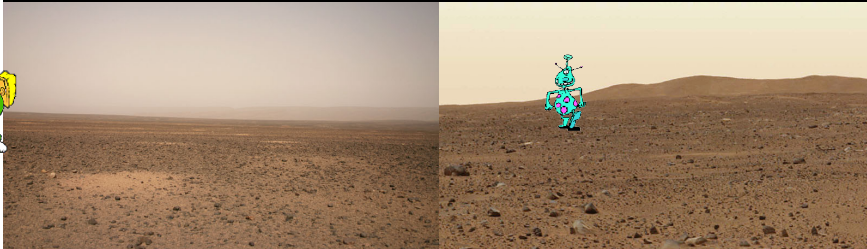
Leslie Looney
Last modified: Wednesday, 06-Jan-2010 13:56:55 CST

<http://eeyore.astro.uiuc.edu/~lwl/classes/astro330h/spring10/>

Welcome to Astro 330

- It's a great time to take this course!
- In 1995, we knew of 9 planets around 1 sun. Now, Jan. 2010, we know of 300 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, science fiction, and fun thrown in too.

Which is Mars? Which is Earth?



A

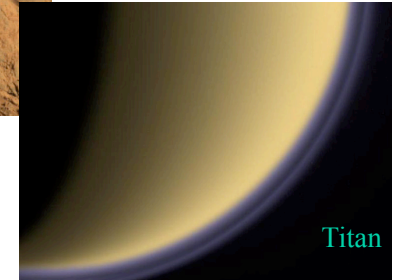
B

Is There Anyone Out There?

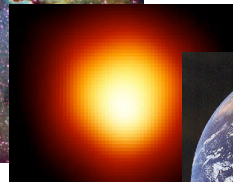
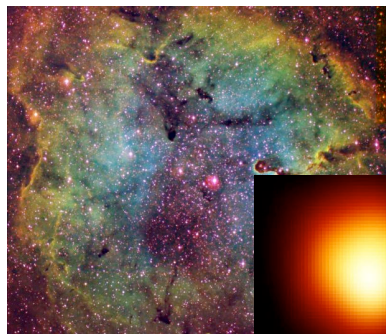


Could there be life in a place like this?

Or perhaps a place like this?



Where Do We Come From?



- How can clouds of gas and dust form stars, worlds - and us?

- ... and where are we going?

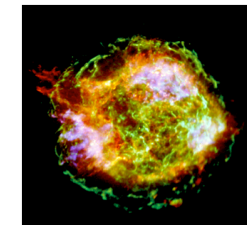
Should we be *AFRAID*?



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



- Will we be swallowed by a black hole?



The Universe: Some Facts to Help you Live in it

10 billion galaxies

100 billion stars in each galaxy

How many planets?

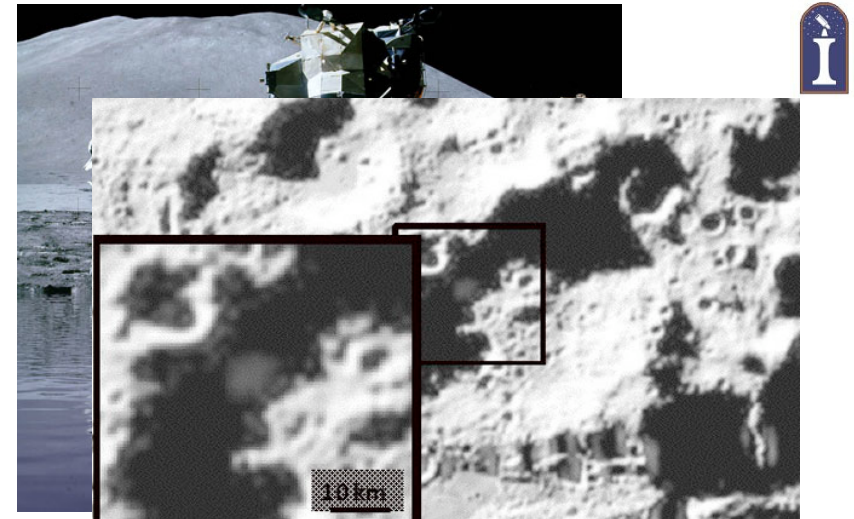
<http://astron.berkeley.edu/~kalas/disksite/learnframes.htm>

Tell someone that there are 100 billion stars in our Galaxy and they will believe you. Tell someone a bench has wet paint and they will have to touch it.

Roving on Mars: Spirit and Opportunity find evidence of water

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

Roving on Mars

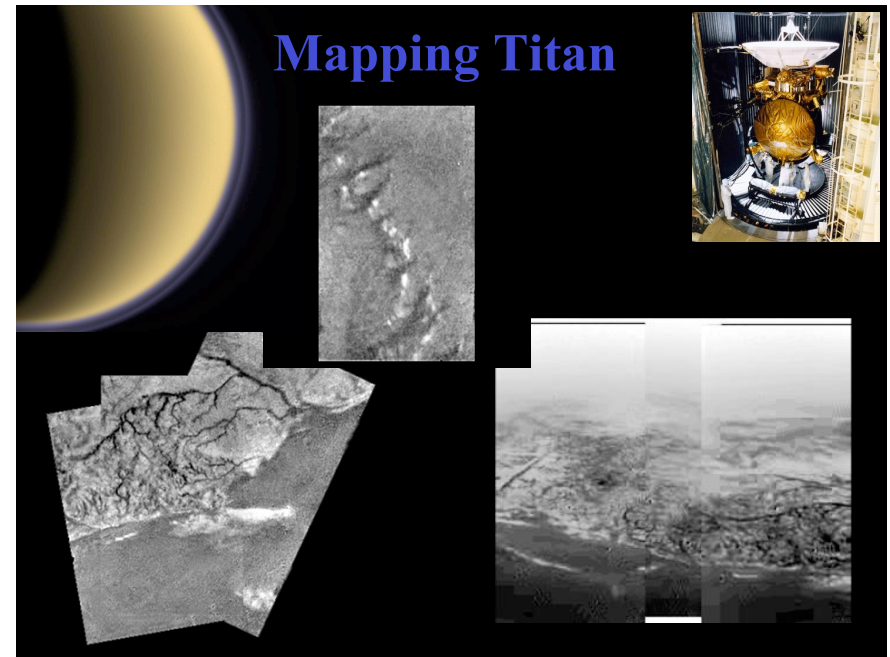
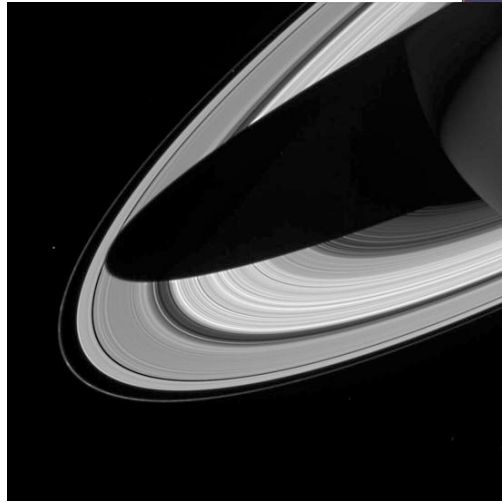


Water on the Moon!



Cassini Explores the Ring World

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



Mapping Titan

Looking for Earth-Like Planets: Kepler



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 330



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.

Class Facts

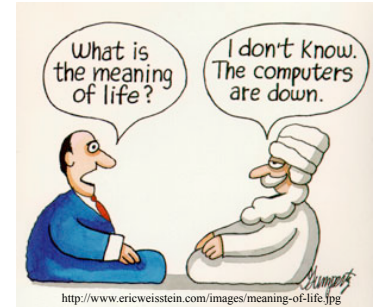


- Today, there is **no** evidence for ET life.
- And we don't even know how life happened on Earth.
- Earth's early geologic record (first 1/2 billion years) is **GONE**
 - Clues to early life formation are gone
 - Earth is about 5 billion years old

Life



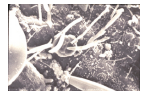
- This examination may bring us to some very depressing conclusions
- What is life?
 - Just sunlight plus geochemistry?
- If we decide that intelligent life is common in the Universe, how will that make us feel?



Class Facts



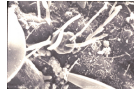
- But, we do have evidence for very early microbial life on Earth (about 3.5-4 billion yrs old).
- Oxygen atmosphere 2 billion years ago!
- First multi-celled life only 1 billion years ago.



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 ($\alpha=1/137.036$) 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!**

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.

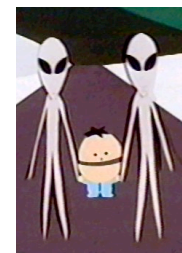
Course Goals



- 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.**



Aliens?



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

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

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.

Grades



Requirement	Percentage of Grade
Class Participation (will drop some)	12%
Presentation Synopsis	1%
Homework Assignments	10 out of 11 15%
Presentation	15%
Research Paper Draft	1%
Research Paper	6%
Midterm	20%
Final	30%
Total	100%

Class Participation



Class Participation

- You should attend lectures and discussions.
- We will have random opportunities for your feedback, in the form of asking questions, "voting" on the possible outcomes of observations or demonstrations, or brainstorming answers to open-ended questions. To reward your participation in these activities, you will often be asked to turn in your response (**worth 12% of your grade!**).
- Although the number of these are not set, often they come upon me on a whim, we probably have these for every class, so some of these will be dropped.

Interesting Question #1



Although there is no proof of ET life, it can be said that

- a) everyone feels a deep connection with the night sky, suggesting that we are from space.
- b) about ½ of the US population believes in aliens.
- c) aliens walk amongst us.
- d) only a very small number of people think that aliens are a possibility.
- e) cows are scared.

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?

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.



<http://www.public.asu.edu/~atjlb/>

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 Feb 9th, the presentation synopsis (after 1st HWs 1&2 are due).

- **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. URLs are fine refs for this class.

Research Paper



- Each student will be writing a research paper on their 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.
- The final paper is due as listed on the website. **Most points are usually lost for bad referencing (expect a couple refs per page on average) 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 MC, 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 Assignments



- Homeworks are due on Compass on Tuesday nights at 11:59pm.
- For MC, will have multiple attempts, without penalty
- First one is due next week!
 - Easy-peasy
- **Late homework may not be accepted.**





Yuck-- Exams

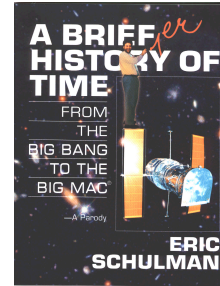


- There will be one in class exam and a comprehensive final exam for this course. The exams will be take home essay exams.

Book 'em Danno



TEXTBOOK: *None*



RECOMMENDED READING:

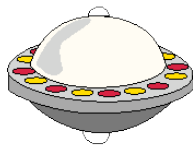
A Briefer History of Time by Eric Schulman

<http://members.bellatlantic.net/~vze3fs8i/bhtes/index.html>

Have we been visited by ETs?



*“Extraordinary Claims Require
Extraordinary Evidence”*



An Example: Meteor 1972

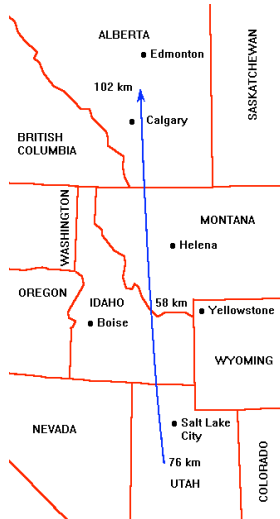


<http://www.uwgb.edu/dutchs/>

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.



Drake Equation



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

Rate of star formation

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

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 a few intentional messages...



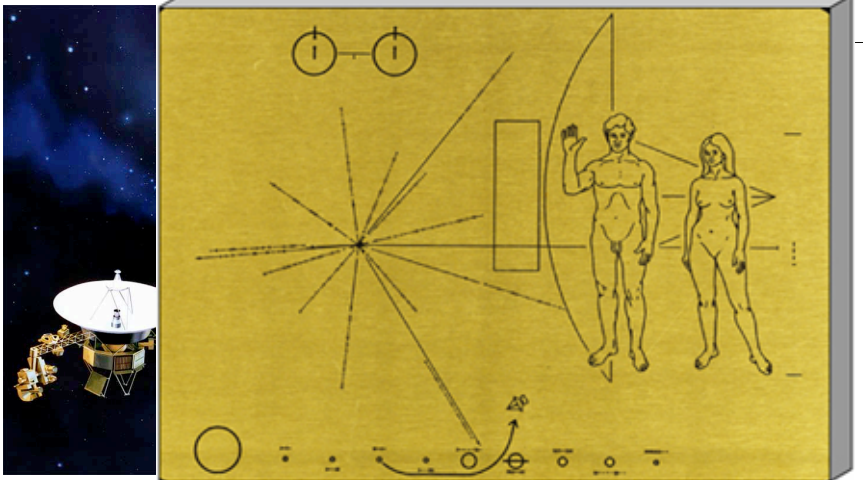
SETI: Listening for ET



- 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/scencearth.html>