Sex in Space: Astronomy 330

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Office Hours:
 W: 11:00 a.m. – noon
  or by appointment

HW1 due yesterday!
(grace period until Feb 3rd)
Make sure to follow directions!

Presentation Synopsis due next Tuesday night.

Music: *Million Miles Away from Home* – Dune

Outline

- Some more details on the presentations.
- What is the size scale of space?
- Can it fit in our little heads?

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.
- Will do these in two person groups! Group up early.

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 Example:
Last Semesters Best One (99.8%)

Extremophiles
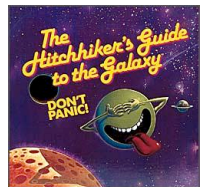
Space is Big!

"Space is big. Really big. You just won't believe how vastly hugely mind-bogglingly big it is. I mean, you may think it's a long way down the road to the chemist, but that's just peanuts to space…

To be fair though, when confronted by the sheer enormity of the distances between the stars, better minds than the one responsible for the Guide's introduction have faltered.

The simple truth is that interstellar distances will not fit into the human imagination."
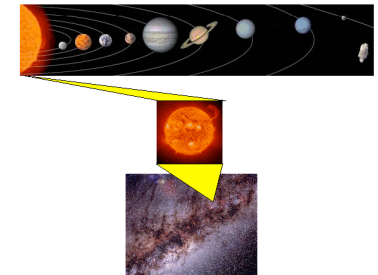
--Douglas Adams
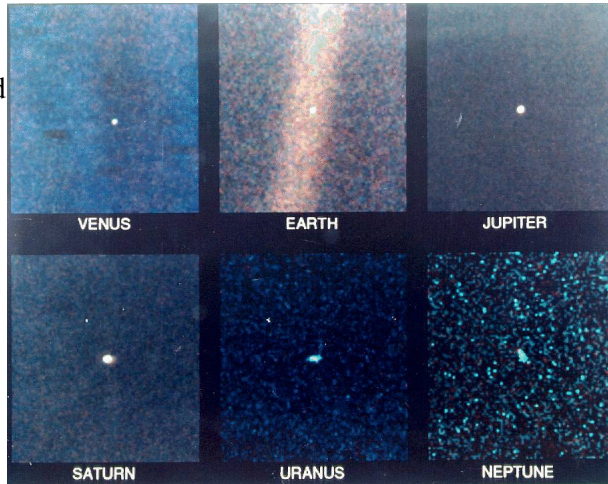*The Hitchhiker's Guide to the Galaxy*

One of

We are:

- 1 planet out of 8 in our solar system.
- 1 stellar system of 100 billion stars in our Milky Way

Perspective of Scale

Images from Voyager (launched in 1974) at 4 billion miles out. Moving at 100 times faster than a speeding bullet (38,000 mph!). And arguable just recently made it into interstellar space.


VENUS   EARTH   JUPITER

SATURN   URANUS   NEPTUNE

http://seds.lpl.arizona.edu/nineplanets/nineplanets/overview.html

Interstellar Travel

Don't forget that the Voyager spacecraft are about the fastest vehicles made by mankind. Even so, Voyager would take over 100,000 years to reach some of the closest star systems.

http://nssdc.gsfc.nasa.gov/photo_gallery/photogallery-spacecraft.html
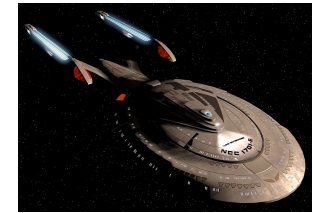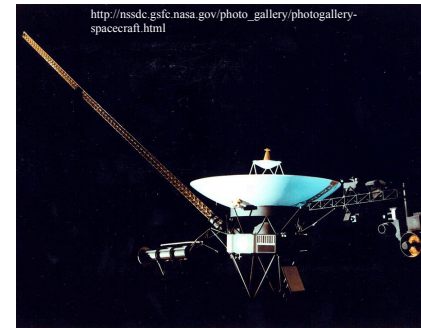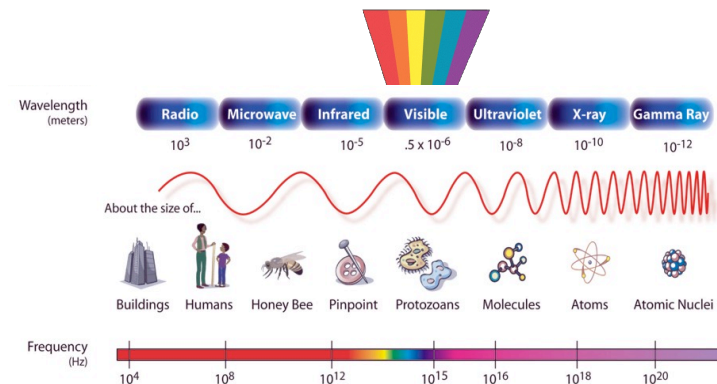
What's the Fastest Way?

- Let's look into the constant speeder– light!
- We'll be talking about it a lot.
- Fastest thing out there.
- Nothing faster allowed– we'll talk more about this later.
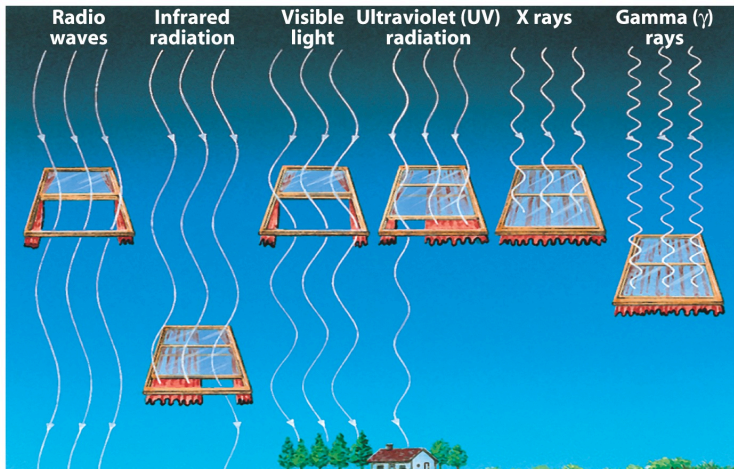

SPEED LIMIT
299,792,458
m/s

What is Light?

- Visible light is only a tiny portion of the full electromagnetic spectrum
- Light comes in many colors that you can not see! The color x-ray or color radio or color microwave.
- Divisions between regions are really only from biology or technologies.

Wavelength (meters)

Radio	Microwave	Infrared	Visible	Ultraviolet	X-ray	Gamma Ray
10^3	10^{-2}	10^{-5}	$.5 \times 10^{-6}$	10^{-8}	10^{-10}	10^{-12}

About the size of...

Buildings Humans Honey Bee Pinpoint Protozoans Molecules Atoms Atomic Nuclei

Frequency (Hz)

10^4 10^8 10^{12} 10^{15} 10^{16} 10^{18} 10^{20}

The atmosphere absorbs some wavelengths and not others

Distances

How far is it to Chicago?

Around 135 miles

Or 217 km

Or 712800 feet

Or 8.7×10^{10} microns

Or 285120 paces

Or 2 hours at car speed

Or 1 The Matrix DVD units at car speed

Or 0.7 ms at light speed

A Light Year

The **light-year**
- Distance that light travels in one year
- Speed of light: roughly 3.00×10^5 km/sec
- 3.16×10^{17} seconds in one year

so 1 light year = (3.00×10^5 km/sec) × (3.16×10^7 sec) = 9.42×10^{12} km

- Nearest star (Proxima Centauri) is about 4.2 light years away.
- Analogous to saying: Chicago is about 2 hours away.

Question

- I want to send a signal to the nearby star Alpha-Centauri (there might be ETI), which is 4.2 light years away.
- I want to communicate quickly.
- So what wavelength of light do I use? Radio? X-rays?
- How long will it take to reach Alpha-Centauri?

First Contact?

- It will take 8.4 years to send out a radio message and get a response.
- It will take 100,000 years to travel on a Voyager-like spacecraft.
- For light to reach the nearby stars in the sword of Orion, it would take 3000 years.
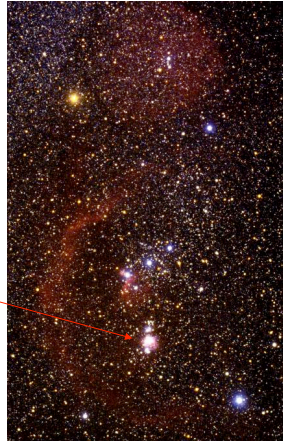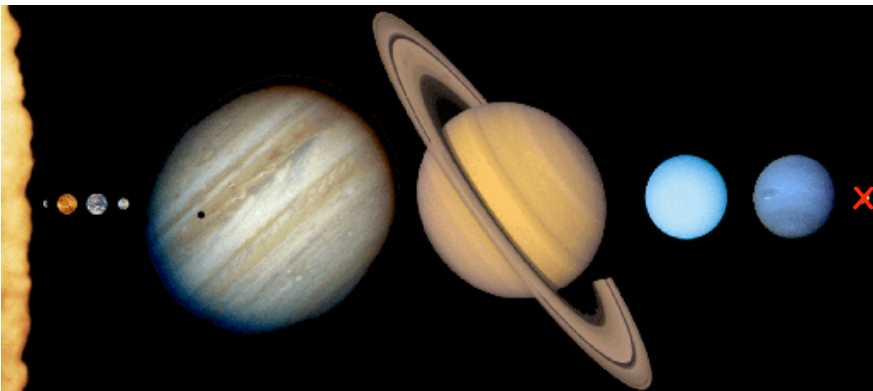

Other Distances

- 1 light year is 9.42×10^{12} km
- AU: the distance from the Sun to the Earth = 149,570,000 km = 1.58×10^{-5} light years
- pc: the distance away that a star would have a parallax of 1 arcsec, so 1 pc = 3.086×10^{13} km = 3.26 light years

Size Scales

To put astronomical scales into a reference, imagine a model of our Solar System.

Scale it:
The Most Math You'll Do in This Class

In groups:
Assume the Sun is the size of a softball (diameter = 4 inches).

1) Calculate the distance from the softball to the "Earth". Then show that distance to me.

2) What would be the distance to the Moon?

3) What is the distance to Proxima Centauri (4.2 light years away)?

Sun's diameter = 1,391,900 km
distance from Earth to Sun (1 AU) = 149,570,000 km
distance from Earth to Moon = 385,000 km
1 km = 1000 meter = 3279 ft = 0.621 miles   1 mile = 5280 feet
1 light year = 9.46×10^{12} km = 5.87×10^{12} miles
Note: A million miles away from home is actually quite close!