Purpose of Astro 102/104

• To learn about our origins and our connection to the universe. To develop an appreciation for Earth as a fragile planetary body in a vast cosmos.

• To understand key principles and processes that govern the natural world. What is the solar system like today? Why? How did it get that way?

• To become familiar with the scientific process. To acquire tools for further inquiry and learning.

Perfect timing

• This is a "Golden Age" of exploration!

• Spacecraft are exploring the planets now!
  – Magellan (’90-’94): Venus.
  – Mars Pathfinder (’97), MGS (’97-’06), Mars Odyssey (’02-now), MER (’04-now), MRO (’06-now): Mars.
  – NEAR (’97-’01), Hayabusa (’05): asteroids.
  – Deep Impact (’05), Stardust (’04-’06): comets.
  – Galileo (’95-’03): Jupiter, satellites.
  – Cassini/Huygens (’04-now): Saturn, satellites.
  – AND MORE PAST, PRESENT, AND FUTURE!
First flyby of Mercury in 30+ years reveals astonishing landforms!

Lakes and rivers of methane on Titan!

Astonishing worlds: Iapetus & Hyperion

New Discoveries Being Made!
- Observations of asteroids:
  - Many are highly porous. WHY?
  - Some have satellites! HOW?
- Satellites of Jupiter and Saturn:
  - Europa may have an ocean!
  - Titan has hydrocarbon rain and rivers!
- Many objects discovered beyond Neptune:
  - Hundreds of trans-Neptunian objects.
  - Pluto demoted! Can they do that?
- Many Sun-like stars have planets!
Methods

• *Discover* and *Explain* important patterns and trends in the data.
• GOAL is to UNDERSTAND these patterns, NOT memorization of facts or numbers.
• Will concentrate on patterns and processes, but *some* knowledge of facts will be needed.

Will there be math?

• At a lower level than what’s in the get rich book.
  – some geometry
  – some algebra
  – smidgen of trigonometry
  – no calculus
  – no logarithms
  – no differential equations

Some Obvious Patterns

Inner Planets differ from Outer Planets.

• **WHY?**

Some Striking Differences

• Example: Our Moon vs. Jupiter’s moon Io.
  – Rocky worlds, about the same size.
• Io:
  – Volcanic.
  – Covered with orange sulfur.
• Moon:
  – Geologically dead.
  – Covered with gray rock.

• **WHY?**
Many Obvious Questions

**What are rings, anyway?**
- Are they permanent or temporary?

**Why do outer planets have rings?**

**What are rings, anyway?**

**How and when did the solar system form?**
- (Answer: ~4,600,000,000 years ago!)

**How do we know that??**

Timescales

**Why Understand the Past?**

- Extrapolation in time \(\Rightarrow\) *predictions* about the future.
  - How will Earth’s atmosphere change?
  - How will our climate change?
  - Will objects strike the Earth? When?
- Extrapolation in space \(\Rightarrow\) *inferences* about other places.
  - Many other stars have planets.
  - Could some of them be Earthlike?
  - Could there be life??
Major Course Topics

(1) General Solar System Concepts.
(2) The Inner Solar System.
(3) Small Bodies and the Outer Solar System.
(4) Origins.

Some Philosophy

• Our goal is to help you learn how to distinguish solid science from nonsense.
• For example:
  – Planets around other stars.
  – Repeated massive mass extinctions due to impacts.
  – Evidence of ancient life on Mars.
  – Ice at the poles of the Moon and Mercury.
• Which of these are TRUE, POSSIBLY TRUE, EXAGGERATIONS, OR EVEN NONSENSE?
• Use Carl Sagan’s baloney detection kit.

A Promise from us...

• We will work hard to help you learn.
• Our Responsibilities:
  – Clearly present the information.
  – Provide opportunities for questions, discussion.
  – Be prepared for lectures, sections, labs.
  – Provide fair and consistent grading.
  – Make astronomy matter!

And from you...

• But you must work hard too!
  – Come to Lecture:
    • Be here on time: prompt 11:15 start.
    • Class will end at 12:05 (not 12:00…)
  – Go to Section.
  – Do the reading.
  – Turn in assignments on time.
  – Ask Questions!
• Absolute academic integrity expected at all times.
Lecture Style

- Follows the textbook, but not verbatim.
- More information provided only in lecture.
- Other lecture features:
  - "The Main Point" highlighted for each class.
  - Active learning.
  - Group activities.
  - Demonstrations.
  - Discussions: Astronomy in the News, etc.
  - Mars rover mission updates.

Handouts:
Syllabus and Ground Rules

Your Weekly Section Meeting

- Your chance for more personal contact.
- Weekly quizzes or problem sets assigned.
- Detailed discussion of reading, lectures.
- Detailed discussion of homework.
- Critical preparation for prelims & final.
- You will get a better grade if you attend lectures and sections.

Lab: Astro 104

- Astro 104 has an additional lab component.
- Four classroom lab activities (in Clark 132):
  - Radioactive Dating.
  - Planetary Orbits.
  - Impact Cratering.
  - Rotation of Saturn and its Rings.
- One on-campus observatory activity (at Fuertes Observatory, weather permitting).
Observing the Sky

• On clear Friday evenings, the Cornell Astronomical Society holds open-house observing at Fuertes Observatory on north campus, from 8:00 pm to midnight.
  – Check http://astro.cornell.edu/facilities/fuertes
• You are strongly encouraged to go out and see the planets with your own eyes! Dress warmly.
• Planetarium program (SkyGazer) comes with your textbook.

Additional Resources

• Course website: http://www.astro.cornell.edu/courses/a102
  – Lecture notes, homeworks, links, etc.
• Textbook publisher website: http://www.masteringastronomy.com
  – Animated figures, tutorials, quizzes, etc.
• Numerous planetary data archives:
  – Header graphic based on images from http://www.solarviews.com © Calvin J. Hamilton

For Additional Help

• Office Hours:
  – Prof. Margot: MF 3:00-4:30 (but call ahead).
  – Prof. Squyres by appointment only (due to continuing Mars rover operations).
• Each TA has his/her own office hours:
  – Consult the handout or web site for details.
• Any of us are available at other times by appointment, with advance notice.

Next Lecture...

• The Sky.
• Historical Overview of Planetary Science.

• Reading this week:
  – Preface and Chapter 1.
  – Chapter 2.1, 2.4.
  – Chapters 3, 4.