Astronomy 2202:
“A Spacecraft Tour of the Solar System”
a.k.a.
“Our Home in the Solar System”
Fall 2016
TR 10:10–11:25 am, SS105
Instructor: Prof. Alexander Hayes
Teaching Assistant: Paul Corlies
http://www.astro.cornell.edu/academics/courses/astro2202/

Overall Objective of this Course

• Develop an understanding of our home planet as a member of a diverse family of objects in our solar system.
• Review the process by which spacecraft exploration missions are conceived, selected, built, and ultimately launched.
• Discuss how you can make a difference.

Our Secret Agenda

• To show you why spacecraft exploration is exciting and teach you how to advocate for it in the future! This way, when you are head of the congressional appropriations committee, you can find funds for the next flagship mission to Titan’s lakes and seas!
By the end of the semester you will be able to:

• Articulate the key differences between Earth, Mars, and Titan as planetary systems.
• Make an informed opinion about the values of space exploration and support your position with clear and rational arguments.
• Have a better understanding of what habitability means in the context of exoplanets.
• Be able to effectively parse complex scientific arguments using prose that is clear, concise, and understandable to an intelligent non-science audience.

Approach

• The course will be separated into four core units:
  – Mars Exploration
  – Cassin’s Exploration of the Saturn System
  – The Planetary Science Decadal Survey
  – Exoplanet Detection Techniques
• Additional lectures will cover timely discoveries:
  – New Horizons Exploration of Pluto
  – Rosetta’s Exploration of Comet 67-P
  – The Europa Multiple Flyby Mission
• The final topics will be chosen by your final projects

Contacts

• Professor: Alex Hayes
  – 412 Space Sciences; phone: x5-1712
  – http://www.alexanderghayes.com
  – Office Hours: TR 9:00 to 10:00 am
  – hayes@astro.cornell.edu

• Teaching Assistant: Paul Corlies
  – 406 Space Sciences; phone: x5-4709
  – Office Hours: MV 9:00 – 10:00 am (405 SS)
  – mmc232@cornell.edu
**Requirements and Grading**

- Attendance at "Lecture" classes is part of your grade
  - Class starts promptly at 10:10 am, ends no later than 11:25 am
- Students are expected to have completed the assigned reading before the listed lecture begins (today is an exception...)  
- **Grading:**
  - 6 Short Reports 25%
  - 4 Longer Reports 25%
  - Class Participation 25%
  - Final Presentation 25%

**Extensions**

- All assignments must be turned in sequentially (1, 2, 3, ...)
- Assignments due dates are listed on the course schedule
- **ANY** requests for extensions must be:
  - Medically/officially justified (Gannett, etc.)
  - Made prior to the day the lab is due
  - Approved in advance by Prof. Hayes or Michelle
- **No extensions** will be granted for the final presentations on Nov. 29 and Dec. 1

**Academic Integrity**

- You are encouraged to discuss the assignments with Prof. Hayes, Michelle, and your fellow classmates, but the work that you turn in must represent your own, original work.
- There is a thin boundary between collaboration, allowed and encouraged in this class, and plagiarism
- Any breach of the academic integrity code listed in the college handbook will be considered grounds for failure in the course. A primary hearing will be held, and a letter will be put in your record in Student Services.
  [http://cuminfo.cornell.edu/Academic/AIC.html](http://cuminfo.cornell.edu/Academic/AIC.html)
Those are the Rules

Read Them
Learn Them
Live Them

You read it, You bought it.

Questions?
Comments?
Concerns?

Course Syllabus and Outline

• The current version of the Astro 2202 syllabus can always be found at:
  http://www.astro.cornell.edu/courses/astro2202/

• Let’s go through the syllabus now...
Familiar Physics in Unfamiliar Environments

Titan, Mars, and Venus are shaped by the same surface processes as Earth.

Wind blown depositional systems are the 'default' environment of our solar system.

Dune and ripples in Nili Patera, Mars
Burns Fm., Mars

Dunes on Venus
Linear dunes on Titan

Who I am

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Figure 8-5. Proposed Mars-2020 rover showing the large extent of heritage from MSL (gray), and the several areas where significant departures from MSL heritage are envisioned.
Aeolian Processes

~100 km

Dunes in Namib desert (L-band/SRL, 30 km wide)

Titan dunes at same scale

Lunine, Pappalardo, Matson, Radebaugh, Icarus 2008

80 km

Titan: A New World
Moon: Apollo 17 landing site
Venus: Venera landing site
Earth: Indonesian glacial deposits
Mars: Viking Lander 1 site
Planetary Habitats

- What were the primordial sources of organic matter, and where does organic synthesis continue today?
- Did Mars or Venus host ancient aqueous environments conducive to early life, and is there evidence that life emerged?
- Beyond Earth, are there modern habitats elsewhere in the solar system with necessary conditions, organic matter, water, energy, and nutrients to sustain life, and do organisms live there now?

Workings of Solar Systems

- How do the giant planets serve as laboratories to understand the Earth, the solar system and extrasolar planetary systems?
- What solar system bodies endanger and what mechanisms shield the Earth’s biosphere?
- Can understanding the roles of physics, chemistry, geology, and dynamics in driving planetary atmospheres and climates lead to a better understanding of climate change on Earth?
- How have the myriad chemical and physical processes that shaped the solar system operated, interacted, and evolved over time?

The Discovery Program

- The Discovery Program has produced spectacular and cost-effective science, and can continue to do so well into the future.
The New Frontiers Program

- New Frontiers missions can address high priority and technically complex science goals that are beyond the capabilities of Discovery missions.

Flagship Priority 1: MAX-C

- The view expressed by the Mars community is that Mars science has reached a point where the most fundamental advances will come from study of returned samples.
- MAX-C will perform in situ science and collect and cache samples, beginning a three-mission campaign to return samples from Mars.
- Mars Sample Return is enabled by ESA participation throughout the campaign.
- Of the three missions in the campaign, only MAX-C is recommended for 2013-2022.
- The campaign is multi-decadal, and its priority is based on its anticipated total science return and total cost.

NATIONAL GEOGRAPHIC
searching the stars for new earths