

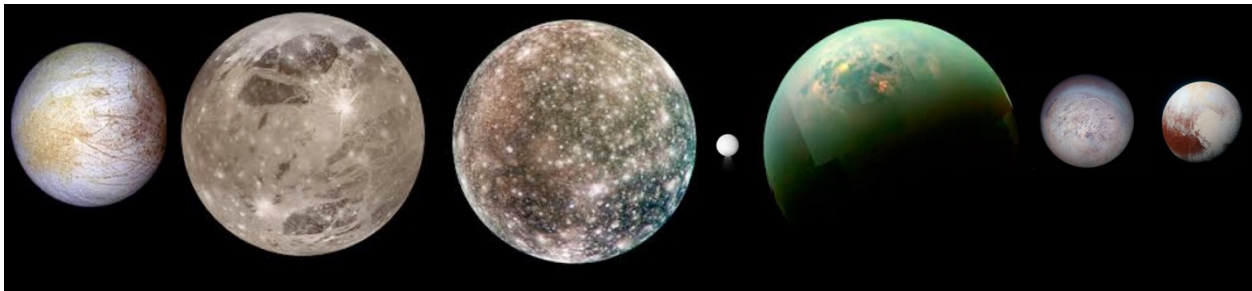
Course Announcement: Spring 2018
Ge 194 (Special Topics in the Planetary Sciences)
“The Physics, Chemistry, and Biology of Ocean Worlds”
MWF 9-9:50 AM (negotiable)

Jonathan I Lunine, Moore Distinguished Scholar (Feb./March) and Visiting Professor (April-June)
(<http://astro.cornell.edu/members/jonathan-lunine.html>)

Ocean worlds are objects in the solar system that host stable, globe-girdling bodies of liquid water—“oceans”. Beyond Earth, three objects—Jupiter's moon Europa, and Saturn's moons Enceladus and Titan—have subsurface oceans whose existence has been detected or inferred by at least two independent spacecraft techniques. Titan also has surface seas of liquid methane and other hydrocarbons. A host of other bodies in the outer solar system (Ganymede, Callisto, Pluto, Triton...) may have subsurface oceans inferred by a single type of observation or by theoretical modeling.

This course will explore the physics, chemistry and (yes) biology of ocean worlds. How are oceans detected? How do they form within the interiors of these bodies, and what heating mechanisms are available to sustain them? What are the chemical and physical properties of subsurface oceans...those bounded at the bottom by rock (Europa, Enceladus) vs those bounded by high pressure ice (e.g., Titan)? Which of the oceans are suspected to be able to support life, and how do we know? What types of organisms, if any, are possible within the hydrocarbon seas of Titan's surface? What are the prospects for searching for life within these liquid bodies or on the ice surfaces that cap them?

The course will assume a reasonable background in undergraduate physics and chemistry. There will be 6-8 homeworks, a midterm, and projects in place of a final. Please feel free to contact me with questions (jlunine@astro.cornell.edu); office 114 N. Mudd.



Syllabus

- April 2 Introduction to ocean worlds—where are they and which deserve special attention
- April 4, 6, 9 Techniques for detection/composition of internal oceans
- April 11, 13 Formation and long-term stability of (water) oceans in satellite interiors (accretional, radiogenic, and tidal energy sources; convective and conductive loss of internal heat)
- April 16 Perched oceans vs those in contact with a rock core (the curious case of Triton vs Pluto).
- April 18, 20 Aqueous chemistry in internal oceans at low (Enceladus) and high (Titan) pressure.
- April 23, 25 Hydrothermal processes at the base of Enceladus' ocean
- April 27 Life detection strategies for Enceladus (and, eventually Europa)
- April 30, May 2. Guest lectures: Conventional vs unconventional aqueous-based life
- May 4 Exam
- May 7, 9 Surface hydrocarbon seas on Titan: detection, measurement of depth and composition.
- May 11, 14 Interaction of the seas and atmosphere of Titan
- May 16, 18 Alkane marine and lacustrine chemistry: what molecules do what in Titan's lakes & seas.
- May 21, 23 Biology in methane seas: what works, what doesn't, and why
- May 25, 30 The future exploration of the ocean worlds
- May June 1 Lightning talks for projects.