Topics

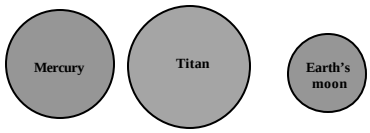
- **today Jovian planets**
- **next time, moons of Jovian planets**
- **Course grades posted on web site**
- **Final exams:**
  - Sec 1 (Dec 11), Sec 2 (Dec 14); both 8AM
  - Review Monday Dec 10, 5-6PM, this room
  - 100 questions, worth 200 points
  - 50% review, 50% last quarter of course

Moons of Jovian Planets

- **dozens of moons per planet**
- **size of our moon, or larger**
- **mixture of water ice, rock**
- **form small "solar systems" with planet as "sun"**
- **tidal stretching can generate internal heat today**
  - due to gravity of Jovian planet
- **But most have ancient, dead, surfaces**

Titan

- **moon of Saturn**
- **2nd biggest moon in solar system**
  - larger than Mercury



Titan's atmosphere

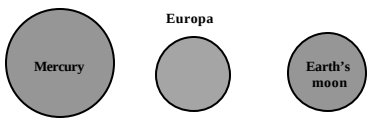
- **completely covered by clouds**
  - air pressure 1.6x Earth's
  - mostly nitrogen (like Earth)
  - temperature around 90K = -300F
- **methane clouds, rain, and ices**
  - methane oceans half mile deep (??)
- **lots of organic molecules**
  - ethane (C_2H_6) most common
- **Organic chemistry is similar to early Earth in many respects**
  - At time when lift first started on Earth

Cassini

- **US, European flight to Saturn, Titan**
- **launched 1997, reach Saturn July 2004**
  - Just beyond Jupiter today
- **Huygens probe to land on Titan**
  - Nov 2004, after radar maps of surface done
  - what chemistry has happened?
  - search for complex organic molecules, proteins, life

Europa

- **moon of Jupiter**
- ***no* impact craters, so very young surface**
- **liquid water ocean lies below surface**



Europa's ocean

- **Europa (like most Jovian moons) mostly water and rocks**
- **cracks and icebergs on *very young* surface show that liquid water is below surface**
- **organic molecules, heat are also present**
- **life thrives with these conditions on Earth**
  - deep in oceans near volcanic vents

Young Europa

- **Heat due to accretion of young Jupiter made it a "second sun"**
- **This, and the proto-sun's greater brightness probably kept Europa's water liquid**
- **"ocean" Europa may have lasted a half billion years**
- **Followed by today's Europa is thick ice sheet on top of liquid water ocean**