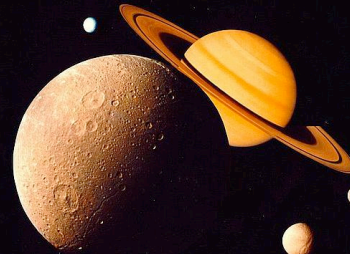


Warm Up Question

What are the two physical properties that determine if a object can retain an atmosphere?

Lecture 37: Saturn's Moons



Astronomy 161 – Winter 2010

Source: NASA/Voyager 1

Key Ideas:

Most diverse moon system of any planet
Trojan and Co-orbital moons

Large moons

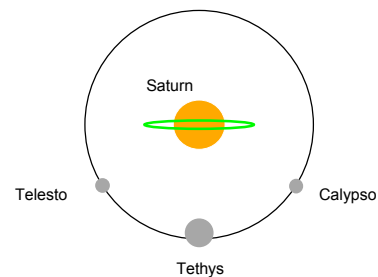
- Cratered Hyperion
- Two-toned Iapetus
- Cryogeysers on Enceladus

Saturn's Giant Moon Titan

- Only moon with a thick atmosphere

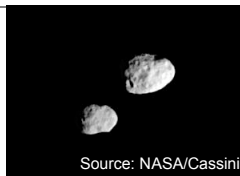
Prospects for Life

Trojan Moons

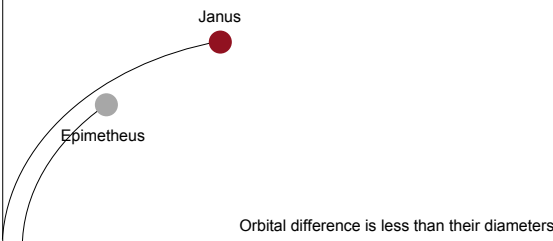


Co-Orbital Moons

Epimetheus and Janus

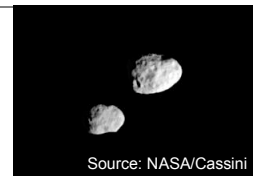


Source: NASA/Cassini

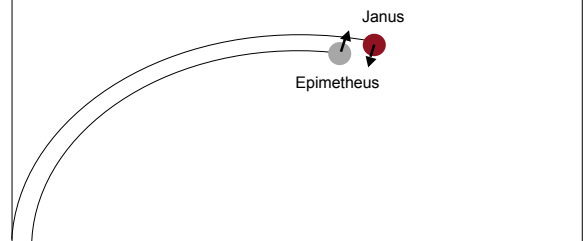


Co-Orbital Moons

Epimetheus and Janus

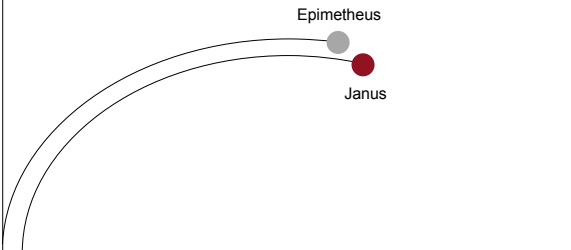
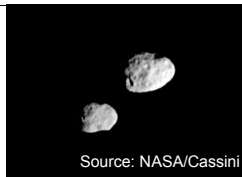


Source: NASA/Cassini



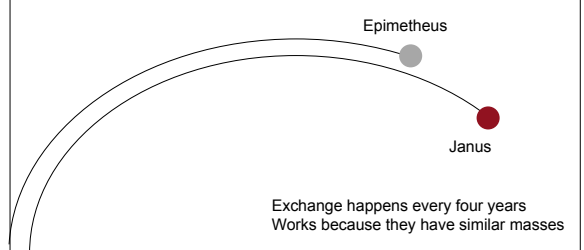
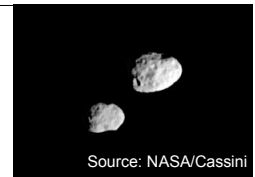
Co-Orbital Moons

Epimetheus and Janus

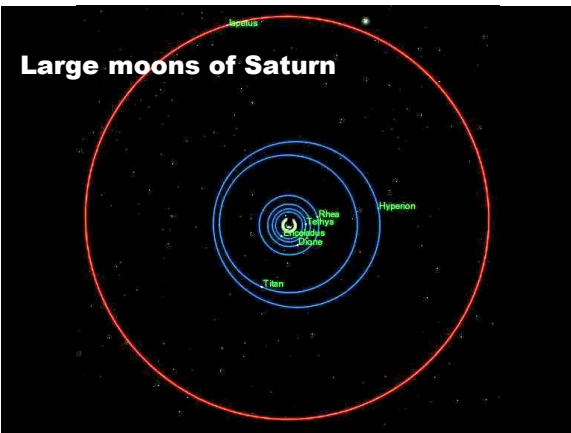


Co-Orbital Moons

Epimetheus and Janus



Large moons of Saturn



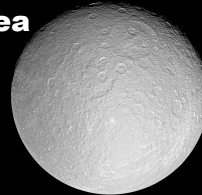
Tethys



Dione



Rhea

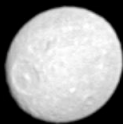


Characterized by
Densities $\sim 1 \text{ g cm}^{-3}$
Spherical due to gravity
Flattened craters

Source: NASA/Cassini

Mimas

Responsible for the
Cassini division
Herschel Crater is
140km across

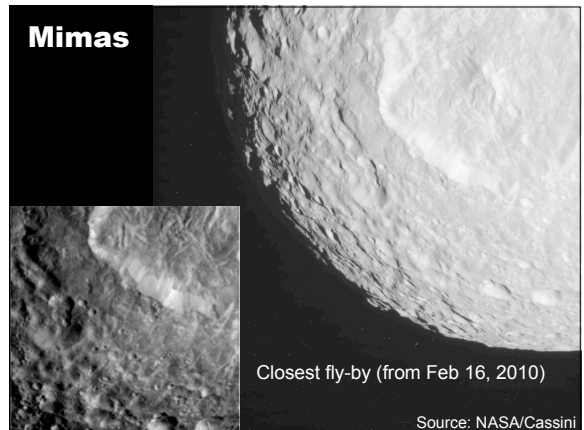


Cassini close-up view

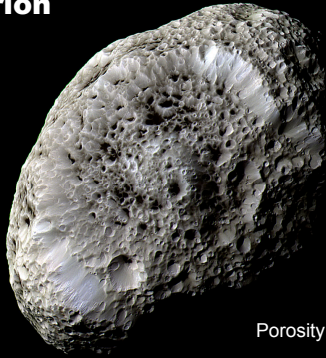
Egg-shaped due to tidal forces

Source: NASA/Cassini

Mimas

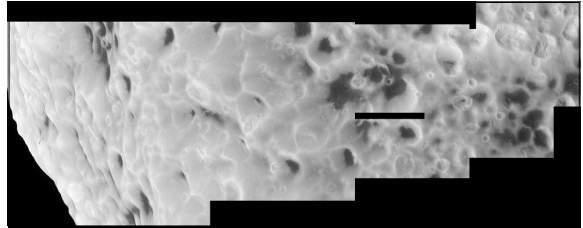


Hyperion



Porosity is about 40%!

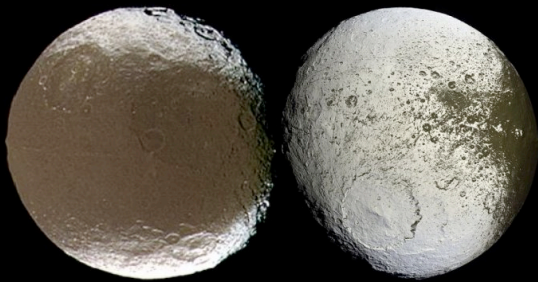
Source: NASA/Cassini



Covered in deep, sharp-edged craters
Main constituent is dirty water ice
Porosity is about 40%!
Craters may form by melting around darker material or compression upon impact

Source: NASA/Cassini

Iapetus

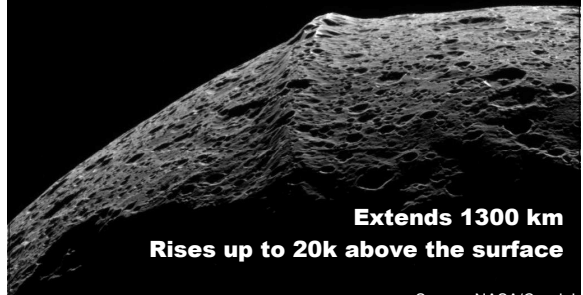


Leading hemisphere
Albedo ~3-5%

Trailing hemisphere
Albedo ~ 50-60%

Source: NASA/Cassini

Iapetus Equatorial Ridge



Extends 1300 km
Rises up to 20k above the surface

Source: NASA/Cassini

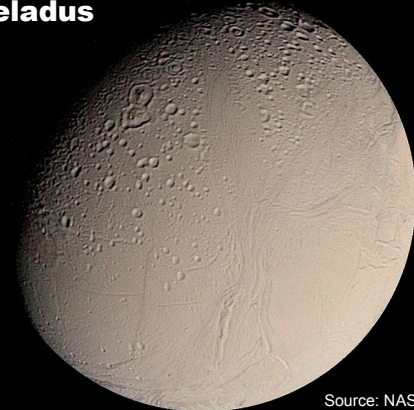
Phoebe



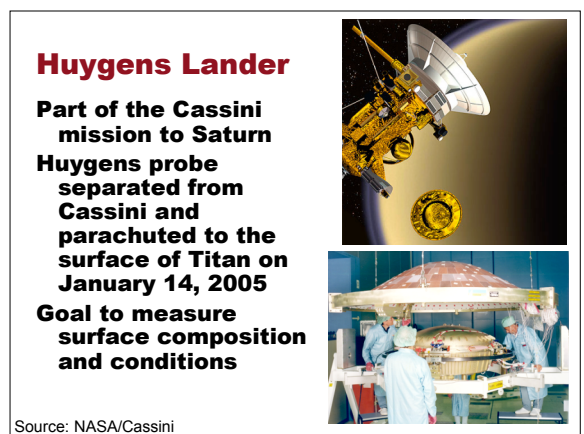
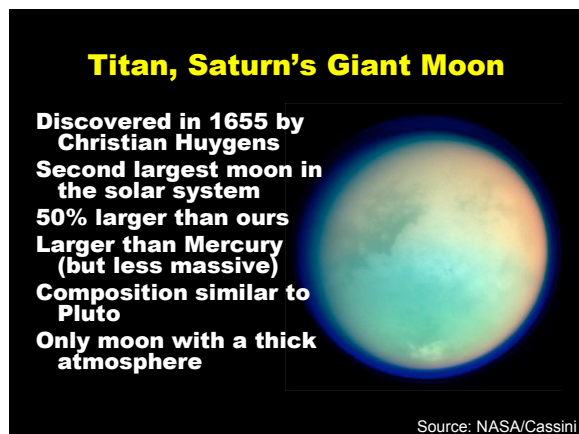
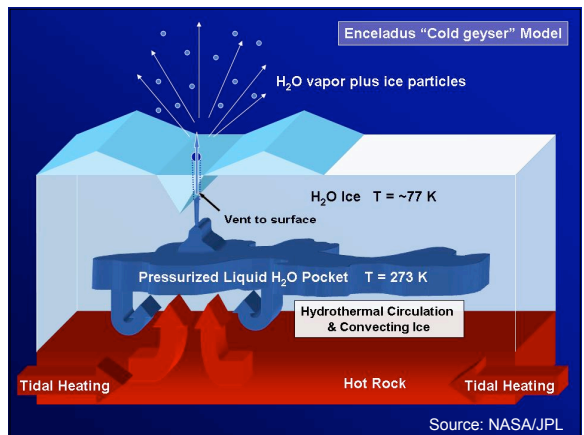
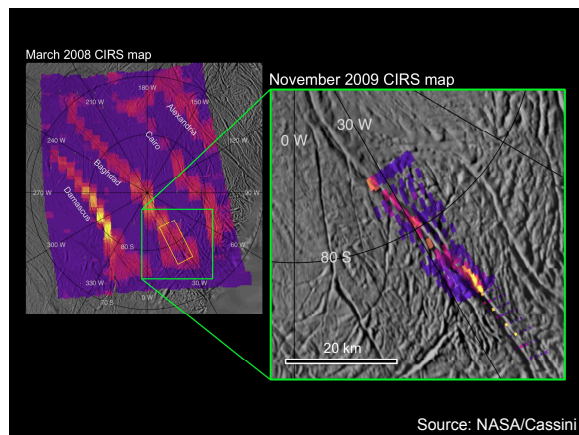
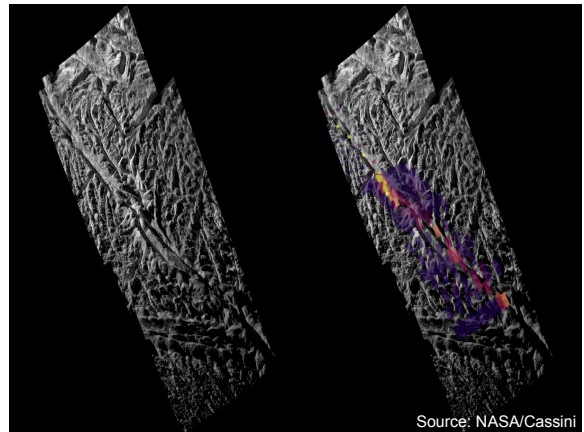
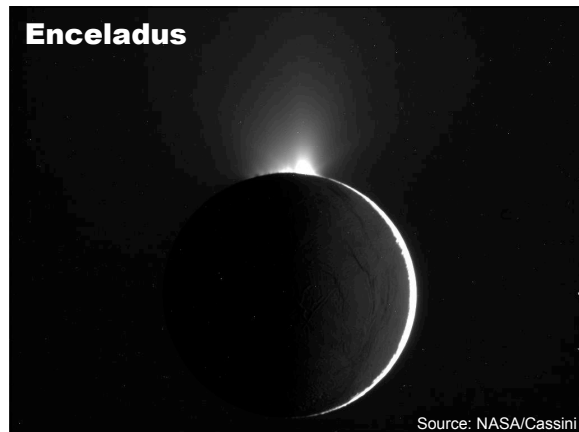
Extremely dark surface that may have polluted **Iapetus**
May have once been part of the Kuiper Belt

Source: NASA/Cassini

Enceladus



Source: NASA/Cassini



Titan's Atmosphere

Composition:

- ~98% N_2 (nitrogen)
- ~2% CH_4 (methane)
- Argon & hydrocarbons like Ethane

Cold, dense atmosphere:

- Temperature: 94 K (-290° F)
- ~1.6 Earth atmospheres
- Clouds of methane & N_2 ices
- Hydrocarbon "smog"

Source: NASA/Cassini

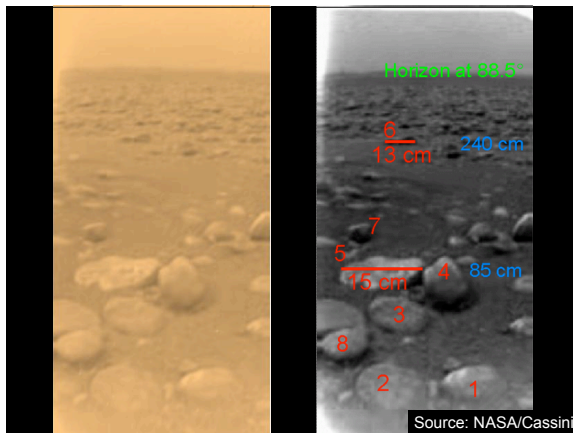
Titan's Surface

Young surface with very few impact craters

Varied Terrain:

- Smooth, dark plains (methane mud flats?)
- Rugged highlands
- Drainage channels
- Impact basins

Source: NASA/Cassini



Source: NASA/Cassini

Radar Map of Titan's Surface

Low reflectivity areas suggestive of liquid (lakes)

Source: NASA/Cassini

Is Methane Titan's "water"?

Methane (CH_4) may play the same role on Titan that water does on the Earth:

- 94 K is between the boiling & freezing points of Methane (and Ethane C_2H_6)
- Get gaseous methane in the atmosphere

Methane condenses into clouds that rain liquid methane

- Signs of drainage flows
- Huygens landed in soft methane/water ice mud
- Water ice is like sand on Titan

Life in the Outer Solar System?

Europa and Titan are the most promising sites to search for life in the Solar System after Mars

Jupiter's Giant Moon Europa

- Liquid ocean under the ice?
- Life could be present there

Saturn's Giant Moon Titan

- Methane-based, rather than water-based, life could be present

Enceladus may also harbor microbial life