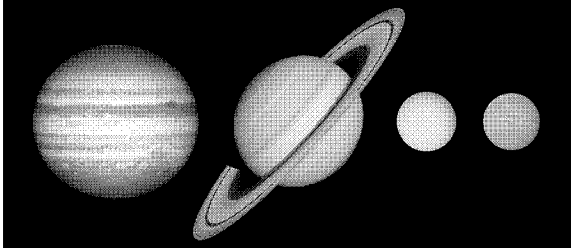


Monday, November 1  
Jovian Planets



---

---

---

---

---

---

---

---

Jovian Planets  
Key Concepts

- 1) Jupiter & Saturn are gas giants, with thick atmospheres over metallic hydrogen mantles.
- 2) Uranus & Neptune are ice giants, with thinner atmospheres over slushy ice mantles.
- 3) All the Jovian planets have extensive moon systems, including 6 giant moons.

---

---

---

---

---

---

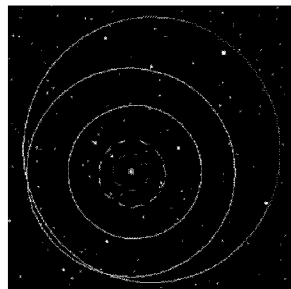
---

---

Jupiter & Saturn: Orbits at a glance

Jupiter:  
a = 5.2 AU  
P = 11.9 years

Saturn:  
a = 9.5 AU  
P = 29.5 years



---

---

---

---

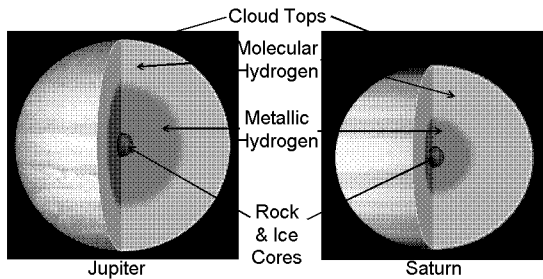
---

---

---

---

Jupiter & Saturn are **gas giants**, with deep atmospheres and metallic hydrogen mantles.



---

---

---

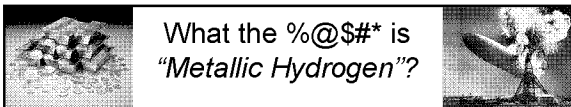
---

---

---

---

---



What the %@\$#\* is  
"Metallic Hydrogen"?

**Metal:** shiny, malleable, electrical conductor;  
contain **free electrons**.

Hydrogen becomes a metal only at **very** high pressures (1.4 million atmospheres).

Just like the Earth, Jupiter & Saturn have a layer of liquid metal.

---

---

---

---

---

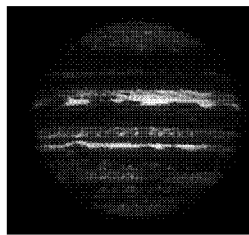
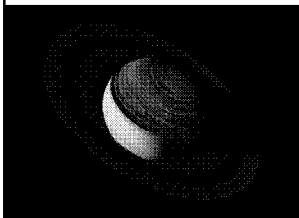
---

---

---

Jupiter & Saturn radiate away more energy than they receive from the Sun.

Why? They're slowly contracting under their own weight.



Gravitational contraction releases energy that heats their interiors and powers their weather.

---

---

---

---

---

---

---

---

## Uranus & Neptune: Orbits at a glance

Uranus:

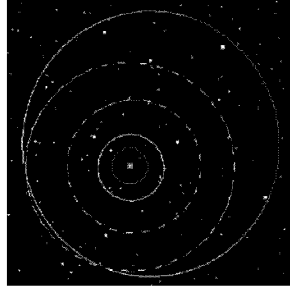
a = 19.2 AU

P = 84 years

Neptune:

a = 30.1 AU

P = 165 years




---

---

---

---

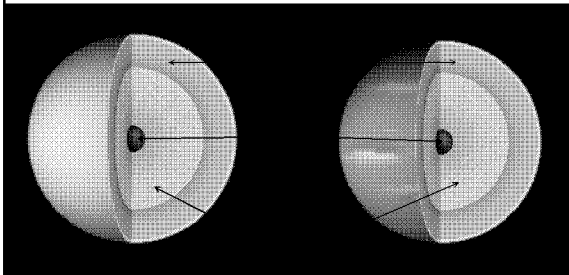
---

---

---

---

Uranus & Neptune are **ice giants**, with deep slushy mantles of  $H_2O$ ,  $NH_3$ , and  $CH_4$  ices.




---

---

---

---

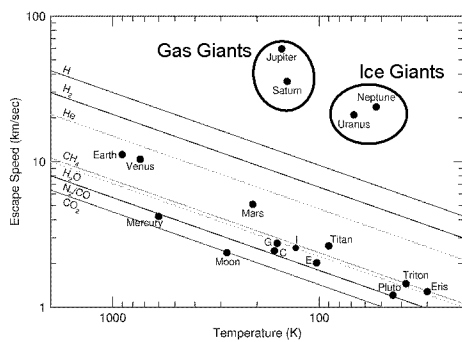
---

---

---

---

Jovian planets have H- and He-rich atmospheres because they're large & cool enough to hold on to them.




---

---

---

---

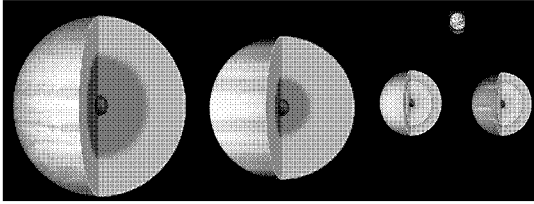
---

---

---

---

Jovian planets have atmospheres dominated by **hydrogen** chemistry.



Jovian planets have "reducing atmospheres" rich in  $H_2$ ,  $H_2O$ ,  $CH_4$ , &  $NH_3$ .

Terrestrial planets have "oxidizing atmospheres" rich in  $H_2O$  &  $CO_2$  (and  $O_2$  on Earth).

---

---

---

---

---

---

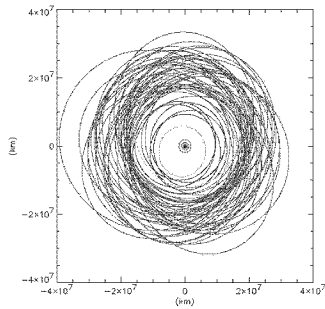
---

---

Jupiter has 63 known moons, four of which are the giant **Galilean moons**.

**4 Galilean moons:**  
Large (>3000 km)  
Spherical  
Differentiated

**59 small moons:**  
Small (<200 km)  
Irregular  
Undifferentiated



---

---

---

---

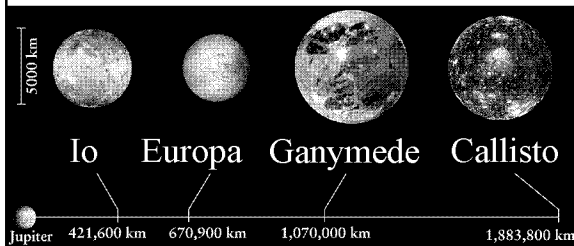
---

---

---

---

The four Galilean moons of Jupiter are large and spherical.



Io & Europa are mostly rocky;  
Ganymede & Callisto are mixed rock and ice.

---

---

---

---

---

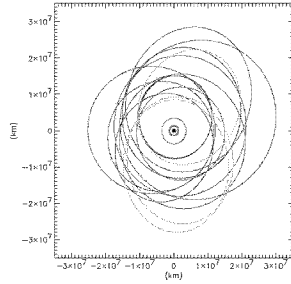
---

---

---

Saturn has 62 known moons, including the giant moon **Titan** and 6 spherical moons.

Moons with a diameter > 300 km are spherical. Those with a diameter < 300 km are irregular.




---

---

---

---

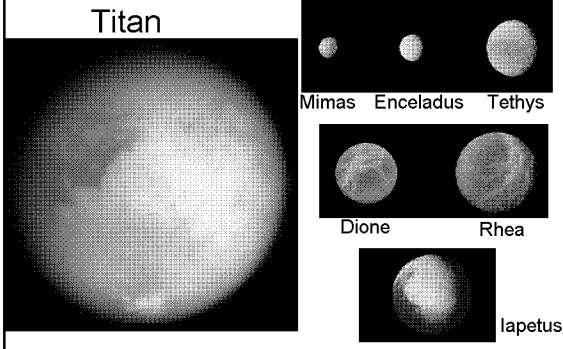
---

---

---

---

The large moons of Saturn (diameter > 300 km):




---

---

---

---

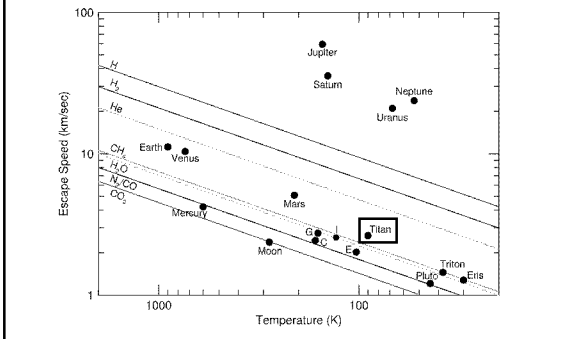
---

---

---

---

Titan is large & cool enough to have a thick atmosphere (98% N<sub>2</sub> and 2% methane).




---

---

---

---

---

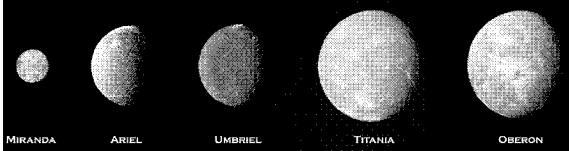
---

---

---

Uranus has 27 known moons; none are large enough to be giant moons.

The largest moons are big enough to be spherical:



---

---

---

---

---

---

---

---

---

---

---

---

---

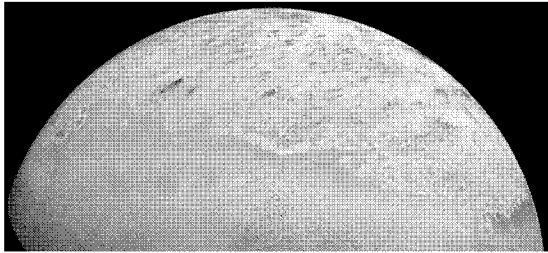
---

---

---

Neptune has 13 known moons; the largest is the giant moon **Triton**.

Triton resembles the icy dwarf planets Pluto & Eris.



---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

Tomorrow's Lecture:

Life on Europa (?)



This Week's Reading:

Chapters 9 & 10

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---