



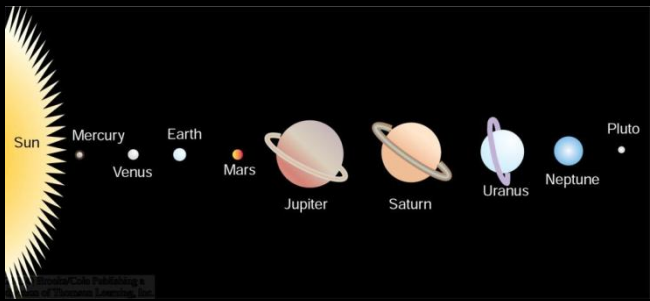
SPACE PHYSICS

Lecture 8

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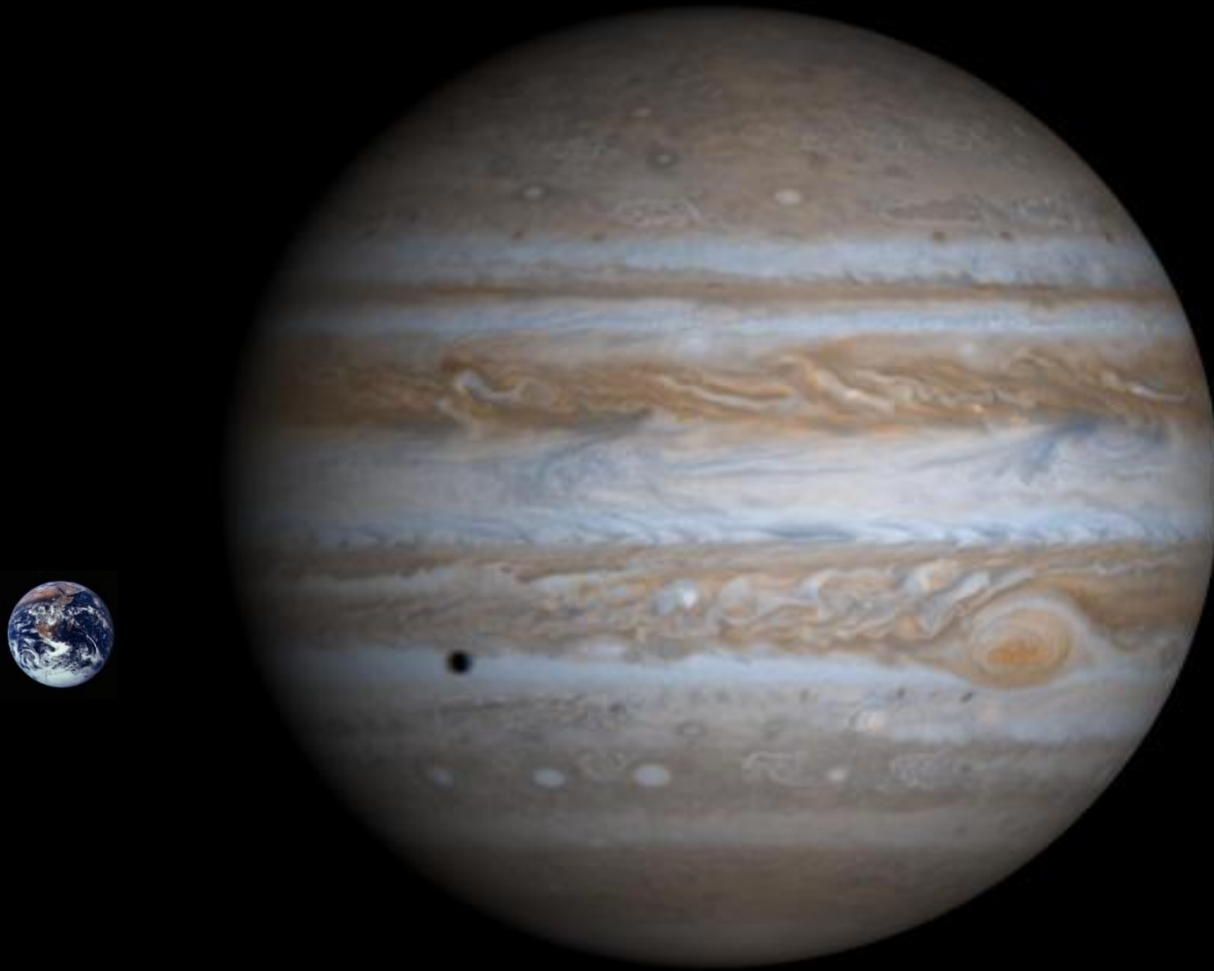
JUPITER

The largest planet in our solar system (about 11 times larger than Earth). Jupiter is a **gas giant**.

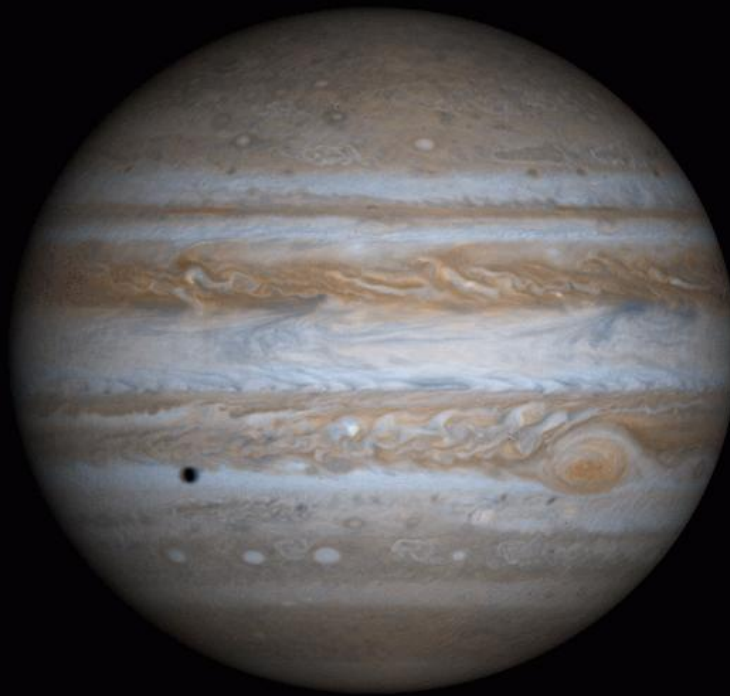


The most prominent feature is the giant red spot that is 48,000 Km long and 16,000 Km wide.

Mass = 0.001 solar (300 earths),
Radius = 11 Earths,



Distance: 5.2AU;
Orbital Period: 12 years;
Rotation period: 10 hours.





Jupiter and Earth compared

- Jupiter's diameter is over ten times greater than the Earth's
- It has over 300 times the mass
- If you weigh 180 pounds on Earth, you would weigh 426 pounds at Jupiter's cloud tops
- Jupiter is five times further from the Sun than the Earth

Jupiter Statistics

Mass (kg)	1.900e+27
Mass (Earth = 1)	3.1794e+02
Equatorial radius (km)	71,492
Equatorial radius (Earth = 1)	1.1209e+01
Mean density (gm/cm³)	1.33
Mean distance from the Sun (km)	778,330,000
Mean distance from the Sun (Earth = 1)	5.2028
Rotational period (days)	0.41354
Orbital period (days)	4332.71
Orbital eccentricity	0.0483
Tilt of axis (degrees)	3.13
Equatorial surface gravity (m/sec²)	22.88
Equatorial escape velocity (km/sec)	59.56
Mean cloud temperature	-121°C
Atmospheric composition	
Hydrogen	90%
Helium	10%

Jupiter

- Kept all its original atmosphere
- 90% Hydrogen
- 10% Helium



Jupiter's Red Spot



- The Great Red Spot, a huge storm of swirling gas that has lasted for hundreds of years.
- Jupiter does not have a solid surface. The planet is a ball of liquid surrounded by gas.

Moons of Jupiter

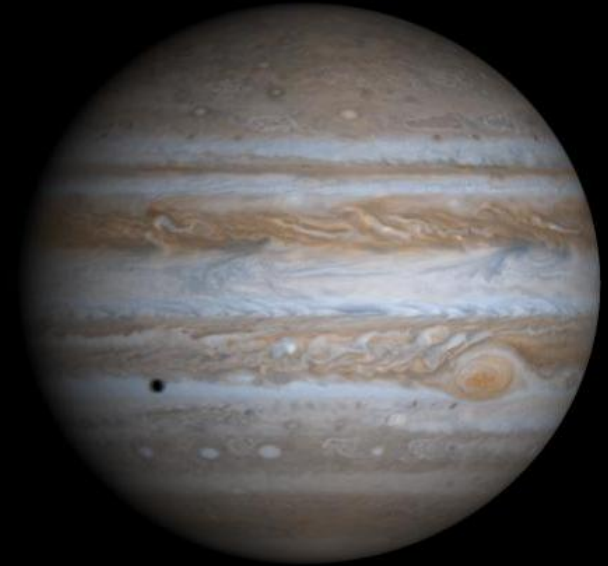
Jupiter has four large Galilean moons, twelve smaller named moons and twenty-three more recently discovered but not named moons.

We'll take a look at the four large Galilean moons which were first observed by Galileo in 1610.

Jupiter

Rotation Period about Axis: 9.8 hours

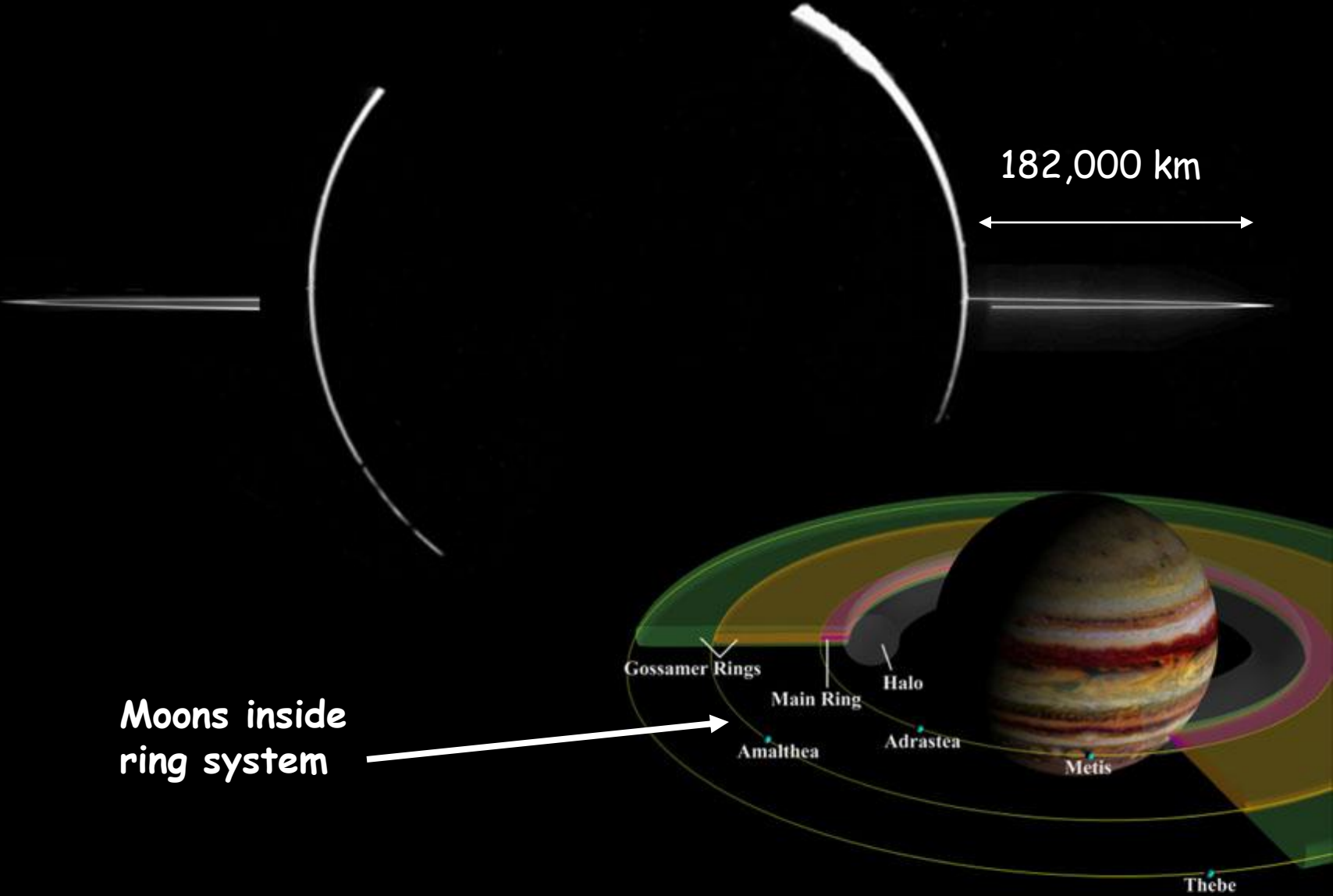
Revolution period: 11.86 Earth years



*Can see it in the night sky
without a telescope!*

- **Cloud-tops average = -153°C**

Ring system - made of fragments of ice



Jupiter's Galilean Satellites



Io

Europa

Ganymede

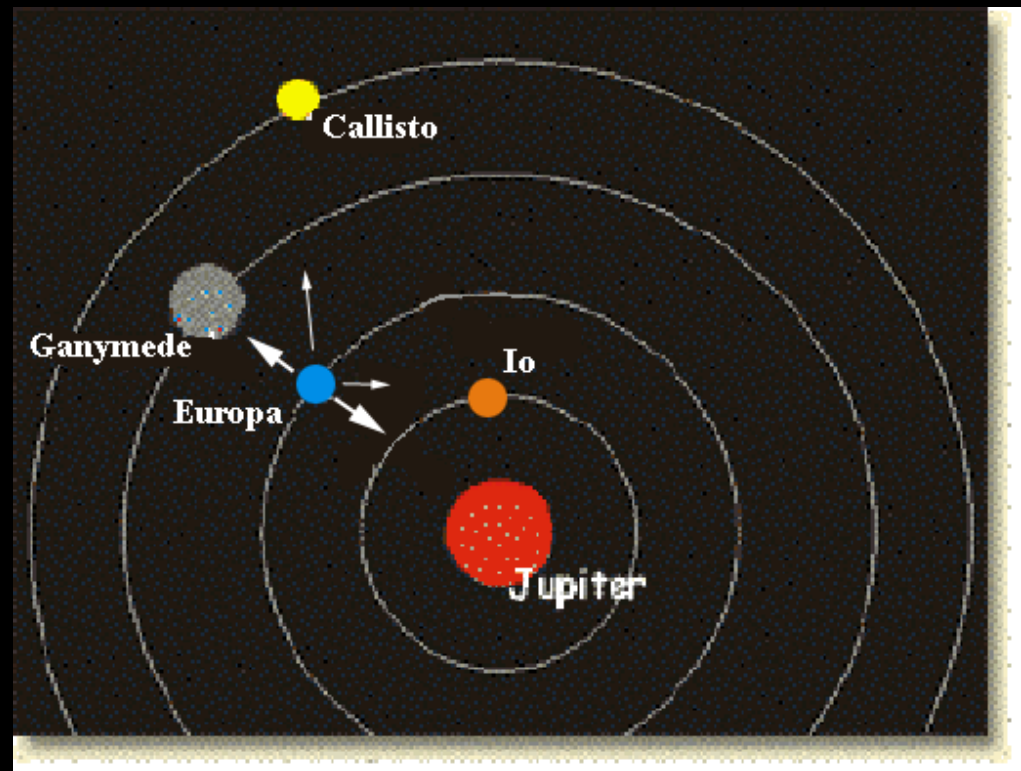
Callisto

← To Jupiter

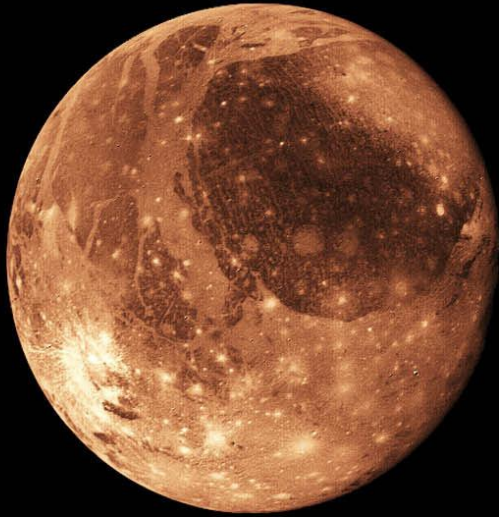
How do we get heat into the interior of Europa?

Europa is tugged towards Jupiter, but is also pulled away from Jupiter by Io, Ganymede and Callisto.

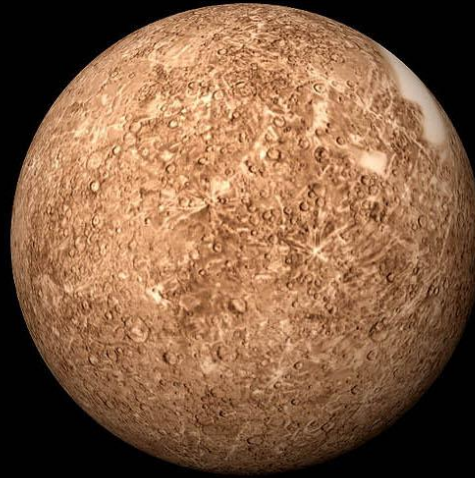
- Without tidal heating, Europa would look like Callisto.



Sizes of some of the Galilean satellites of Jupiter



Ganymede



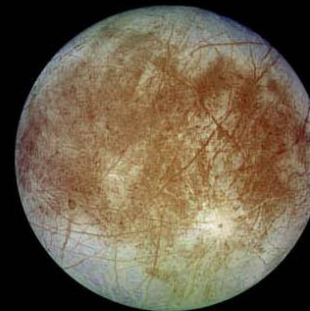
Mercury



Callisto



Moon

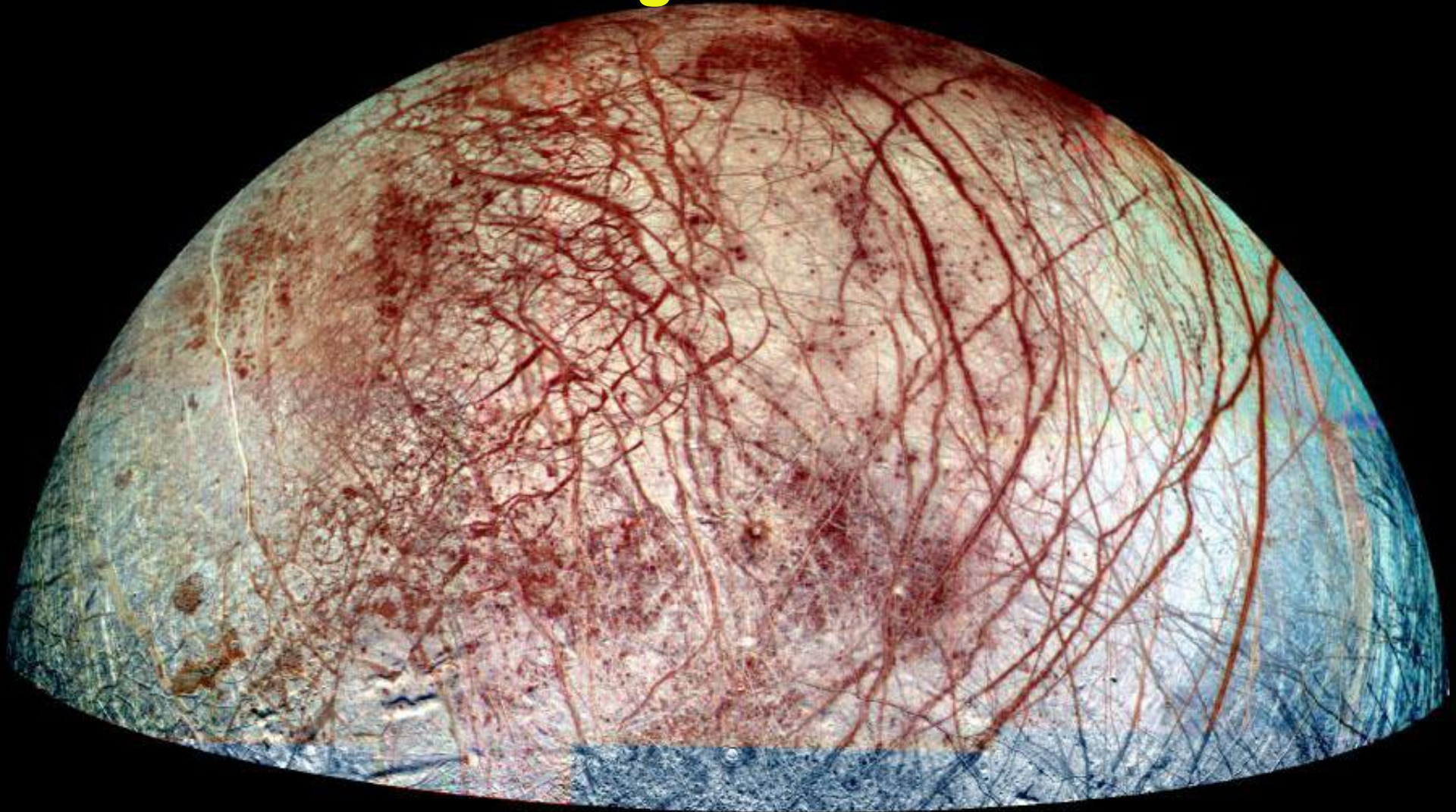


Europa



Io

Europa: 3,138 km diameter; density 3.04 gm/cc



Saturn

Mass = 95 Earths, Radius = 9.4 Earths, density = 0.7 x water (floats)

Distance: 9.5 AU; Orbital Period: 29.4 years; Rotation period: 10.5 hours.

Although it is impossible to think of Saturn without its rings, they are of no planetary consequence, and are temporary. All the other outer planets also have rings systems (but not as nice).



The Density of Saturn is 0.69 g/cm³

Saturn is made of materials that are lighter than water. If you could fit Saturn in a lake, it would float!



Saturn Statistics

Mass (Earth = 1)	9.5181e+01
Equatorial radius (km)	60,268
Equatorial radius (Earth = 1)	9.4494e+00
Mean density (gm/cm³)	0.69
Mean distance from the Sun (km)	1,429,400,000
Mean distance from the Sun (Earth = 1)	9.5388
Rotational period (hours)	10.233
Orbital period (years)	29.458
Orbital eccentricity	0.0560
Tilt of axis (degrees)	25.33
Orbital inclination (degrees)	2.488
Equatorial escape velocity (km/sec)	35.49
Mean cloud temperature	-125°C
Atmospheric pressure (bars)	1.4

Saturn

- *Saturn is the second largest planet and the sixth from the sun.*

Saturn is also made up mostly of Hydrogen and Helium

- *75% hydrogen and 25% helium*
- *Water, methane, ammonia and "rock"*
- *Rocky core*
- *Winds up to 500 m / second*
- *Top of cloud Temperature -160 °C*



*Can see it in the night sky
without a telescope!*

56 moons and counting



- *Saturn is a gas giant.*
- *Saturn's magnetic field is 20x less than Jupiter's, but its core rotation period (10.5 hours) is similar.*
- *Saturn's Moons:*
 - *Titan is the big one, and is larger than planet Mercury!*
 - *Mimas has a huge crater.*
 - *Epimetheus and Janus, just inside the orbit of Mimas, are continually exchanging orbits with one another in a "waltz" -- they are called the coorbital satellites.*

SATURN

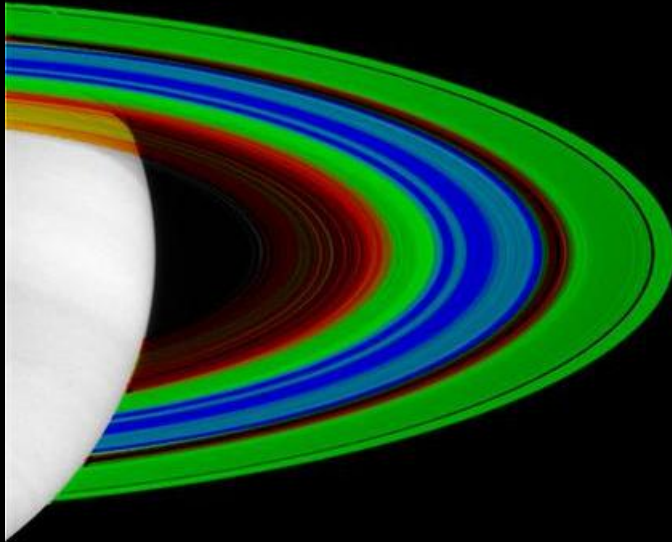


Saturn's rings are not solid; they are composed of small countless particles

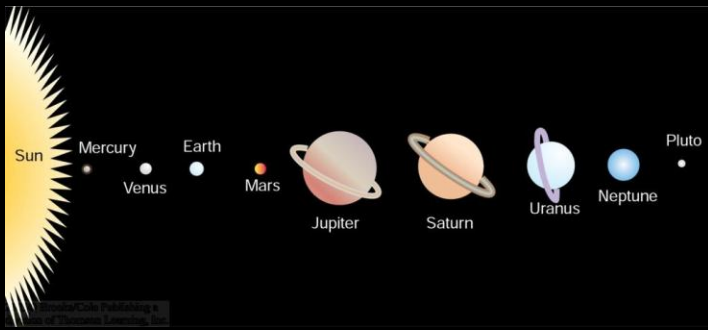
Taking just 29 years to rotate around the sun, Saturn rotates every 10 hours thus creating strong winds . The rings are very thin. Though they're 250,000km or more in diameter, they're less than one kilometer thick.

Temperatures range from 55° C to -200° C

Water ice in rings



Red: -162 °C
Blue -202 °C
Green -183 °C



Uranus

- Uranus is the third largest planet and the seventh from the sun.
- Uranus is one of the giant gas planets.
- Uranus is blue-green because of the methane in its atmosphere.

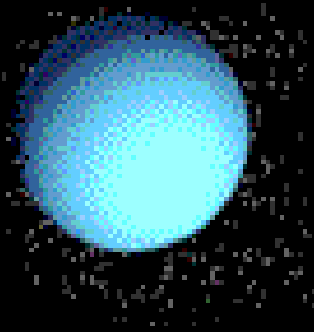
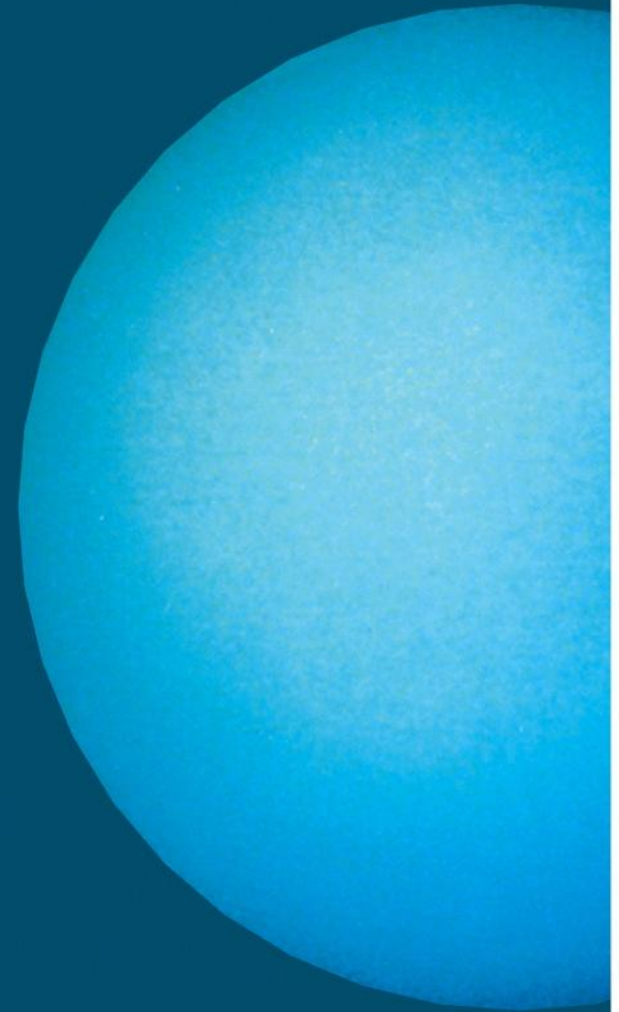


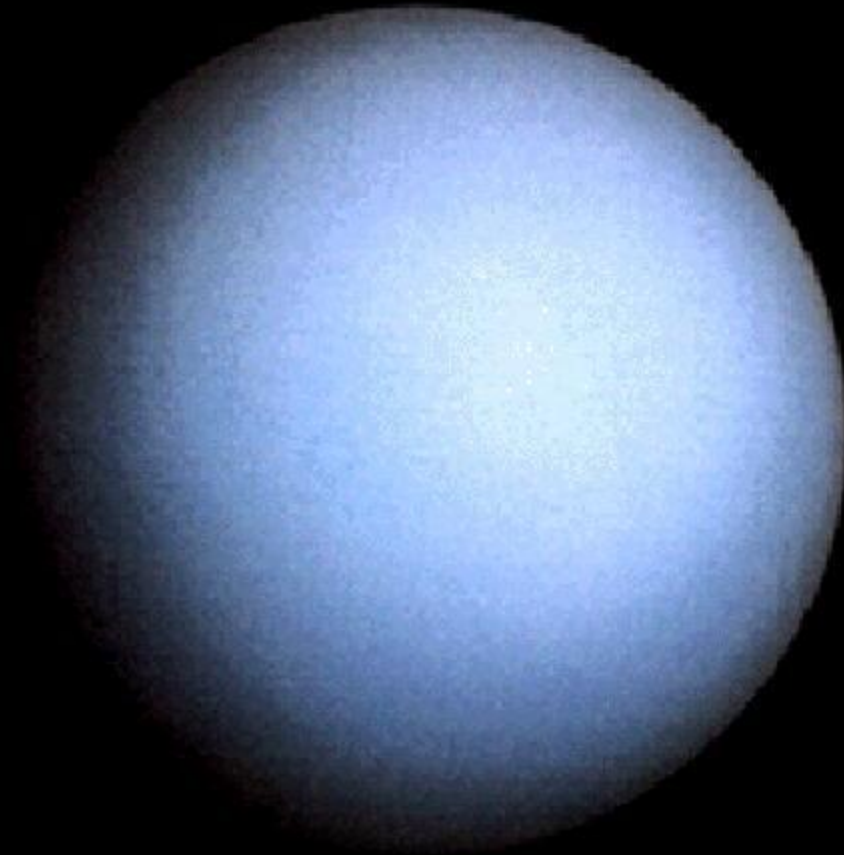
Table 16-1

Uranus Data

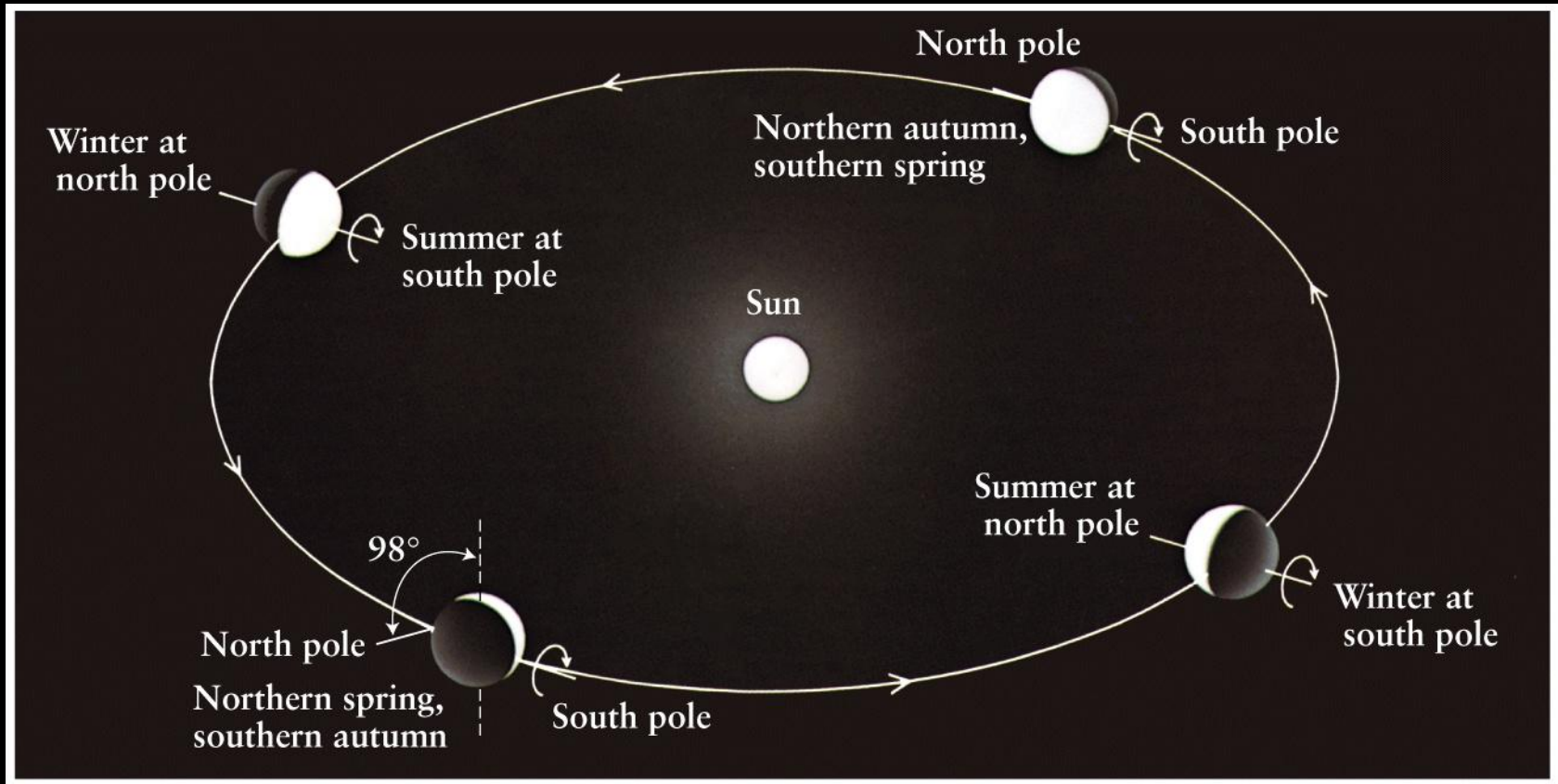
Average distance from Sun:	19.194 AU = 2.871×10^9 km
Maximum distance from Sun:	20.017 AU = 2.995×10^9 km
Minimum distance from Sun:	18.371 AU = 2.748×10^9 km
Eccentricity of orbit:	0.0429
Average orbital speed:	6.83 km/s
Orbital period:	84.099 years
Rotation period (internal):	17.24 hours
Inclination of equator to orbit:	97.86°
Inclination of orbit to ecliptic:	0.77°
Diameter:	51,118 km = 4.007 Earth diameters (equatorial)
Mass:	8.682×10^{25} kg = 14.53 Earth masses
Average density:	1318 kg/m ³
Escape speed:	21.3 km/s
Surface gravity (Earth = 1):	0.90
Albedo:	0.56
Average temperature at cloudtops:	-218°C = -360°F = 55 K



First planet found “on purpose” (1846)



Orbit of Uranus around the Sun: Rotation axis tilted at 98 degrees !

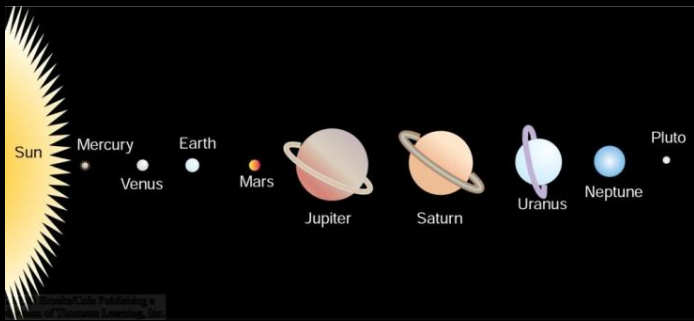


daylight lasts 42 years followed by 42 years of night

Uranus takes 84 years to revolve around the Sun.

Uranus

- Uranus ~ 25,000 Kms radius
- Uranus rotates somewhat backwards like Venus; rotation period = 17hr 14m
- Weak magnetic field ~ 0.74 x Earth's, could be a very small metallic mantle
- H₂O (ice) mantle



URANUS

Only 2,870,000,000 billion kilometer from our sun, this planet has a rocky core surrounded by water, ammonia and methane in both ice and liquid form.

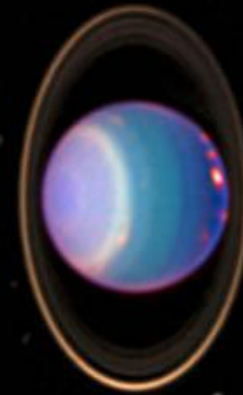
Temperature -212°C at surface



Uranus

- *15% H, little helium – mostly ices*
- *Uniform through out; no rocky core*
- *Blue from methane absorption of red light (atmosphere)*
atmosphere has mostly hydrogen and helium

Uranus



11 rings, 27 satellites

*one of
Neptune's
moons*



Miranda



Ariel



Proteus



Umbriel



Titania



Oberon



Earth's moon



Uranus' Moons