Chap 12b  Saturn

Gaps and Shepard Moons
- Gaps and Mimas
- Shepards and F ring
- Co-orbital satellites
- Encke gap and Pan

Medium-sized moons
- Titan

Moons beyond Titan
- Hyperion, Iapetus, and Phoebe
- (Mimas, Enceladus, Tethys, Dione, Rhea)

Gaps and Shepards
- Cassini and Encke gaps----- Mimas
- Encke gap and Pan
- Atlas and A ring
- Pandora and Prometheus and F-Ring
- Co-orbital satellites Janus and Epimetheus,
  - Enceladus and E ring

Cassini Division and Encke Division------ Mimas

Cassini Division
- At the outer edge of the B-Ring is Cassini Division.
- In the Gap, are three ringlets
- 2:1 resonance with Mimas: -- The material in the gap circle Saturn 2 times for every one time for Mimas

Encke Division --> Mimas and Pan

Encke Division and Mimas
- Encke Division 1/10 the width of the Cassini Division and is 360 km wide
- 5:4 resonance with Mimas: -- The material in the gap circle Saturn 5 times for every three times for Mimas

Encke gap and Pan
In this gap are: 2 kinky ringlets and a small satellite (Pan)
Pan acts as a shepherd and is responsible for keeping the Encke gap open. It has a diameter of 20 kilometers
Atlas, orbits near the outer edge of the A-ring and is about 40 by 20 kilometers in size. A shepherd satellite for Saturn’s A-ring.

Shepherd moons, Pandora and Prometheus, orbit just outside and inside the F ring.

The twisted core of the F ring is flanked by three fainter ringlets.

The inner moon is orbiting faster than the ring particles, and the ring particles are orbiting faster than the outer moon.

F ring and shepherd moons

Co-orbital satellites Janus and Epimetheus, Janus and Epimetheus can't pass because their orbits are too close and the satellites are too big—they play a never-ending game of tag.

From A to C, moon 2 gains on moon 1. However, before it can overtake it, the two moons swap orbits, moon 1 pulls moon 2 up and moon 2 pulls moon 1 down and they change orbits. The whole process repeats every four years.

How Shepherd Moons Work

As the ring particles pass the outer moon, the gravity of the outer moon pulls back on the ring particles causing them to lose energy. These particles slow down. The particles on the outer edge of the ring, having been decelerated, move to a lower orbit.

As the inner moon passes the ring particles, its gravity pulls on the individual particles, giving them energy and increasing their velocity. The particles on the inner edge of the ring, having been accelerated, move to a higher orbit.
E Ring---Ice volcanoes

E ring is a result of particles injected into Saturn orbit by the Enceladus geysers:

Cryovolcanism: geysers arise from near-surface pockets of liquid water with temperatures near 0 degrees C—-that’s hot when compared to the moon’s surface temperature of -200 degrees C.

Enceladus backlit by the sun show the fountain-like sources of the fine spray of material from ice-fountains of the moon Enceladus. The spray forms Saturn's E ring.

Tethys and Dione--->Lagrangian Satellites

Lagrangian satellites are pairs of moons that share an orbit. The smaller satellite orbits at the Langrangian point of a larger satellite. Lagrangian points lie 60° ahead or behind the larger satellite.

Tethys: Calypso and Telesto are Lagrangian satellites. Dione: Helene is the Lagrangian satellite of

E Ring

Cryovolcanism:

medium-sized moons (Mimas, Enceladus, Tethys, Dione, Rhea)

Diameters ~1500 km---400 km

Total moons = 46 (May 9,2005)

Lagrangian Satellites

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Titan is larger than the planets Mercury and Pluto.

Orbital Period = 15.94 days

The Huygens probe landed on the surface

It has an atmosphere which is more dense than those of Mercury, Earth, Mars.

Surface pressure: 60% greater than air pressure on Earth

Because of the thick, hazy atmosphere, surface features are only visible in infrared images.

The thick, orange-colored haze absorbs visible sunlight, allowing only 10 percent of the light to reach the surface.

Lower down in the atmosphere, the haze turns into a globe-enshrouding smog of complex organic molecules.

Radar imaging provide convincing evidence for large bodies of liquid on Titan today. Dark patches, which resemble lakes, seem to be sprinkled over Titan. Dark patches were seen ranging from 1.8 miles to more than 43 miles across.

Scientists have speculated that liquid methane or ethane might form lakes on Titan, particularly near the somewhat colder polar regions. The surface temperature is a chilling -178°C.
Hyperion - chaotic rotation - unpredictable tumbling caused by Titan.

The spongy appearance is caused by dark materials accumulating on crater floors that is warmed by sunlight and melt deeper into the surface, allowing surrounding ice to vaporize away.

Iapetus-- is two-faced: its leading side is very dark (reflects 3% of incoming light), while its trailing side is bright (reflects 50% of incoming light).

Phoebe retrograde orbit---550 days---may be a captured Centaur, comet/Asteroid that orbit the Sun between Jupiter and Neptune.