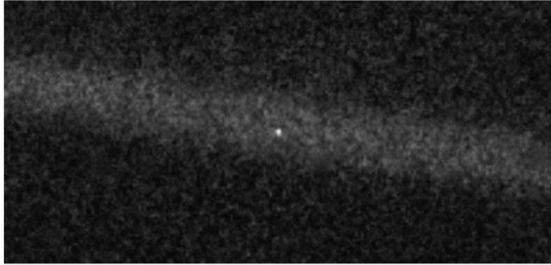


Chapter 7 Our Planetary System

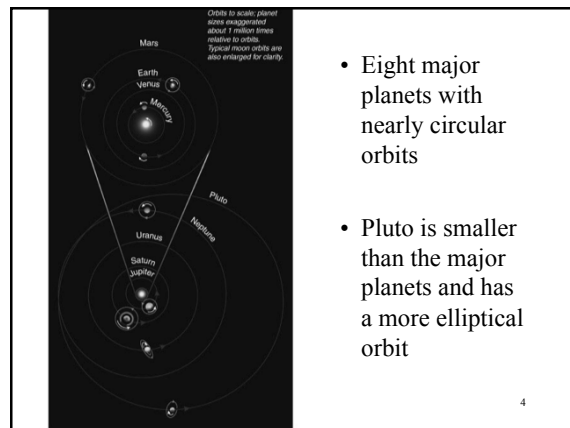
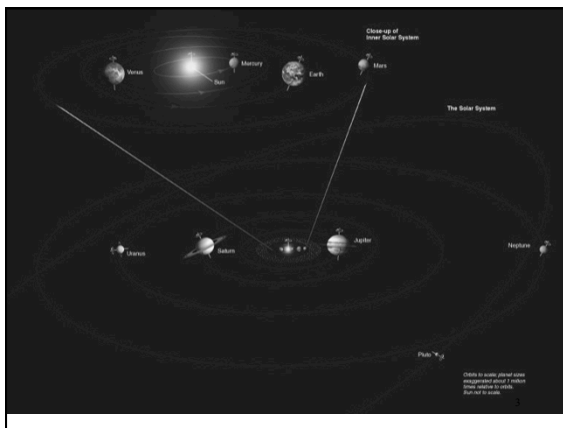


Earth, as viewed by the Voyager spacecraft

Studying the Solar System

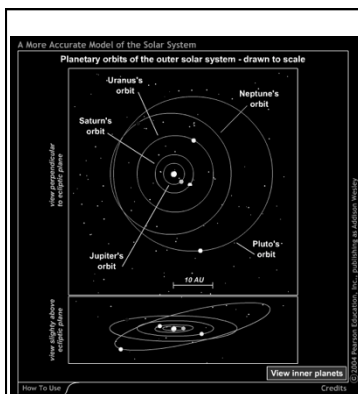
- What does the solar system look like?
See model simulator views at <http://space.jpl.nasa.gov>
- What can we learn by comparing the planets to one another?
- What are the major features of the Sun and planets?

2



- Eight major planets with nearly circular orbits
- Pluto is smaller than the major planets and has a more elliptical orbit

4



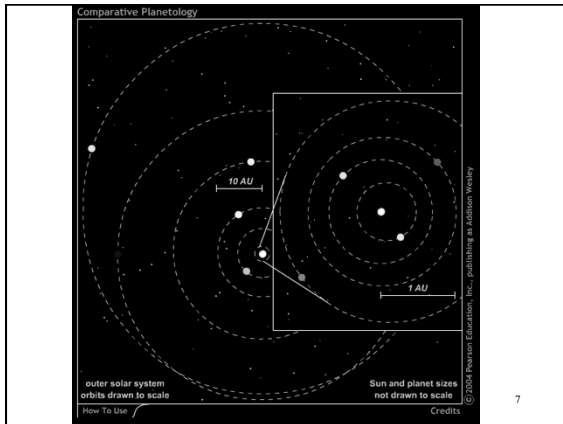
- Planets all orbit in same direction and nearly in same plane

5

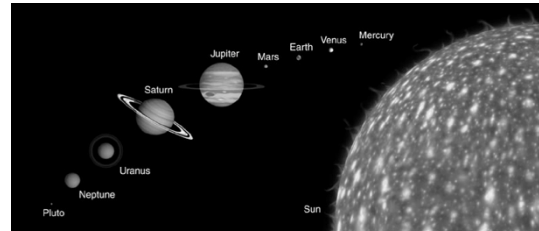
Comparative Planetology

- Comparing the planets reveals patterns among them.
- We can learn more about Earth by studying other worlds in the solar system.
- Focus on *processes* common to multiple worlds.

6



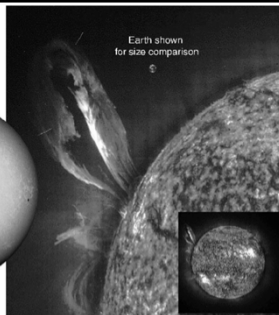
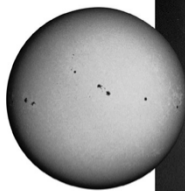
What are the major features of the Sun and planets?



Sun and planets to scale

8

Sun



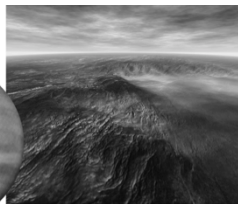
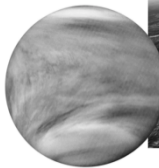
- Over 99.9% of solar system's mass
- Made mostly of H/He gas (plasma)
- Converts 4 million tons of mass into energy each second

Mercury (NASA MESSENGER)



- Made of metal and rock; large iron core
- Desolate, cratered; long, tall, steep cliffs
- Very hot and very cold: 425°C (day), -170°C (night)

Venus



- Nearly identical in size to Earth; surface hidden by clouds
- Hellish conditions due to an extreme **greenhouse effect**
- Even hotter than Mercury: 470°C, day and night

11

Earth

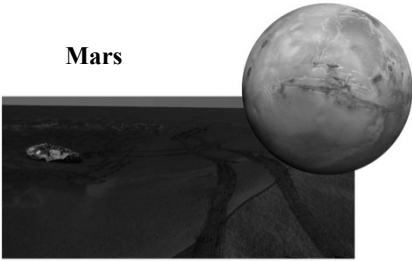


Earth and Moon to scale

- An oasis of life
- A large portion of surface liquid water
- A surprisingly large moon

12

Mars



- Looks almost Earth-like, but don't go without a spacesuit!
- Giant volcanoes, a huge canyon, polar caps, more...
- Water flowed in the distant past; could there have been life?

13

Mars Science Laboratory

<http://mars.jpl.nasa.gov/msl/>



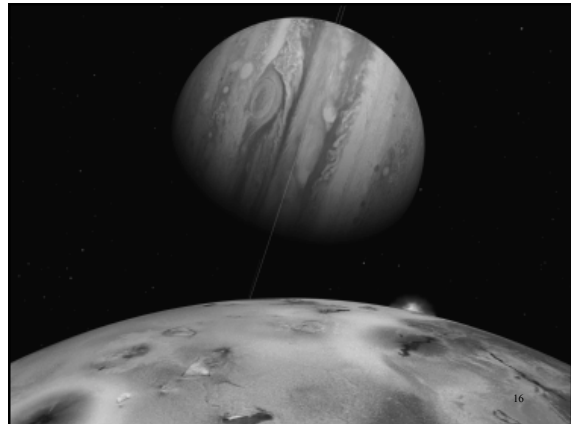
14

Jupiter



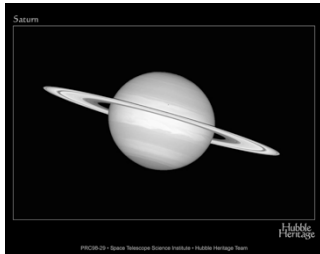
- Much farther from Sun than inner planets
- Mostly H/He; no solid surface
- 300 times more massive than Earth
- Many moons (4 Galilean) and rings

15



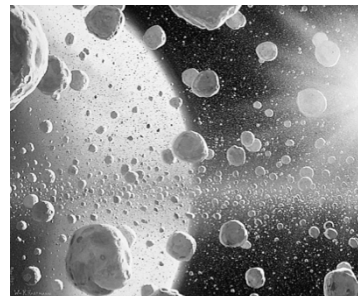
16

Saturn



- Giant and gaseous like Jupiter
- Spectacular rings
- Many moons, including cloudy Titan
- Cassini spacecraft currently studying it

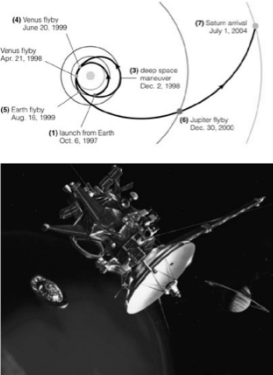
17



Artist's conception

Rings are NOT solid; they are made of countless small chunks of ice and rock, each orbiting like a tiny moon.

18



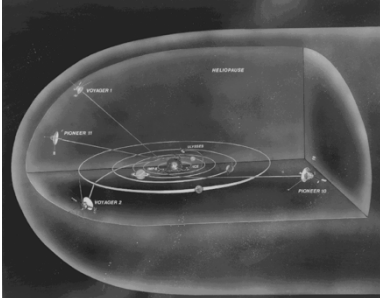
(4) Venus flyby June 20, 1999
 (2) Venus flyby Apr. 21, 1999
 (6) Earth flyby Aug. 18, 1999
 (1) launch from Earth Oct. 6, 1997
 (3) deep space maneuver Dec. 2, 1999
 (5) Jupiter flyby Dec. 30, 2000
 (7) Saturn arrival July 1, 2004

Cassini probe arrived July 2004
(Launched in 1997)

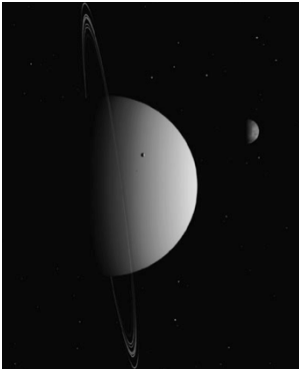
19

Voyager 1 & 2 to Outer SS

<http://voyager.jpl.nasa.gov/index.html>
<http://voyager.jpl.nasa.gov/multimedia/audiovideo/discovery20110428-640.mov>



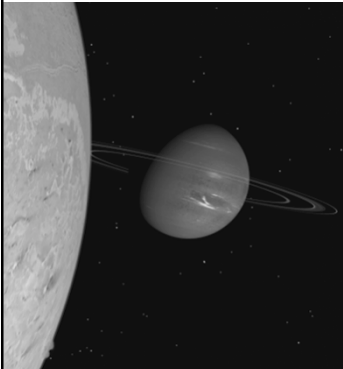
20



Uranus

- Smaller than Jupiter/Saturn; much larger than Earth
- Made of H/He gas & **hydrogen compounds** (H_2O , NH_3 , CH_4)
- Extreme axis tilt
- Moons & rings

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Neptune

- Similar to Uranus (except for axis tilt)
- Many moons (including Triton)

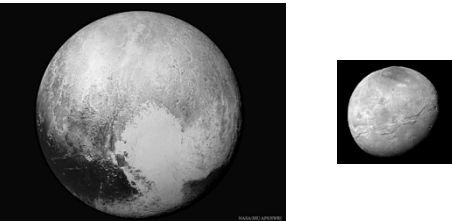
22

New Horizons to Pluto (July 2015)



23











Pluto



- Much smaller than other planets
- Icy, comet-like composition
- Its moon Charon is similar in size

24

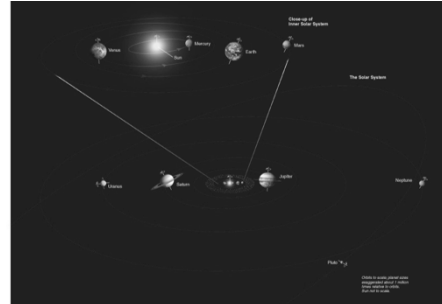
TABLE 11 The Planetary Data*

Photo	Planet	Relative Size	Average Distance from Sun (AU)	Average Equatorial Radius (km)	Mass (Earth = 1)	Average Density (g/cm ³)	Orbital Period	Rotation Period	Axial Tilt	Average Surface Temperature (°C) (day/night)	Composition	Known Moons (2012)	Rings?
	Mercury	-	0.387	2440	0.055	5.43	87.9 days	58.6 days	0.0°	700 K (day) 100 K (night)	Rocks, metals	0	No
	Venus	•	0.723	6051	0.82	5.24	225 days	243 days	177.3°	740 K	Rocks, metals	0	No
	Earth	•	1.00	6378	1.00	5.52	1.00 year	23.93 hours	23.5°	240 K	Rocks, metals	1	No
	Mars	•	1.52	3397	0.11	3.93	1.88 years	24.6 hours	25.2°	210 K	Rocks, metals	2	No
	Jupiter	●	5.20	71,492	318	1.33	11.9 years	9.93 hours	3.1°	125 K	H, He, hydrogen compounds ^b	67	Yes
	Saturn	●	9.54	60,268	95.2	0.70	29.5 years	10.6 hours	26.7°	95 K	H, He, hydrogen compounds ^b	62	Yes
	Uranus	●	19.2	25,559	14.5	1.32	84.8 years	17.2 hours	97.9°	60 K	H, He, hydrogen compounds ^b	27	Yes
	Neptune	●	30.1	24,764	17.1	1.64	165 years	16.1 hours	29.6°	60 K	H, He, hydrogen compounds ^b	13	Yes
	Pluto	•	39.5	1160	0.0022	2.0	248 years	6.39 days	112.3°	44 K	Ices, rock	5	No
	Eris	•	67.2	1200	0.0026	2.3	357 years	1.08 days	70°	43 K	Ices, rock	1	No

*Including the dwarf planets Pluto and Eris, Appendix F gives a more complete list of planetary properties.
^aSurface temperatures for all objects except Jupiter, Saturn, Uranus, and Neptune, for which cloud-top temperatures are listed.
^bIncludes water (H₂O), methane (CH₄), and ammonia (NH₃).
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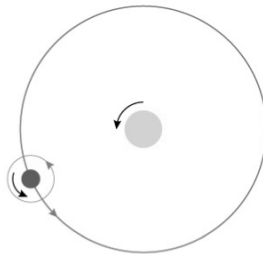
25

What features of the solar system provide clues to how it formed?



26

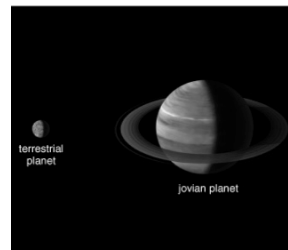
Motion of Large Bodies



- All large bodies in the solar system orbit in the same direction and in nearly the same plane
- Most also rotate in that direction

27

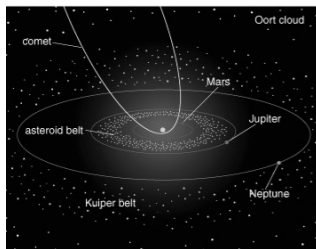
Two Main Planet Types



- Terrestrial planets are rocky, relatively small, and close to the Sun
- Jovian planets are gaseous, larger, and farther from Sun

28

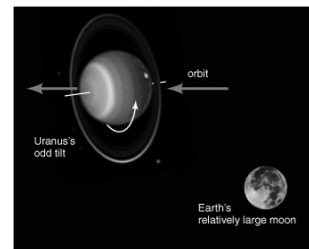
Swarms of Smaller Bodies



- Many rocky asteroids and icy comets populate the solar system

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Notable Exceptions



- Several exceptions to the normal patterns need to be explained

30

Next time:

- Chapter 8:
Formation of the Solar System
please read pages 215 – 228 in text.