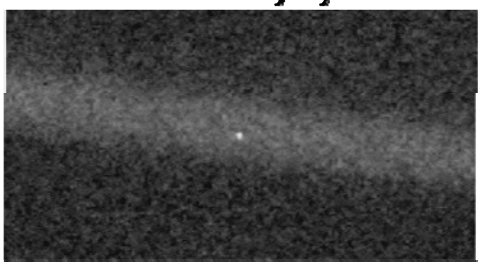
Chapter 7
Our Planetary System



Earth, as viewed by the *Voyager* spacecraft

7.1 Studying the Solar System

Our goals for learning:

- What does the solar system look like?
- What can we learn by comparing the planets to one another?
- What are the major features of the Sun and planets?

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

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

Comparative Planetology

- We can learn more about a world like our Earth by studying it in context with other worlds in the solar system.
- Stay focused on *processes* common to multiple worlds instead of individual facts specific to a particular world.

- Comparing the planets reveals patterns among them
- Those patterns provide insights that help us understand our own planet

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

- Made of metal and rock; large iron core
- Desolate, cratered; long, tall, steep cliffs
- **V**ery 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

Earth

- An oasis of life
- The only surface liquid water in the solar system
- A surprisingly large moon

Mars

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

Jupiter

- Much farther from Sun than inner planets
- Mostly H/He; no solid surface
- 300 times more massive than Earth
- Many moons, rings …

Jupiter's moons can be as interesting as planets themselves, especially Jupiter's four *Galilean moons*

- Io (shown here): Active volcanoes all over
- Europa: Possible subsurface ocean
- Ganymede: Largest moon in solar system
- Callisto: A large, cratered "ice ball"

Saturn

- Giant and gaseous like Jupiter
- Spectacular rings
- Many moons, including cloudy Titan

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

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

Neptune

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

Pluto (and other Dwarf Planets)

- Much smaller than major planets
- Icy, comet-like composition
- Pluto's main moon (Charon) is of similar size

What have we learned?

- What does the solar system look like?
  - Planets orbit Sun in the same direction and in nearly the same plane.
- What can we learn by comparing the planets to one another?
  - Comparative planetology looks for patterns among the planets.
  - Those patterns give us insight into the general processes that govern planets
  - Studying other worlds in this way tells us about our own Earth

What have we learned?

- What are the major features of the Sun and planets?
  - Sun: Over 99.9% of the mass
  - Mercury: A hot rock
  - Venus: Same size as Earth but much hotter
  - Earth: Only planet with liquid water on surface
  - Mars: Could have had liquid water in past
  - Jupiter: A gaseous giant
  - Saturn: Gaseous with spectacular rings
  - Uranus: A gas giant with a highly tilted axis
  - Neptune: Similar to Uranus but with normal axis
  - Dwarf Planets: Most (like Pluto) are icy like comets

7.2 Patterns in the Solar System

Our goals for learning:

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

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

Two Main Planet Types

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

Swarms of Smaller Bodies

- Many rocky asteroids and icy comets populate the solar system

Notable Exceptions

- Several exceptions to the normal patterns need to be explained

What have we learned?

- What features of the solar system provide clues to how it formed?
  - Motions of large bodies: All in same direction and plane
  - Two main planet types: Terrestrial and jovian
  - Swarms of small bodies: Asteroids and comets
  - Notable exceptions: Rotation of Uranus, Earth's large moon, etc.