

## Today's Class: Exploring the Solar System

- Reading on Mercury – Sections 9.3 and 10.3 in Cosmic Perspective.
- Look over instructions for final paper due on Dec. 7.



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## Today's Class

- Overview of Solar System
- Tour through the Solar System – Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, dwarf planets.
- How do robotic spacecraft work?
  - Flybys
  - Orbiters
  - Landers
  - Sample Return

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## Reading Class Exercise: The major way in which we learn about Earth's interior is through

- Drilling deep into the crust.
- Using X-rays to image the interior.
- Studying seismic waves.
- Using spacecraft imagery.

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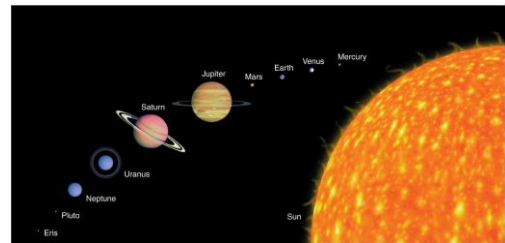
## The major way in which we learn about Earth's interior is through

- Drilling deep into the crust.
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- Studying seismic waves.**
- Using spacecraft imagery.

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## What are the major features of the Sun and planets?



- Sun and planets to scale

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## Mercury

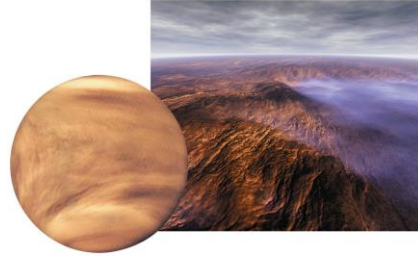


- Made of metal and rock; large iron core
- Desolate, cratered; long, tall, steep cliffs
- Very hot, very cold: 425°C (day), -170°C (night)

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## 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

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## Earth

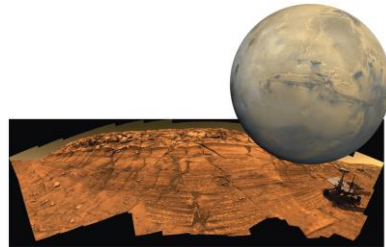


- An oasis of life
- The only surface liquid water in the solar system
- A surprisingly large moon

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## 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?

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## Jupiter

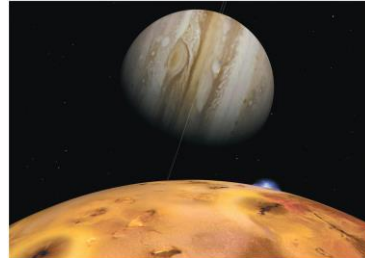


- Much farther from Sun than inner planets
- Mostly H/He; no solid surface
- 300 times more massive than Earth
- Many moons, rings

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## Jupiter



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"

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## Saturn

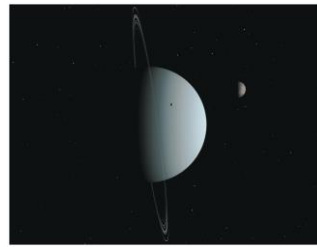


- Giant and gaseous like Jupiter
- Spectacular rings
- Many moons, including cloudy Titan

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## Uranus



- Smaller than Jupiter/Saturn; much larger than Earth
- Made of H/He gas and hydrogen compounds (H<sub>2</sub>O, NH<sub>3</sub>, CH<sub>4</sub>)
- Extreme axis tilt
- Moons and rings

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## Neptune

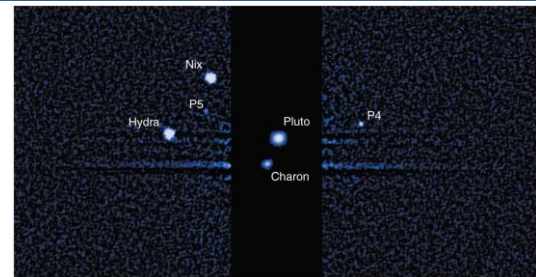


- Similar to Uranus (except for axis tilt)
- Many moons (including Triton)

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## Dwarf Planets: Pluto, Eris, and more



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

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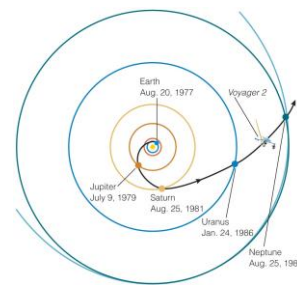
## How do robotic spacecraft work?

1. Flybys
2. Orbiters
3. Probes or Landers
4. Sample Return Missions
5. Combination spacecraft (e.g., landers & orbiters)

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## Flybys



- A flyby mission flies by a planet just once.
- Cheaper than other mission but less time to gather data

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## Orbiters

- Go into orbit around another world
- More time to gather data but cannot obtain detailed information about world's surface



Lunar Reconnaissance Orbiter

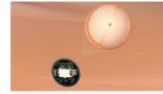
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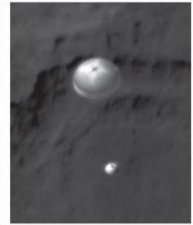
## Probes or Landers



1 Friction slows spacecraft as it enters Mars atmosphere.



2 Parachute slows spacecraft to about 350 km/hr.



3 Rockets slow spacecraft to halt; "sky crane" tethers lowers rover to surface.



4 Tether released, the rocket heads off to crash a safe distance away.

As it flew overhead, the Mars Reconnaissance Orbiter took this photo of the spacecraft with its parachute deployed.

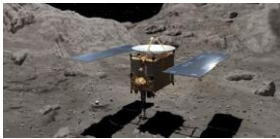
- Land on surface of another world
- Explore surface in detail

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## Sample Return Missions

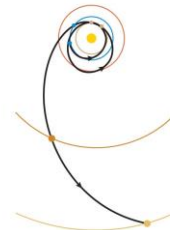
- Land on surface of another world
- Gather samples
- Spacecraft designed to blast off other world and return to Earth
- *Apollo* missions to Moon are one example; *Hyabusa* to an asteroid is another; OSIRIS-REx



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## Combination Spacecraft



- *Cassini/Huygens* mission contains both an orbiter (*Cassini*) and a lander (*Huygens*).

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