



The Moon, Our Cosmic Companion

What We Will Learn Today

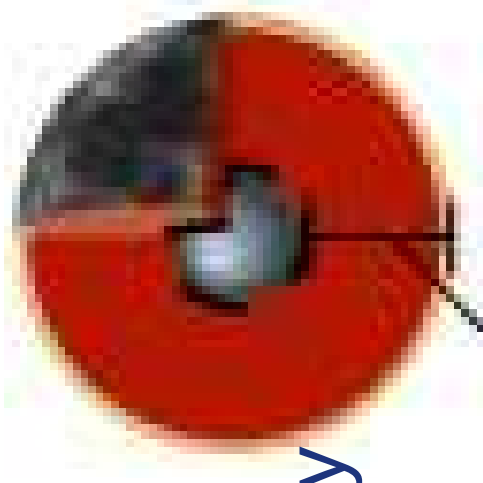
- What are the Moon's features?
- What geological processes shaped our Moon?
- Why does the Moon have such a thin atmosphere?
- How have we explored the Moon?
- How is the Moon unique in the solar system?

Moon Details

Property	Value
Semi-major axis	384,000 km (0.0026 AU)
Size (radius)	0.27 R _{earth}
Mass	0.012 M _{earth}
Average density	3.34 g/cc
Composition	Rocks, metals
Average surface temperature	380 K (day), 120 K(night)
Orbital period	27.3 days (Sidereal)
Rotation period (sidereal)	27.3 days
Axis tilt	1.5° (relative to the ecliptic)
Orbital inclination	5.1° (relative to the ecliptic)
Orbital eccentricity	0.055
Gravity	1/6 Earth's gravity

Geology of the Moon

- Small core
 - Consistent with formation theory
- Thick lithosphere
 - Cooled quickly, no convection
- Geological processes stopped early
 - Geologically dead now

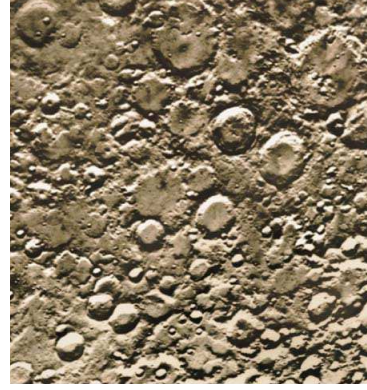


Impact Craters & Maria

- Lots of impact craters
 - Moon formed before the period of heavy bombardment
- Dark regions
 - Called maria, after the Latin word for seas
 - Relatively crater-free
 - Younger surface, paved by early activity on the Moon (~ 3 billion years old)
 - Runny lava, basalt, smooth surface
 - Tectonic stress features



Fig 9.20



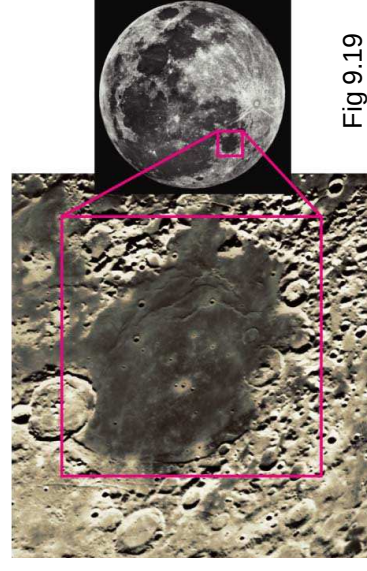
4 billion years ago



Huge impact



Few 100 million years later

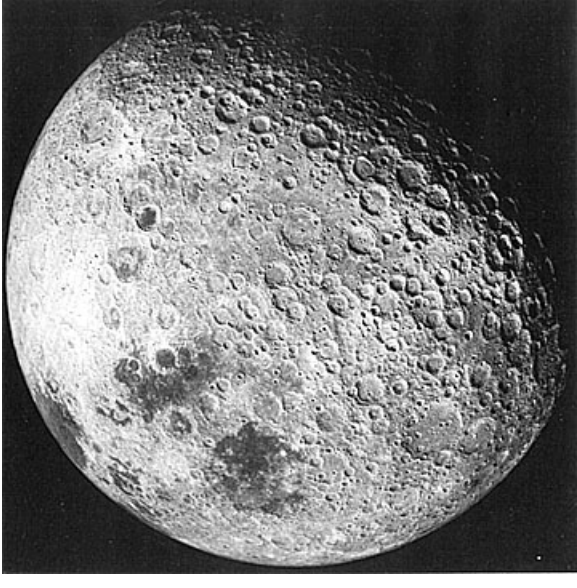


Current image

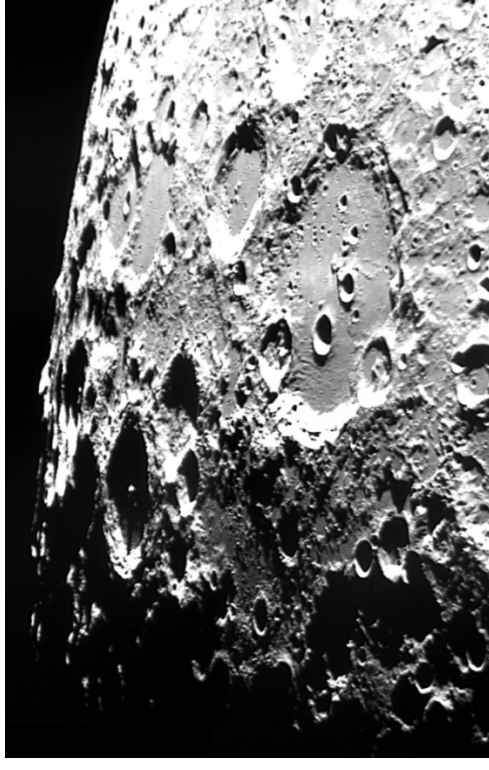
Fig 9.19

Lunar Highlands

- Bright regions
 - Higher concentration of aluminum
- Higher, by a few kilometers
- Older, over 4 billion years
- Heavily cratered
- Far-side of the Moon is largely highlands
 - Perhaps mantle pulled towards Earth by its gravity
 - Remember, Moon was closer to the Earth then
 - Therefore thinner crust on the earth side cracks easier



Far side of the Moon



The Moon Today: Desolate

- Virtually no atmosphere
 - Too small, weak gravity, no volcanism
 - Created by surface ejection
 - Lost as air escapes into space
- No wind
- No water
 - Some ice in the bottom of craters at poles
- Rare impacts
- Regular micrometeorites
 - Sandblast the surface
 - Smooth powdery soil: *Regolith*
- The result: No erosion
 - Astronaut's footprints will remain for millions of years!

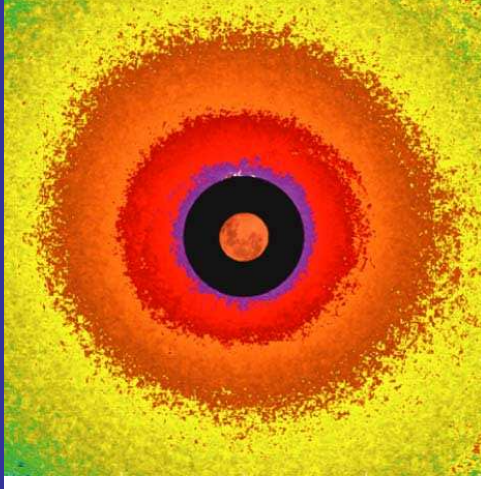


Fig 10.22



Fig 9.21

Lunar Exploration

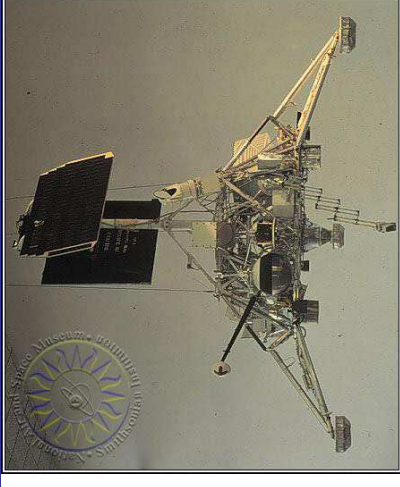
- Good target for early space missions
- 1960's cold war & space race
- Soviets won rounds 1, 2, 3, 4
 - Launched first artificial satellite
 - Sputnik 1, 1957
 - Orbited the moon first
 - Luna spacecraft, 1957
 - Put man in space first
 - Yuri Gagarin, April 12, 1961
 - Landed spacecraft on moon
 - Luna 9, 1966



Vostok spacecraft

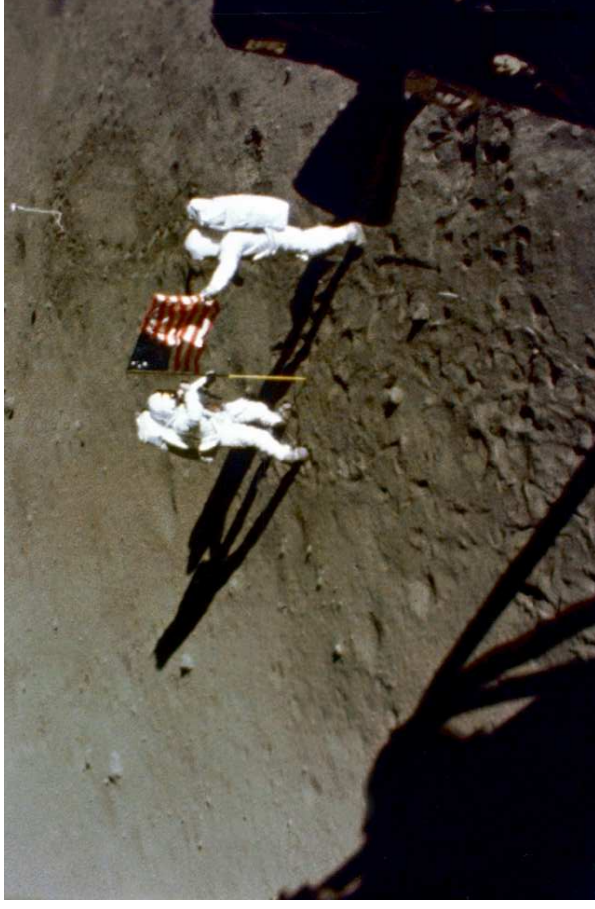
Humans in Another World!

- US won round 5
 - Landed humans on moon
 - Apollo 11, July 20, 1969
 - Neil Armstrong, 'Buzz' Aldrin, Michael Collins
- Over the next 3 years
 - 5 more manned Apollo missions explored lunar surface
 - Collected rock samples
- Then, abandoned due to declining public interest



US Surveyor Craft

5 of 7 landed safely on the Moon
1966-68



Return to the Moon?

- Since 1972, no human has returned to the Moon
- The United States and China are currently planning expeditions to our neighboring world
- In each case, plans include a possible lunar base
- The US plans to use the return to the Moon as a stepping stone to Mars



NASA plans for a Lunar Base

Unique Features of the Moon

- Formed by collision
- Largest moon among terrestrial planets
- Small core
- Synchronous rotation
 - Tidally locked
- Only known world visited by aliens!