

# Chapter 22

## Lecture Notes

- I. The Space Race
  - a. After WWII the US and the USSR (Soviet Union), were in a “**Cold War**”. Each trying to reach space and take command of the “high ground”.
  - b. Soviets were way ahead in the beginning.
    - i. First to orbit artificial satellite, **Sputnik I**
    - ii. First to put a man in space and first to orbit the earth, **Yuri Grigaran**
    - iii. First to place a female into space
  - c. US played “catch up”
    - i. **John F. Kennedy** speech promises before the decade of the 60’s is out, to land an American on the moon and return him safely to the Earth
    - ii. **NASA : National Aeronautics and Space Administration**
    - iii. 1<sup>st</sup> American in space, **Alan Shepard** w/ 15 minute suborbital flight
    - iv. 2<sup>nd</sup> American in space, **Gus Grissom**, also in a suborbital flight, blew the hatch on the capsule after splashdown and the capsule was lost. Because of this “accidental” blowing of the hatch a redesign is partially responsible for the Apollo 1 disaster.
    - v. 3<sup>rd</sup> American in space, **John Glenn**, first American to orbit the Earth later becomes US Senator from Ohio.
  - d. US manned space programs

Program	# of Astronauts	Purpose
<b>Mercury</b>	One astronaut	To see if we could survive or live in space
<b>Gemini</b>	Two astronauts	To see if we could work and Rendezvous
<b>Apollo</b>	Three Astronauts	Land safely and explore the moon
<b>Shuttle</b>	5 – 7 astronauts	Cargo ship to transport into low Earth orbit
<b>International Space Station</b>	Varies	Permanent Manned presence in space

- i. 7 Original Mercury Astronauts: **Alan Shepard, Gus Grissom, John Glenn, Wally Schirra, Scott Carpenter, Gordon Cooper and Deke Slaton**
- ii. Gemini proves rendezvous possible and first American Space walk
- iii. Apollo Program
  1. **Apollo 1** Disaster: **Ed White, Roger Chaffe and Gus Grissom** die in launch pad fire while inside their Apollo 1 capsule. Fire was a result of 100% pure oxygen inside capsule, redesigned hatch that opened in instead of pushing out, and a short, a spark that ignited the fire.
  2. **Apollo 8**: Jim Lovell was on board this flight and was the first manned orbital flight around the moon.
  3. **Apollo 9**: Earth orbit test of the LEM, Lunar Excursion Module, tested the descent engine, the ascent engine and docking procedures.
  4. **Apollo 10**: Lunar orbital flight, Command module and LEM separate, Lem begins the descent to the lunar surface only to stop short and conduct a planned “abort”, never reaching the lunar surface.
  5. **Apollo 11**: July 20, 1969 - First humans to walk on the moon:
    - a. **Neil Armstrong**: 1<sup>st</sup> to walk on the moon.
    - b. **Buzz Aldrin**: 2<sup>nd</sup> to walk on the moon, took communion on the lunar surface

- c. **Michael Collins**, remained in lunar orbit onboard the Command Module while Armstrong and Aldrin explore the lunar surface.
  - 6. **Apollo 12**: Successful 2<sup>nd</sup> Lunar exploration, “glitch” occurred when lightning struck the spacecraft shortly after takeoff. No significant damaged occurred.
  - 7. **Apollo 13**: Major malfunction, explosion in the oxygen tank in the service module causes this near disaster. Jim Lovell, Fred Haise and Jack Swaggart were on board. Ken Mattingly was bumped by Swaggart two days before the flight because he was exposed to the measles. He becomes instrumental in the successful return of the Apollo 13 crew.
- iv. **Shuttle Program**
  - 1. Known as the **STS, Space Transport System**, the cargo transport vehicle that takes objects into low earth orbit and to the international space station.
  - 2. Composed of three parts.
    - a. **External Fuel Tank** – only part that is not reusable – it falls back to the earth, burning in the atmosphere.
    - b. **Two solid rocket boosters** – used to help propel the orbiter into orbit. Once the fuel is exhausted, they are released and parachute back to the Atlantic ocean and reused.
    - c. **Orbiter**: the reusable spacecraft that glides back to Cape Canaveral to be used over and over again.
  - 3. In 1981, Columbia became the first orbiter in space.
  - 4. **Challenger** was destroyed by faulty “O-ring” on the solid rocket booster during a cold winter launch. Flames burned through the SRB and ignited the external fuel tank causing catastrophic explosion killing all aboard, including **Kristy McCauliff**, the first “teacher” to be selected to enter space.
  - 5. January 2003, **Columbia** sustained damage to the orbiter wing on take off. Not realizing the problem in time the orbiter disintegrated during reentry killing all on board.

## II. The Earth in Space

- a. **Axis** – imaginary line passing through the North and South Pole
- b. Earth’s axis is tilted at **23 ½ degrees**
- c. **Rotation**: the Earth spinning on its axis one time – 1 24 hour day and night cycle
- d. **Revolution**: The movement of one object orbiting around another in space. One revolution of the Earth around the Sun requires 365 ¼ days.... 1 year.
- e. Seasons:
  - i. Seasons occur because of the Axis tilt of the Earth.
  - ii. North pole pointed toward the sun results in more direct sunlight hitting the northern hemisphere.... Summer in the northern hemisphere, winter in the Southern hemisphere. **Summer Solstice** usually around **June 21**
  - iii. Six months later North pole points away from the sun, less direct light hits the northern hemisphere... Winter occurs in northern hemisphere, Summer in the Southern hemisphere. **Winter Solstice** usually around **Dec 21**
  - iv. **Spring Equinox** – around **March 21**; date there is an equal length of daylight and nighttime hours.
  - v. **Autumnal Equinox** - around **September 23**; date there is an equal length of daylight and nighttime hours.

## III. Phases, Eclipses and Tides

- a. The moon **orbits** the Earth every **27.3 days** and **rotates** on its axis every **27.3 days**. This causes the same side of the moon to always face the earth.

- b. Phases of the moon: **New moon – Waxing Crescent – 1st Quarter – waxing gibbous – Full moon – Waning gibbous – 3rd Quarter – Waning Crescent - New Moon**
- c. Requires approx **29.5 days** to complete the phases
- d. **Eclipses** – moon’s orbit is tilted at approx 5 degrees above the plane that the Earth orbits the sun.
  - i. When the moon’s shadow hits the earth a **solar eclipse** occurs.
    - 1. When the entire sun is hidden by the moon a **total eclipse** occurs. This happens when the **umbra** part of the shadow falls on the Earth.
    - 2. When only part of the sun is hidden by the moon a **partial eclipse** occurs. This happens when the **penumbra** part of the shadow falls on the Earth.
  - ii. When the Earth’s shadow hits the moon a **lunar eclipse** occurs
- e. Normal Daily Tides –
  - i. Moon and Sun gravity play important parts in the cycle of tides on the Earth.
  - ii. Moon’s gravity plays a strong role in the formation of tides than does the sun’s gravity.
  - iii. **High Tide:**
    - 1. Moon’s gravity pulls the water on the Earth nearest to the moon towards it. This creates a “bulge” in the water that faces the moon, a high tide.
    - 2. Another high tide occurs on the opposite side of the Earth because the moon pulls stronger on the Earth than the water farthest from the earth and “leaves this water behind” hence another high tide here.
  - iv. **Low Tide:**
    - 1. Water on the sides of the Earth perpendicular to those two areas closet to and farthest from the Earth are low tide areas of the Earth.
  - v. Usually two high tides and two low tides each day
- f. Special Tides: Spring and Neap Tides
  - i. **Spring Tides:**
    - 1. When the Sun and the Moon line up together with the Earth, their gravity act together causing extremely high high tides and very low low tides.
    - 2. Occur during new or full moons
  - ii. **Neap Tides:**
    - 1. When the sun and moon are perpendicular to the Earth their gravity comes close to canceling each other out. Consequently the high and low tides have the least difference in their high and low points.
    - 2. Occur during 1<sup>st</sup> and 3<sup>rd</sup> quarter phases of the moon

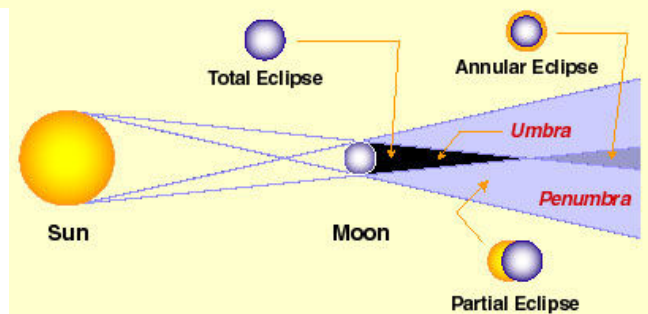
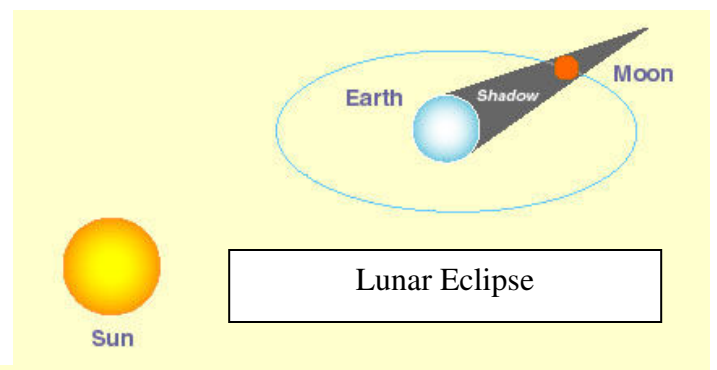
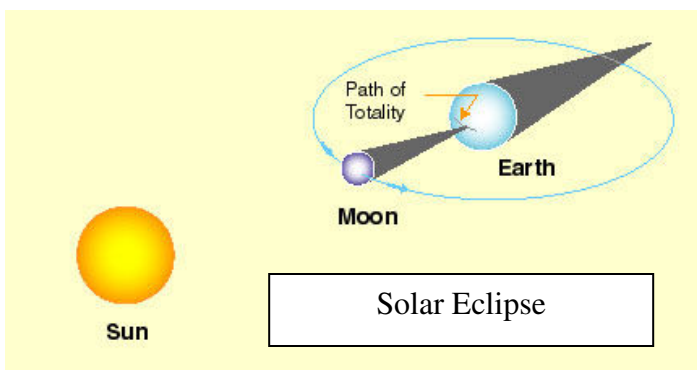
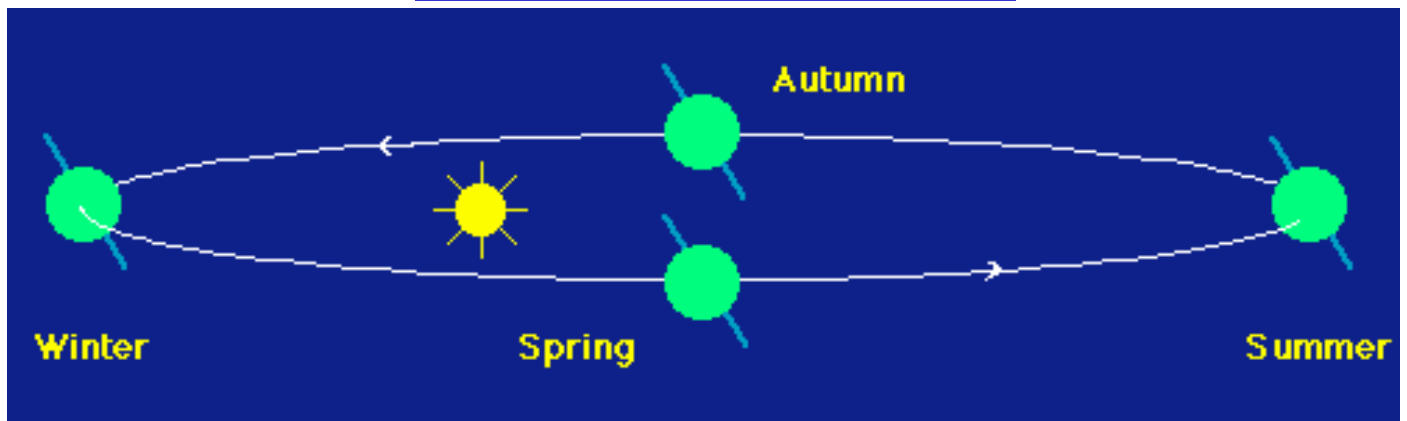
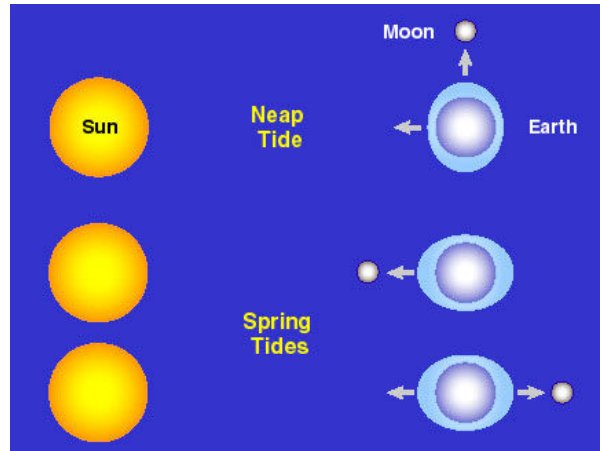
#### IV. Rockets and satellites

- a. A rocket moves forward due to Isaac Newton’s Law of motion that states: **For every action there is an equal and opposite reaction.**
- b. Satellites are used for: Communication, navigation, weather data collection or research.
- c. **Geosynchronous orbit:** orbits of satellites that revolve at the exact same rate that the Earth rotates... therefore they remain exactly overtop the same spot on the earth.

#### V. Earth’s Moon: 250,000 miles away, 1/6 the size of the Earth

- a. Origins of the Moon:
  - i. **Daughter theory:** During formation of the Earth, the earth spun so fast that the moon was thrown away from the forming Earth and developed into the moon
  - ii. **Sister Theory:** The moon formed separately at about the same time as the Earth
  - iii. **Capture theory:** a foreign body traveling through space was captured by the Earth’s gravity and remains in orbit

- iv. **Collision Theory:** This is the theory that best fits the evidence, when the Earth was very young and consisted of molten rock, a collision with an object about the size of Mars occurred and flung material into orbit. The material collected to form the moon.
- b. Features of the Moon
  - i. **Craters:** round pits on Lunar surface caused by the collision of the asteroids
  - ii. **Highlands:** Mountains on the moon
  - iii. **Maria:** Lunar “seas” – not “water seas” but formed after asteroid collisions broke through the thin lunar crust causing magma to flood and fill the craters that were present at the time.



# Phases of the Moon

