

Chapter 27.3 Outline

The sun-earth- moon system

Daily Motions

The sun , moon, and stars always seem to have a pattern of how we see them in the sky. The sun rises in the east and then sets in the west, as well as everything else. We can see this because our earth rotates, but in reality the sun , moons , stars, and planets don't orbit the earth every day, it just seems that way.

Earth's rotation

2 ways to see how earth rotates:

A **Foucault pendulum** swings in a constant direction. But as Earth turns under it, the pendulum seems to shift its orientation.

Observe the way that air on Earth is diverted from a north-south direction to an east-west direction by the Coriolis effect.

Day Length

The time period from one noon to the next is called a solar day. the length of a day as we observe it is four minutes longer than the time it takes Earth to rotate once on its axis. As Earth rotates, it also moves in its orbit and has to turn a little farther each day to align again with the Sun.

Annual Motions

The plane of Earth's orbit is called the ecliptic plane. As earth orbits, more constellations can be seen.

The effects of Earth's tilt

23.5 degrees tilted

A cycle of the seasons is a result of this tilt

angle of the Sun above the horizon from summer to winter. More hours of daylight cause the summer months to be warmer.

Solstices

At a solstice, the Sun is overhead at its farthest distance either north or south of the equator. Lines of latitude that correspond to position are tropics of capricorn and tropic of cancer. The area between these latitudes is commonly known as the tropics.

Summer solstice: June 21 when the Sun is directly overhead at the Tropic of Cancer, 23.5° north latitude. longest day of the year. Appears in the antarctic circle.

Winter solstice: december 21 the Sun does not appear in the region within the Antarctic Circle. shortest day sun is directly overhead at the tropic of capricorn , 23.5 degrees south latitude these are reversed for those living in the southern hemisphere

Equinoxes

midway between solstices equal days and nights. At an equinox, Earth's axis is perpendicular to the Sun's rays and at noon the Sun is directly overhead at the equator

Autumnal and Vernal Equinoxes again reversed for southern hemispherians...

Changes in altitude

Sun's max height (zenith), on the summer solstice, a person located at

23.5° north latitude sees the Sun's zenith directly overhead. At the equinox, it appears lower, and at the winter solstice, its lowest. Then it starts moving higher again to complete the cycle.

Phases of the moon

the sequential changes in the moon's appearance are called lunar phases.

Waxing and waning

darkness moving to the right side of the moon is the waxing phase. The waxing phases are called : waxing crescent, first quarter, and waxing gibbous.

Then, as the Moon moves to the far side of the Earth from the Sun, the entire sunlit side of the Moon faces Earth. This is known as a full moon.

after the full moon , the sunlight seen decreases and this is called waning.

the waning phases are: waning gibbous , waning crescent, and third quarter when the sunlight visible is showing half of the moon.

Synchronous rotation

synchronous rotation, the state at which the moon's orbital and rotational periods are equal as the moon orbits earth , the same side faces it all the time because the Moon spins exactly once each time it goes around Earth

Lunar Motions:

The length of time it takes for the Moon to go through a complete cycle of phases is called a lunar month which is about 29.5 days on earth, which is longer than its orbit around earth.

The moon also rises and sets 50 minutes later each day because the it moves 13° in its orbit over a day and Earth has to turn another 13° for the Moon to rise.

Tides

Moon's gravity pulls on Earth along an imaginary line connecting Earth and moon, and this creates bulges of ocean water on both the near and far sides of Earth As Earth rotates, these bulges remain aligned with the Moon, so that a person at a shoreline on Earth's surface would observe that the ocean level rises and falls every 12 hours

Spring and Neap tides

when the Sun and the Moon are aligned along the same direction, their effects are combined, and tides are higher than normal these are spring tides. lower than normal tides are called neap tides When the Moon is at a right angle to the Sun-Earth line, the result is neap tides

Solar Eclipses

A solar eclipse occurs when the Moon passes directly between the Sun and Earth and blocks the Sun from view

Total solar eclipse - When the Moon perfectly blocks the Sun's disk, only the dim, outer gaseous layers of the Sun are visible.

A partial solar eclipse is when the moon only covers a portion of the sun's disk

How solar Eclipses occur

During a solar eclipse, the Moon passes between Earth and the Sun. Those on Earth within the darkest part of the Moon's shadow (umbra) see a total eclipse. Those within the lighter part, or penumbral shadow, see only a partial eclipse

Effects of tilted orbits

Normally, no solar eclipse takes place. Only when the Moon crosses the ecliptic plane is it possible for the proper alignment for a solar eclipse to occur, but even that does not guarantee a solar eclipse. The plane of the Moon's orbit also rotates slowly around Earth, and a solar eclipse occurs only when the intersection of the Moon and the ecliptic plane is in a line with the Sun and Earth.

Annular eclipses

The closest point in the Moon's orbit to Earth is called perigee, and the farthest point is called apogee.

Annular eclipse- When the Moon is near apogee, it appears smaller from Earth, and thus won't completely block the disk of the Sun during an eclipse

Earth's orbit also has a perigee and apogee.

-When Earth is nearest the Sun and the Moon is at apogee from Earth, the Moon would not block the Sun entirely. The opposite is true for Earth at apogee to the Sun and the Moon at perigee to Earth.-

Lunar Eclipses

A lunar eclipse occurs when the Moon passes through Earth's shadow.

this can happen only if there's a full moon when the Moon is on the opposite side of Earth from the Sun. earth's shadow has an umbra and penumbra too.

A total lunar eclipse occurs when the entire Moon is within Earth's umbra. 2 hrs sunlight refracted from earth's atmos. gives moon a reddish color

these eclipses don't occur every full moon because the Moon in its orbit usually passes above or below the Sun as seen from Earth.