ASTR 1010

Look over Chapter 2: Discovering the Universe for Yourself

Things You Should Get to Know

- Horizon
- Zenith
- Meridian
- Azimuth
- Altitude
- Angles
- Arcminutes
- Arcseconds
- Celestial Sphere
- Constellations
- Equinoxes
- Solstices
- Asterism
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- The Moon's Nodes
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Zenith

The **Horizon** is the boundary between the Earth and sky.

The **Zenith** is the point straight above you.

Fig 1-1, p.20

The Dome of the Sky

The **Meridian** is a line joining due south through the zenith to due north.

In general you can pinpoint the position of any object in the sky by stating its **Azimuth** (which is measured clockwise around the horizon from due south) and the **Altitude** (which is measured from the horizon upwards).

Defining the Solar day

24 hours is a solar day: the average time between successive meridian crossings of the Sun.

Angular Size

Since we can not determine actual sizes or distances we measure **Angles** when we look at objects in the sky.

We measure these angles by extending imaginary lines outward from our eyes.

Smaller Angular Units

For more precise astronomical measurements, we subdivide each degree into 60 **Arcminutes** and further subdivide each arcminute into 60 **Arcseconds**:

$1^\circ = 60 \text{ arcminutes} = 3{,}600 \text{ arcseconds}$

$35^\circ 27' 15'' = 35 \text{ degrees}, 27 \text{ arcminutes and } 15 \text{ seconds}$

The Celestial Sphere

Knowing that the Earth is round, you might imagine the dome of your sky to be part of a great **Celestial Sphere** that surrounds the Earth.

The stars all appear to reside on the celestial sphere. Also to the naked eye, even the objects in our own solar system appear to travel on the same celestial sphere.

Celestial Poles

The point where the Earth's axis intersects the celestial sphere in the Northern Hemisphere is known as the **North Celestial Pole**.

In the Southern Hemisphere, the extension of Earth's axis in the opposite direction defines the **South Celestial pole**. .

Midway between the two poles we have the **Celestial Equator**.

Patterns in the Sky

This pattern is was given the name Orion, the Hunter by the ancient Greeks.

Constellations

The Ancient Greeks	Orion the Hunter
The Ancient Chinese	Shen a Supreme Warrior
Hindus in Ancient India	Skanda a Warrior on a Peacock
Aborigines of Norhtern Australia	Three Fisherman in a Canoe
Wasco Indians of Oregon	Three Fisherman in a Canoe
Chemehuevi Indians of California	Three Mountain Sheep

The patterns of stars seen in the sky are called **Constellations**.

In astronomy the term constellation refers to a region of the sky.

Canis Major (The Great Dog)

The name of Sirius comes from the Greek meaning "scorching", because the ancient Greek had believed that the season of hot summer was caused when the Sun and Sirius lined up.

Draco (The Dragon)

The constellation of Draco is circumpolar; its gigantic curve surrounding the Little Dipper of Ursa Minor is one of characteristics.

Hercules

Hercules is a fairly large constellation in summer, but isn't very obvious. Though the constellation is faint, a fairly strained shape of "H" that forms Hercules' body is a good mark to find that.

Ursa Major (The Big Bear)

The Big Bear, Ursa Major, is the third largest constellation in the skies, seen at northern sky in evening of spring.

Asterism

An **asterism** is a star-pattern that is not a constellation. Asterisms may be contained within a single constellation or consist of stars belonging to different constellations.

The Zodiac

As seen from the earth it appears that the Sun is tracing a path through the constellations.

The Sun passes through 12 constellations called the **Zodiac**.

The Signs of the Zodiac

Sign	Symbol
Aries	ram, ♈
Taurus	Bull, ♉
Gemini	twins, ♊
Cancer	crab, ♋
Leo	lion, ♌
Virgo	virgin, ♍
Libra	scale, ♎
Scorpio	scorpion, ♏
Sagittarius	archer, ♐
Capricornus	seagoat, ♑
Aquarius	water bearer, ♒
Pisces	fish, ♓

The Length of a Day

The Earth makes one complete rotation about every 23 hours 56 minutes and 4.09 seconds.

From our viewpoint on the Earth, the stars therefore seem to spin around us with the same period.

This period of time is refereed to as a **Sidereal Day**.

The Solar Day

The Sun takes about 4 minutes longer then the stars to circle our sky (Called the **Solar Day**) because the Earth is orbiting the sun at the same time that it is rotating.

The Seasons

The orientation of the Earth's axis relative to the Sun changes over the course of the year, which is the causes the Seasons.

Equinoxes and Solstices

Spring (or Vernal) Equinox- Both hemispheres receive equal amounts of sunlight.

Summer Solstice-The northern hemisphere receives its most sunlight.

Fall (or Autumnal) Equinox- Both hemispheres receive equal amounts of sunlight.

Winter Solstice-The northern hemisphere receives its most sunlight.

Lunar Motion

The moon orbits the Earth at an average distance of about 380,000 km.

It travels around the Earth at an average speed of about 3,680 km/hr (2,270 mph).

The moon completes a full orbit around the Earth in one **Sidereal Month**.

$$1\,\text{Sidereal Month} \approx 27\tfrac{1}{4}\,days$$

The Phases of the Moon

Since half the moon is always illuminated by the Sun, the amount of this illumination we see from Earth depends on the moons position in its orbit

The Synodic Month

Each complete lunar phases (from new moon to new moon) is called a **Lunar** (or **Synodic**) **Month**

$$1 \text{ Synodic Month} \approx 29\tfrac{1}{2} \textit{ days}$$

The Lunar (or Synodic) Month is longer then the Sidereal Month because of the motion of the Earth around the Sun.

The Moon's Rotation

From the Earth we always see the same side of the moon.

This means that the moon must rotate once on its axis in the same time that it makes a single orbit of the Earth.

The Moon's Nodes

The Moon's orbit is inclined to the ecliptic plane by about 5°

Due to this inclination the moon spends most of its time above or below the ecliptic plane. It crosses the ecliptic plane twice during each orbit. The two points where the moon crosses the ecliptic plane are called the Nodes of the moon's orbit.

Eclipses

Any time one astronomical object casts a shadow on another we say that an **Eclipse** is occurring.

The Shadow of the Moon or the Earth consists of two parts:
The **Umbra** where sunlight is completely blocked out.
The **Penumbra** where sunlight is only partially blocked out.

Total Lunar Eclipse

If the Sun, the Earth and the Moon are nearly perfectly aligned, the Moon will pass through the Earth's umbra, and we will see a **Total Lunar Eclipse**.

Partial Lunar Eclipse

If the alignment is somewhat less perfect, only part of the full moon will pass through the umbra and we will see a **Partial Lunar Eclipse**.

Penumbral Lunar Eclipse

If the Moon passes only through the Earth's penumbra, we will see a Penumbral Lunar Eclipse.

Total Solar Eclipse

If a solar eclipse happens to occur when the Moon is relatively close to the Earth, the Moon's umbra touches a small area of the earth (about 270 km in diameter) anyone in that area will see a **Total Solar Eclipse**.

Partial Solar Eclipse

Surrounding the region of totality is a much larger area (about 7,000 km in diameter) that falls within the moon's penumbral shadow anyone within this region will see a **Partial Solar Eclipse**.

Annular Solar Eclipse

Anyone in the small region for the Earth directly behind the umbra will see an Annular Eclipse, in which a ring of sunlight surrounds the disk of the Moon.

Retrograde Motion

When planets apparently reverse their motion across the sky is referred to as **Retrograde Motion**.