EARTH SCIENCE

UNIT 9 -KEY

ASTRONOMY

Half of the sun | Sun | Mercury | Venus | Earth | Moon | Mars | Jupiter | Saturn | Uranus | Neptune | Pluto

Planets to scale

Pluto

Neptune

Uranus

Venus | Merkury
Earth
Mars
Jupiter
Saturn

Red dwarf | White dwarf

Red giant | Yellow giant | Blue giant | Black hole | Solar system
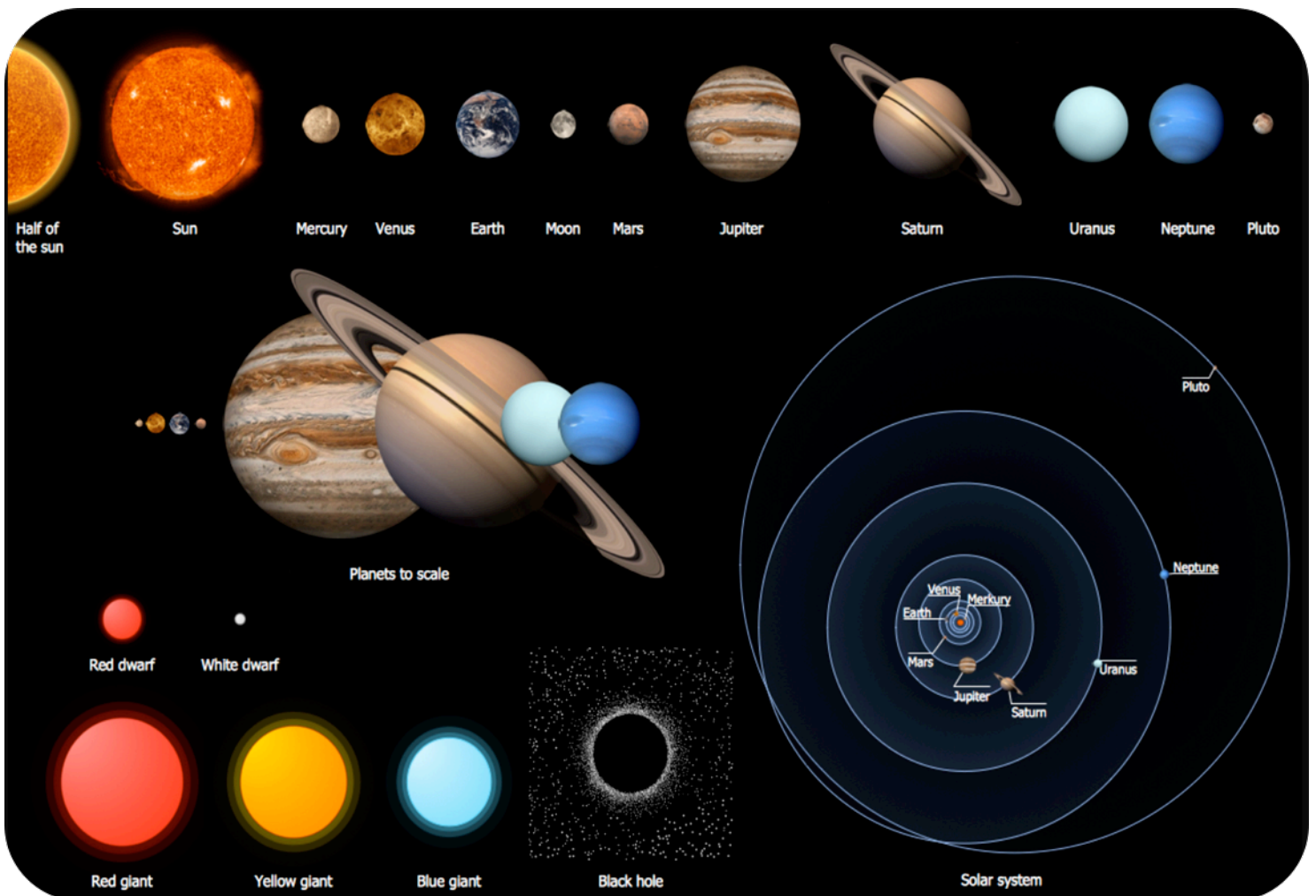
YOUR PLANET

YOUR INHERITANCE

YOUR LEGACY

THE SOLAR SYSTEM

I. **The Solar System**: **THE SUN AND ALL CELESTIAL OBJECTS THAT ORBIT THE SUN HELD BY THE SUN'S GRAVITY**.

   a. **Celestial Body**: **ANY OBJECT IN SPACE OUTSIDE EARTH'S ATMOSPHERE**.

      i. **Examples**: **MOON, PLANETS, STARS, SUN**.

   b. **MAIN COMPONENTS/MEMBERS OF THE SOLAR SYSTEM**:

      i. **PLANETS**
         1. Planets are objects that orbit the sun, have enough mass to be nearly round, are not satellites, & have removed debris and other objects from around its orbit.

      ii. **SATELLITE**
         1. Satellites are celestial bodies that orbit earth or another planet.

      iii. **ASTEROIDS**:
         1. Small rocky bodies orbiting the sun.

      iv. **COMETS**:
         1. Balls of frozen gases, rock and dust that orbit the sun. Jets of gas and dust form long "tails" that can be seen from earth.
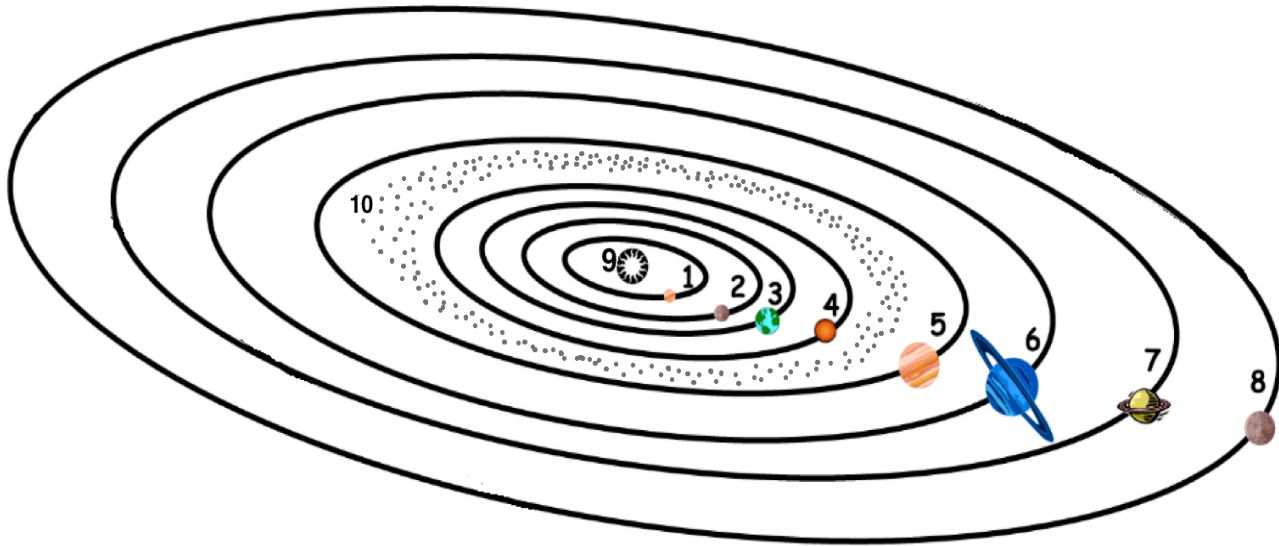
      v. **METEOROIDS**:
         1. Small space rocks moving through the solar system.

      vi. **METEOR**:
         1. A meteoroid that enters Earth's atmosphere.

c. Solar System Diagram

Orbits of the planets
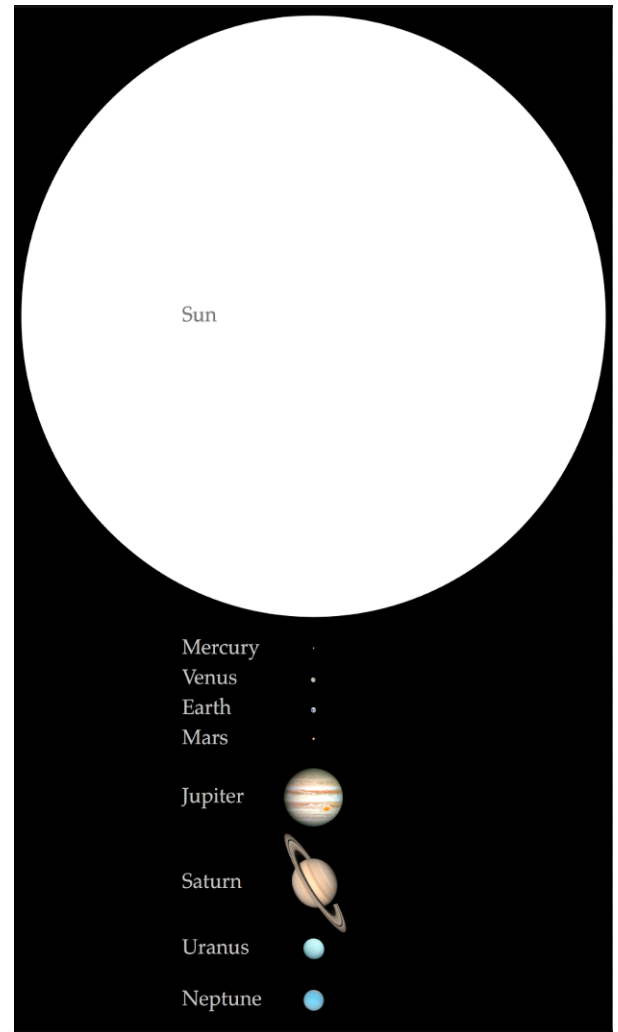The orbits are not drawn
to scale.

	NAME OF PLANET	SYMBOL	PLANET TYPE
1	**MERCURY**	☿	**INNER "TERRESTRIAL"** **EARTH-LIKE PLANETS**
2	**VENUS**	♀	
3	**EARTH**	⊕	
4	**MARS**	♂	
5	**JUPITER**	♃	**OUTER "JOVIAN"** **GAS GIANTS**
6	**SATURN**	♄	
7	**URANUS**	⛢	
8	**NEPTUNE**	♆	
9	*SUN*	☉	
10	*ASTEROID BELT*		

d. The Planets:

    i.

        Relative size of the
        sun and planets:

Sun

Mercury

Venus

Earth

Mars

Jupiter

Saturn

Uranus

Neptune

    ii.

        Orbits of the planets and
        their relative distance:

Mars

Venus

Mercury

Earth

Neptune

Uranus

Saturn

Jupiter
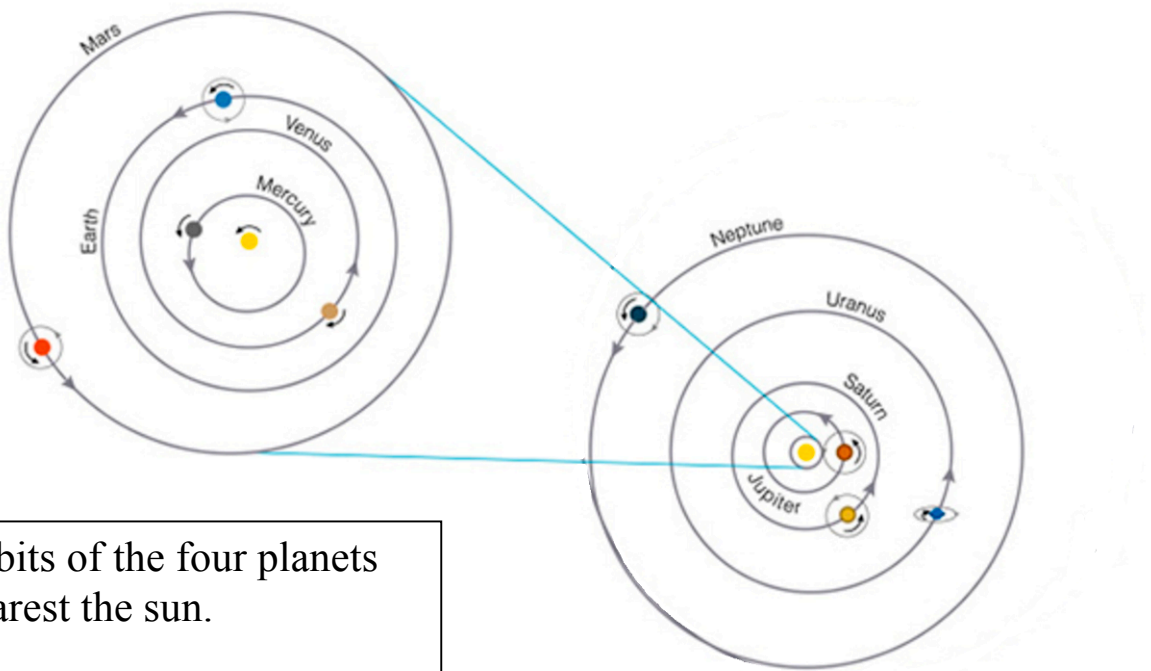
Orbits of the four planets
nearest the sun.

Orbits of the outer planets.
The innermost circle
represents Mars' orbit.

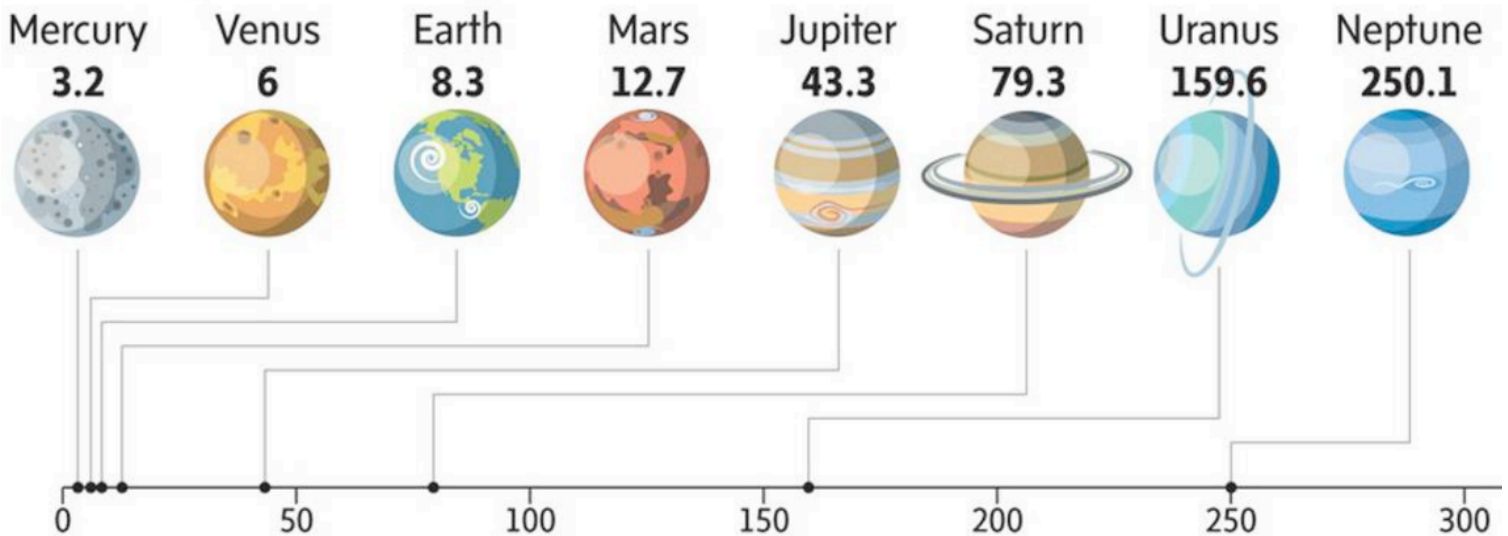## II. EARTH'S PLACE IN THE UNIVERSE

    a. Light year:

        i. **The distance light travels in one year**

        ii. **6,000,000,000,000 miles**

        iii. The speed of light is **186,000** miles/second.

        1. The time it takes sunlight to reach each planet:

So how long does light take to travel from the Sun to each planet?
(In minutes)

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
3.2	6	8.3	12.7	43.3	79.3	159.6	250.1

0   50   100   150   200   250   300

        2. The time it takes sunlight to reach:

           a. The nearest star **ALPHA CENTURI** = **4.3 YEARS**

           b. The brightest star **SIRIUS** = **8.6 YEARS**

           c. The nearby Andromeda Galaxy = **2,000,000 YEARS**

        3. **Starlight**:

           a. We see all night stars as they **WERE** when the light **LEFT THAT STAR**.

           b. When we look at distant stars and galaxies, we look back in TIME.

        4. **Galaxies**:
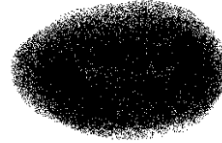
           a. Billions of stars held together by **GRAVITY**

b. **Shape of galaxies**:
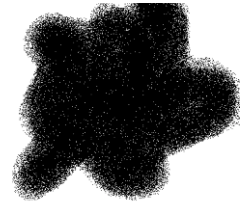
    i. **SPIRAL**

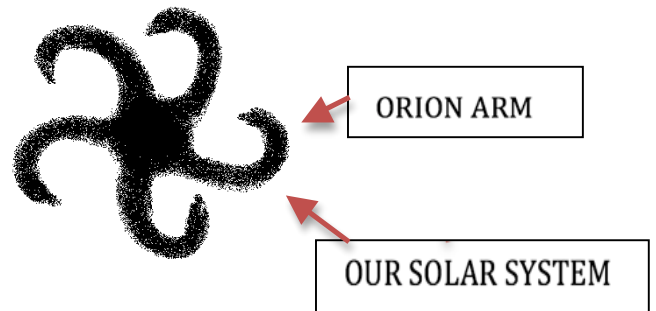   ii. **ELLIPTICAL**

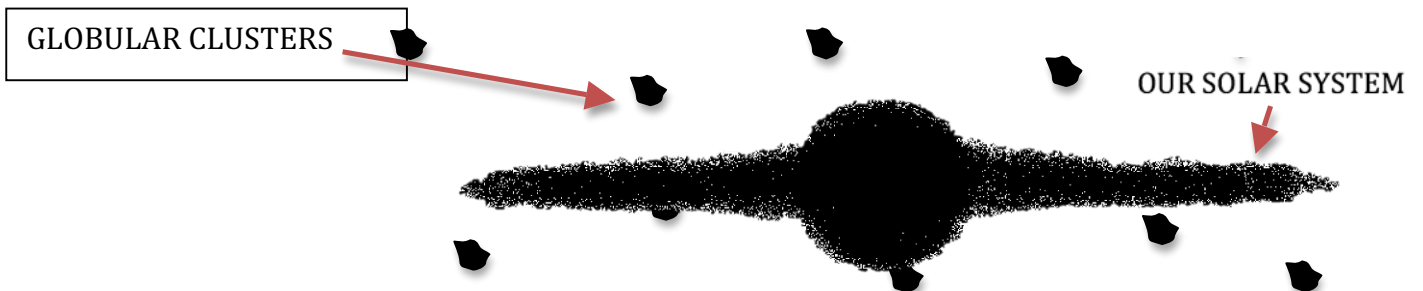   iii. **IRREGULAR**

c. The Milky Way Galaxy:
    i. Our sun is only one of the estimated **180 BILLION** stars that make up the Milky Way Galaxy.

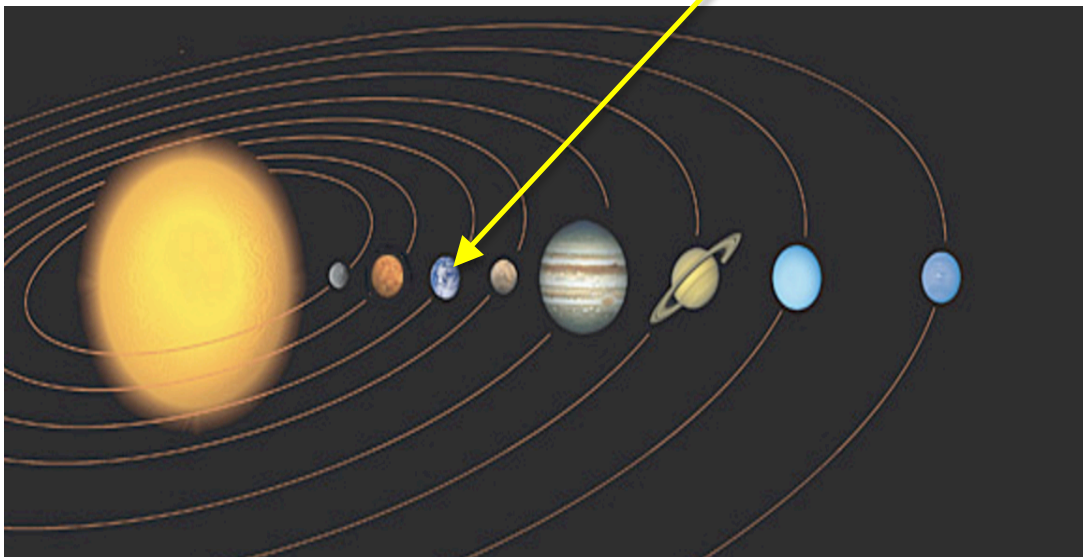   ii. The Milky Way Galaxy is a **SPIRAL** galaxy.

1. Top View:

ORION ARM

OUR SOLAR SYSTEM

2. SIDE VIEW:

GLOBULAR CLUSTERS

OUR SOLAR SYSTEM

5. Levels and structure of the universe (earths place in the universe)

a. **<u>PLANET EARTH</u>**:
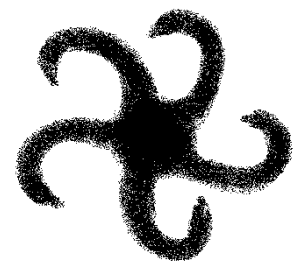   **<u>A SMALL, DENSE, ROCKY PLANET</u>**
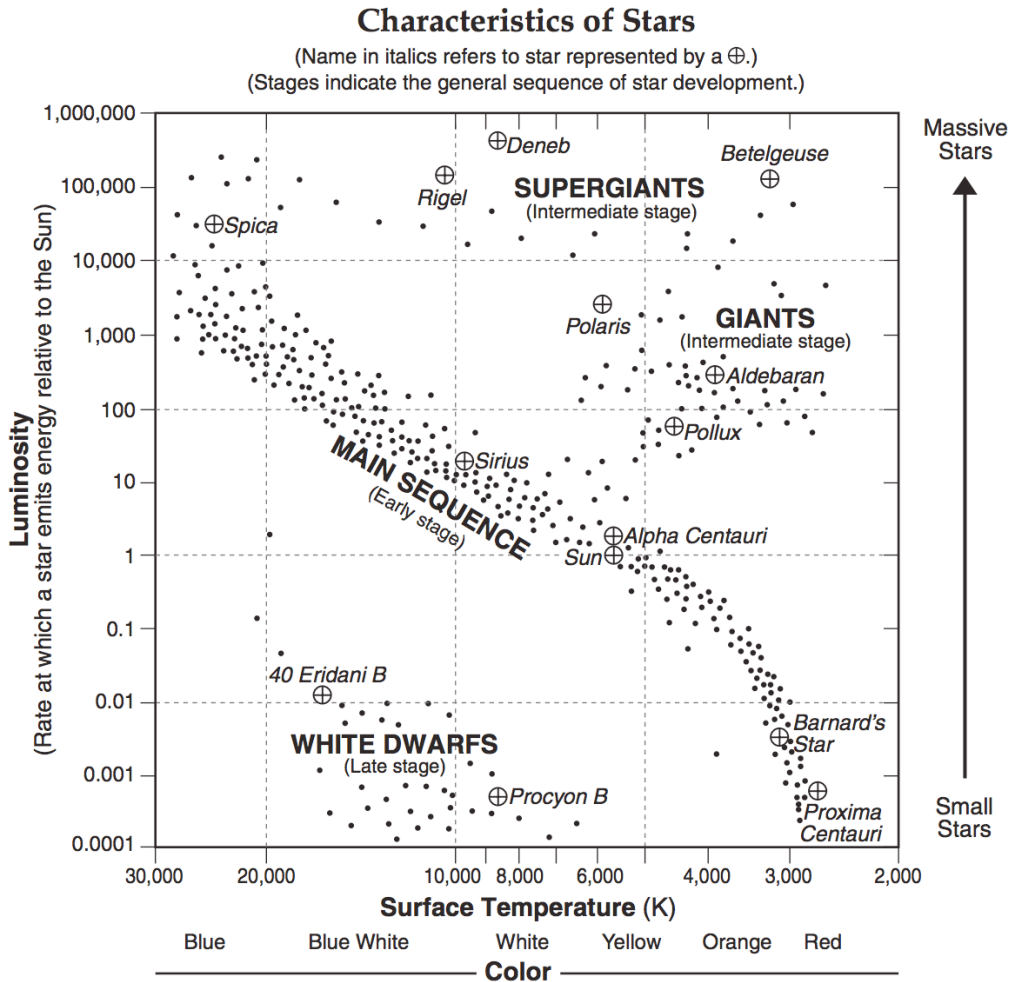
b. **<u>OUR SOLAR SYSTEM</u>**

c. **<u>MILKY WAY GALAXY</u>**: **<u>OUR SUN & SOLAR SYSTEM IS ONE OF THE ESTIMATED 180 BILLION STARS MAKING UP THIS SPIRAL GALAXY.</u>**

d. **<u>UNIVERSE: OUR MILKY WAY GALAXY IS ONE OF BILLIONS OF GALAXIES IN AN EXPANDING UNIVERSE</u>**.

6. ESRT Page <u>15</u>: <u>Solar System Data</u>

Characteristics of Stars

(Name in italics refers to star represented by a ⊕.)
(Stages indicate the general sequence of star development.)

Solar System Data

Celestial Object	Mean Distance from Sun (million km)	Period of Revolution (d=days) (y=years)	Period of Rotation at Equator	Eccentricity of Orbit	Equatorial Diameter (km)	Mass (Earth = 1)	Density (g/cm³)
SUN	—	—	27 d	—	1,392,000	333,000.00	1.4
MERCURY	57.9	88 d	59 d	0.206	4,879	0.06	5.4
VENUS	108.2	224.7 d	243 d	0.007	12,104	0.82	5.2
EARTH	149.6	365.26 d	23 h 56 min 4 s	0.017	12,756	1.00	5.5
MARS	227.9	687 d	24 h 37 min 23 s	0.093	6,794	0.11	3.9
JUPITER	778.4	11.9 y	9 h 50 min 30 s	0.048	142,984	317.83	1.3
SATURN	1,426.7	29.5 y	10 h 14 min	0.054	120,536	95.16	0.7
URANUS	2,871.0	84.0 y	17 h 14 min	0.047	51,118	14.54	1.3
NEPTUNE	4,498.3	164.8 y	16 h	0.009	49,528	17.15	1.8
EARTH'S MOON	149.6 (0.386 from Earth)	27.3 d	27.3 d	0.055	3,476	0.01	3.3

7. **ESRT Page 15 Practice**

1. Compared to terrestrial planets, Jovian planets have

   A) smaller equatorial diameters and shorter periods of revolution
   B) smaller equatorial diameters and longer periods of revolution
   C) larger equatorial diameters and shorter periods of revolution
   D) **larger equatorial diameters and longer periods of revolution**

2. Which planet has a density that is *less* than the density of liquid water?

   A) Mercury   B) Earth
   C) Mars   **D) Saturn**

3. Which characteristic of the planets in our solar system increases as the distance from the Sun increases?

   A) equatorial diameter
   B) eccentricity of orbit
   C) period of rotation
   D) **period of revolution**

4. Compared to the size and density of Earth, the Moon has a

   A) **smaller diameter and lower density**
   B) smaller diameter and higher density
   C) larger diameter and lower density
   D) larger diameter and higher density

5. Which planet has completed less than one orbit of the Sun in the last 100 years?

   A) Mars   B) Mercury
   C) **Neptune**   D) Uranus

6. Which two characteristics do all Jovian planets have in common?

   A) small diameters and low densities
   B) small diameters and high densities
   C) **large diameters and low densities**
   D) large diameters and high densities

7. Compared to Jovian planets, terrestrial planets have

   A) larger masses
   B) larger equatorial diameters
   C) **shorter periods of revolution**
   D) shorter periods of rotation

8. Which planet is located approximately ten times farther from the Sun than Earth is from the Sun?

   A) Mars   B) Jupiter
   C) **Saturn**   D) Uranus

9. Which object in our solar system has the greatest density?

   A) Jupiter   B) **Earth**
   C) the Moon   D) the Sun

10. Which planet would float if it could be placed in water?

   A) Mercury   B) Earth
   C) **Saturn**   D) Pluto

b. **The Doppler Effect:** **THE APPARENT CHANGE IN THE WAVELENGTH OF LIGHT (OR SOUND) THAT OCCURS WHEN AN OBJECT IS MOVING TOWARD OR AWAY FROM THE OBSERVER**.

   i.

Long wavelength
Low frequency

Small wavelength
High frequency

   ii. **RED SHIFT – BLUE SHIFT**

1. **Red Shift and Blue Shift describe how light changes as objects in space (such as stars or galaxies) move closer or farther away from us.**

2. **Visible light is a spectrum of colors (like a rainbow).**

    a. When an object moves **AWAY** from us, the light is shifted to the **RED** end of the spectrum and its wavelength gets **LONGER**.
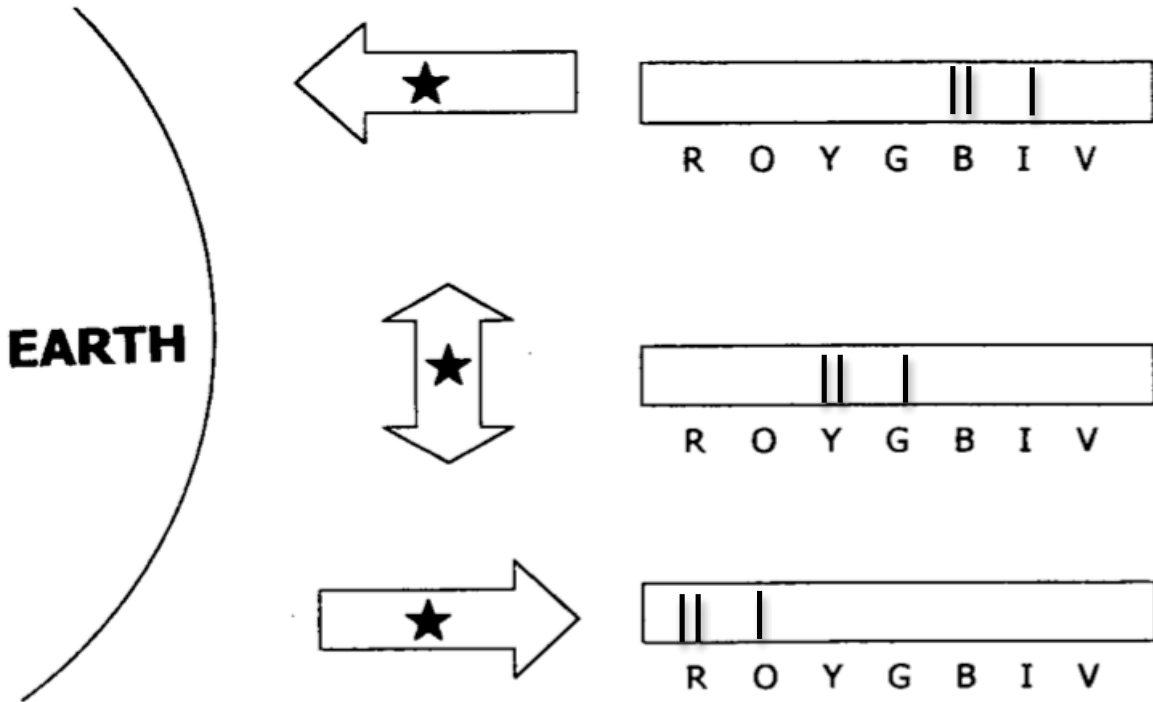
    b. When an object is moving **CLOSER** to us, the light is shifted to the **BLUE** end of the spectrum and the wavelength gets **SHORTER**.

Standard Bright Line Spectrum
Of Element X (Earth Laboratory) →

R   O   Y   G   B   I   V
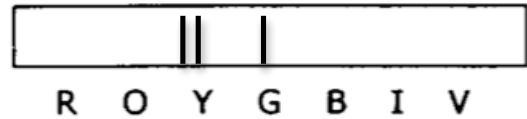
Relative Motion of Star   Spectrum

★

R   O   Y   G   B   I   V

EARTH

★

R   O   Y   G   B   I   V

★

R   O   Y   G   B   I   V

3. The Big Bang Theory
   a. In the late 1920'S, Edwin Hubble discovered that ALL galaxies were "red shifted" when viewed from earth.

   This meant that all galaxies were **MOVING AWAY FROM EACH OTHER**, and thus, the universe must be **EXPANDING**.

   b. This led to the theory that the universe began as a cosmic explosion that ocured15-20 billion years ago. The universe we live in today has evolved from this explosion of matter and energy.

   c. An echo of background radiation can still be detected by radio telescope.

d. The data table below shows the distances of some galaxies from Earth. It also shows the "red shift" of each galaxy and how many units of red shift are exhibited by each galaxy.

1.

GALAXY	DISTANCE (light years)	RED SHIFT (arbitrary units) VIOLET ——————→ RED						
		0	1	2	3	4	5	6
VIRGO	70 000 000	▌						
URSA MAJOR 1	900 000 000		▌					
LEO	1 100 000 000		▌					
BOOTES	2 300 000 000				▌			
HYDRA	3 600 000 000						▌	

2.
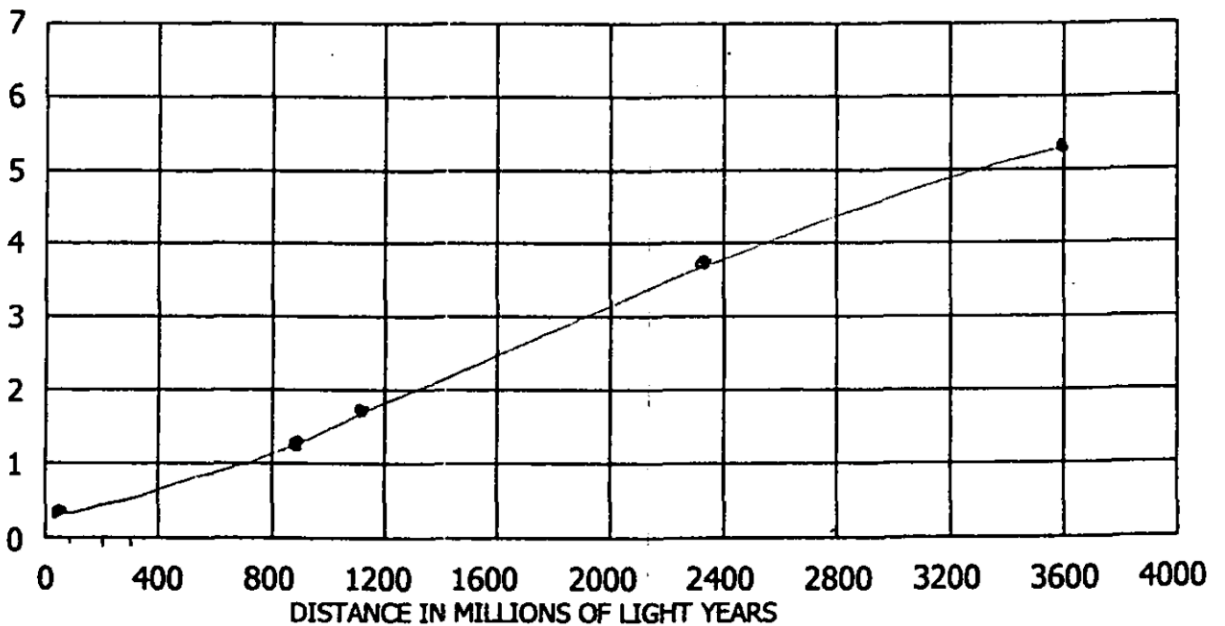
3. The amount of "red shift" is a result of the **SPEED** at which the galaxy is moving.

4. CONCLUSION: As the distance from earth **INCREASES**, the amount (or degree) of red shift of a galaxy **INCREASES**. This indicates that **THE FARTHER A GALAXY IS, THE FASTER IT IS MOVING.**
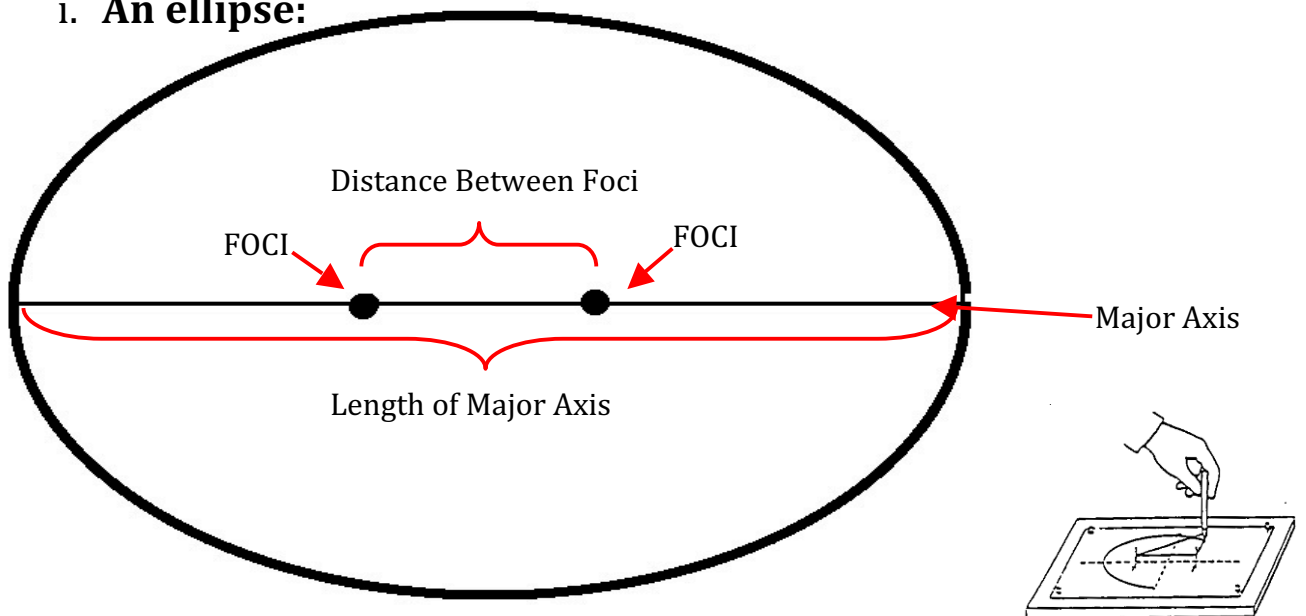
III.   KEPLER'S LAWS OF PLANETARY MOTION:

a. LAW 1: **THE ORBIT OF EACH PLANET IS AN ELLIPSE, AND THE SUN IS AT ONE FOCI**.

i. **An ellipse:**

Distance Between Foci

FOCI   FOCI
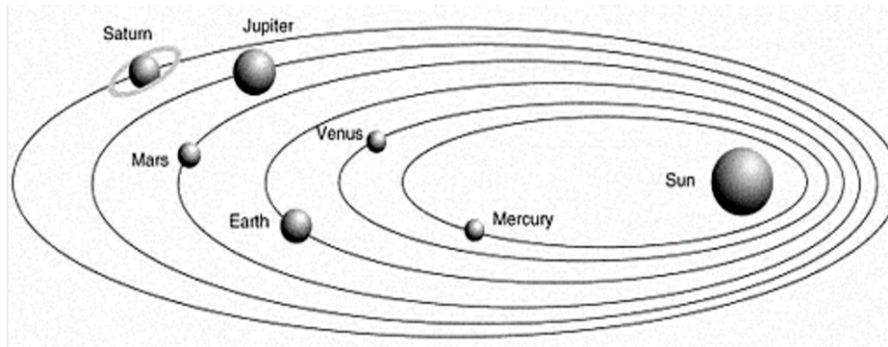
Major Axis

Length of Major Axis

ii. **ECCENTRICITY:** a measure of the "shape" of an ellipse. The **LESS** circular it is, the **MORE** eccentric it is.

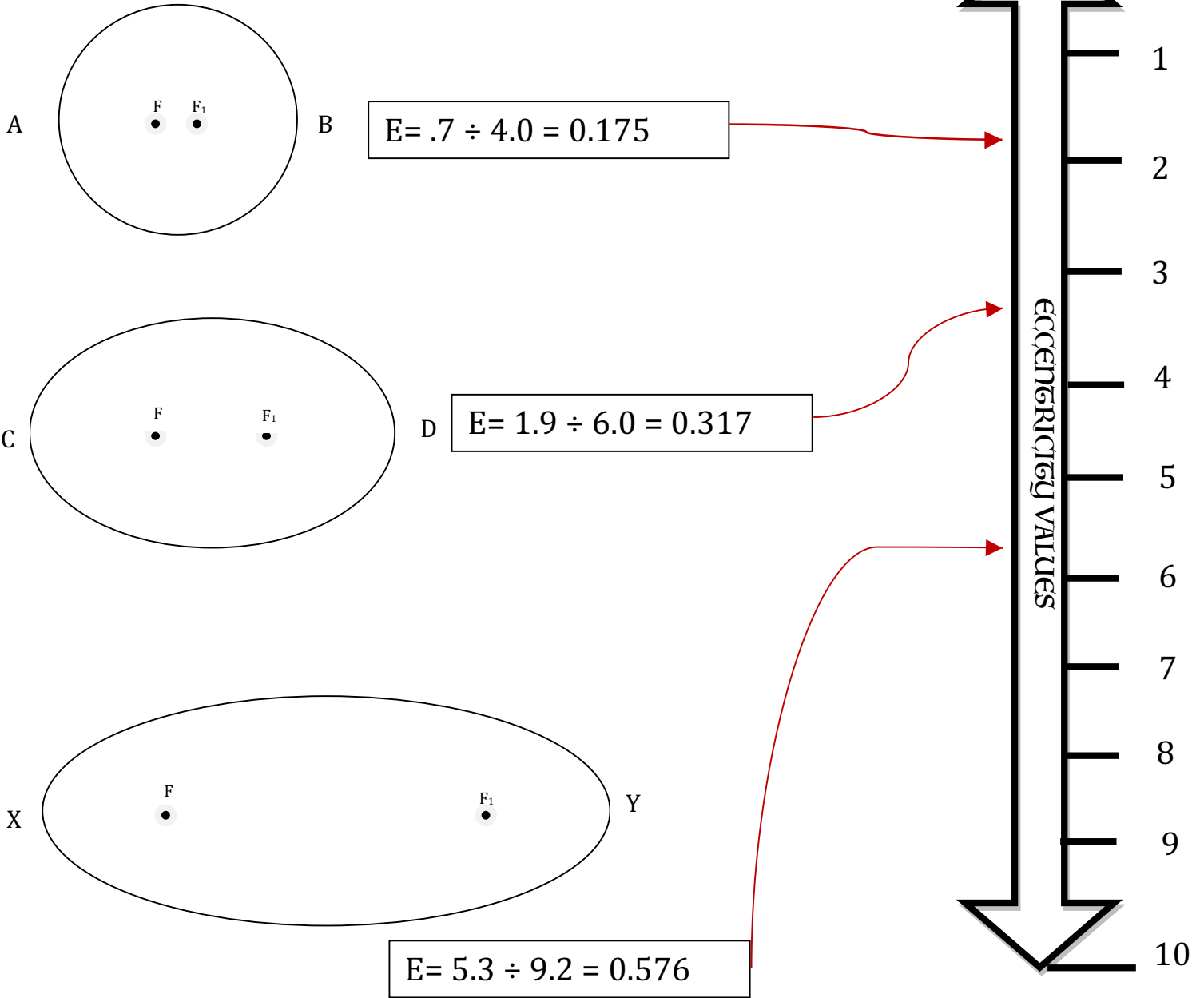$$eccentricity = \frac{distance\ between\ focus\ points}{length\ of\ major\ axis}$$

ESRT Page **1**

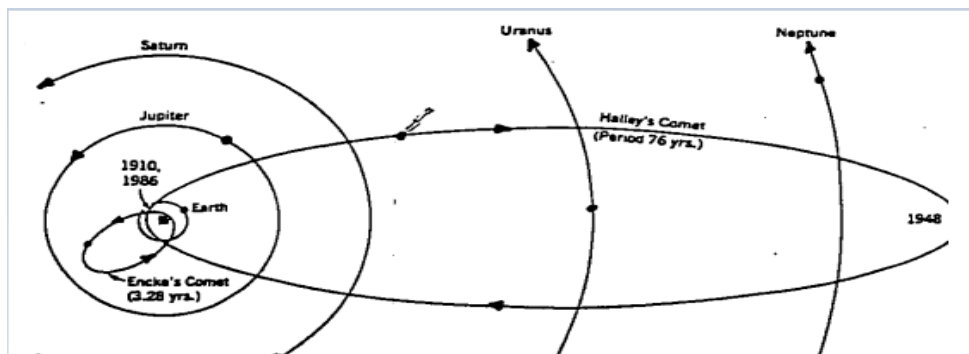iii. **Formula**:

iv. **Sample Problem** – Based on the ellipse above:

1. Eccentricity = 3.1cm / 12.6 cm = 0.246

v. **Eccentricity Sample Problems** (Range of values)

A

F   F$_1$

B $E = .7 \div 4.0 = 0.175$

C

F   F$_1$

D $E = 1.9 \div 6.0 = 0.317$

X

F   F$_1$

Y

$E = 5.3 \div 9.2 = 0.576$

ECCENTRICITY VALUES

0
1
2
3
4
5
6
7
8
9
10

vi. **Relationship**: <u>**AS THE DISTANCE BETWEEN FOCI INCREASES, THE SHAPE OF THE ELLIPSE BECOMES MORE ELLIPTICAL / ECCENTRIC.**</u>

vii.

b. **LAW 2** – <u>**AS A PLANET ORBITS THE SUN, ITS ORBITAL VELOCITY (SPEED) CHANGES; IT IS FASTEST WHEN IT IS CLOSER TO THE SUN.**</u>

<u>**JAN 1 PERIHELION MAXIMUM SPEED**</u>

<u>**JULY 1 APHELION MINIMUM SPEED**</u>

NOT TO SCALE
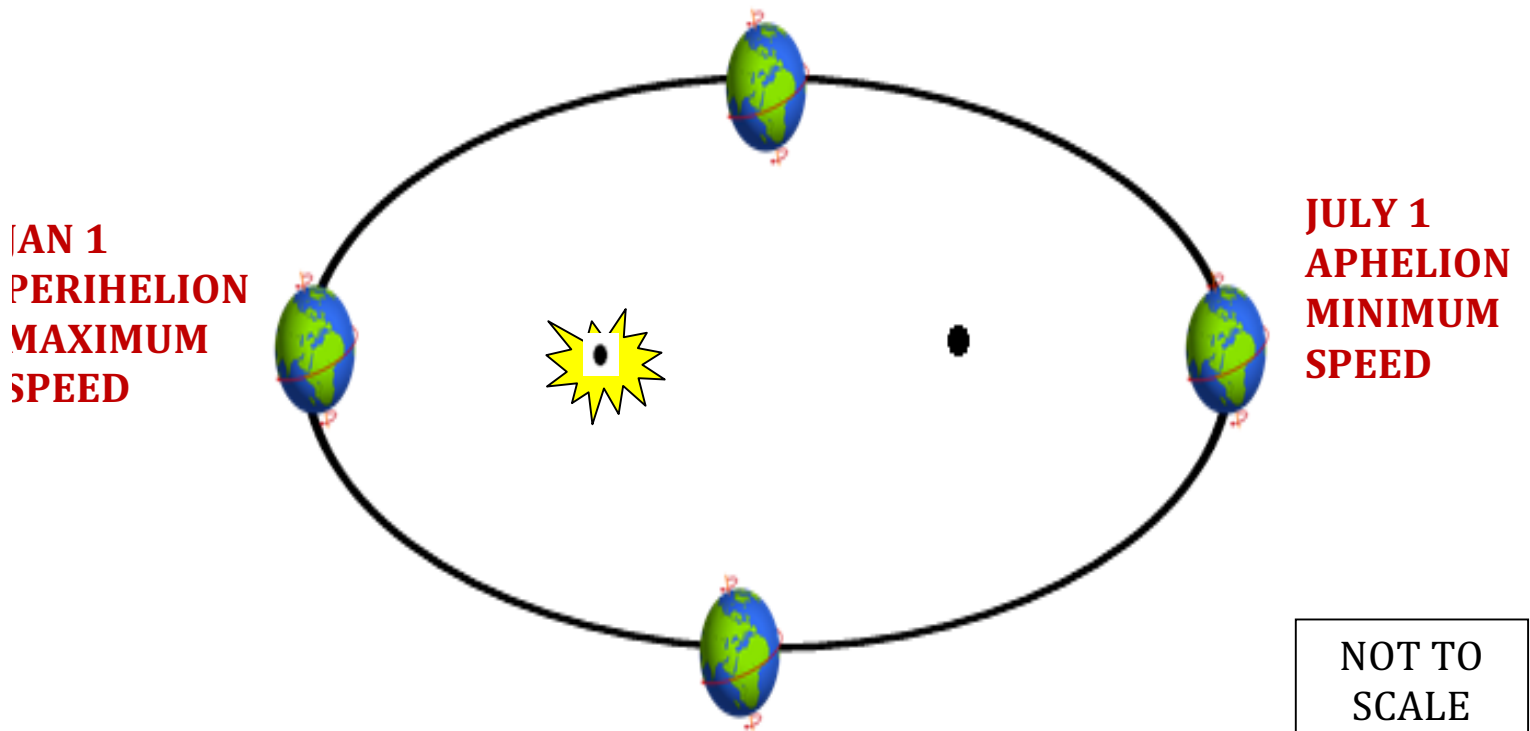
i. PERIHELION: <u>**POINT IN THE ORBIT NEAREST THE SUN**</u>
ii. APHELION: <u>**POINT IN THE ORBIT FARTHEST FROM THE SUN**</u>

c. LAW 3: <u>**THE FARTHER A PLANET IS FROM THE SUN, THE LONGER ITS PERIOD OF REVOLUTION**</u>.
   i. Farther planets have <u>**LONGER**</u> orbital paths and <u>**SLOWER**</u> orbital speeds
   ii. Closer planets have <u>**SHORTER**</u> orbital paths and <u>**FASTER**</u> orbital speeds.
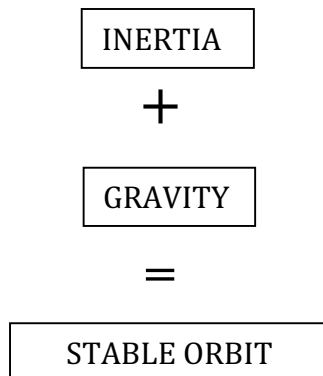
IV.   **GRAVITY**:
   a. **Newton's Law of Gravity**

   i.   **ALL OBJECTS POSSESS GRAVITY** and will pull all other objects with a certain gravitational force.

   ii. **The mass of an object determines the amount of gravitational force that object possesses. The greater the mass, the greater the gravitational pull.**

   iii. **The gravitational force between two objects changes as the distance between them changes. As distance increases, gravitational pull decereases.**

   b. **Gravity and Inertia**:
      i. **Newton's law of Inertia states that AN OBJECT'S MOTION WILL NOT CHANGE UNLESS THAT OBJECT IS ACTED UPON BY AN OUTSIDE FORCE**.

INERTIA
+
GRAVITY
=
STABLE ORBIT
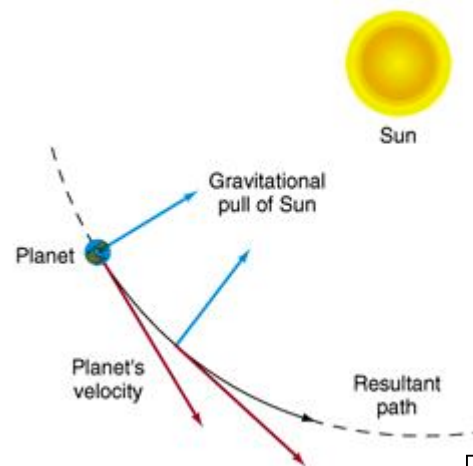
NOT TO SCALE

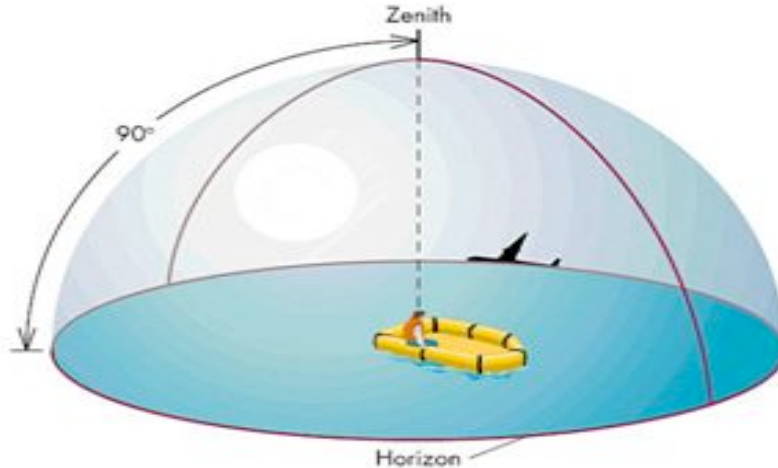   1. **INERTIA**: **CAUSES A PLANET TO MOVE IN A STRAIGHT LINE**

         2. **GRAVITY**: **PULLS A PLANET TOWARDS THE SUN**.

V. CELESTIAL OBSERVATIONS
- a. **CELESTIAL OBJECT**: **ANY OBJECT IN SPACE (OUTSIDE EARTH'S ATMOSPHERE)**
    - i. Examples: **MOON, PLANETS, STARS, SUN**.

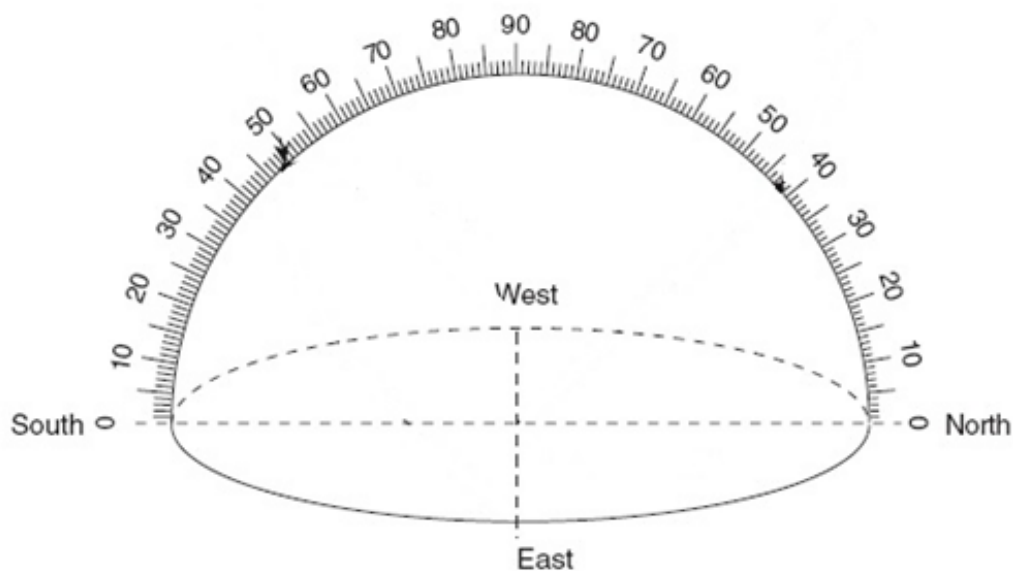- b. **CELESTIAL SPHERE** = **MODEL OF THE SKY**

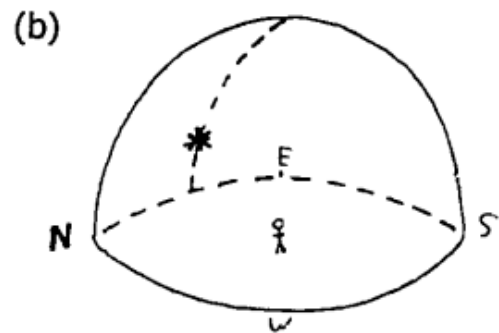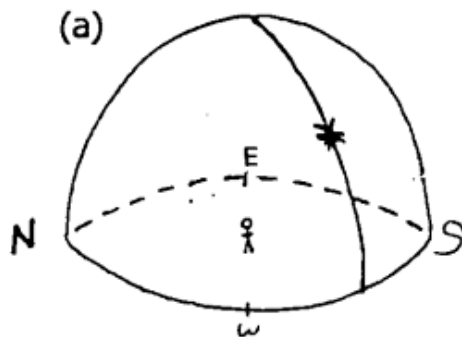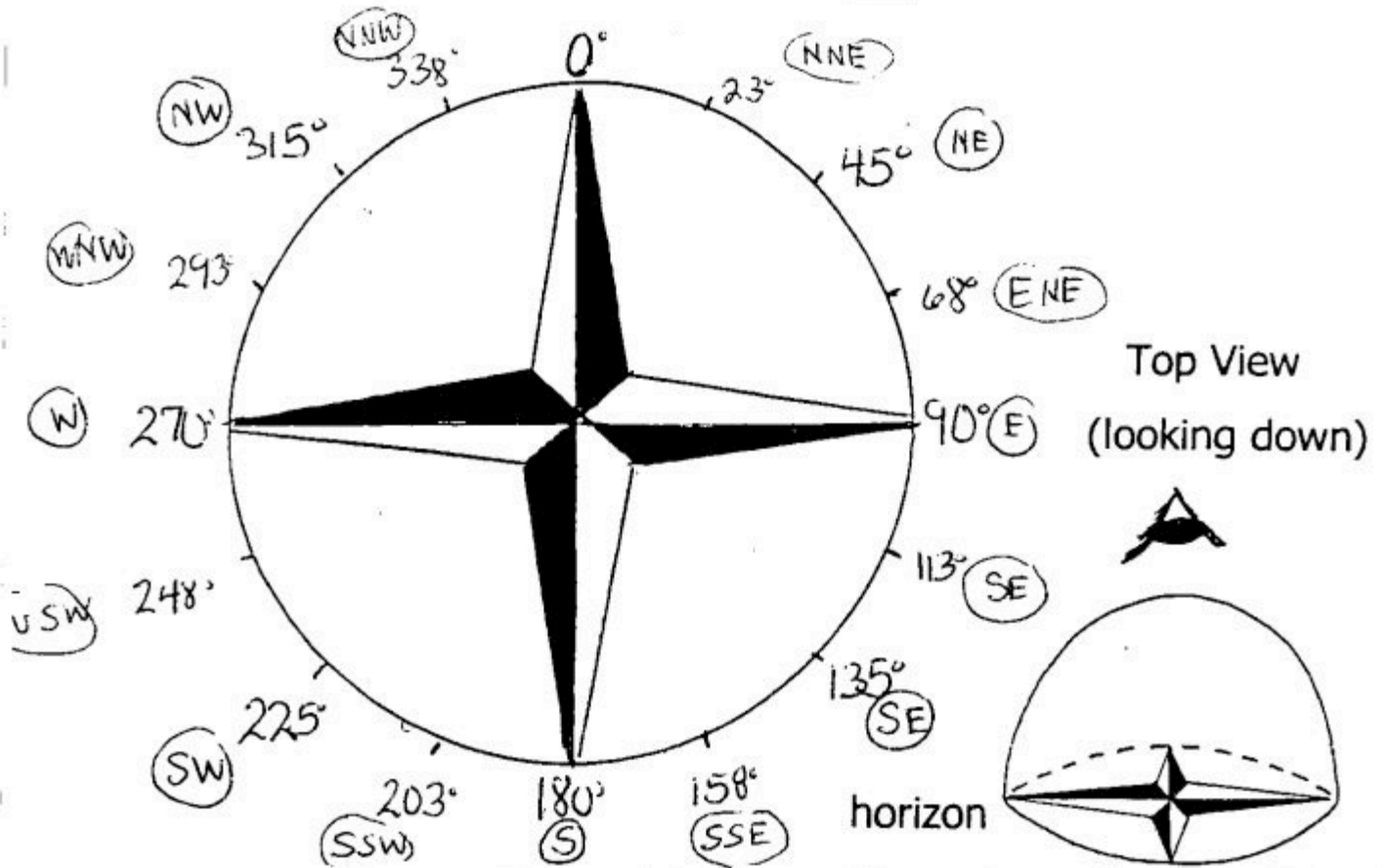- i. **Zenith**: **THE HIGHEST POINT IN THE SKY DIRECTLY ABOVE THE OBSERVER'S HEAD**.

- ii. **HORIZON**: **IMAGINARY BOUNDARY BETWEEN THE SKY AND THE GROUND**.

- c. Location on the celestial sphere: **THE HORIZON SYSTEM**
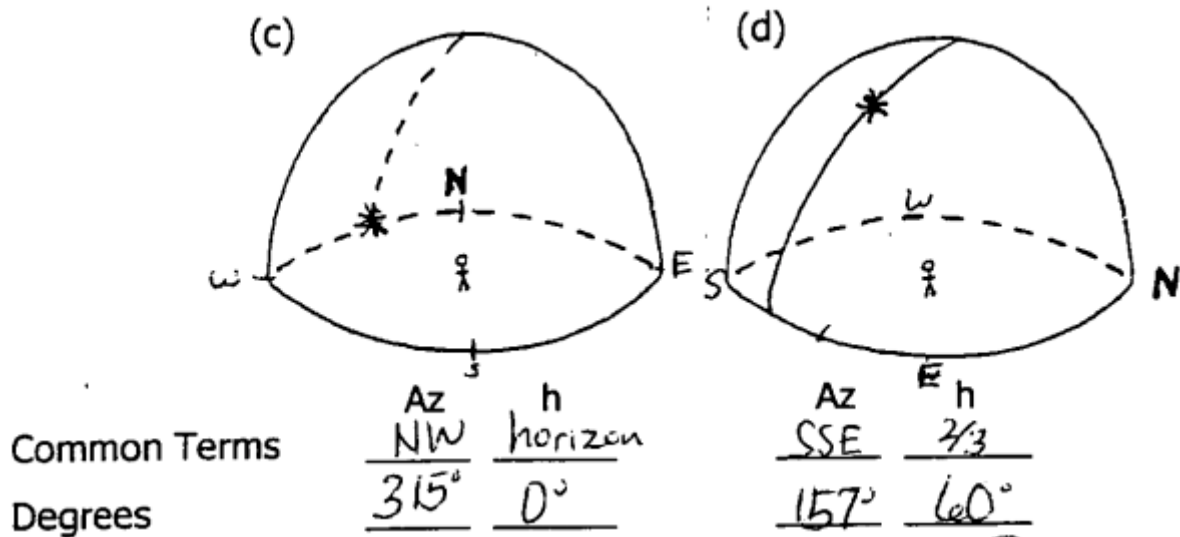   - i. **Altitude**: **ANGULAR DISTANCE ABOVE THE HORIZON**.

d. **AZIMUTH** = <u>**ANGULAR DISTANCE ALONG THE HORIZON FROM NORTH 0⁰, CLOCKWISE**</u>.

Top View
(looking down)

(a)   (b)

	Az	h	Az	h
Common Terms	SW	½	NE	⅓
Degrees	225°	45°	45°	30°

(c)   (d)

Common Terms	Az	h		Az	h
	NW	horizon		SSE	2/3
Degrees	315°	0°		157°	60°

e. **ROTATION**: <u>**THE SPINNING OF A CELESTIAL BODY (EARTH) ON AN IMAGINARY AXIS**</u>.
   i. Earth's:
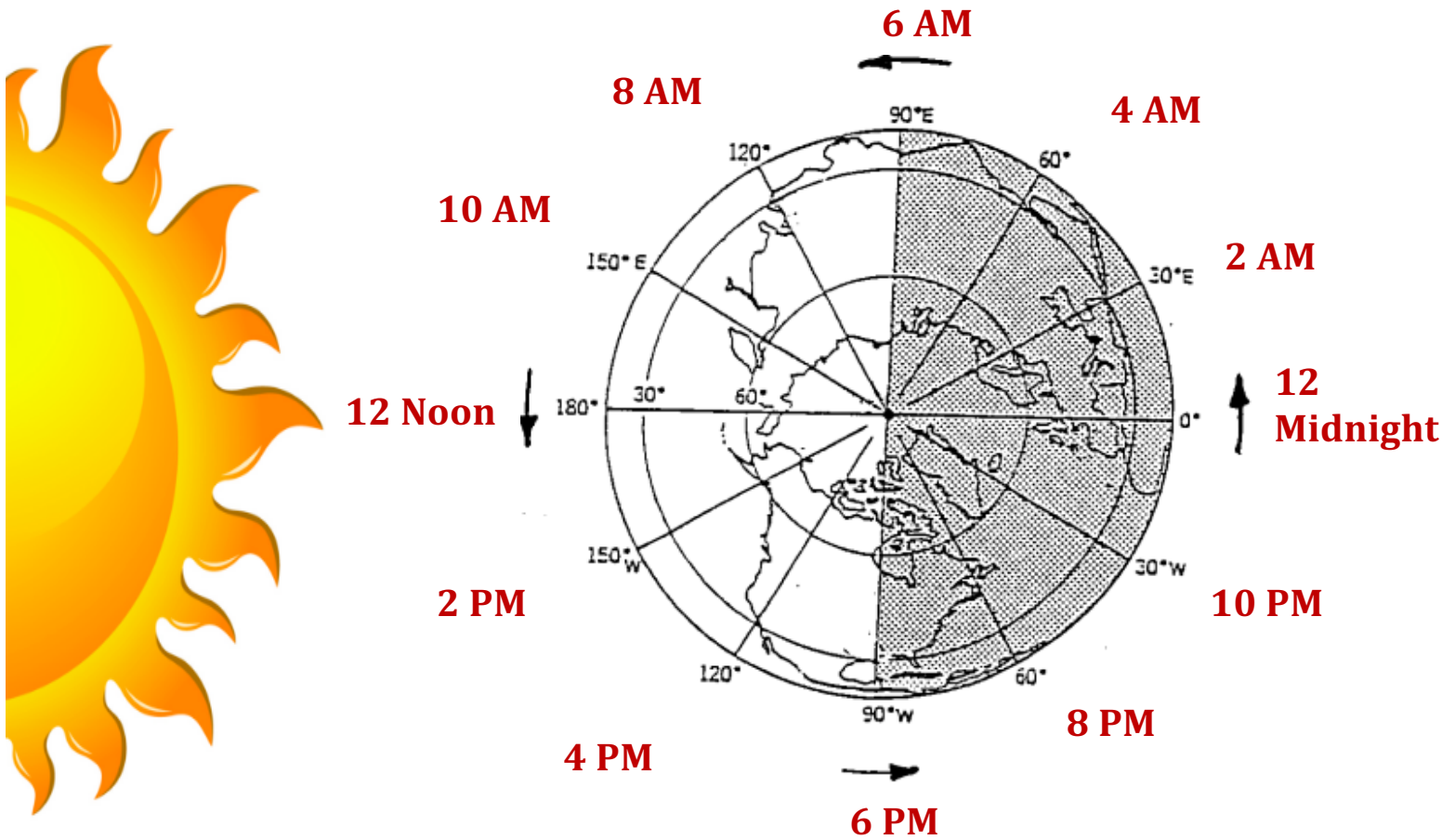   1. Direction of rotation: <u>**WEST**</u> to <u>**EAST**</u>

      2. Angular rate of Rotation: THINK – One complete rotation
         a. <u>**360**</u> degrees
         b. <u>**24**</u> hours
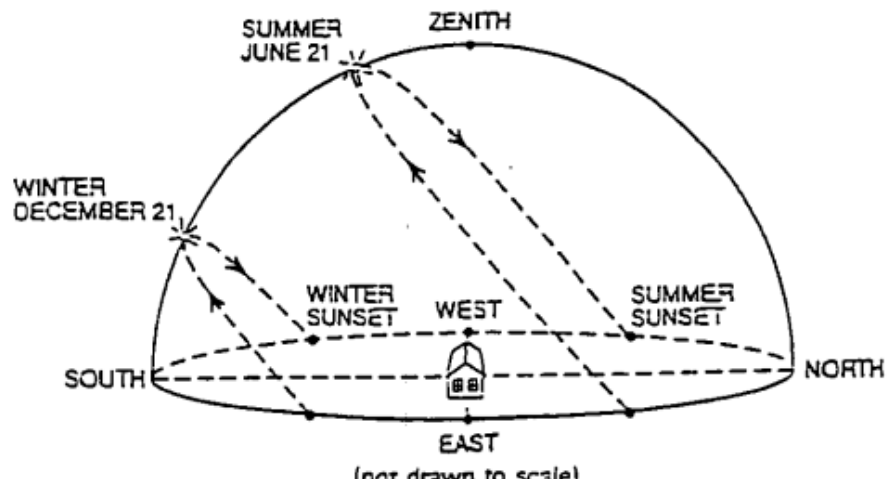   c. <u>**Rate**</u> = <u>**360 ÷24 HOURS = 15° / HOUR**</u>
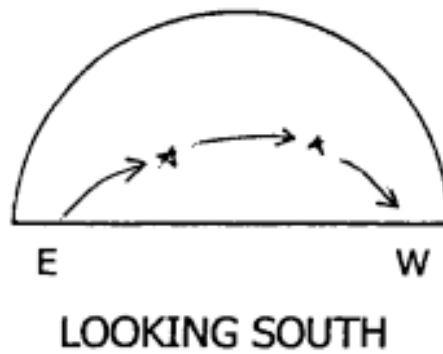
f. **Effects of earth's rotation**:
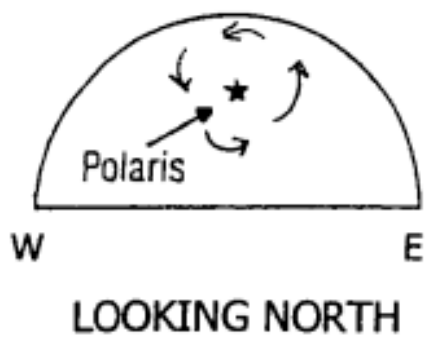   i. Day and Night

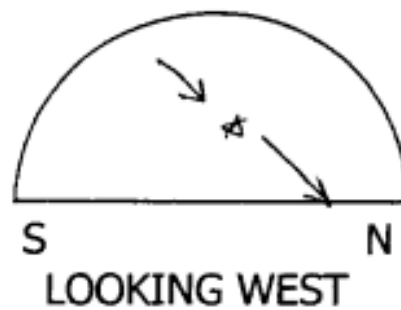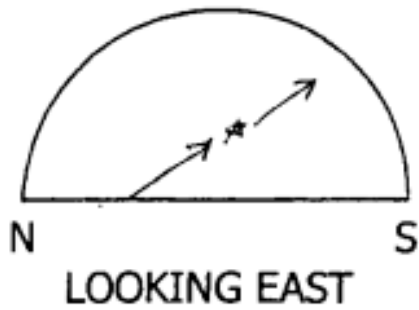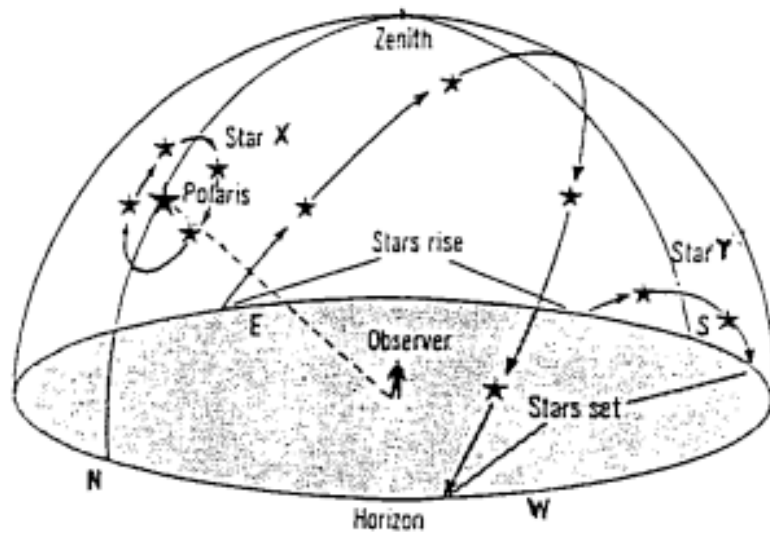g. <u>APPARENT MOTION OF THE SUN</u>:
   i. Earth rotates from <u>**WEST**</u> to <u>**EAST**</u> (note diagram above)
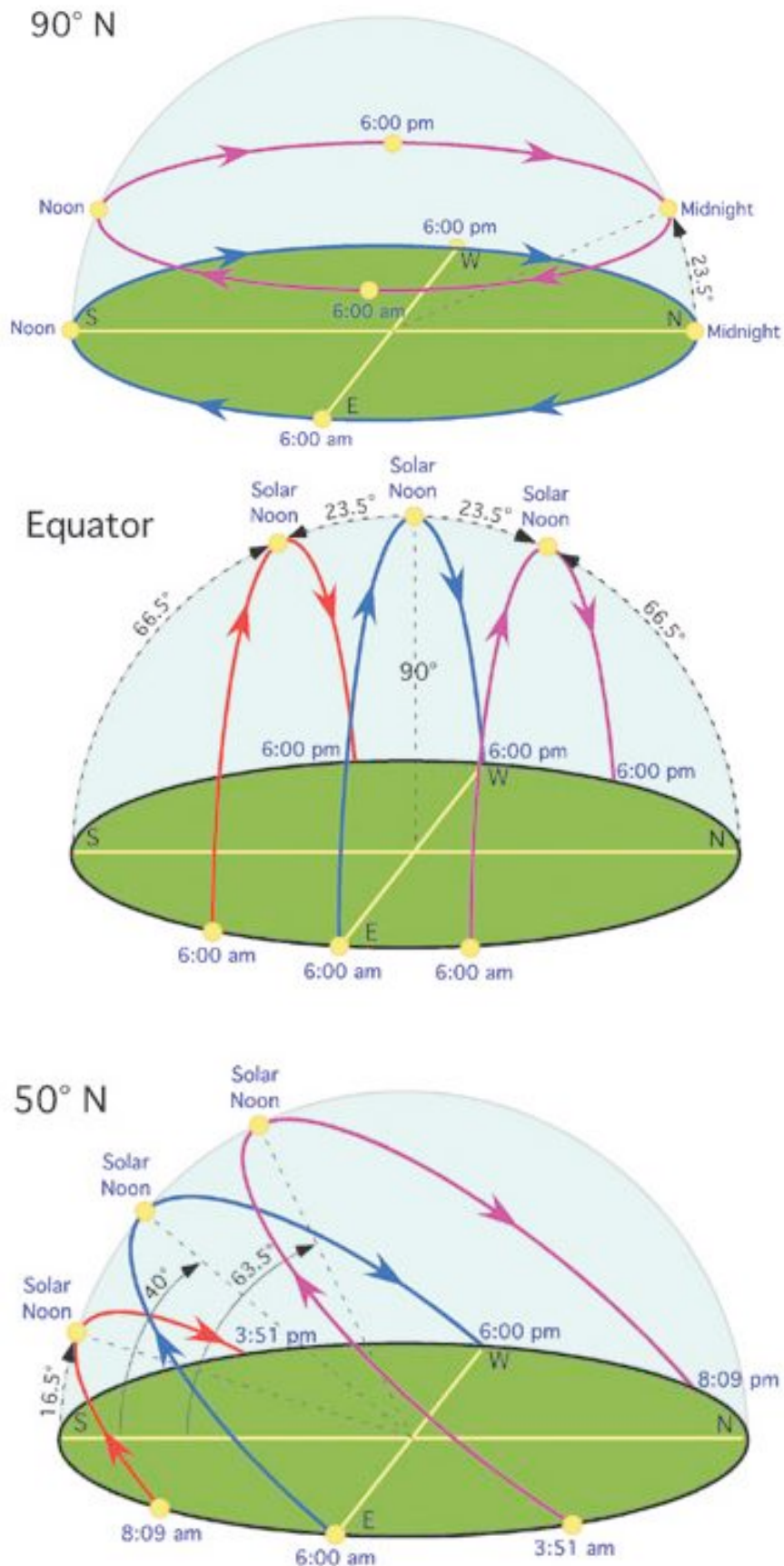   ii. Sun "appears" to move in an arc from <u>**EAST**</u> to <u>**WEST**</u> (Note diagram above)

h. **APPARENT DAILY MOTION OF THE STARS:**
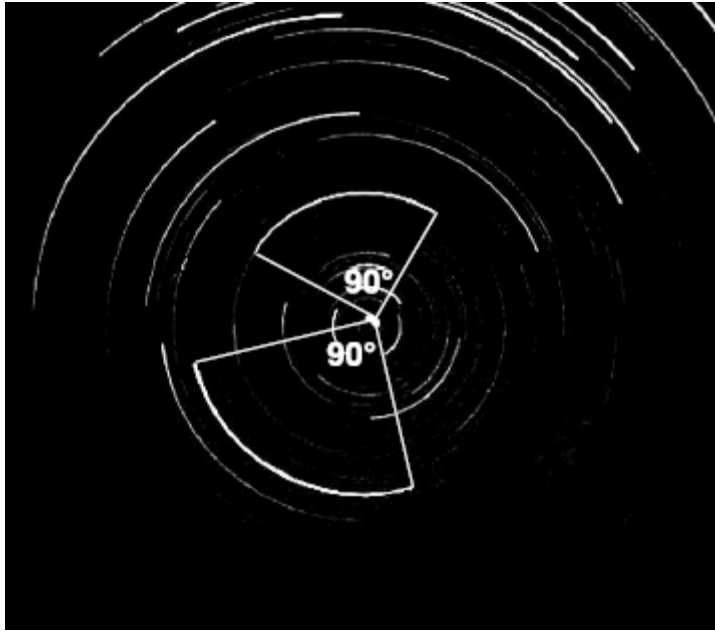

LOOKING EAST

LOOKING WEST

LOOKING NORTH

LOOKING SOUTH

i. The apparent daily motion of celestial objects (like stars) changes when the observer's **LATITUDE** on Earth changes.

NO STARS
RISE OR
SET!

90° N

6:00 pm

Noon

Midnight

6:00 pm

W

23.5°

6:00 am

Noon   S   N   Midnight

E

6:00 am

Equator

Solar
Noon

Solar   Solar
Noon   23.5°   23.5°   Noon

66.5°   66.5°

90°

6:00 pm   6:00 pm   6:00 pm

W

S   N

6:00 am   E
6:00 am   6:00 am

50° N

Solar
Noon

Solar
Noon

Solar   40°   63.5°
Noon

3:51 pm   6:00 pm

W

16.5°   8:09 pm

S   N

8:09 am   E
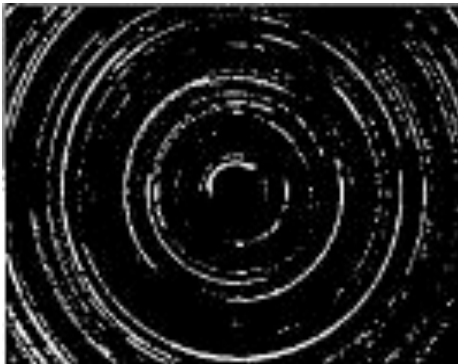6:00 am   3:51 am

j. **STAR TRAILS** – time- exposed photographic images that shows the apparent motion of stars; they appears as blurry lines across the film.

Time Exposure **6** hours

:

Angular distance of star trails **90⁰**

STAR TRAIL PHOTOGRAPHS LOOKING NORTH, SOUTH, EAST, AND WEST.

.

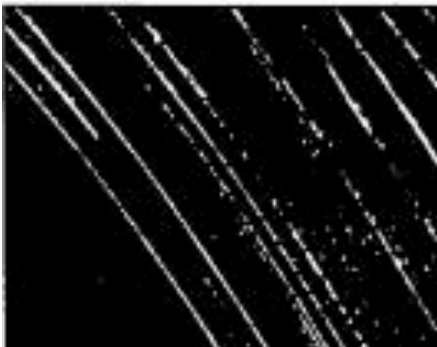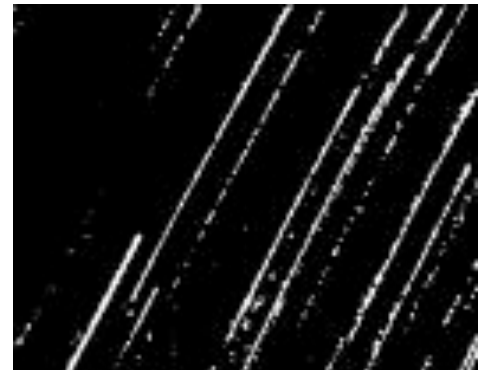A: **NORTH**   B.   **SOUTH**


C: **WEST**   D.   **EAST**

VI.   MODELS OF THE UNIVERSE

a. **GEOCENTRIC ("Earth Centered") MODEL**
  i. About 2000 years ago, the Greek astronomer, Claudius Ptolemy developed a detailed model of the universe based on the idea of revolving spheres.

  ii. In this model of the universe, the **EARTH** was at the center and all heavenly bodies moved around **EARTH** in **PERFECT CIRCLES**.

  iii. In Ptolemy's geocentric model:

   1. **EARTH** is in the **CENTER** and doesn't move.

   2. The **STARS** are located on a transparent sphere that rotates once each day from east to west around Earth.

   3. The **SUN**, the **MOON**, and each **PLANET** are carried by separate spheres of different sizes. These spheres also rotate east to west around earth (However, they rotate at slightly slower speeds than the sphere of stars and therefore have a general eastward drift relative to the stars. This explained the yearly cycle of nighttime stars.)

   4. Each planet is located on an "epicycle" (or "epicircle" that also rotates. So as each planet moves around Earth on its sphere, it is also moving or rotating on its epicycle. This explained the strange "retrograde motion" of the planets relative to background stars. That is, the planets seemed to move backwards compared to the stars when you observed them for several weeks.)

  iv. This model was accepted for almost 1400 years because it explained celestial observations made from Earth **AND IT SEEMED SO OBVIOUS**.

v. **Ptolemy's GEOCENTRIC MODEL OF THE UNIVERSE**:
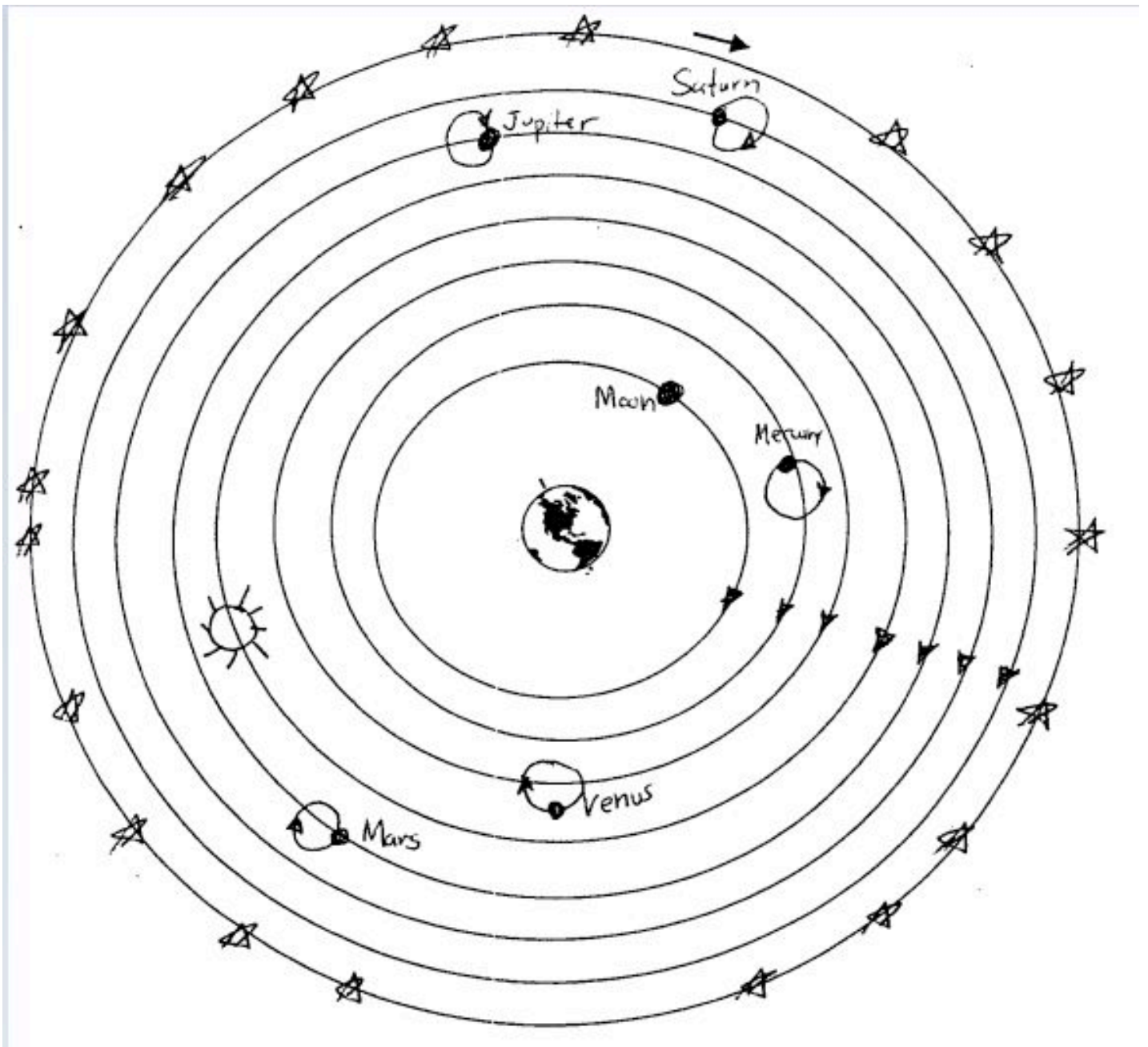
vi. The geocentric model does NOT explain terrestrial (Earth) observations such as:

1. <u>**THE MOVEMENT / ROTATION OF A PENDULUM'S DIRECTION**</u>

2. <u>**THE CURVATURE OF THE PATH OF PROJECTILES, WINDS, AND OCEAN CURRENTS (CORIOLIS EFFECT)**</u>

b. **<u>HELIOCENTRIC ("SUN-CENTERED") MODEL</u>**:

    i. In the 1500's a new model of the universe was proposed in a book by the Polish astronomer Nicholas Copernicus.

    ii. In this model of the universe, the **<u>SUN</u>** was at the center.

    iii. Copernicus' heliocentric model can be summarized as follows:

        1. The **<u>SUN</u>** is located in the **<u>CENTER</u>** of the system and does NOT move.

        2. The **<u>STARS</u>** are located on a stationary / unmoving, transparent sphere. The sphere is a great distance from the sun.

        3. The **<u>PLANETS</u>**, including **<u>EARTH</u>**, move in **<u>CIRCLES</u>** around the sun.

        4. The **<u>MOON</u>** moves in a circle around Earth.

        5. Earth rotates on its axis from **<u>WEST</u>** to **<u>EAST</u>** each day.

    iv. Copernicus' heliocentric model does NOT explain the apparent cyclic variations in the size of the Sun and the cyclic variation in the orbital speeds of the planets. This is because in Copernicus' heliocentric model, **<u>THE PLANETS ORBIT THE SUN IN PERFECT CIRCLES</u>**.

c. Heliocentric Model (2nd Version)

    i. In 1609, Johannes Kepler published a book which included his first two "laws" of planetary motion". These laws explain why the apparent size of the sun changed and why the speed of a planet changes as it orbits the sun.

    ii. This is because **<u>THE ORBITS OF THE PLANETS WERE ELLIPTICAL AND NOT CIRCULAR</u>**.

VII. **REVOLUTION**: <u>**THE ORBITING OF ONE CELESTIAL BODY AROUND ANOTHER CELESTIAL BODY**</u>.
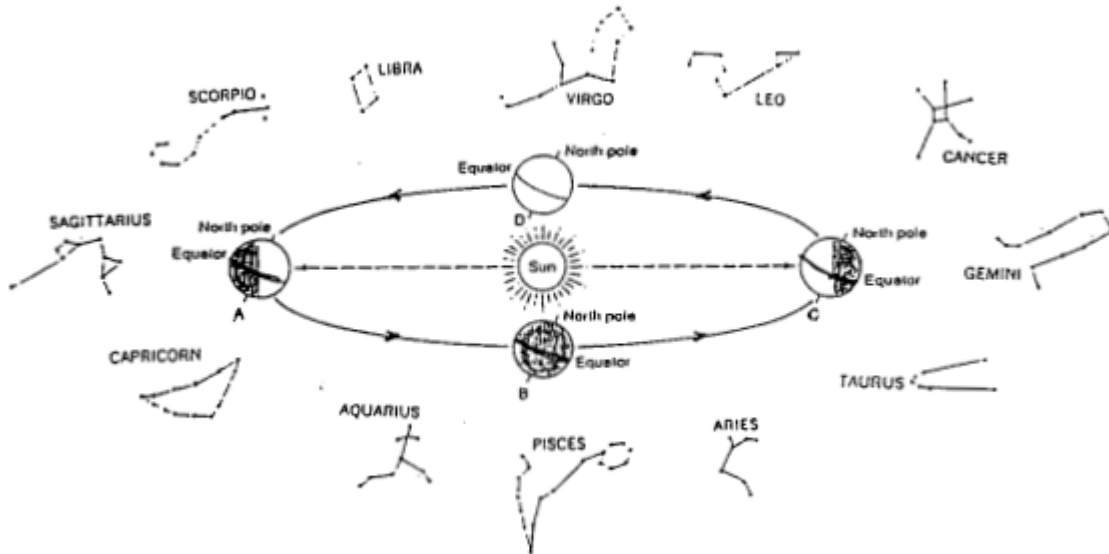   a. Earth's angular rate of revolution
       THINK – One complete revolution:
             1. <u>**360**</u> degrees
             2. <u>**365**</u> days

             3. Rate: <u>**360 ÷ 365 = 1⁰/Day**</u>
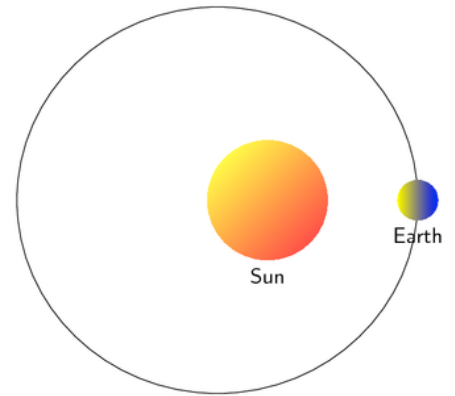
   b. Effects of earth's Revolution:
          i. Nighttime constellations change in a yearly cycle.

         ii. <u>**CONSTELLATIONS**</u>: groups of stars that form patterns of imaginary things such as animals, legendary heroes, and mythological Gods.
        iii. <u>**ZODIAC**</u>: a band of 12 constellations that forms a background for the sun as seen from the revolving earth.
         iv. **Complete the data table below based on the diagram above**.

| POSITION OF EARTH	SEASON	CONSTELLATIONS VISABLE AT NIGHT
A	SUMMER	Scorpio, Sagittarius, Capricorn
B	FALL	Aquarius, Pisces, Aries
C	WINTER	Tauris, Gemini, Cancer
D	SPRING	Leo, Virgo, Libra

VIII. **SEASONS OF THE YEAR** -
   a. Causes:
      i. Earth **REVOLVES** around the sun
      ii. Earth is **TILTED** / inclined on its axis **23.5⁰**.
      iii. Earth's axis is always pointed in the **SAME** direction
      iv. The apparent path of the sun **CHANGES** with the seasons.
      v. The intensity (strength) of insolation is **GREATEST** when sunlight (insolation) is perpendicular to the surface – striking at **90⁰**because the sunlight is concentrated in the smallest possible space.
      vi. As the angle of insolation **INCREASES**, the intensity of insolation **INCREASES**.

   b. The apparent path of the sun changes with the **SEASONS** and with **LATITUDE**.
      i. NYS: **43⁰** Latitude
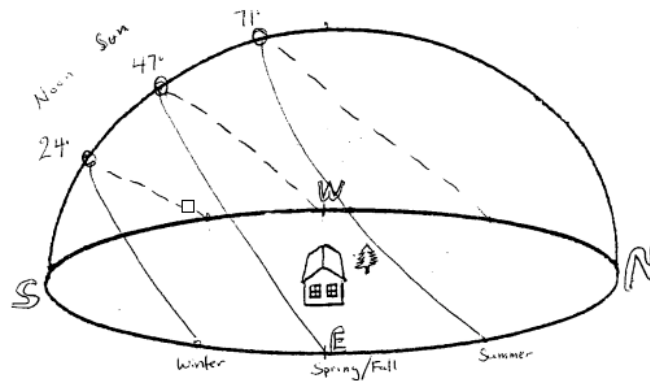
      ii. Equator **0⁰** Latitude
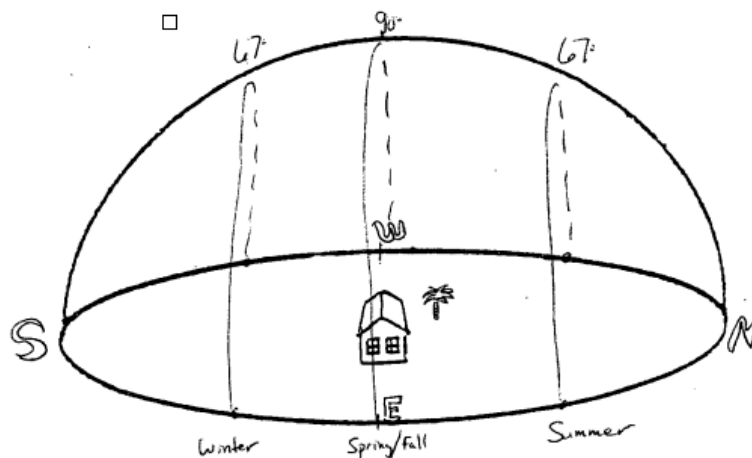
IX. **The Moon**
   a. The moon is a **NATURAL SATELLITE OF EARTH**.

      1. **LUNA** = Latin word for the moon
      2. **DIANA** = Roman Goddess of the moon.

   b. **PHYSICAL PROPERTIES OF THE MOON**
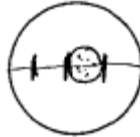   i. Size:
         1. Diameter: **2160** miles

         2. Compared to Earth

$$\frac{\text{Diameter of Moon} = \textbf{2160} \text{ miles}}{\text{Diameter of Earth} = 8000 \text{ miles}} = \frac{1}{4}$$

         3. Scale of size:

         4. Gravity
           a. **1/6** the gravity of Earth
           b. **SMALLER – LESS MASS**

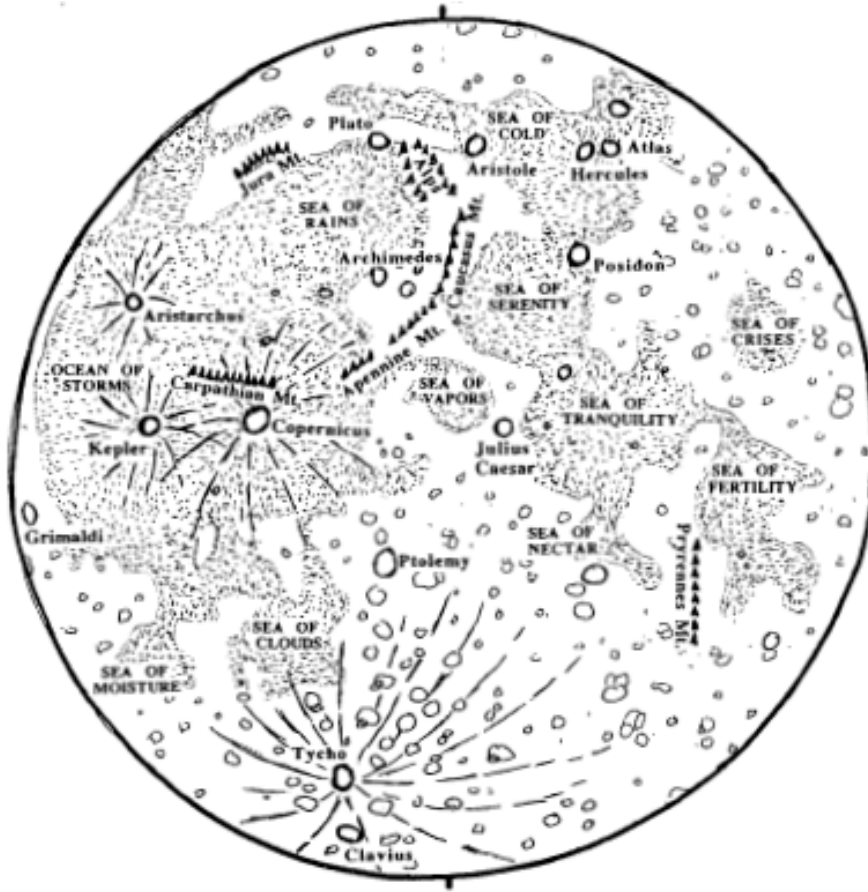   5. ATMOSPHERE:
           a. **VIRTUALLY NONE**
           b. **GRAVITY TOO WEAK – GASSES ESCAPE OUT INTO SPACE**.

         6. TEMPERATURES:
           a. **240⁰F** on the lighted side
           b. **-240⁰F** on the dark side.
           c. These large temperature extremes exist because **THE MOON DOES NOT HAVE AN ATMOSPHERE TO TRANSFER HEAT**.

c. LUNAR TOPOGRAPHY – Surface features of the moon.

i. **CRATERS**: Bowl-shaped depressions formed primarily as a result of the impact of meteors.

1. There are many more craters on the moon than on earth because **THE MOON DOES NOT HAVE AN ATMOSPHERE TO 1) BURN-UP INCOMING METEORS AND 2) NO EROSION TO WEAR THE CRATERS AWAY**.

2. **MARIA** – Appear as the "dark areas" on the moon's surface. Once thought to be **SEAS**.

3. **RAYS** – appear as "bright streaks" that radiate from certain craters. Consist of shattered debris that was splashed out by the impact of meteors that formed the craters.

4. **HIGHLANDS** – appear as the "light areas" on moon's surface. Consist of **CRATERS** and **MOUNTAINS**.

d. **THE MOON'S REVOLUTION**:
   i. Period of revolution vs Cycle of phases
      1. **PERIOD OF REVOLUTION- HOW LONG IT TAKES THE MOON TO MAKE ONE COMPLETE REVOLUTION AROUND EARTH**.

         a. **27.3 DAYS** (ESRT Page **15**)

      2. **CYCLE OF MOON'S PHASES – HOW LONG IT TAKES THE MOON TO GO THROUGH ALL PHASES FROM FULL MOON TO THE NEXT FULL MOON.**

         a. **29.5 DAYS**
         b. **ONE MONTH**

   ii. The moon revolves around Earth in an **ELLIPTICAL** orbit, and Earth is at one **FOCI**.
   iii. This causes the moon's apparent **DIAMETER / SIZE** to change in a **CYCLIC** manner.
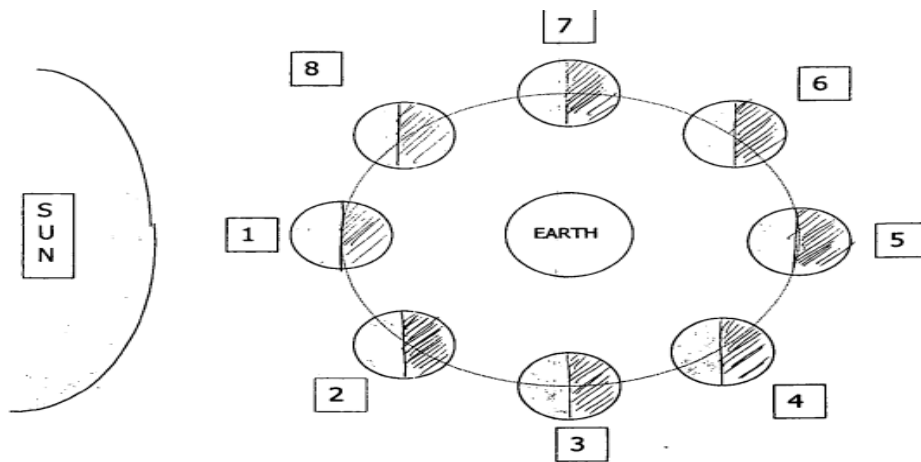
e. **PHASES OF THE MOON**:
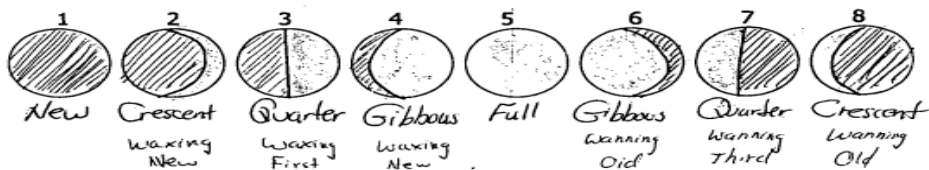   i. Caused by **THE MOON'S REVOLUTION AROUND EARTH**.
   ii. Our earth view of **THE ILLUMINATED (LIT) PART OF THE MOON'S SURFACE THAT FACES EARTH**.
   iii.
      1. The Moon orbiting Earth as seen from space:


b. Phases of the moon as viewed from Earth

2. **WANING**- The **DECREASING** of the moon's visible, illuminated surface from **FULL** moon to **NEW** moon.
3. **WAXING**- The **INCREASING** of the moon's visible illuminated surface, from **NEW** moon to **FULL** moon.

f. **THE NEAR AND FAR SIDE OF THE MOON**

  i. **NEAR SIDE** – the bright side of the moon that always faces earth. It is nearly half highlands and half maria.

  ii. **FAR SIDE**- the side of the moon that **NEVER** faces Earth. It is mostly highlands and craters.

  iii. The same side of the moon (the near side) always faces Earth **BECAUSE THE MOON'S PERIOD OF ROTATION EQUALS THE PERIOD OF ITS REVOLUTION**.
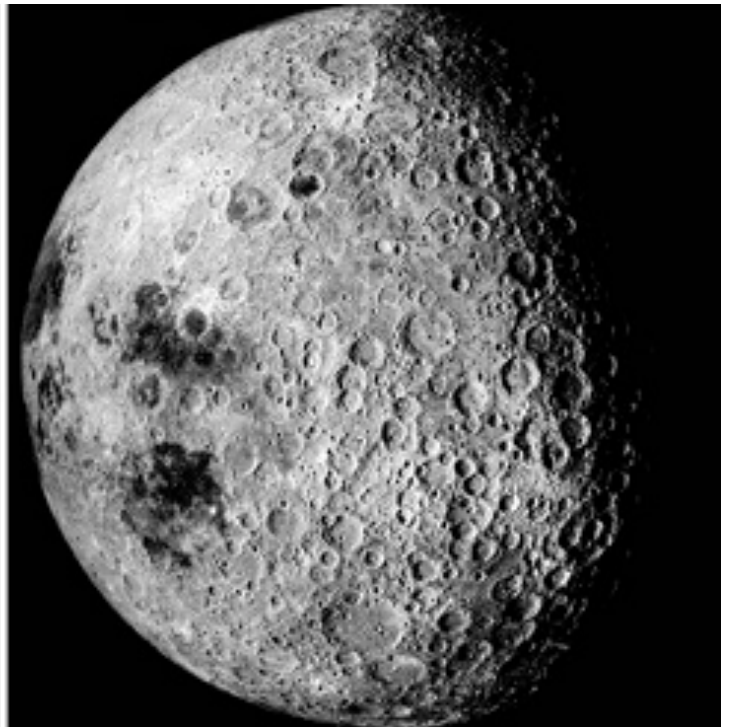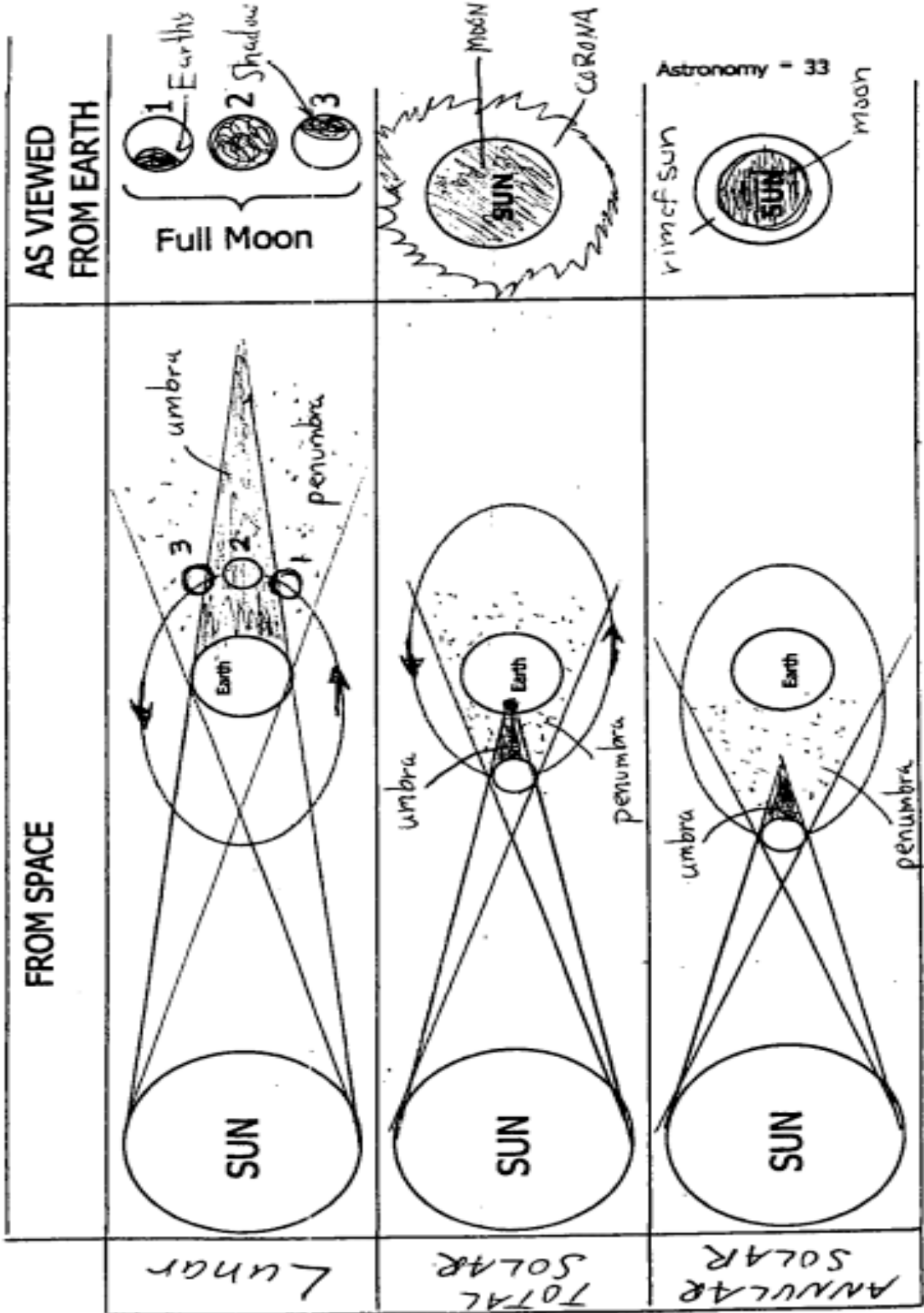

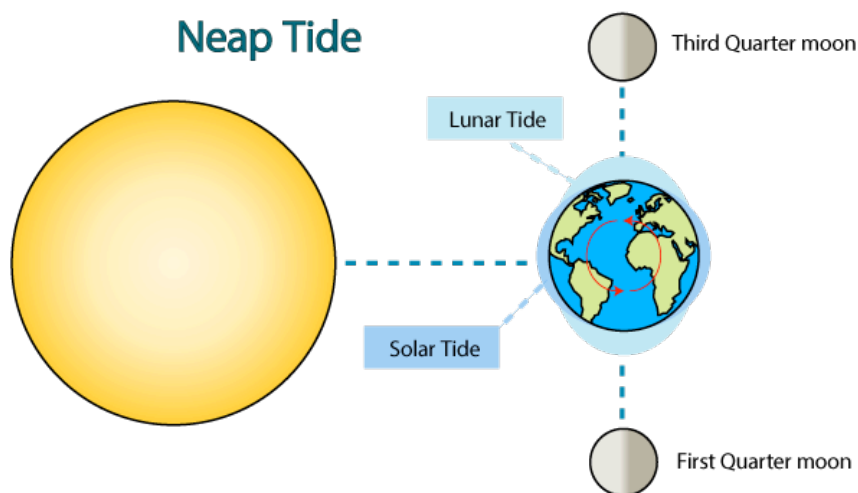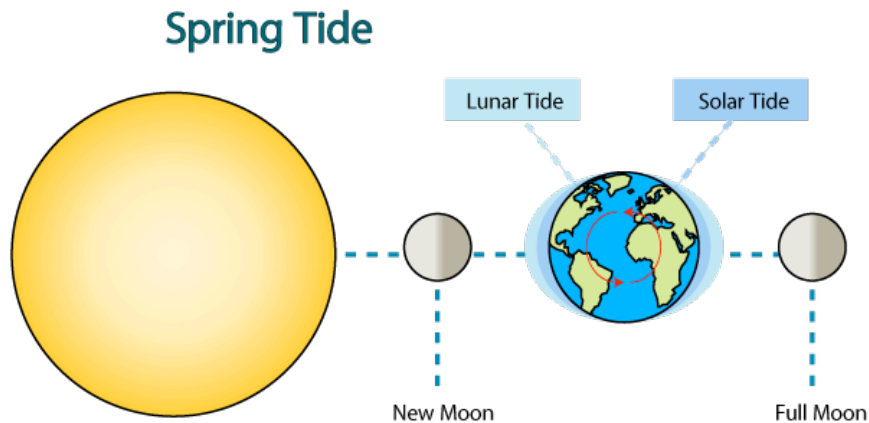**NEAR SIDE**   **FAR SIDE**

g. ECLIPSES

X. TIDES

    a. Tides are the **PERIODIC RISING AND FALLING OF THE OCEANS**
        i. Caused by the moon's **GRAVITY**
       ii. Affected by Earth's **ROTATION**.

    b. **SPRING TIDE**: **HIGH** tides occur during the **FULL MOON** and the **NEW MOON** phases when the **SUN**, **MOON**, and **EARTH** are in line.

    c. **NEAP TIDES**: **LOW** tides occur during the moon's **QUARTER** phases and the moon is **NOT** in line with the Earth and sun.

Spring Tide

Lunar Tide   Solar Tide

New Moon   Full Moon

Neap Tide

Third Quarter moon

Lunar Tide

Solar Tide

First Quarter moon

d. The period from high tide to high tide is normally about **12 HOURS AND 25 MINUTES**. It is a **CYCLIC** change.
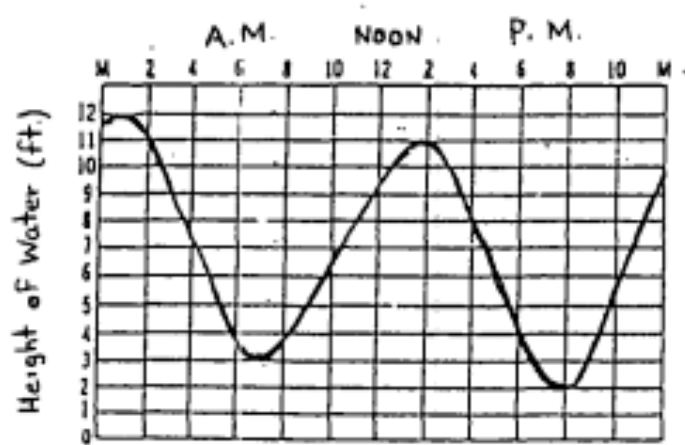
e. The next high tide will occur at **2:20 – 2:25 AM**
f. The next low tide will occur at **8:20 – 8:25 AM**

UNIT 9 EXAM TOPICS

UNIVERSE

-Structure
-Doppler Effect

STARS

-ESRT Page 15
-Nuclear Fusion

PLANETS

-ESRT Page 15
-Terrestrial & Jovian
-Geocentric & Heliocentric

ECCENTRICITY

-ESRT Page 1
-Velocity
-Kinetic Energy
-Gravitational Force
-Foci
-Major Axis

THE MOON

-Phases
--Draw
--Read
-Time required – revolution vs Cycle of
-Phases
-Eclipses
-Solar
-Lunar
-Position of celestial objects
-Rotation and revolution

CELESTIAL SPHERES

-Draw paths
-Read paths
-4 specific dates

ROTATION

-15 degrees per hour
-Evidence
-Foucault Pendulum
-Coriolis effect
-Time zones
-Polar view diagrams
-Daily patterns

REVOLUTION

-1 degree per day
-Evidence
-Seasons
-Dates
-Position
-Latitude of direct rays
-Duration of insolation

TIDES

-Spring and neap
-Position of moon, sun, earth

UNIT 8 EXAM VOCABULARY

Asteroid	Impact Crater
Axis of Rotation	Jovian Planet
Big Bang Theory	Luminosity
Celestial Object	Meteor
Comet	Milky Way Galaxy
Constellation	Moon
Coriolis Effect	Nuclear Fusion
Doppler Effect	Phases of the Moon
Eccentricity	Red Shift
Eclipse	Revolution
Ellipse	Rotation
Focus	Solar System
Foucault pendulum	Star
Galaxy	Terrestrial Planet
Geocentric Model	Tides
Gravitation	Time Zones
Heliocentric Model	Universe