



Lesson 1

Unit 3

The Universe

Def. of the Universe :

It is the space which contains all galaxies, stars, planets, moons and living organisms.

- "Everything on the earth".

Note that

- The universe is very vast.
- The sun and earth are tiny parts in the universe.

Stars :

large - round bodies- generating great amounts of **heat&light**

They seem small points as they are millions of kilometers away from us.

- Although stars are very far from each other, they form groups called (**Galaxies**).

The universe contains many galaxies and each galaxy has a distinctive shape according to the harmony and order of the groups of stars in it.

- The stars move in fixed orbits around the center of the galaxy.
- The galaxy that our solar system belongs to is known as
(The Milky Way Galaxy).

The Milky Way Galaxy

- Spiral galaxy. - Contain more than 200 billion star.
- In the center of the galaxy a lot of old stars gather surrounded by small stars which is located in the spiral arms of the galaxy.



- The milky way is given that name bec. It appears in the sky at night as splashing milk or spreading straw.

The components of the universe

- **The universe :**
 - Wide extended space contains galaxies.
 - No. of galaxies = 100.000 million galaxies.
- **Galaxies :**
 - Group of stars rotate together in cosmic space by effect of gravity.
 - Bigger units form the universe.
 - Gather in clusters.
 - Move away from each other.
 - Rotate in a system around center of the universe.
- **Clusters of galaxies.**

Group of galaxies that rotate together in cosmic space by gravity.

The milky ways

It contains the sun and solar system.

- The solar system :

Consists of one star which is the sun and eight planets revolving around it including the planet Earth on which we live.

Distance between stars are very large, so, the distances in the far space are not measured in km. → measured by light year.

Light year



It is the distance covered by light in one year and it equals 9.467×10^{12} km. (9460000 Million Km).

Example

Whats meant by : The distance between the sun and a star is three light years :

$$\text{Distance} = 3 \times (9.467 \times 10^{12}) = 28.401 \times 10^{12} \text{ km}$$

Solar system

- Solar system consists of eight planets revolving around the sun.
- Sun and surrounding planets revolve around the center of the galaxy.
- Sun takes about 20 million years to complete one rotation around the center of the galaxy.
- Solar system is located in one of the spiral arms of the milky way on the edge of the galaxy.

How did the universe originated

- Scientists believe that the matter of the universe was originally.



* small in volume.

* constant in expansion.

The Big Bang theory is the most believed theory for the universe originated.

Stages of the Big Bang explosion,...



- 1- Big bang stage.
- 2- Stage of galaxies formation.
- 3- Stage of stars and solar system.
- 4- Stage of earliest life formation.
- 5- Recent stage.

Stage 1, Big Bang

- Explosion happened → expanded rapidly
and suddenly.
- Density of the gaseous ball ↓ and temp ↓.
- The atomic particles merged to form primary gaseous cloud from hydrogen and helium.

Stage 2,

- After billions of years
 - Primary gaseous clouds connected together → forming homogenous small clouds.
 - These clouds represent the primary matter of the galaxies.
- Note that continuous contraction and expansion help in this formation of the primary matter of galaxies.

Stage 3,



Galaxies are formed
after 3000 million years.

Stage 4,

Our galaxy (Milky Way) took its disc form after 5000 million years.

Stage 5,

After 10000 million years
Sun and earth planets created.

Stage 6,

Earliest life forms began to appear on earth.

Activity to show expansion of the universe and separation of galaxies,

- Bring some flour and mix it with water and some bread yeast. Mix the components well to make bread dough (representing universe).
- Insert some raisins in dough (representing galaxies).
- Leave the dough to ferment in warm environment.

→ Observation, - dough expands.

- grains of raisins become apart

Similarly the separation of grains of raisins resembles the separation of galaxies.

Note :

Scientists discovered radio waves coming from space.

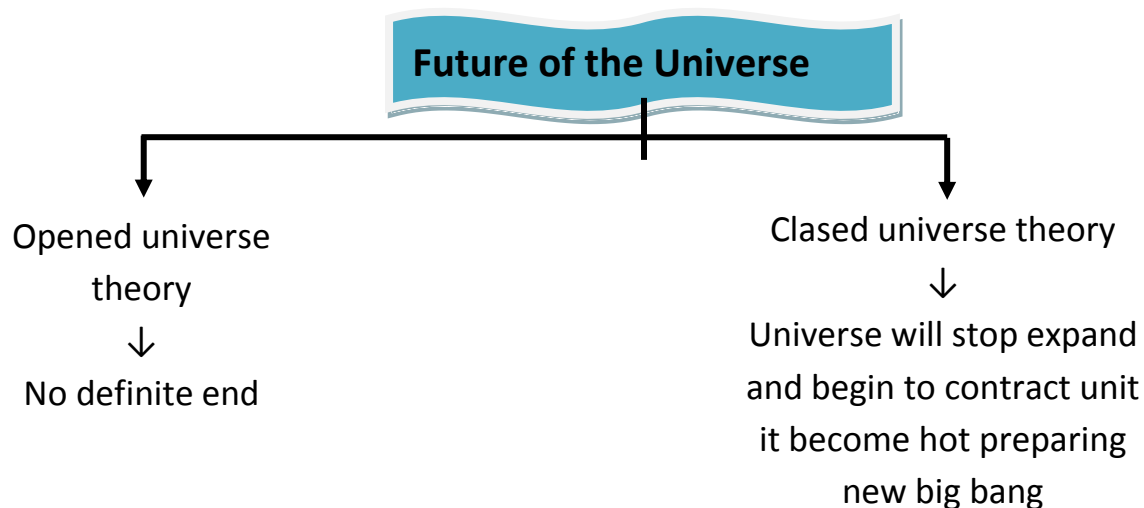
They concluded that these waves are a type of the echo coming from Big Bang.



Origin of the universe in old ages :

- Myth dominated the human imagination.
- By development of human mind, it became clear to the ancient Egyptians and Babylonians the relationship between the eternal universe and the multiple Gods controlling it.
- Philosophers of Greek and Romans attempted to develop theories of cosmic phenomena.

Astrology prevailed at both Indian and Chinese civilization.



The Solar System

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Solar system consists of :

1- Sun.



2- 8 planets revolving around the sun.

3- Comets.

4- Asteroids.

5- Moons.

- Solar system extends over 12000 million km in space.
- In the past → they thought that the solar system is the center of the universe.

Now → Astronomic system is considered just a tiny spot compared to the rest of the universe.

- The planets and other celestial objects were originated in the system since 4600 million years from the matter remained from the evolution of the sun.

The Sun

- Biggest star in solar system.
- The sun represents more than 99% of the total mass of the solar system.

Gravity in the solar system

- Newton discovered the (1) gravitational force towards the ground.
- And he proved that there is a force of gravity "attraction force" among (2) planets and the sun, and between (3) planets and moon.



So, all planets revolve around the sun in fixed orbits by the action of attractive force of the sun on these planets → (Central gravitational force).

And this depends on → the mass of each object.

→ the distance between them.

Def. of central gravitational force (centripetal force) :

- It is the force that keeps the planets in continuous rotation along their orbits around the sun.

Newton's law of universal gravitation:

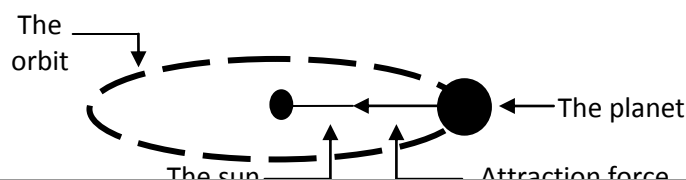
The force of attraction between two bodies is directly proportional to the product of their masses and inversely proportional to square of the distance between them.

↑ attar → ↑ mass

↓ att → ↑ distance²

Note

- By Gravity :
- The matter of the celestial body remains firm.
- Also it attract gases towards planet or moon forming the atmosphere around it.
- If there is no gravity "no attraction force" between sun and Earth the earth will leave its orbit and float in a random fashion in space → destruction of earth.





Note that as the planet moves away from sun → gravity ↓ and so it become slower.

Theories about the evolution of solar system

There are about 20 theories about the evolution of the solar system.

The important theories are :

- 1- Nebular theory.
- 2- The crossing star theory.
- 3- The modern theory.
- 4- Recent theories.

I- Nebular theory : (Laplace 1796) :

- French scientist (Pierre Laplace) published a research entitled (World order).
- The research included a perception about the evolution of the solar system affected by two observations which are :
 - 1- There is something that looks clouds or nebula in the space.
 - 2- The space contains many clouds surrounding planets.

Assumption of Nebular theory :

- 1- The solar system was a glowing gaseous sphere revolving around itself. (Nebula).



- 2- As time passes, the nebula lost its heat gradually, so, its size contracted and its revolving speed around itself increased.
- 3- Under the effect of centrifugal force, the nebula lost its sphere form and became a flat rotating disc.
- 4- Parts got separated from flat disc by the effect of centrifugal force to form gaseous circles that also rotate in same direction like nebula rotation.
- 5- The gaseous circles cooled down, frozen formed the planets of solar system.

The remaining flame mass → is the sun.

II- The crossing star theory :

(Chamberlain and Moulton 1905) :

Assumptions , ...

- 1- The solar system was originally a big star (the sun).
- 2- Another huge star approached to sun.
- 3- The star attracted the sun's material to it which led to great expansion in the part of the sun facing it.
- 4- This expanded part was exploded and a gaseous line was formed of great length that occupied the distance between sun and last planet.
- 5- Due to this explosion sun escaped from the gravity of the star.
- 6- The gaseous line started to condense due to attraction forces → cooling → planets formed.



3- The modern theory of the world,...

(Alfred Hale 1944),...

- This theory is based on what is sometimes seen when a star greatly glows for a short time to become one of the most shining stars in the sky.
- After a day, its glow disappears gradually to return to its normal nature → this glow is due to the explosion of that star as a result of nuclear reactions that occurs suddenly.
- The star bombs huge amounts of gaseous material when these reaction occurs.

Assumptions

- 1- The existence of a star rotating near the sun.
- 2- The star was exposed to explosion due to huge nuclear reactions.
- 3- The force of the explosion led to the bombing of the star's nucleus away from gravity sun.
- 4- A cloud of gas remained and subjected to cooling and contraction processes forming planets.
- 5- The attraction force of the sun controlled the orbits of planets around it.

4- The more recent theories:



- The sun was surrounded by a sphere of gas (a mixture of hydrogen and helium) and dust (iron, rocks, ice) called "Solar Nebula".
- **The solar nebula turned into a flat rotating disk, then:**
 - The dust compressed together forming four inner planets which are, Mercury, Venus, Earth, Mars.
 - The dust and ice combined with gases forming four outer planets which are : Jupiter, Saturn, Uranus and Neptune.



- The earth is the largest inner planet and it has one moon rotating around it.
- Neptune is the smallest outer planet and is four times larger than earth.
- There are 2 moons rotating around Mars and no moons rotating around mercury and venus.
- The difference in length of the day and year from planet to another,...
- **Day** : It is the period taken by the planet to make one complete rotation around its axis.
- **Year** : It is the period taken by the planet to make one complete rotation around the sun.
- **Factors led to the difference in length of the day:**
 - 1- Radius led of the planet.



2- Speed of rotation of the planet around its axis.

Factors led to the difference in the length of the year :

- Distance between the planet and sun.
- Speed of rotation of the planet around the sun.

The longest day is on → Venus.

The shortest day is on → Jupiter.

The shortest year is on → Mercury.

The longest day is on → Neptune.

Activity to explain the difference in the length of the year from a planet to another :

- Draw 4 circles with a united center around 5 students on a play ground.
- Each student stand on one of the circles in a way that all in straight line.
- Using the watch calculate the time that each students takes to make a complete rotation.

Observation

The difference in time that each student takes to make a complete rotation is due to the difference in the distance that the student moves around the center.

Conclusion



- The difference in the length of the year from one planet to another is due to :
 - 1- The difference in the distance that each planet takes to rotate around the sun. (The center of the solar system).
 - 2- The difference in the speed of the planets rotation around the sun.

Science, Technology and Society

Weightlessness

- The continuous force of Earth's gravity on our bodies gives us weight.
- But, when you are inside a lift going downward fast, you feel that you are lighter in weight.
- This phenomenon occurs in the spacecrafts as astronauts fall down inside it with some speed, so they get weightless.

Notes :

- 1- Universe was formed almost in homogenous parts.
- 2- Gravity helped in gathering of more masses leaving empty spaces between them.
- 3- Areas of gathered matter form the Galaxies.



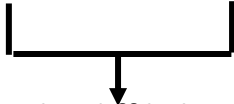
Science, Technology and Society

A solar Telescope,...

- Centered on earth or carried into space to study sun.
- Sun light is gathered → then separated by



Spectrometer into spectrum.



(Shows the diff light wave lengths by sun)

- By studying spectrums of sun we can study and get information about sun.
- Solar telescope works on reflecting the sun rays downward to a mirror in a tunnel under earth surface a picture of sun is formed in monitoring room.

Modern equipments

- May be on earth or sent to space to get photos and information.

Examples :

I- Telescopes,...

Rotating in orbits around the Earth so

Can see celestial bodies

catch rays able to penetrate earth atmosphere

II- Spacecrafts

- They are sent in deserted trips to revolve round other planets or land on them.
- These spacecrafts are controlled by computers from surface of Earth.
-

III- The Hubble telescope

- Launched in April 1990.
- Rotates around at height 500km.
- Collect photos → able the astronomers to study the edition of universe.



Space suit

- The first astronauts wore one space suit for the trip.
- Today they wear clothes that differ due to missions they perform.
- There is also a normal type of special clothes to be worn inside spacecraft during its rotation.