



*A. The Universe*

1. Only one exists—or are there more?
2. Composed of space and 100 billion galaxies
3. A galaxy is a grouping of millions or billions of stars kept together by gravity

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How did the universe begin?

- ♦ The current understanding of the how the universe began is described by the Big Bang Theory—it wasn't big and there wasn't a bang!

http://science.howstuffworks.com/dictionary/astromy-terms/big-bang-theory-1.htm

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**Formation of the Universe**

- ♦ **Big Bang Theory:** Explains how universe *developed* from very tiny, dense **"singularity"**

**BIG BANG THEORY**  
In the Beginning There Was Nothing.....  
Which Exploded

More on the Big Bang Theory

The theory states: the universe began from an initial point (or singularity) which has expanded over billions of years to form the universe as we now know it today.

More on the Big Bang

- ♦ Description of the big bang:
  - ♦ <https://www.youtube.com/watch?v=gS-yWMuBNr4>
- ♦ Evidence for the big bang:
  - ♦ [https://www.youtube.com/watch?v=xtrYF\\_hxxUM](https://www.youtube.com/watch?v=xtrYF_hxxUM)

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## Formation of the Universe

- ◆ **Big Bang Theory:** According to BBT, **UNIVERSE** is **13.7 Billion** years old



## Formation of the Universe

- ◆ **Big Bang Theory:** Does **NOT** explain what **initiated** creation of universe  
– Only describes **expansion** of universe

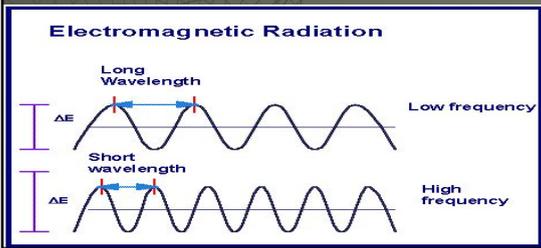


4. Edwin Hubble (in 1929) proposed that the Universe is expanding
  - a. This is supported by a phenomenon called the Doppler shift
    - 1). Stars are moving away from Earth and their light becomes dimmer. This is called the red shift. This gives support of the expanding universe
    - 2). If stars move toward Earth, we see a blue shift – light becomes brighter

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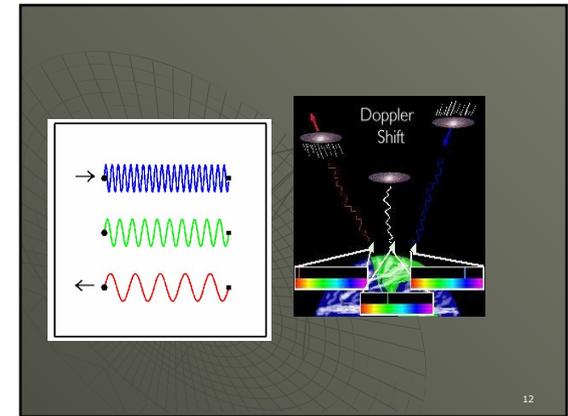
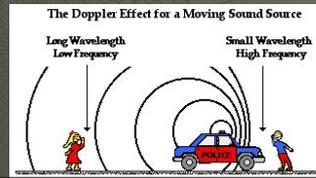
## Putting it Together...

- ◆ **Inversely Proportional:**
  - Wavelength **increases** = Frequency **decreases**



## Universe is EXPANDING

- ◆ **Doppler Effect:** – Change in **frequency** of waves moving **relative** to its source
  - Stars moving **AWAY** = **RED** shift
  - Stars moving **TOWARD** = **BLUE** shift
  - **Greater** the shift = **faster** the speed



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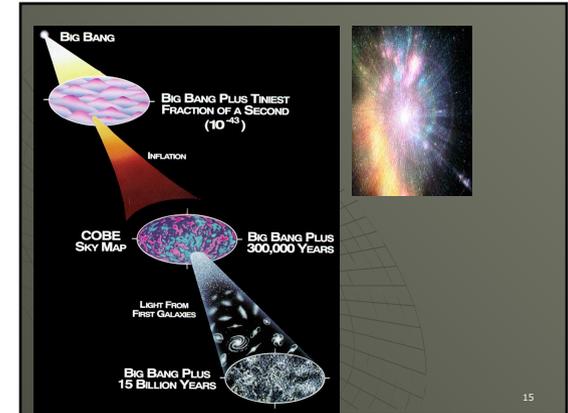
# Universe is EXPANDING

## Evidences?

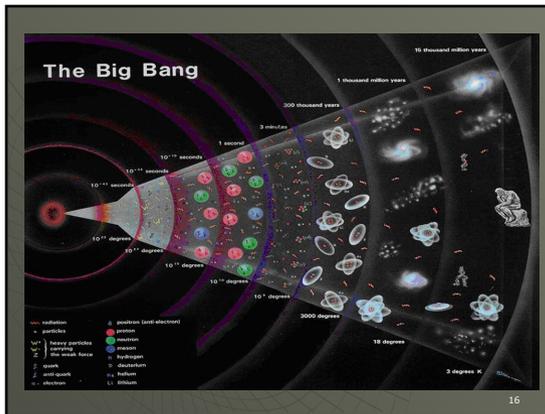
- **Cosmic Background Radiation** – **Low** temp waves indicating **explosion** occurred
- **Gravity** – Responsible for movement of **dust** clouds to form **planets** and **stars**



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## B. Galaxies

1. Galaxies are classified according to their shape
2. Spiral galaxies often appear bluish because they contain many young stars
  - a. Young stars give off blue light when they burn
3. Elliptical galaxies often appear reddish because they contain many old stars
  - a. Old stars give off red light when they burn

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## Galaxies, cont.

4. A large cluster of galaxies is called a supercluster
5. Our solar system is inside the galaxy known as the Milky Way
  - a. The Milky Way is classified as a spiral galaxy
6. The Milky Way contains interstellar matter that may form new stars

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## Contents of Galaxies

Galaxies are made of stars, planetary systems, gas clouds, and star clusters. Nebulas are giant clouds of gas and dust where stars may be forming.



Nebula are found in spiral galaxies but not elliptical galaxies.

## Main Types of Galaxies



Spiral



Irregular



Elliptical



## Spiral Galaxies



## Properties of Spiral Galaxies

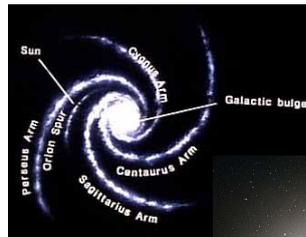
- Shaped like flattened disks with one or more spiral arms.



- Our galaxy, Milky Way, is a spiral galaxy.
- Our solar system is located in one of the spiral arms.



## Milky Way Galaxy



Top View ↑

Side View →



## Elliptical



## Properties of Elliptical Galaxies

- About 1/3 of all galaxies.
- Simply massive blobs of stars.



- Round or elliptical in shape.
- Contain very little gas or dust.
- Because of little gas, no new stars are forming.
- The largest and smallest galaxies are elliptical galaxies.

## Properties of Irregular Galaxies

- Do not fit into any other category.
- Chaotic mix of stars, gas and dust
- Usually found near large spiral galaxies who may be distorting their shape.



## C. The Solar System

1. Copernicus (1473-1543) first proposed that Earth and the other planets orbit the sun
2. The orbits of the planet were first said to be elliptical by Kepler (1571-1630)
3. The brightest object in our sky (besides the sun and the moon) is Venus

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Nickolas Copernicus



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## Formation of Solar System

- ◆ **Nebular Theory:** **SOLAR SYSTEM** formed from huge, rotating **cloud** disk of **dust** and **gases**



5. The most widely accepted model of the formation of the solar system is the **nebular model** where the solar system condensed out of a nebula – a huge cloud of interstellar gas and dust
  - i. Planets may have formed out of material orbiting the early sun through the process of accretion where small particles collide and stick together to form larger masses
  - ii. Gaseous clouds—nebulae, which slowly rotate, gradually collapse and flatten due to gravity and eventually form stars and planets.

Our solar system is approximately **4.6 billion years old.**

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## What is the difference between the Solar System, Galaxy, and Universe?

- Basically **SIZE** is the biggest distinction.
  - We live on planet Earth which is part of our local Solar System.
  - Our Solar System includes the Sun and everything that orbits the Sun.
  - Our Sun, is just one Star in the Milky Way Galaxy.
  - The Milky Way Galaxy is just one Galaxy in the Universe.



## KEPLER

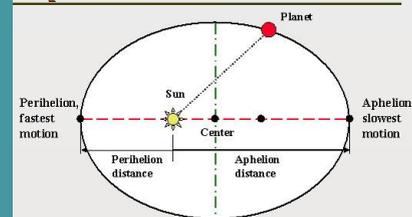
- **HELIOCENTRIC MODEL**
- **3 LAWS OF PLANETARY MOTION**



## Kepler's First Law

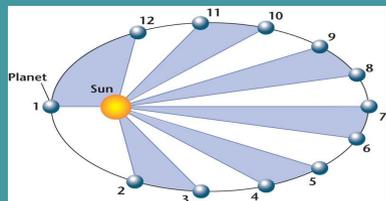
- Orbit of *every* planet is an **ellipse** with **Sun** at one foci (*focus*)

### Kepler's 1st Law



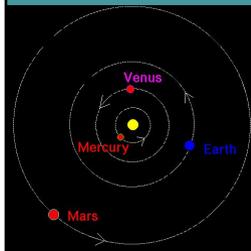
## Kepler's Second Law

- ◆ Planet moves **fastest** when **closest** to Sun and **slowest** when **farthest** from Sun
- ◆ **Equal areas** are swept out in **equal** amount of **time**



## Kepler's Third Law

- Compares **distance** of each planet from **Sun** and its **orbital period** around Sun

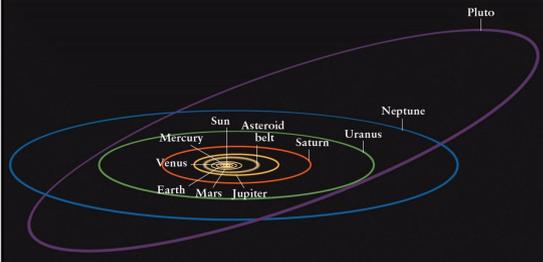


The order of the planets are Mercury, Venus, Earth, Mars, and Jupiter, Saturn, Uranus, and Neptune.



## What's the Difference?

- **SIZE** and **COMPSITION**



## Terrestrial Planets

- **Inner 4 Planets:**

- Mercury
- Venus
- Earth
- Mars

- **Small, solid, rocky surfaces**

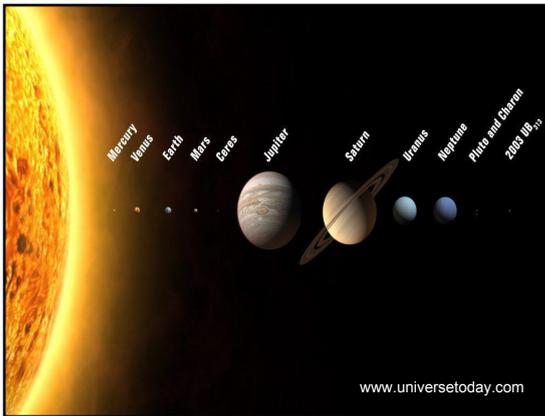


## Jovian Planets

- **Outer 4 Planets:**

- Jupiter
- Saturn
- Uranus
- Neptune

- **Larger, gaseous, and lacks solid surfaces**



www.universetoday.com

## Earth Facts

- **Distance to Sun: ~92,000,000 Million miles**
- **Age of Earth: ~4.6 Billion Years**
- **Size: 5<sup>th</sup> largest in solar system**



- Mercury is closest to the sun and has very hot temperatures
- The inner planets and outer planets are separated by an asteroid belt
- The great red spot on Jupiter is believed to be a giant storm
- All of the gaseous outer planets have rings