

A cosmic scene featuring a large reddish planet on the right, a crescent moon in the upper center, and a blue nebula on the left.

# The Universe

# Formation of the Universe

- Steady State Theory

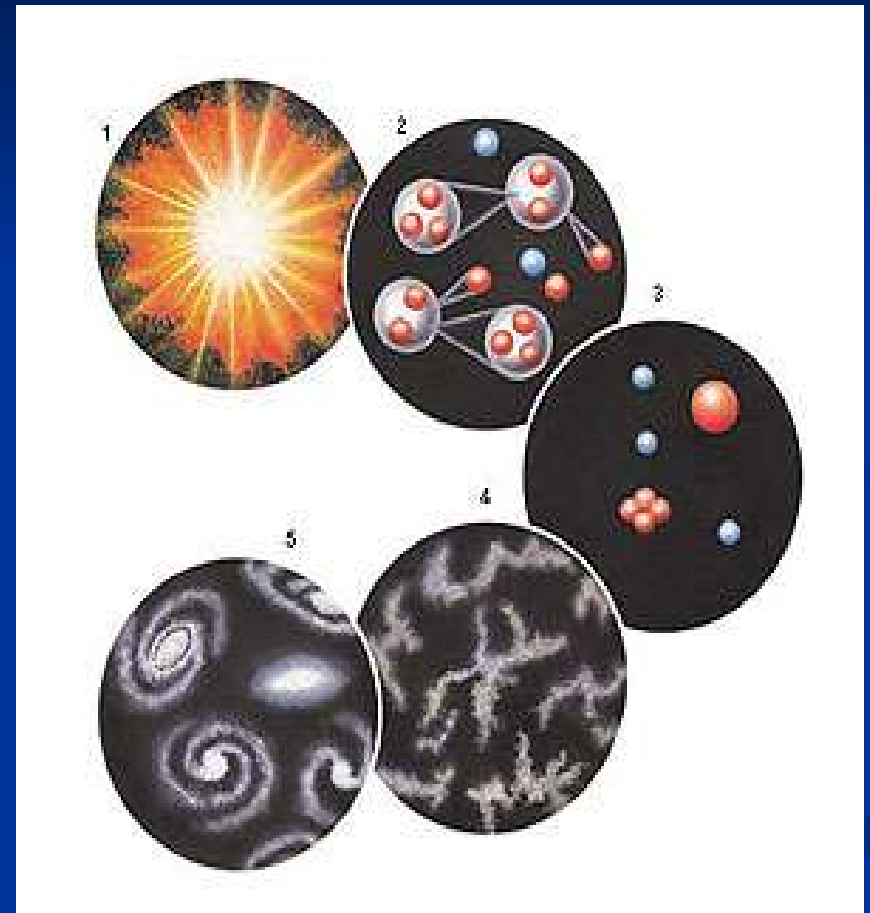
Theory which states the universe always was

- Big Bang Theory

Theory which states that the universe came to be and expanded from an extremely dense state (a singularity).

# Timeline of events

- 1. Time: 0  
Matter and energy are created in the Big Bang.
- 2. Time: 60 secs  
Temperature: 1 billion °C.  
Protons and neutrons join together to make nuclei of atoms.
- 3. Time: 300,000 years  
Temperature: 3000°C.  
Electrons combine with nuclei to produce atoms of hydrogen and helium.
- 4. Time: 1 billion years  
Temperature: -250°C.  
Gravity causes matter to clump together to form galaxies, where stars form.
- 5. Time: 10 billion years  
Temperature: -270°C.  
The sun and planets form.



# Evidence for Big Bang

- 1. Cosmic Background Radiation (heat, energy from the initial explosion in the form of microwaves, uniform throughout the sky)

Cosmic Radiation video clip

<http://video.pbs.org/video/1855438915/>

# Evidences continued...

COBE satellite has recently detected cosmic microwaves that have come from the outer reaches of the universe, some of which show varied temperature, evidence for cooling. (evidence for heat of initial explosion)

2. Doppler Shift/ Hubble's Law – Light which is reaching us from far away galaxies show a shift toward the red end of the light spectrum. Hubble found the galaxies with the most redshift were the ones that were farthest away and were moving the fastest. (evidence for expansion)

<http://www.teachersdomain.org/resource/phy03.sci.phys.fund.hubble2/>

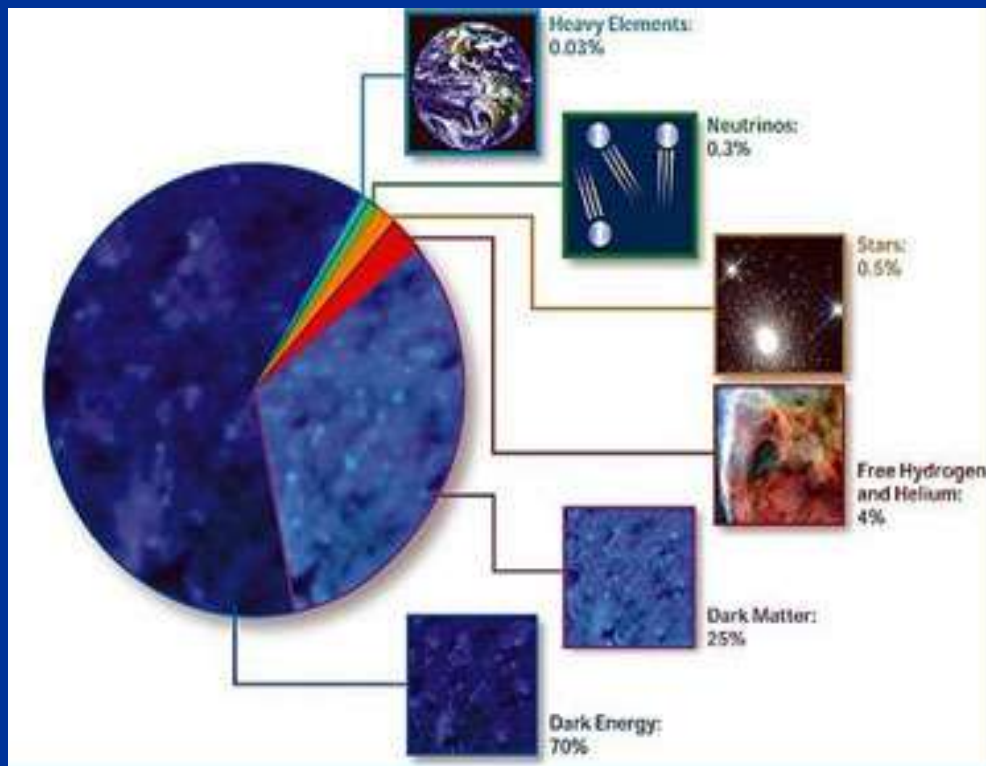
# Evidences.....

3. Abundance of light elements in the universe  
(evidence that the initial elements were the simplest ones)
4. We can look back in time at supernova we see now, that occurred billions of years ago.  
(evidence for the age of galaxies and stars)

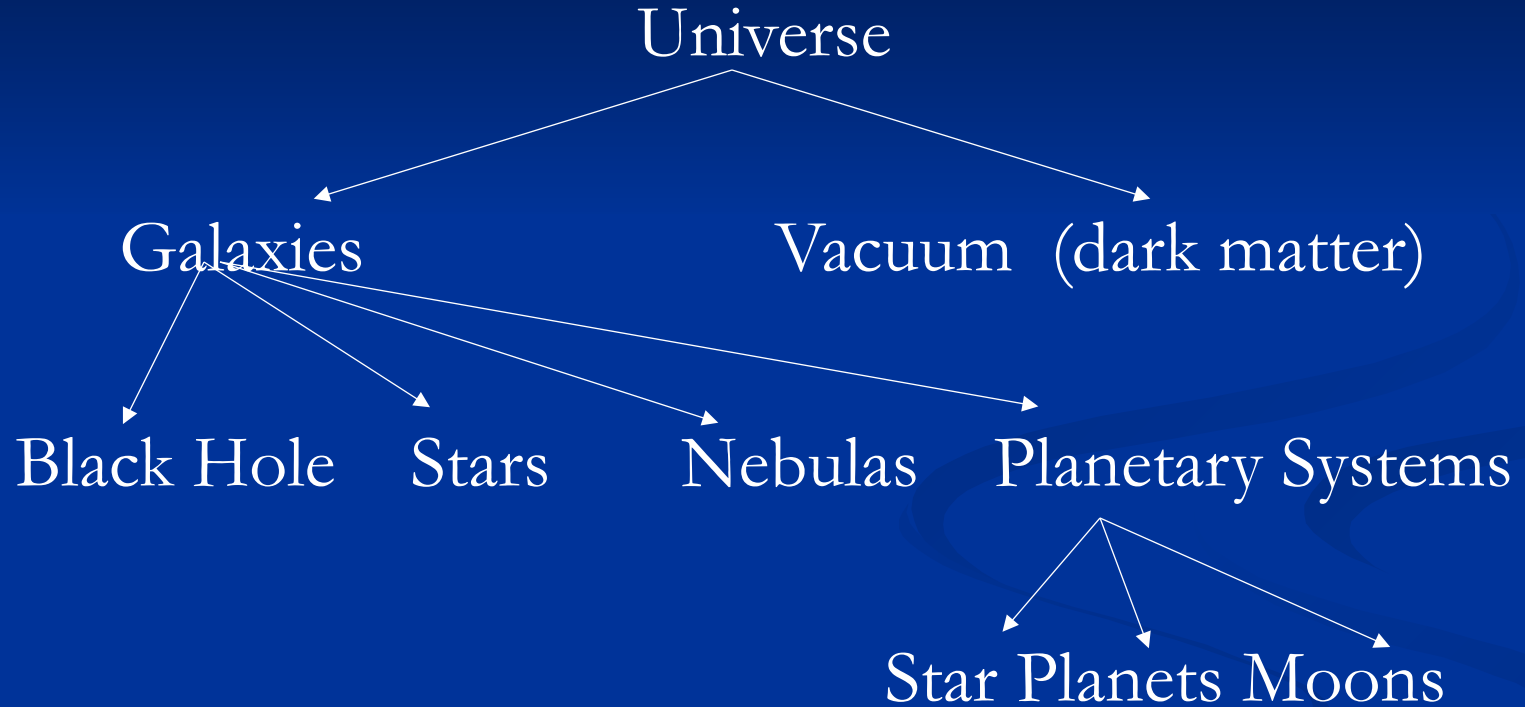
<http://www.teachersdomain.org/resource/psu06-swift.sci.time/>

# The Universe

- The Universe is roughly 14 billion years old
- The universe was once considered 95% “empty”



# The Universe



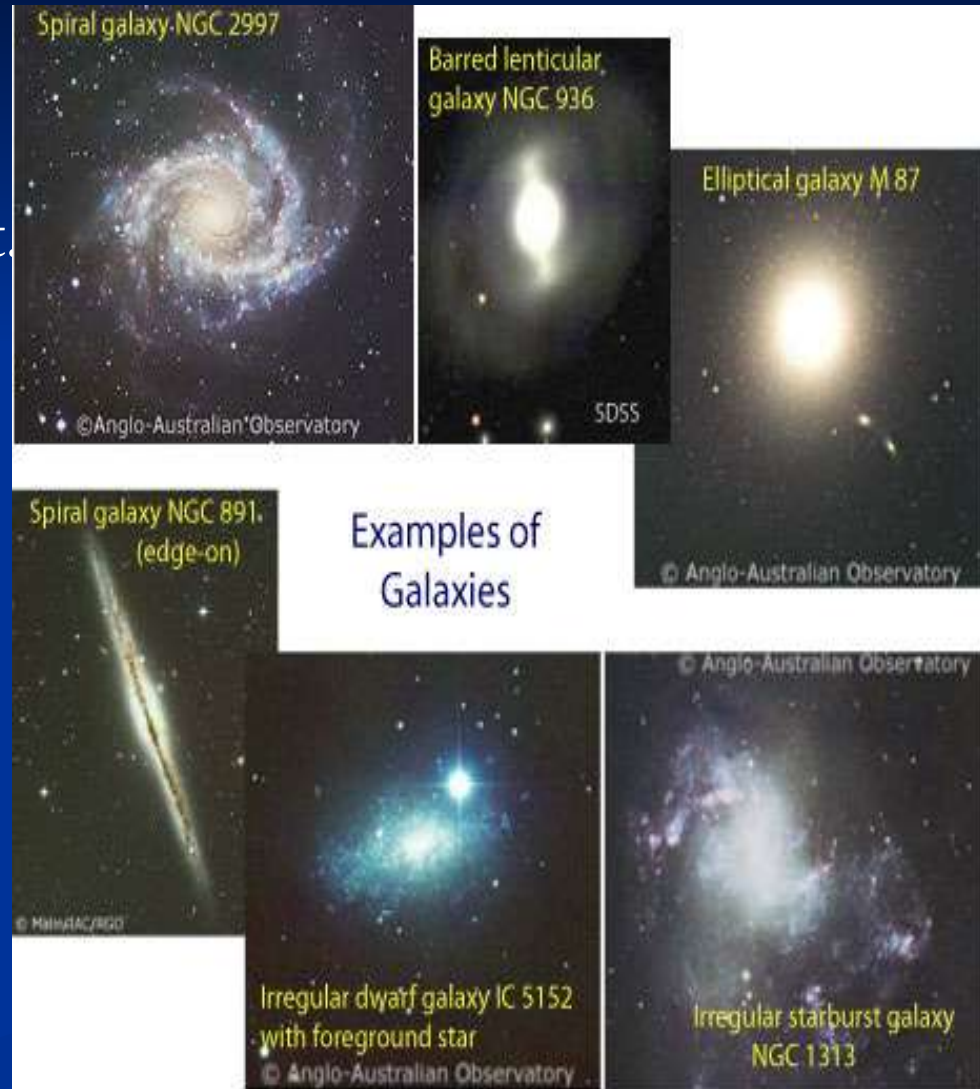


# Galaxies

- A group of stars, star clusters, dust and gas bound together by gravity.
- Average galaxy – billions of stars
- Big galaxy – trillions of stars
- Galaxies often have black holes at the center
- Our galaxy is the Milky Way

# Types of Galaxies

- Spiral – contains bright young stars, gas and dust (Pinwheel shape)
- Elliptical – Round or oval. Older stars with little gas and dust
- Irregular – Smaller than other galaxies, and have bright young stars with lots of gas and dust



What type of galaxy is this?

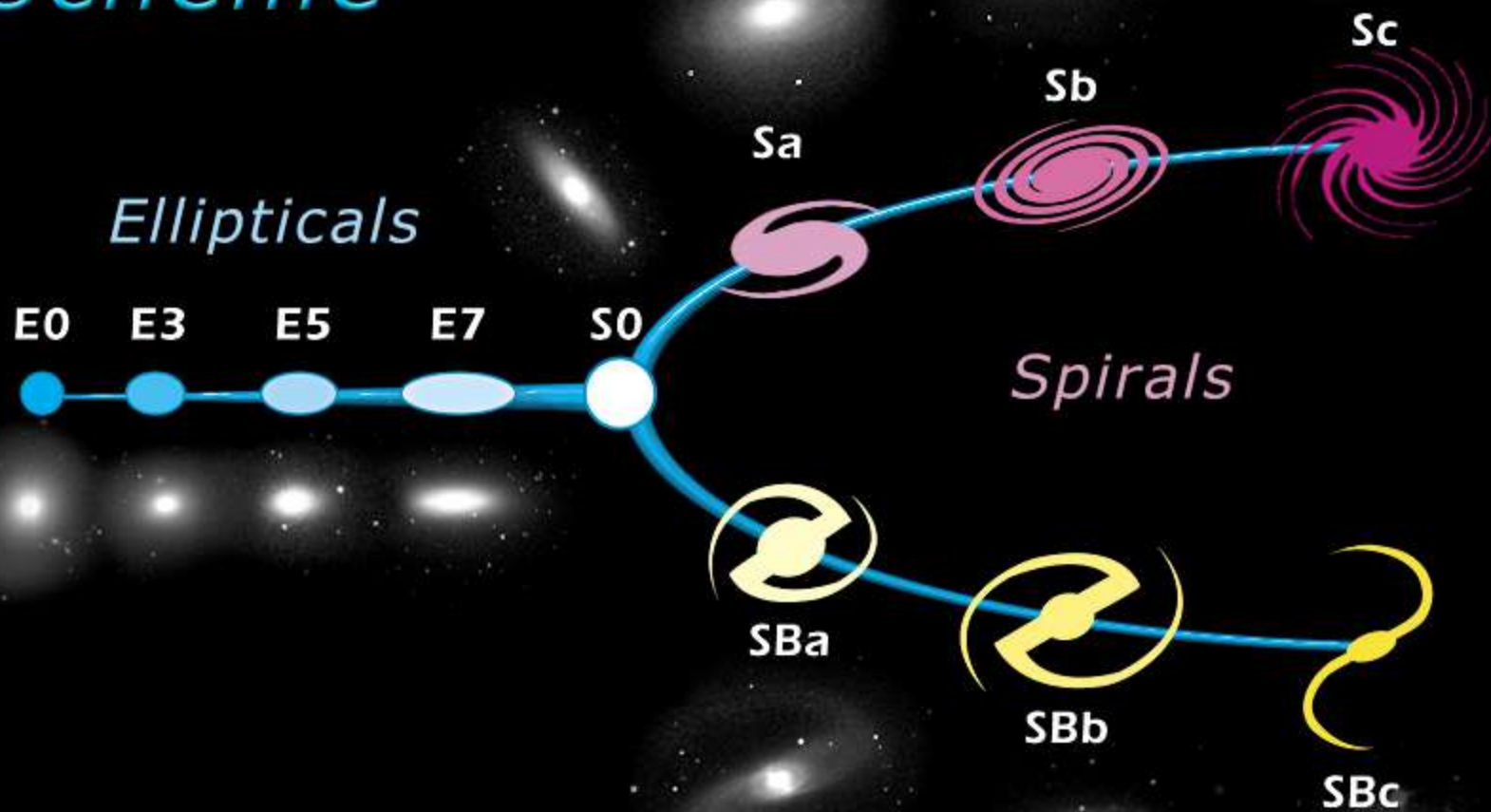


# These.....?



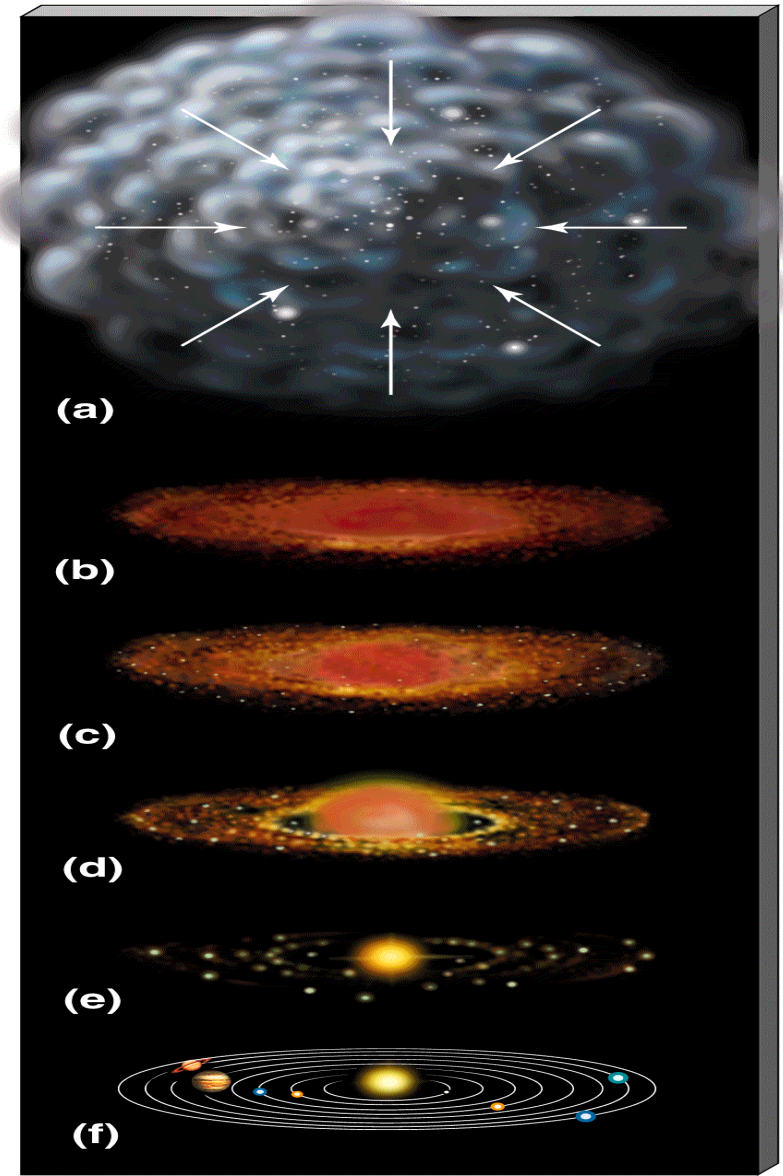
M87 © Anglo-Australian Observatory  
Photo by David Malin

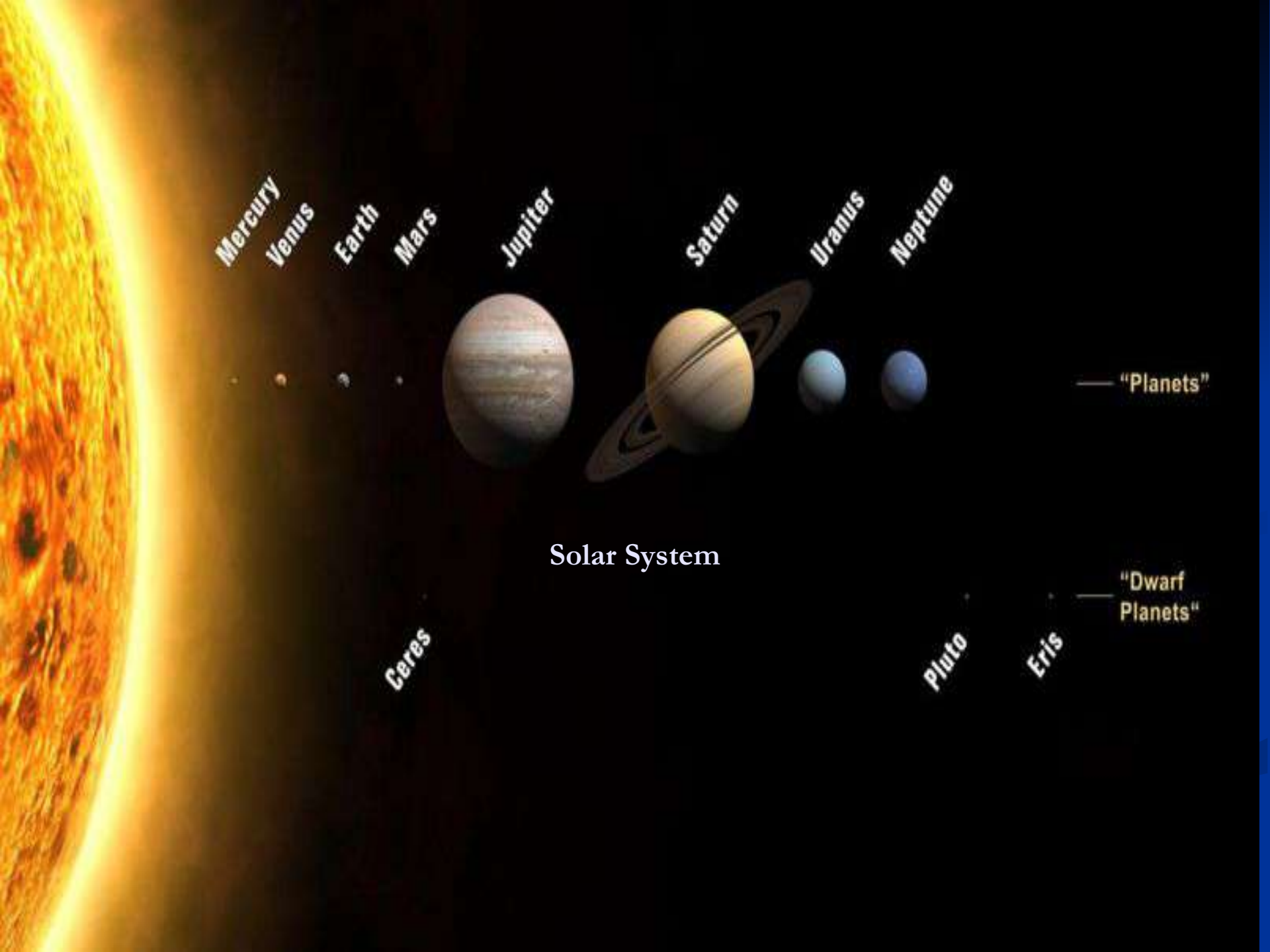
# Edwin Hubble's Classification Scheme



# Formation of solar system

- a. Cloud of dust and gas collapse
- b. Gravity pulls solar nebula together
- c. Nebula flattens and forms rotating disk
- d. Gravity pulls most of the gas into the center of the disk and fusion occurs
- e. Gas and dust form planetismals on outer parts of disk
- f. Planetismals collided and grew larger into planets, with the denser rockier material in the inner planets and the lighter gaseous material in the outer planets





*Mercury*

*Venus*

*Earth*

*Mars*

*Jupiter*

*Saturn*

*Uranus*

*Neptune*

*Ceres*

*Pluto*

*Eris*

Solar System

— "Planets"

— "Dwarf  
Planets"

# Our Solar System

- Sun – star at the center, exerts a powerful gravitational force which keep objects in orbit around it. Accounts for 99% of mass in our solar system
- Inner planets (4) – Rocky or terrestrial planets; small and dense. These are Mercury, Venus, Earth and Mars
- Asteroid Belt – Located between Mars and Jupiter. Consists of asteroids (planetismals that failed to become planets.) 1-200km across, made of carbon, minerals



# Continued....

- Outer Planets – Gaseous planets, large in size. Jupiter, Saturn, Uranus and Neptune.
- Large planet = large force of gravity = greater number of satellites
- Kuiper Belt – Small bodies, icy objects that contain water, methane and ammonia
- Oort cloud – Spherical cloud of comets outside our solar system

# Astronomical Units

- Used as a unit of distance *in our solar system*.
- 1AU is 93 million miles, or 150,000,000km, the distance from the sun to the earth.
- Ex: Mercury is 57.6 million km from the sun.  
What is the distance in AU?
- $\frac{57,600,000\text{km}}{150,000,000 \text{ km/AU}} = 0.384 \text{ AU}$

# Light Years

- A light year is a measure of distance, and is the distance light travels in a year
  - 9.46 trillion km
  - Used for large distances (larger than our solar system), ex: to a nearby galaxy or star.
- Light Years

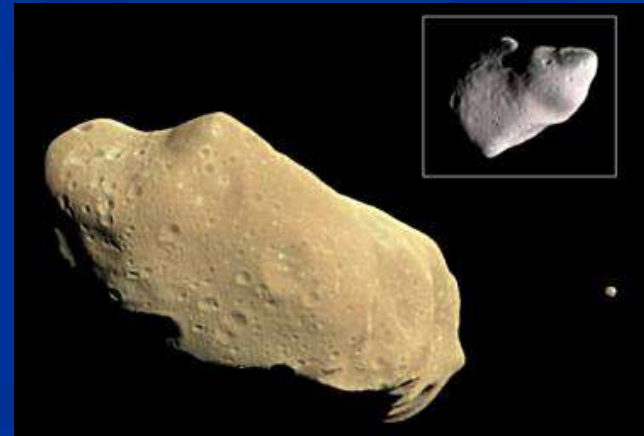
# Satellites

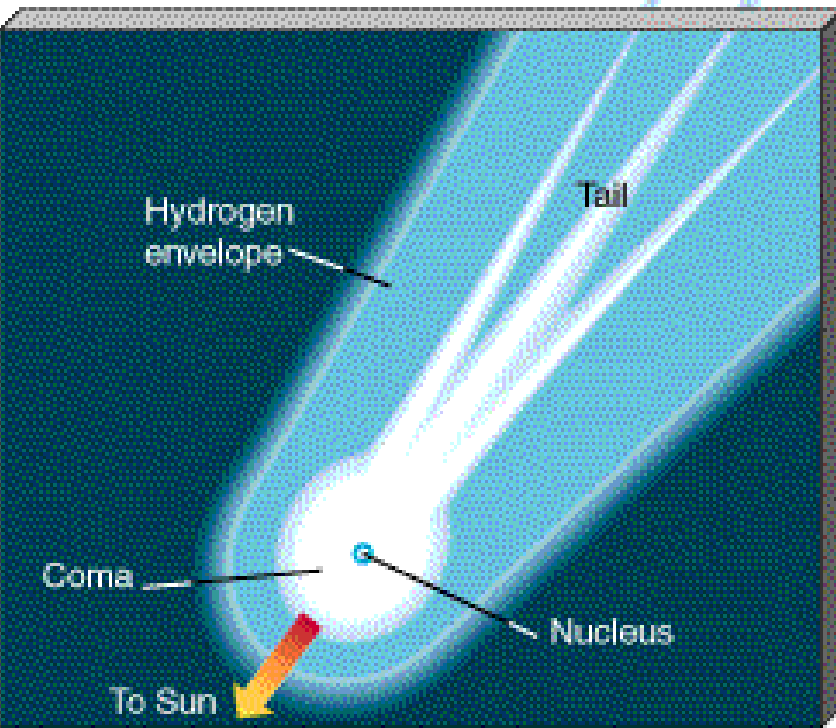
- Any object that orbits another in space
- Can be moons, man made objects, planets, comets etc.



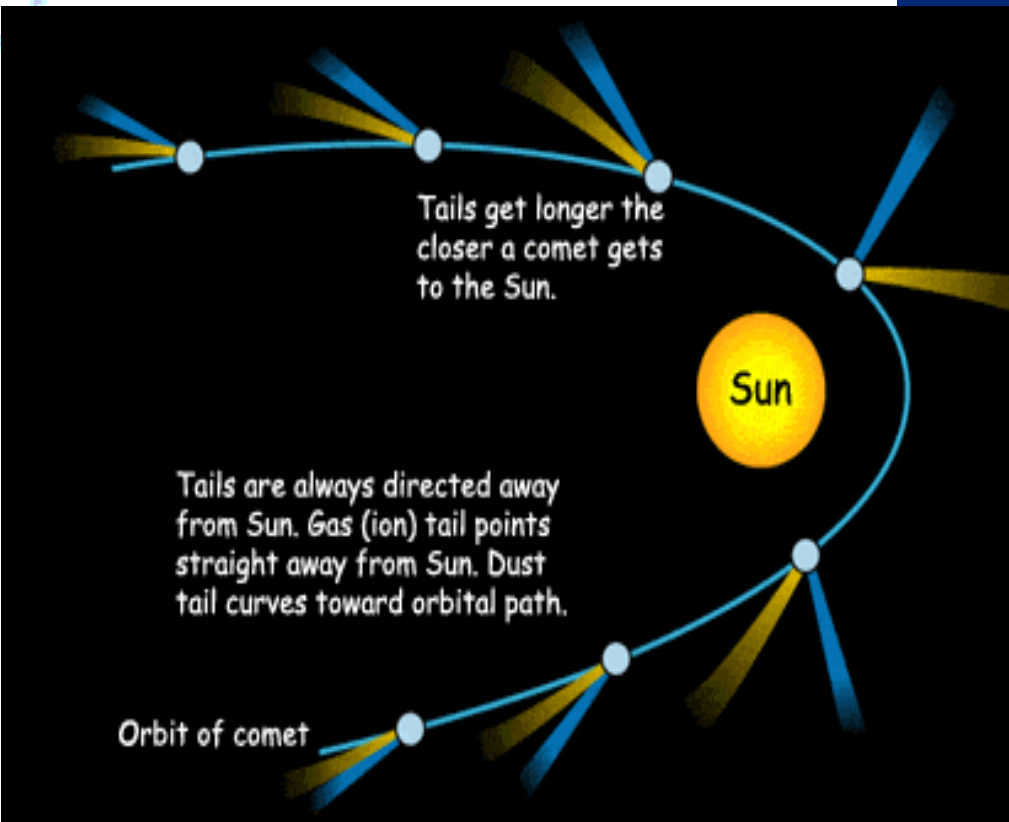
# Comets and Asteroids and Meteors

- Comets are like a ball of rock and dirty snow. As they approach the sun the gas vaporizes
- [http://news.nationalgeographic.com/news/2005/07/0720\\_050719\\_deep\\_impact.html](http://news.nationalgeographic.com/news/2005/07/0720_050719_deep_impact.html)
- Asteroids are made of rocky and/or iron-nickel material and most are found in an orbit between Mars and Jupiter. (10m-200 km across)
- Meteors, are usually sized from a grain of sand to about a softball. Made of rock, iron and ice. Called meteors when travel through planets atmosphere
- Meteorites are what have hit the ground



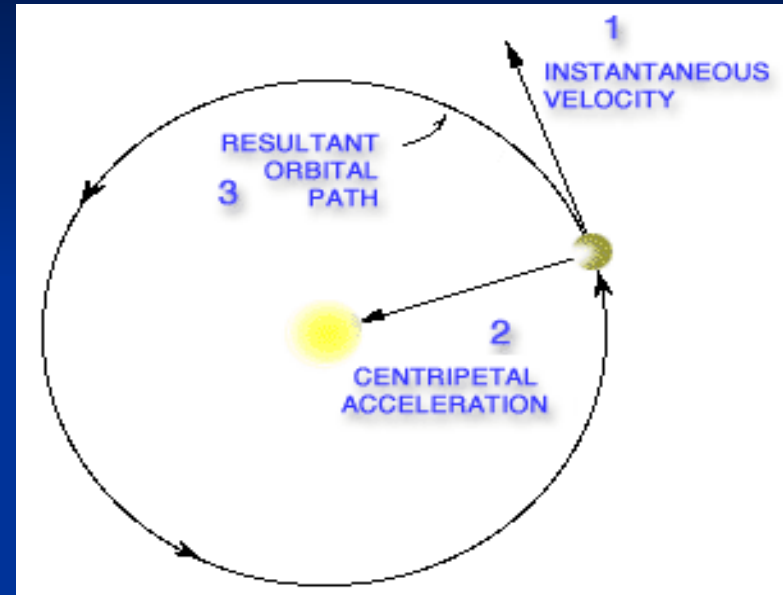


(a)



# Orbiting

- What keeps a satellite in orbit?
- There are 2 simultaneous motions acting upon the satellite: gravity and instantaneous velocity.



<http://www.teachersdomain.org/resources/ess05/sci/ess/eiu/moonorbit/index.html>

# Revolution vs. Rotation

- Rotation – movement of a planet or an object on its axis, a full 360 degrees. Ex: the time it takes for 1 rotation of the earth is one day, or 24 hours. (The earth is split into time zones spaced 1 hour apart)
- Rotation causes day and night

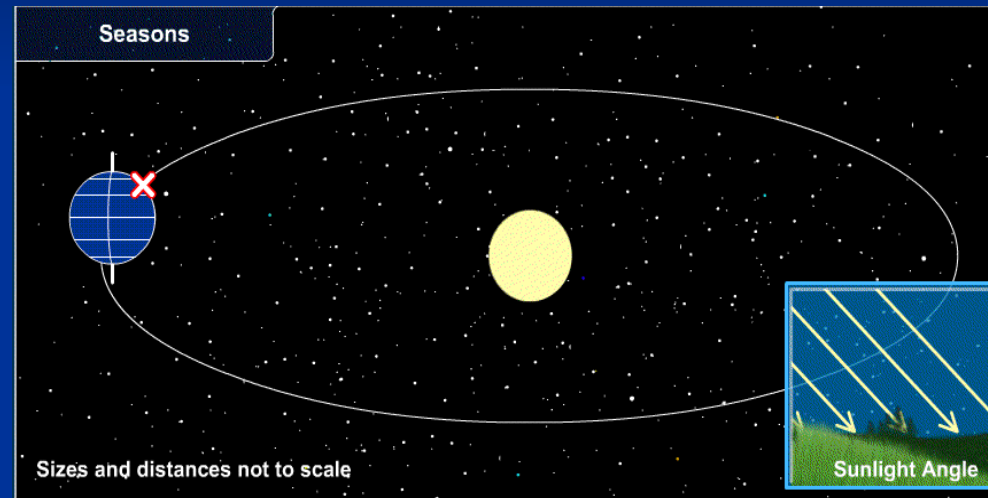




# Revolution continued....

- Revolution is the movement of one object around another Ex: path travelled by the earth around the sun is one year or  $365 \frac{1}{4}$  days. Earth's orbit (path) is slightly elliptical

- [http://esminfo.prenhall.com/science/geoanimations/animations/01\\_EarthSun\\_E2.html](http://esminfo.prenhall.com/science/geoanimations/animations/01_EarthSun_E2.html)

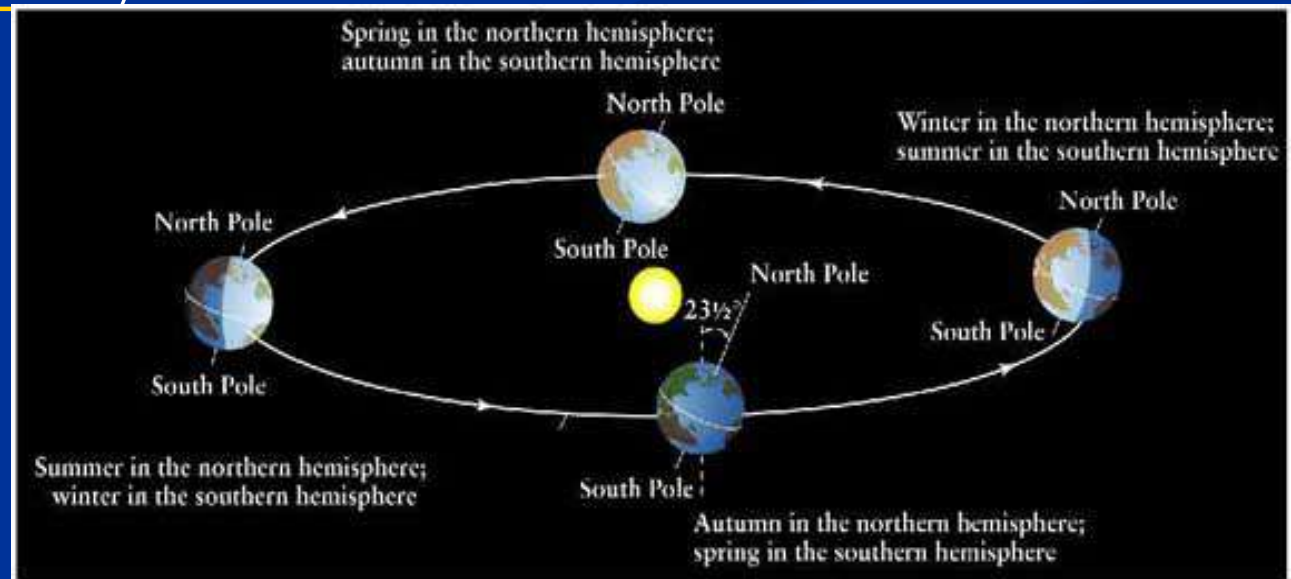


# The planets.....

- All the planets except Venus, Uranus, and Pluto rotate on their axis around the sun in an eastward direction
- <http://library.thinkquest.org/03oct/01944/planet-table.htm>

# The reason for the season...

- The earth's tilt on its axis is the reason for the seasons.  
[http://phschool.com/atschool/phsciexp/active\\_art/seasons/index.html](http://phschool.com/atschool/phsciexp/active_art/seasons/index.html)
- [http://www.teachersdomain.org/resource/ess05.sci.ess.e.arthsys.lp\\_seasons/](http://www.teachersdomain.org/resource/ess05.sci.ess.e.arthsys.lp_seasons/)











# The moon

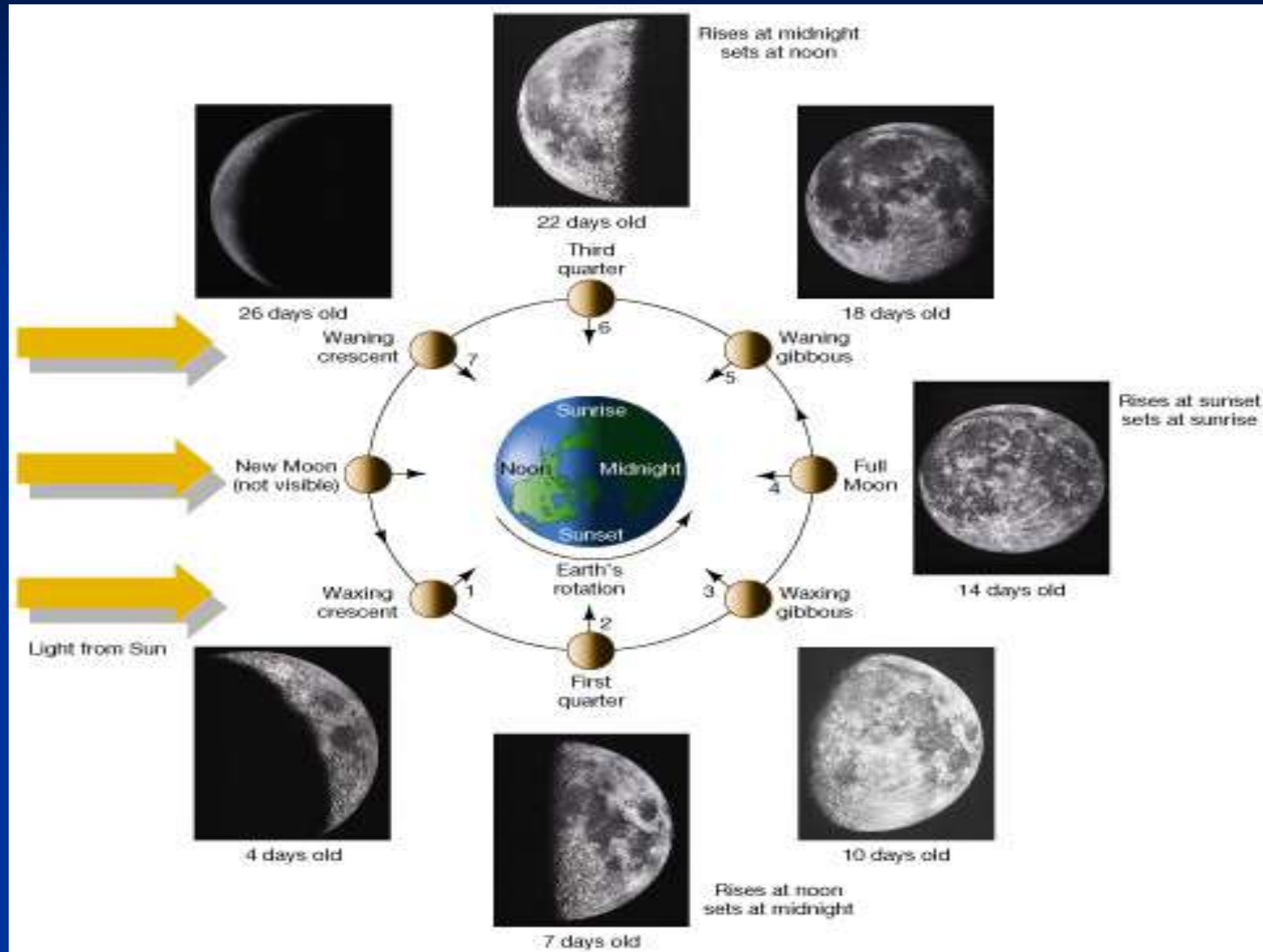
- Made of similar material as the earth, less gravity, no atmosphere, hot and cold
- Revolves around the earth every 27.32 days, and rotates once in the same time.
- <http://www.teachersdomain.org/resource/ess05.sci.ess.eiu.moon/>
- Earth and moon viewer :
- <http://www.fourmilab.ch/earthview/>

# The Lunar Cycle

- What causes the phases of the moon?
- Phases of the moon depend on the moon's, sun's, and earth's position
- <http://phschool.com/webcodes10/index.cfm?fuseaction=home.gotoWebCode>
- Waxing - when the lit side of the moon appears to be getting bigger
- Waning – when the lit side of the moon appears to be getting smaller

Phase	Illustration
New	
Waxing Crescent	
First Quarter	
Waxing Gibbous	
Full	
Waning Gibbous	
Third Quarter	
Waning Crescent	

# Phases of the moon



# Eclipses

- Lunar Eclipse – when the shadow of the earth falls on the full moon and covers it.
- Solar eclipse – when the shadow of the moon falls on part of the earth.
- <http://www.teachersdomain.org/resource/ess05.sci.ess.eiu.eclipse/>

# Tides

- Tides are caused by the moon's gravitational pull on the ocean.
- High tide and low tide depends on where the moon is in relation to the earth

