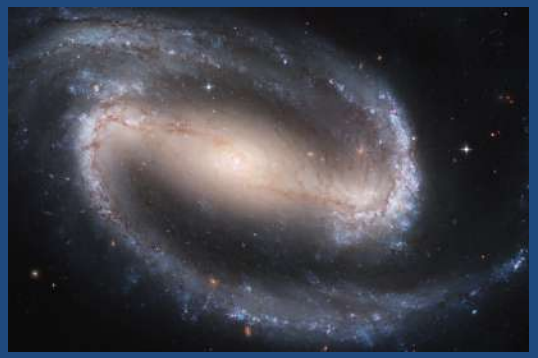
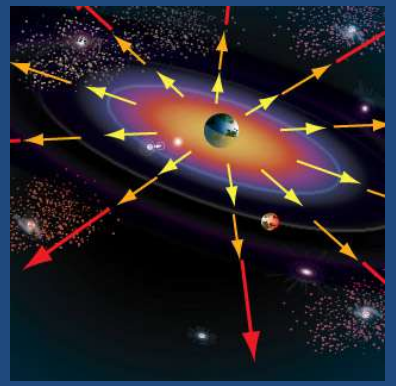
Galaxies, Other Objects and the Expansion of the Universe

- Types of Galaxies
- Asteroids
- Meteors, Meteoroids, and Meteorites
- Comets
- The expansion of the Universe





Galaxies

- Using a system invented by Edwin Hubble, astronomers classify galaxies into three major types:

1. **Spiral**
2. **Elliptical**
3. **Irregular**

Galaxies

- The sizes of the three types span a wide range, from

  Dwarf galaxies

  - **which contain 100 million (10^8) stars**

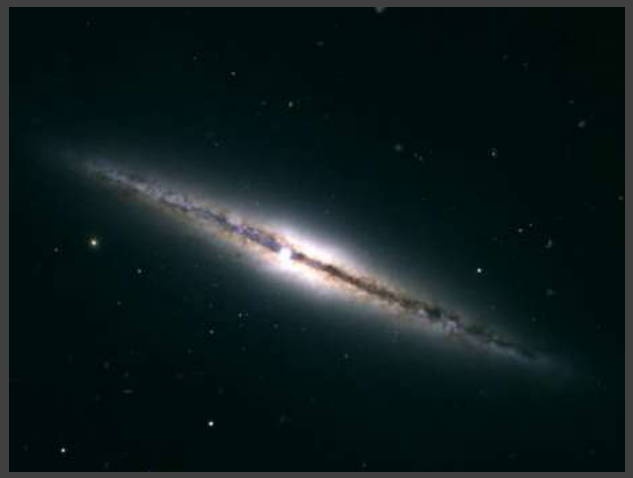
to

  Giant galaxies

  - **which contain 1 trillion (10^{12}) stars**

Spiral Galaxies





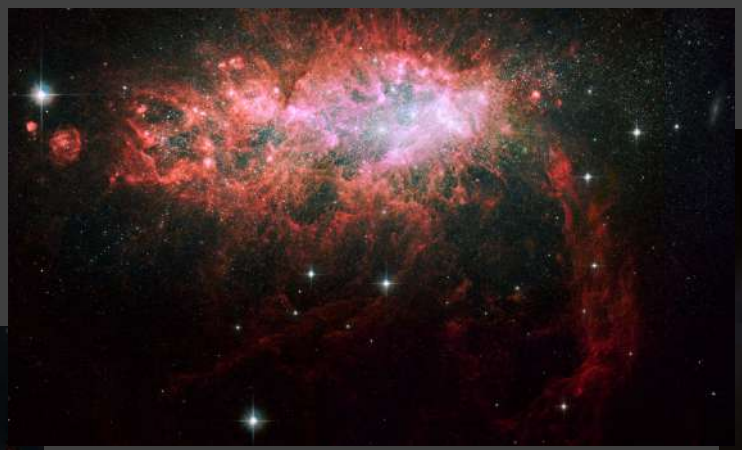
- **<u>Look like a pinwheel from above</u>**
- Looks like a plate with a bulge from the side
- Has many long “arms” spiraling out from the centre
- Ex/ Ours – the Milky Way Galaxy

Elliptical Galaxies

- Range in shape from a perfect sphere to a stretched-out ellipse
- Contain some of the oldest stars in the universe
- **Over half of all galaxies are elliptical and they make up the larger ones**

Irregular Galaxies

- A “none of the above” category; neither spiral nor elliptical
- **<u>Are made up of newly forming stars as well as old stars</u>**



The Local Group

- We combine galaxies into groups based on location
- The Milky Way belongs to a group of about 40 Galaxies called the Local Group
- The diameter of the Local Group is about 10 million light years across

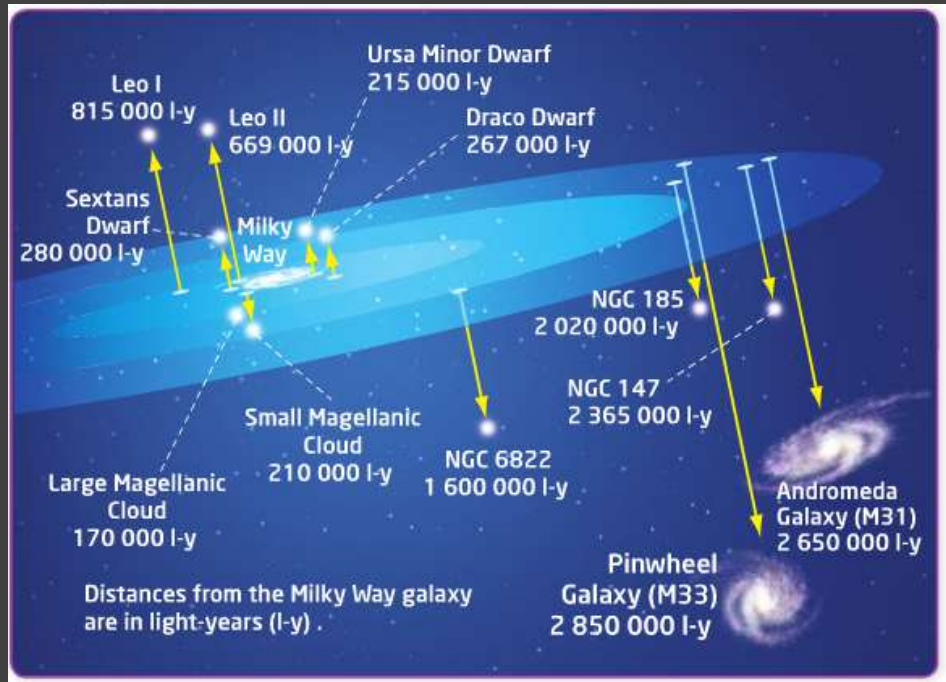


Figure 9.6 This image shows some of the galaxies in the Local Group. The yellow arrows are scaled to help you visualize the distances of each galaxy from the Milky Way.

- There are 24 galaxies in the universe for every person living on Earth!

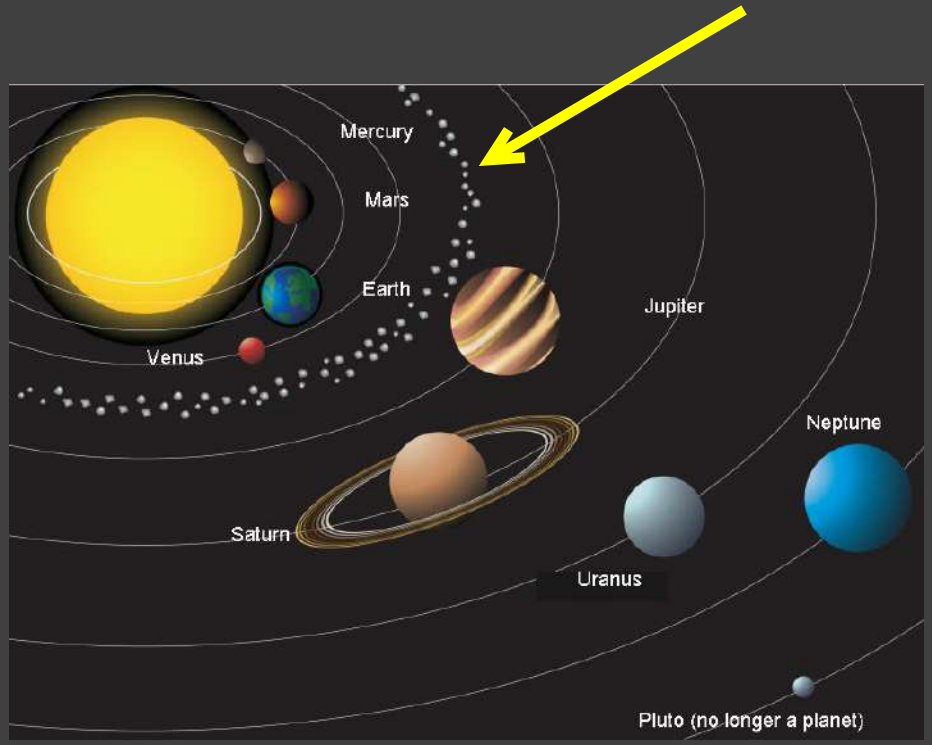
Note: images are not to scale

Galaxies of the Universe

Other Objects In The Solar System

Asteroids

- Small rocky objects that orbit the Sun
- Thousands of small rocky objects in a ring is called the ASTEROID BELT (Between Mars and Jupiter)



Asteroids

- Size ranges from 6 meters to 933 km
- Dinosaur killer ~ 10 km across
- Landed near the Gulf of Mexico

Map showing asteroid impact in Gulf of Mexico

Asteroid Impact – Dinosaur Killer

Meteors and Meteorites

- Meteoroid is a lump of rock of metal that is pulled down by Earth's gravity

- Generally a small asteroid that has broken up or debris left behind by a comet

- A Meteor is a bright streak of light across the sky as a meteoroid burns up.

- Meteorite is a large meteoroid that **<u>doesn't completely burn up in the atmosphere therefore, hitting the Earth and producing a larger crater.</u>**

February 2013 Meteor Explosion over Russia

- The Meteor had an initial mass of about 12,000–13,000 metric tones (heavier than the Eiffel Tower), and measured between 17 and 20 meters in size (65 feet).

- It was moving at approximately 18.6 km/s (over 41,000 mph or 66,960 km/h), almost 60 times the speed of sound.

- It exploded 23.3 km above the ground releasing 500 kilotons of TNT, 20–30 times more energy than was released from the atomic bomb detonated at Hiroshima but without the radiation.

- The explosion injured thousands due to the release of energy which created a shockwave shattering windows and topping smaller structures.

Comets

- Chunk of frozen matter (usually ice) that travels in a very long orbit around the sun.
- Comets have tails a few million km long
- When the comet approaches the sun, it is warmed. **Frozen substances become gases, which are then pushed outward by solar wind to produce a bright tail.**

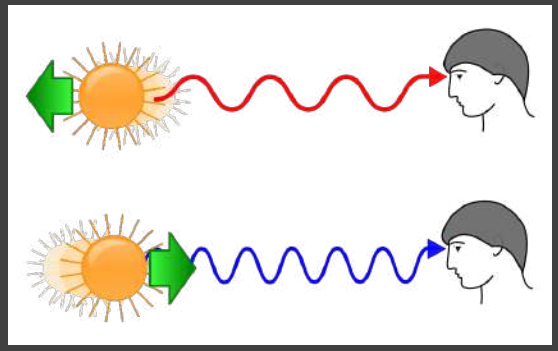
Bill Nye – Comets and Meteors

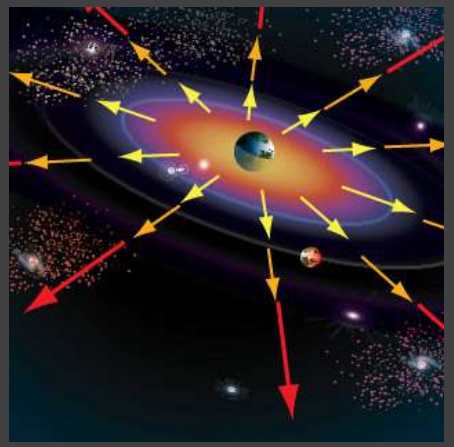
The Big Bang Theory

- The Universe started out as an extremely compact, small and unimaginably dense structure
- The Universe began expanding **14 Billion Years ago until it reached its present state**

The Universe is Still Expanding

- We know this due to the phenomenon known as red and blue shift.
- When objects are moving away at a fast rate, they appear red. When they are moving towards you quickly, they appear blue.
- **We observe most galaxies are moving away from a central point (origin of the Universe?).**





Red and Blue Shift

The Universe Timeline