Module 2
Earth & Solar System

BUMI DALAM TATASURYA

- Matahari dan planet-planetnya
- Anatomi bumi
- Dinamika bumi

A GALAXY IS BUILT BY MANY SOLARS SYSTEM

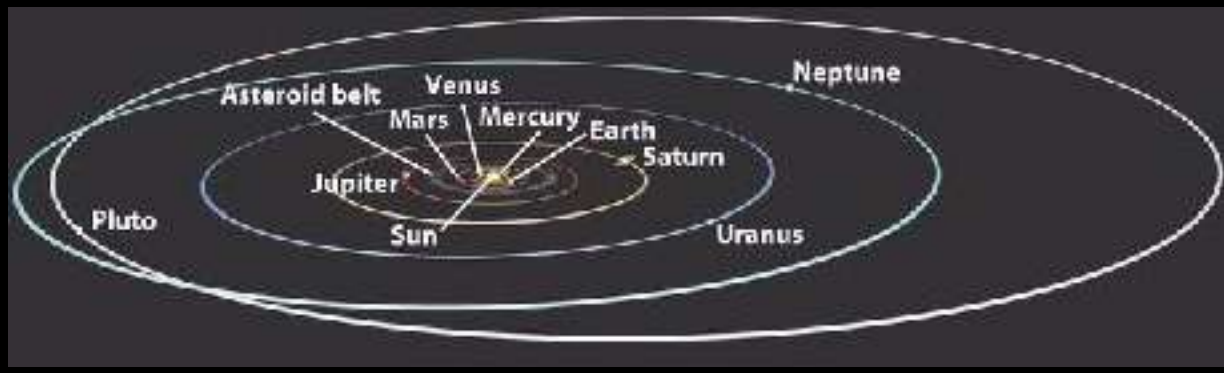
MILKY WAY GALAXY

Universe of galaxy groups

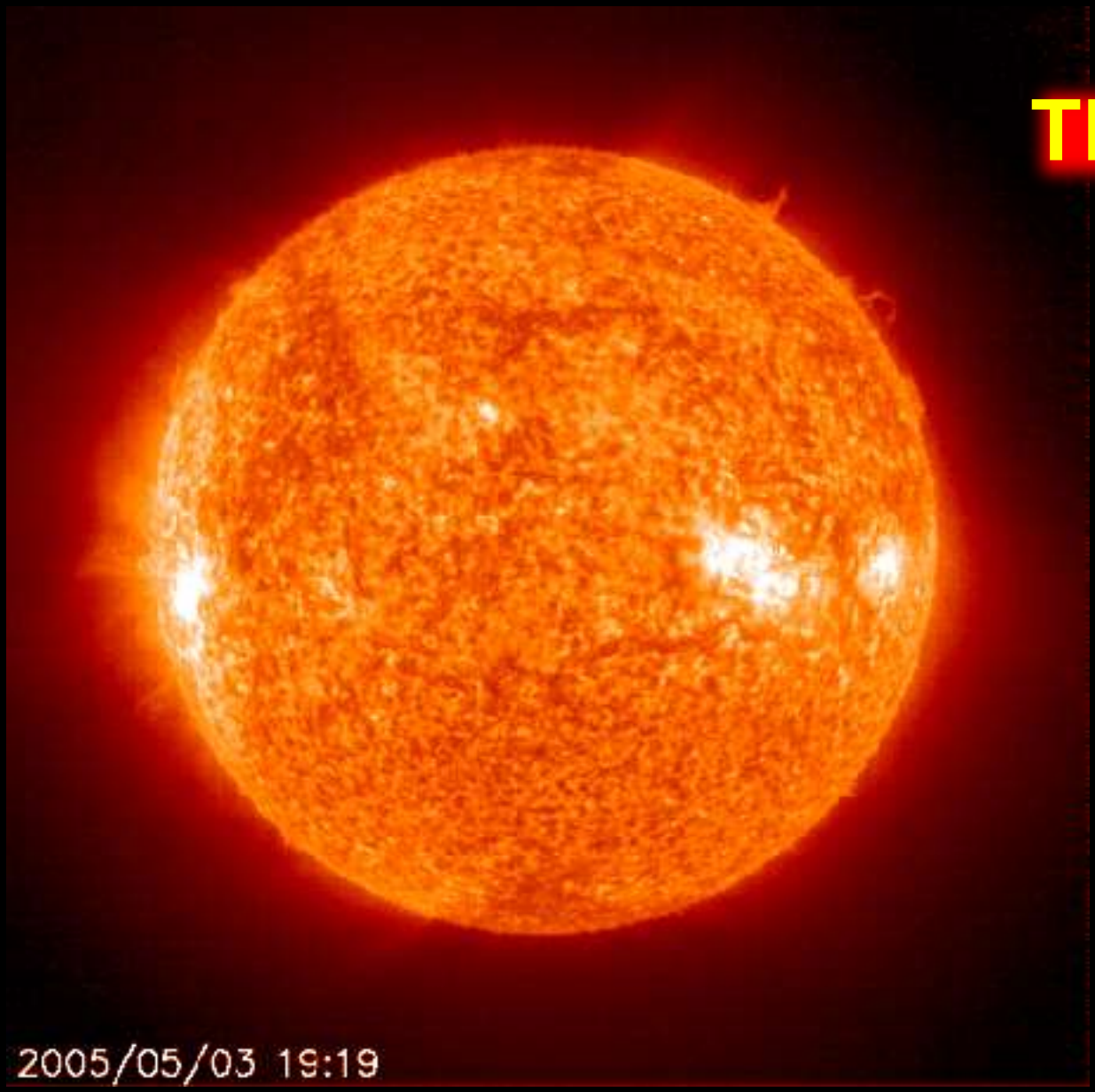
Local Group

Milky Way

Solar System



THE SUN



99% of the mass of the solar system is in the Sun

The SUN

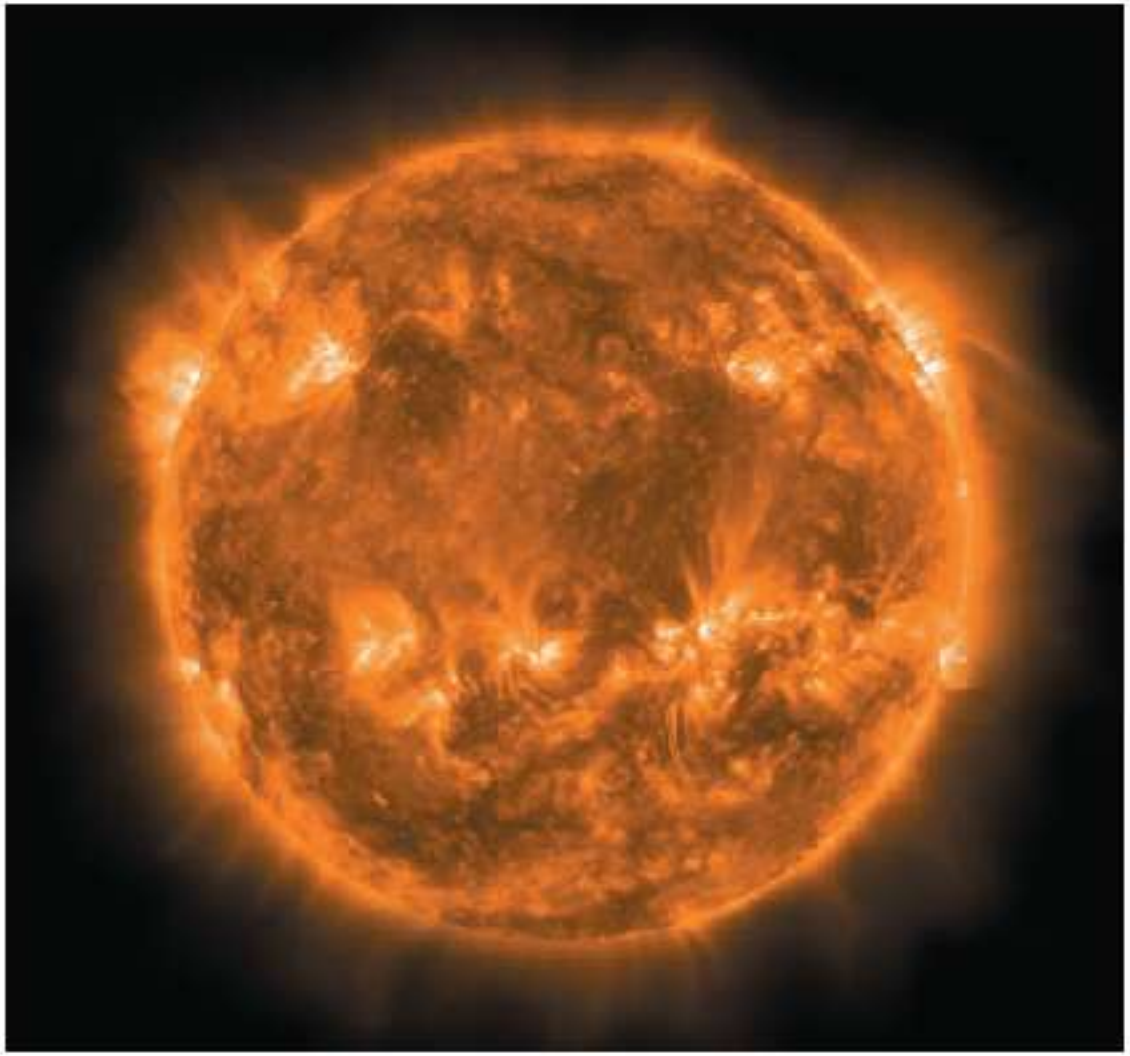
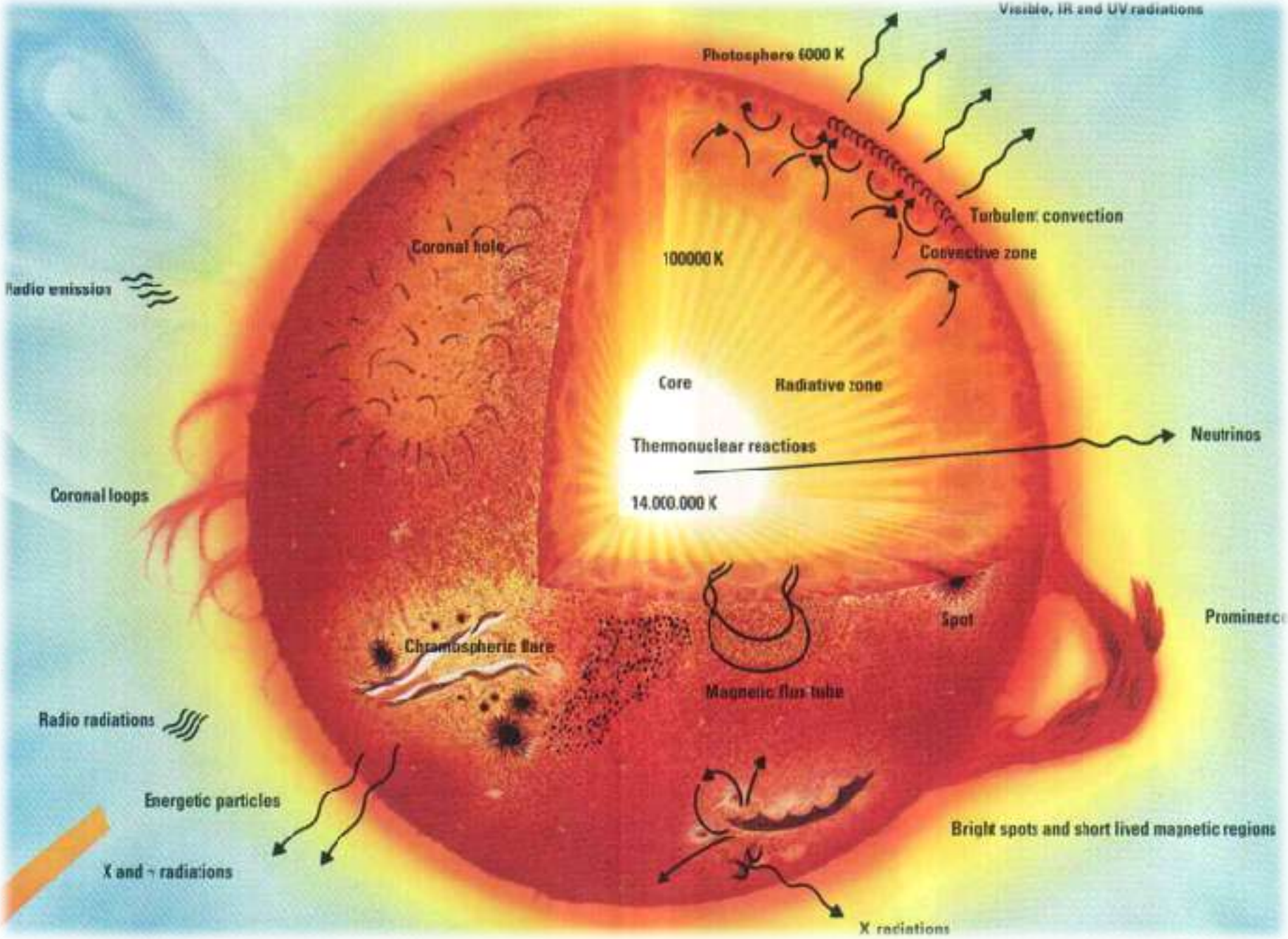
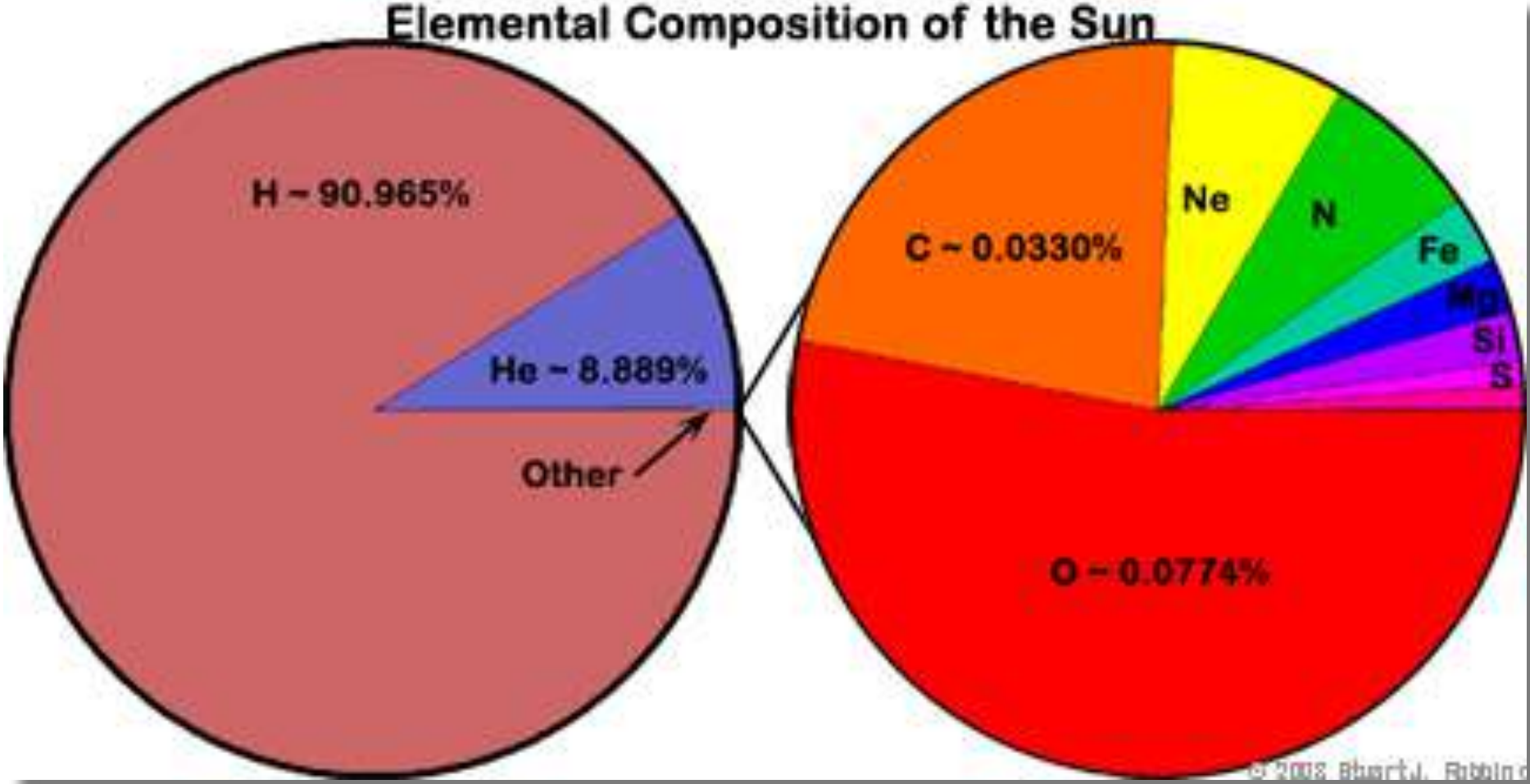


FIGURE 9.2 The Sun is a seething mass of hydrogen and helium where energy is formed by nuclear fusion. Some of this energy is transmitted by electromagnetic radiation to Earth, where it drives the circulation of the atmosphere and the ocean. This image was constructed from radiation characteristic of a temperature of about 1 million degrees Celsius *(Courtesy of the TRACE Project, Lockheed Martin Solar and Astrophysics Laboratory, and NASA)*

(Hamblin & Christiansen, 2009)

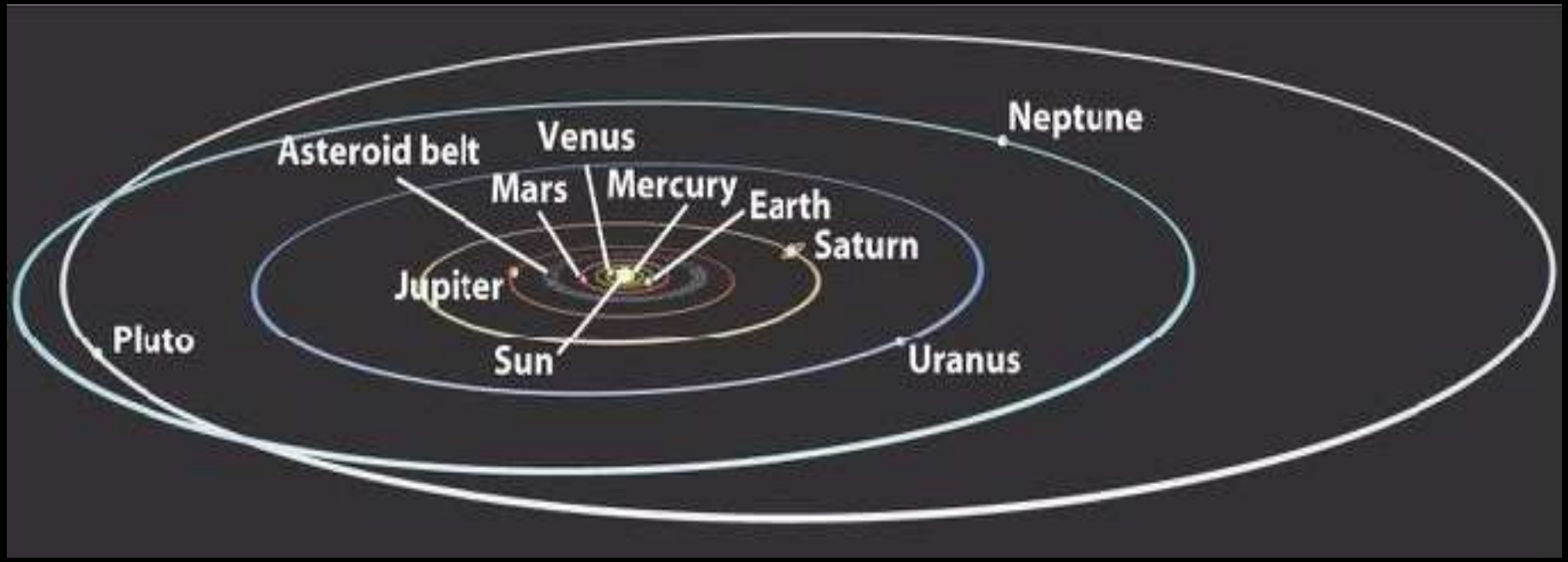

Visible, IR and UV radiations
Photosphere 6000 K
Turbulent convection
Convective zone
Coronal hole
100000 K
Radio emission
Core
Radiative zone
Thermonuclear reactions
Neutrinos
14.000.000 K
Coronal loops
Spot
Prominence
Chromospheric flare
Magnetic flux tube
Radio radiations
Energetic particles
Bright spots and short lived magnetic regions
X and γ radiations
X radiations

Composition of the Sun

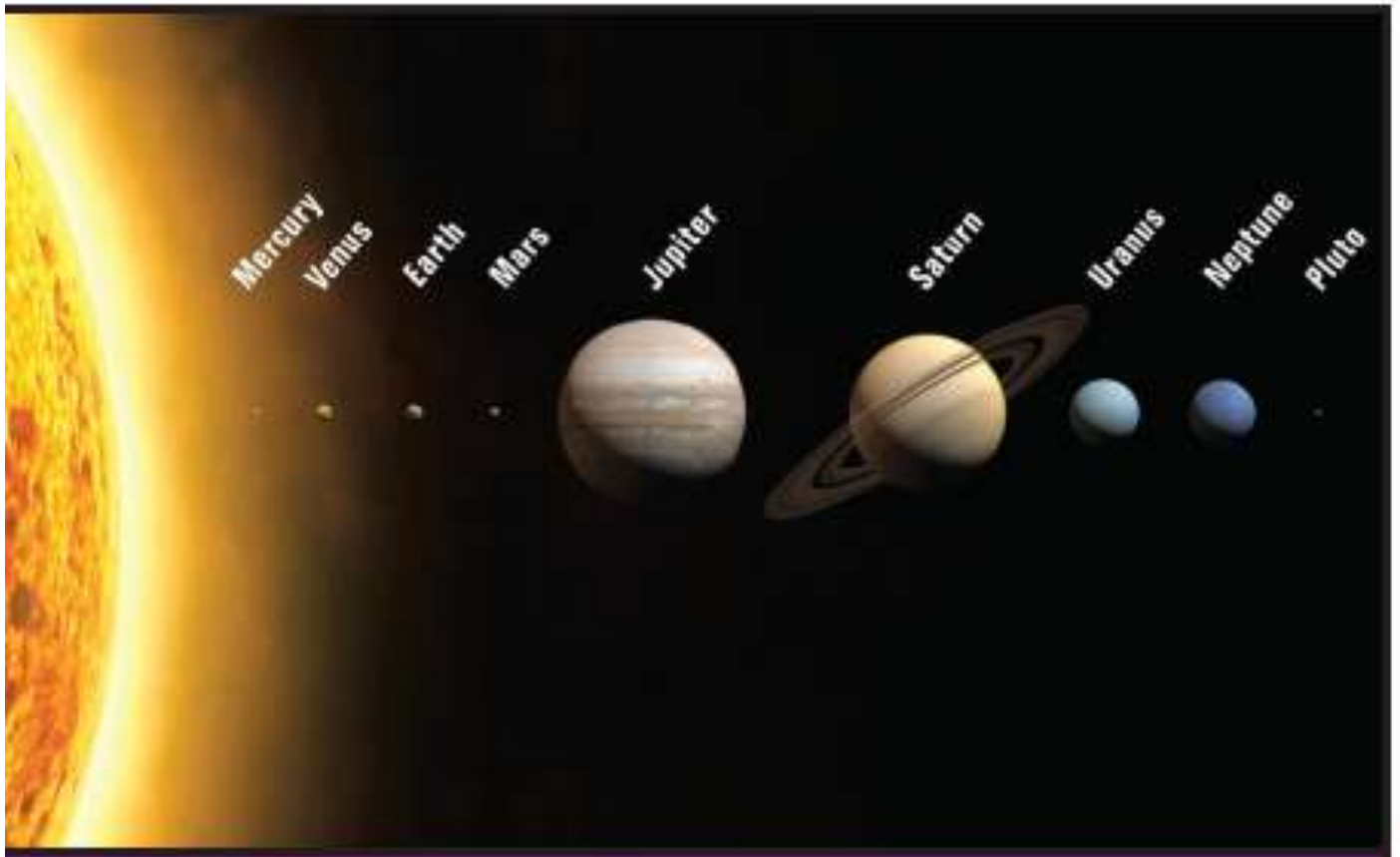


Planets

- orbit the sun in the plane of the sun's equator
- come in two groups:
    + the Terestrial Planets (Me, V, E, & Ma)
    + the Jovian Planets (J, S, U, & N)



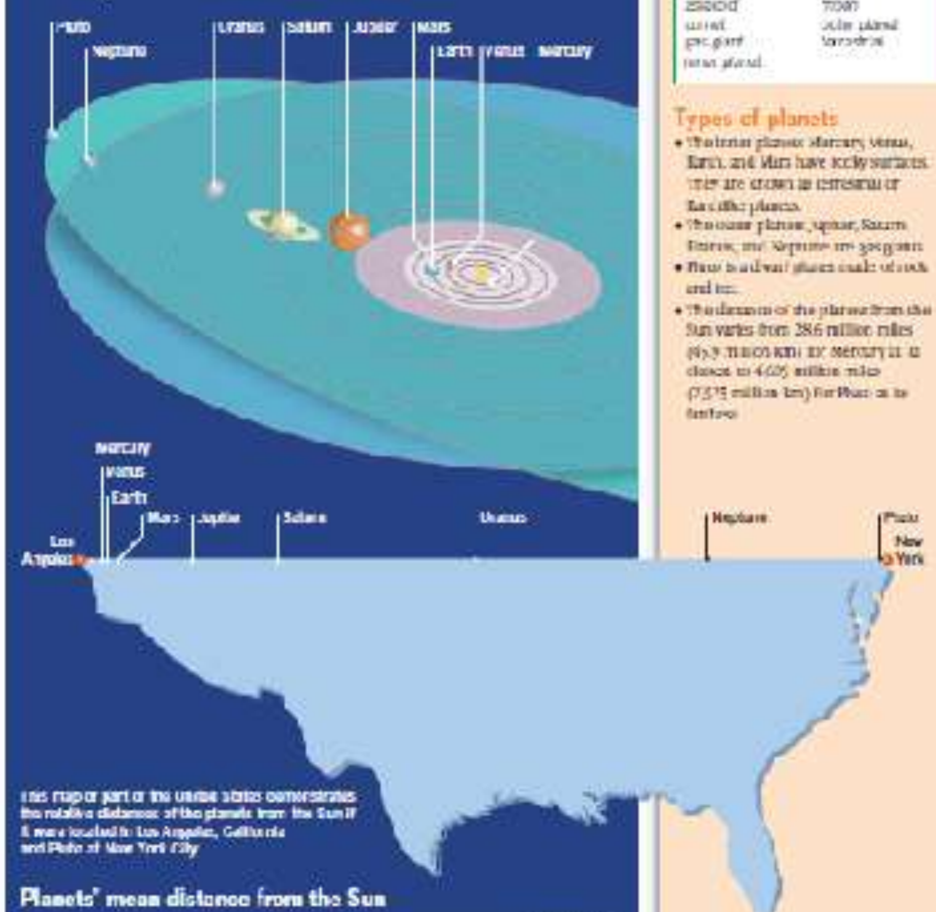
SOLAR system



This picture shows the eight planets in our solar system. The Sun appears on the left, and the dwarf planet Pluto is on the right. This picture shows the size of each planet compared to others.

The solar system

Planetary orbits



This map of part of the United States demonstrates the relative distances of the planets from the Sun if it were located in Los Angeles, California and Pluto at New York City

Planets' mean distance from the Sun

	Miles	Kilometers
Mercury	36,000,000	57,900,000
Venus	67,200,000	108,200,000
Earth	93,000,000	149,600,000
Mars	141,600,000	227,900,000
Jupiter	483,800,000	778,600,000
Saturn	890,800,000	1,433,600,000
Uranus	1,784,800,000	2,872,600,000
Neptune	2,793,100,000	4,494,500,000
Pluto	3,647,200,000	5,869,600,000

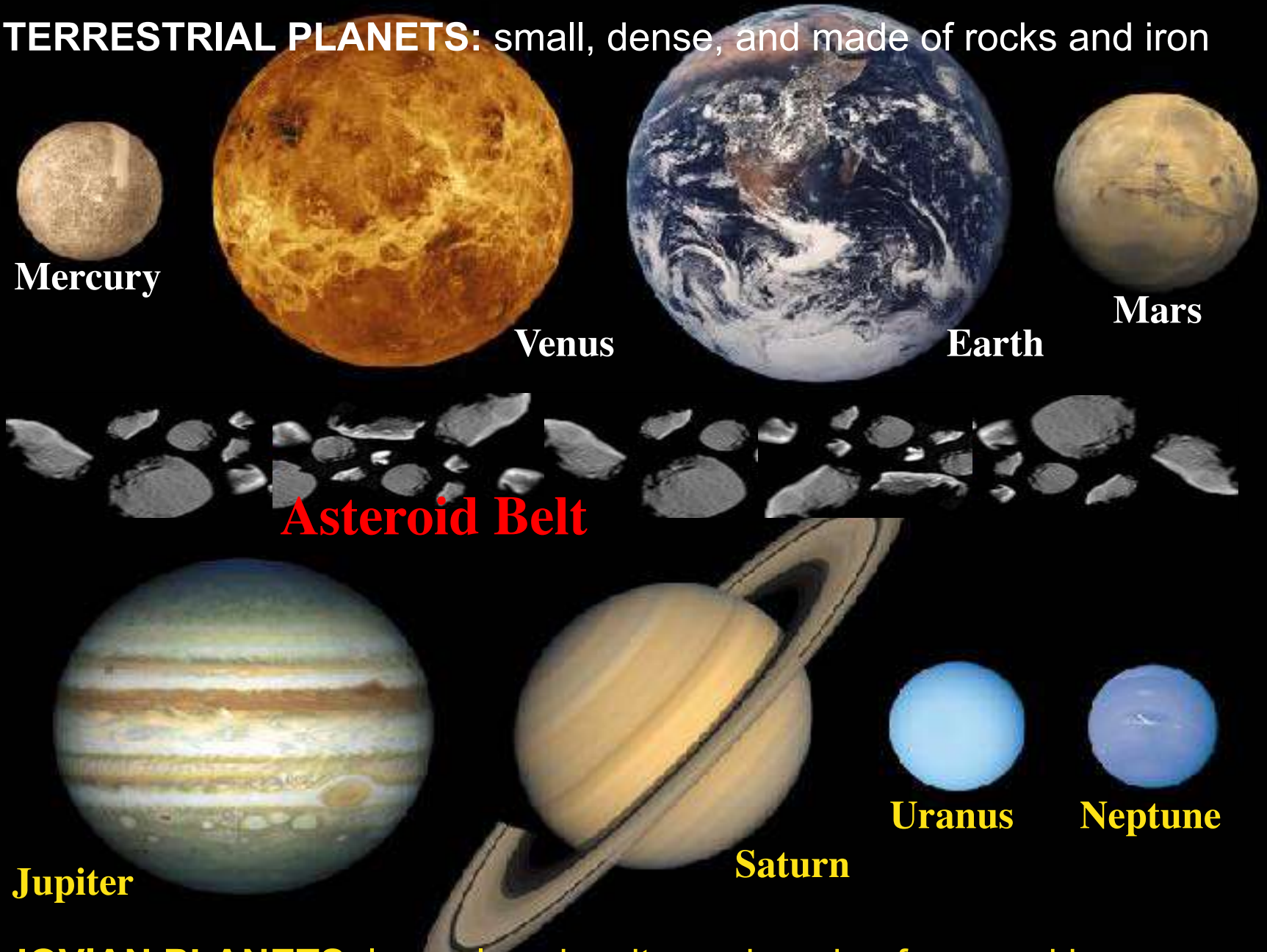
Key words

asteroid	moon
comet	outer planet
gas giant	terrestrial
inner planet	

Types of planets

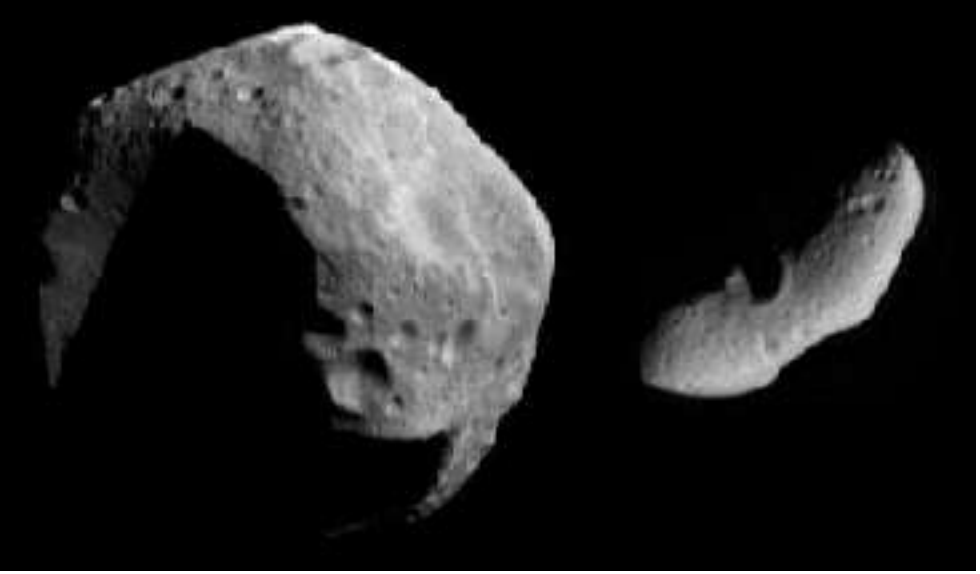
- The inner planets Mercury, Venus, Earth, and Mars have rocky surfaces. They are known as terrestrial or Earth-like planets.
- The outer planets Jupiter, Saturn, Uranus, and Neptune are gas giants.
- Pluto is a dwarf planet made of rock and ice.
- The distance of the planets from the Sun varies from 28.6 million miles (46.0 million km) for Mercury at its closest to 4,605 million miles (7,375 million km) for Pluto at its farthest.

TERRESTRIAL PLANETS: small, dense, and made of rocks and iron



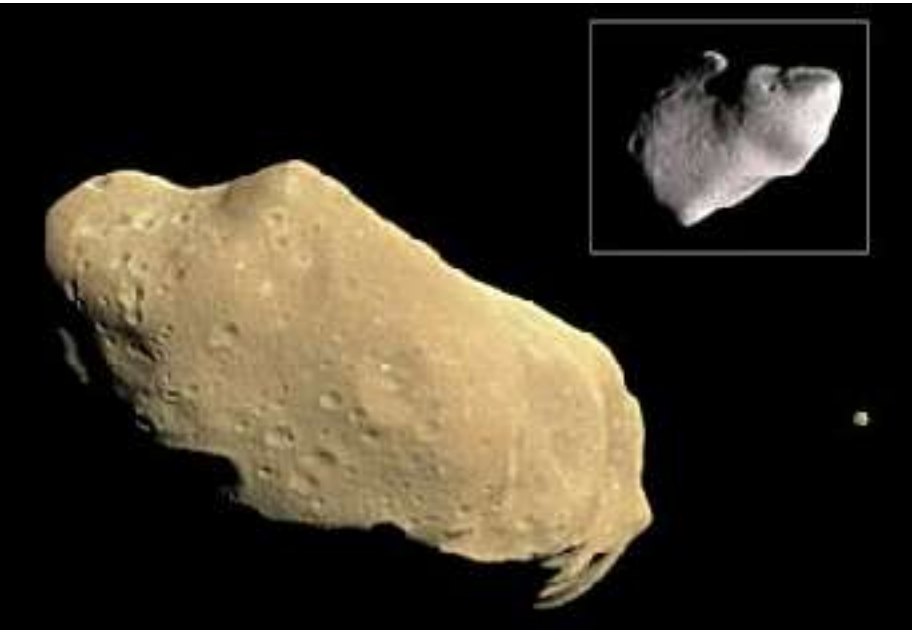
JOVIAN PLANETS: large, low density, and made of gas and ice

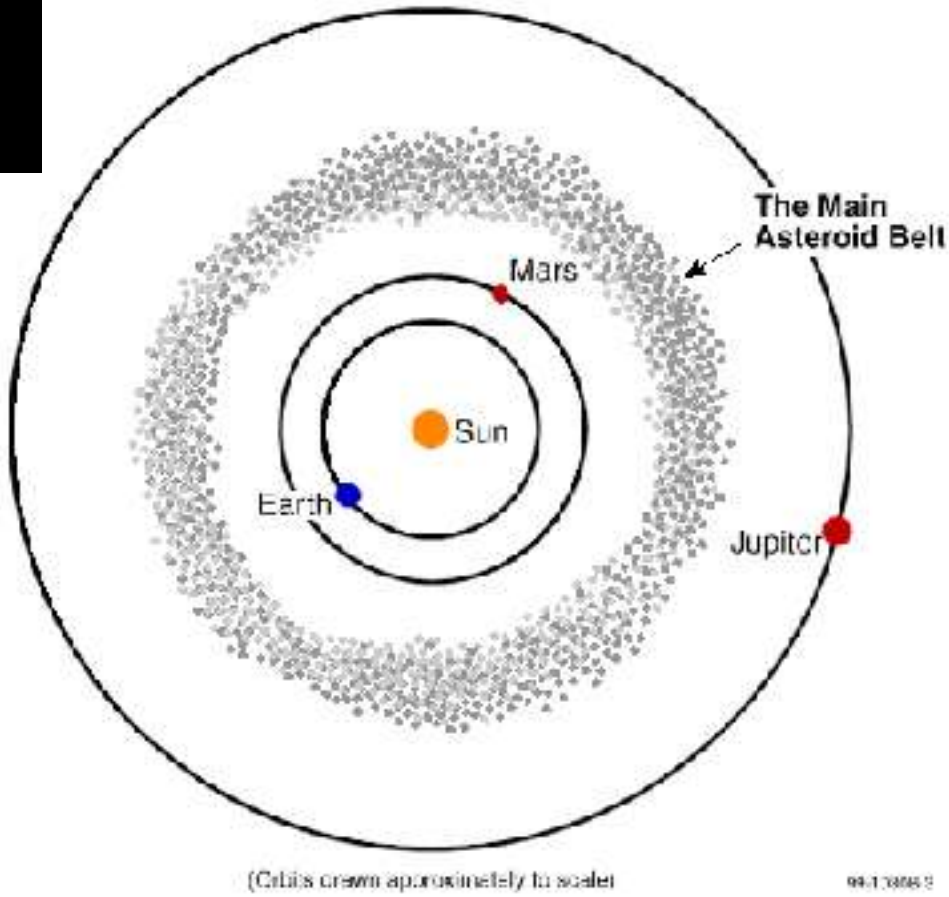
Asteroids



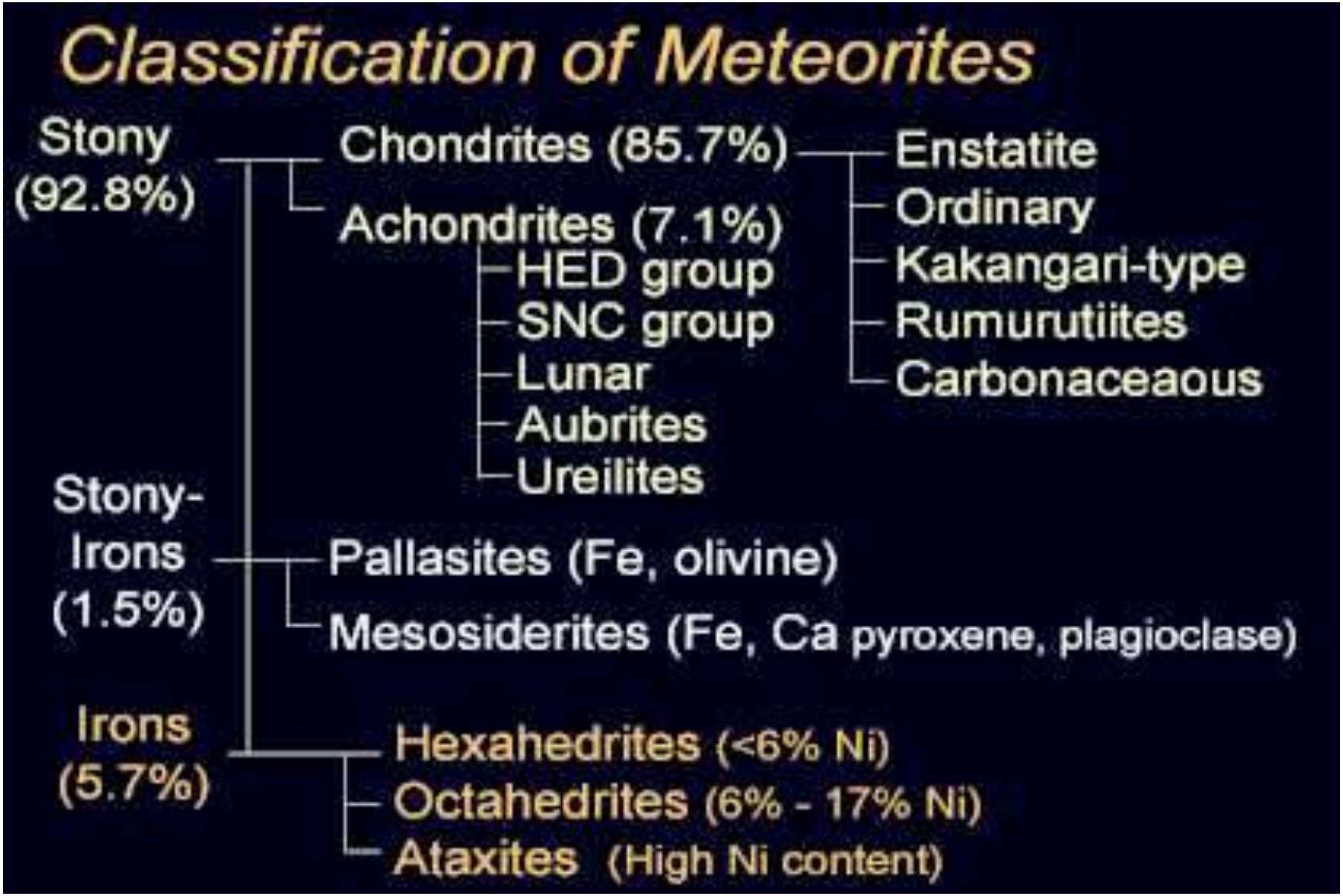
Mathilde & Eros (NEAR)

Ida & Dactyl



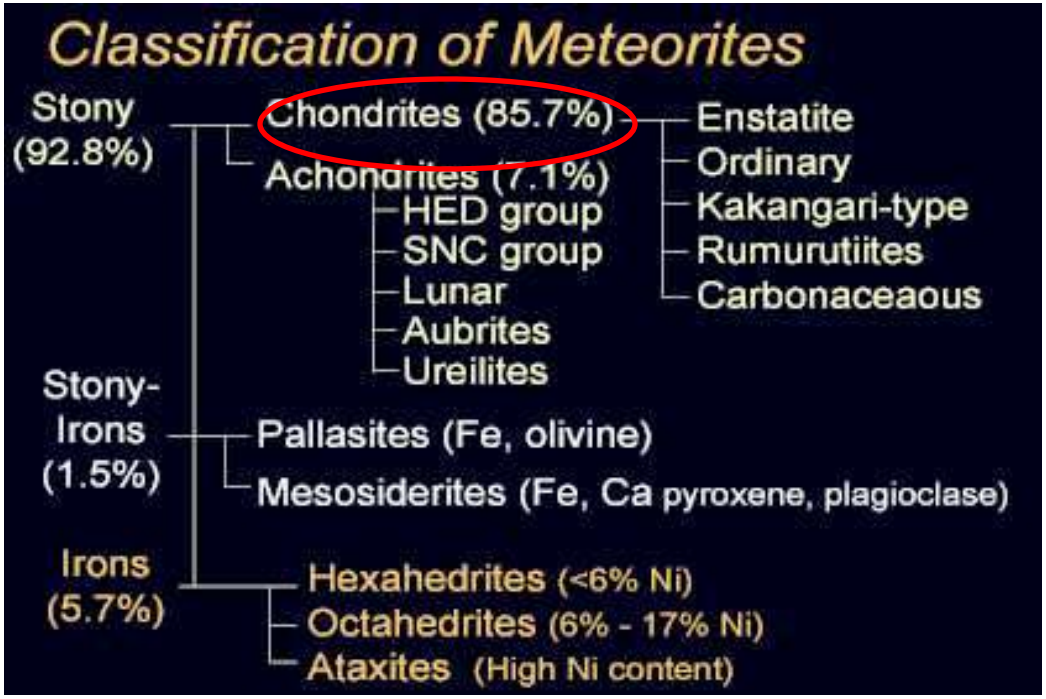


Meteorites


Classification of Meteorites
Stony (92.8%)
Chondrites (85.7%)
Enstatite
Ordinary
Kakangari-type
Rumurutiites
Carbonaceaous
Achondrites (7.1%)
HED group
SNC group
Lunar
Aubrites
Ureilites
Stony-Irons (1.5%)
Pallasites (Fe, olivine)
Mesosiderites (Fe, Ca pyroxene, plagioclase)
Irons (5.7%)
Hexahedrites (<6% Ni)
Octahedrites (6% - 17% Ni)
Ataxites (High Ni content)

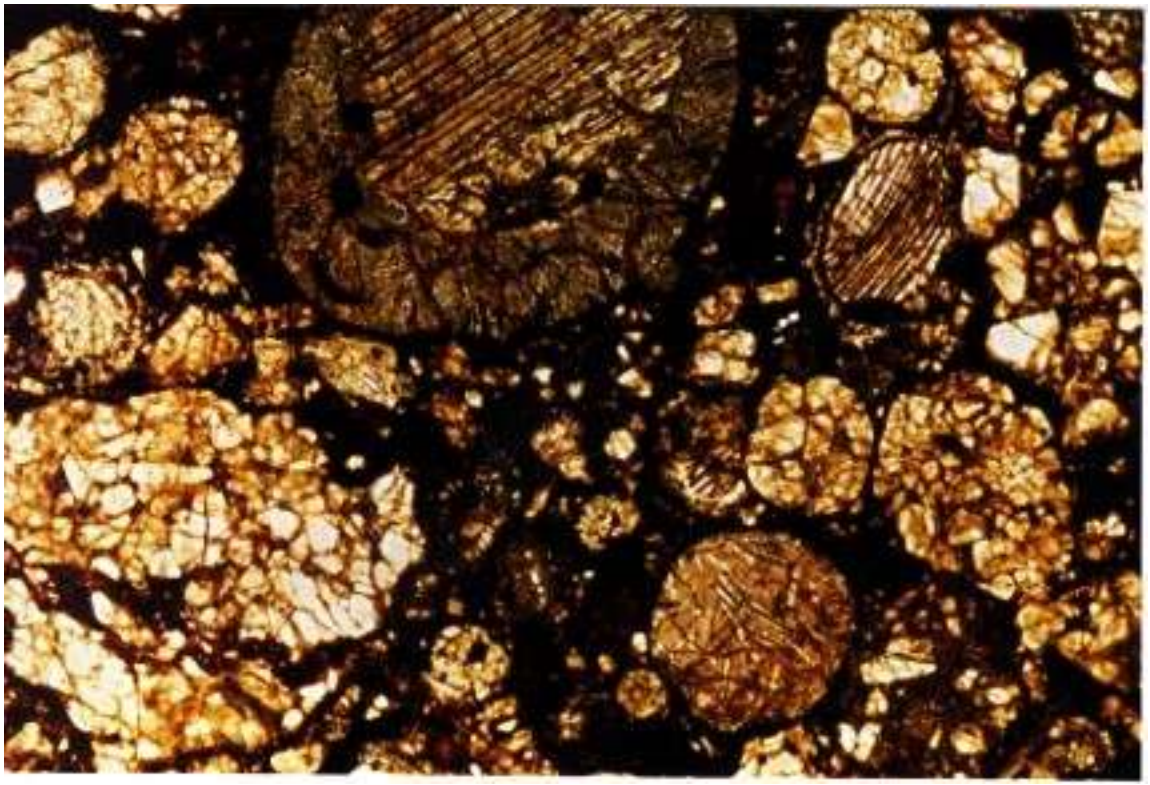
Chondrites

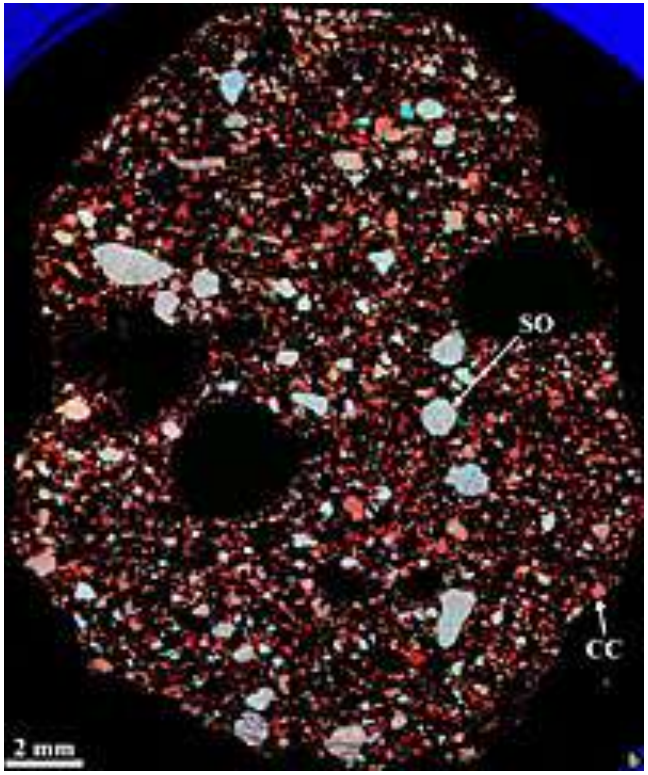

Carbonaceous


Classification of Meteorites
Stony (92.8%)
Chondrites (85.7%)
Achondrites (7.1%)
HED group
SNC group
Lunar
Aubrites
Ureilites
Enstatite
Ordinary
Kakangari-type
Rumurutiites
Carbonaceaous
Stony-Irons (1.5%)
Pallasites (Fe, olivine)
Mesosiderites (Fe, Ca pyroxene, plagioclase)
Irons (5.7%)
Hexahedrites (<6% Ni)
Octahedrites (6% - 17% Ni)
Ataxites (High Ni content)


Ordinary

Chondrites under microscope

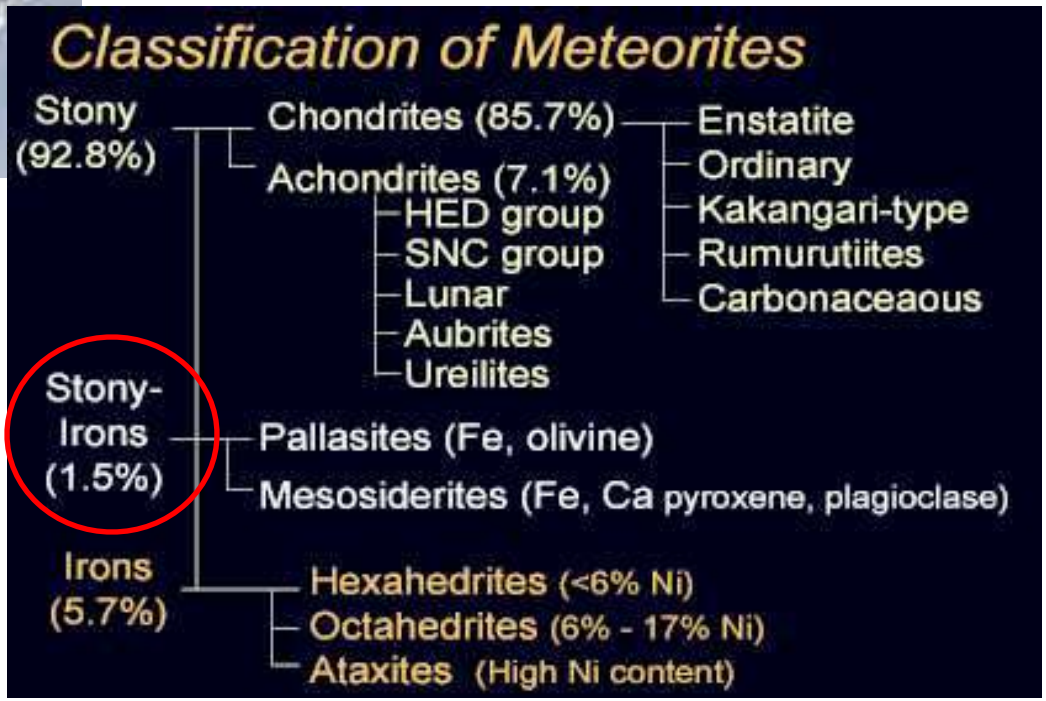




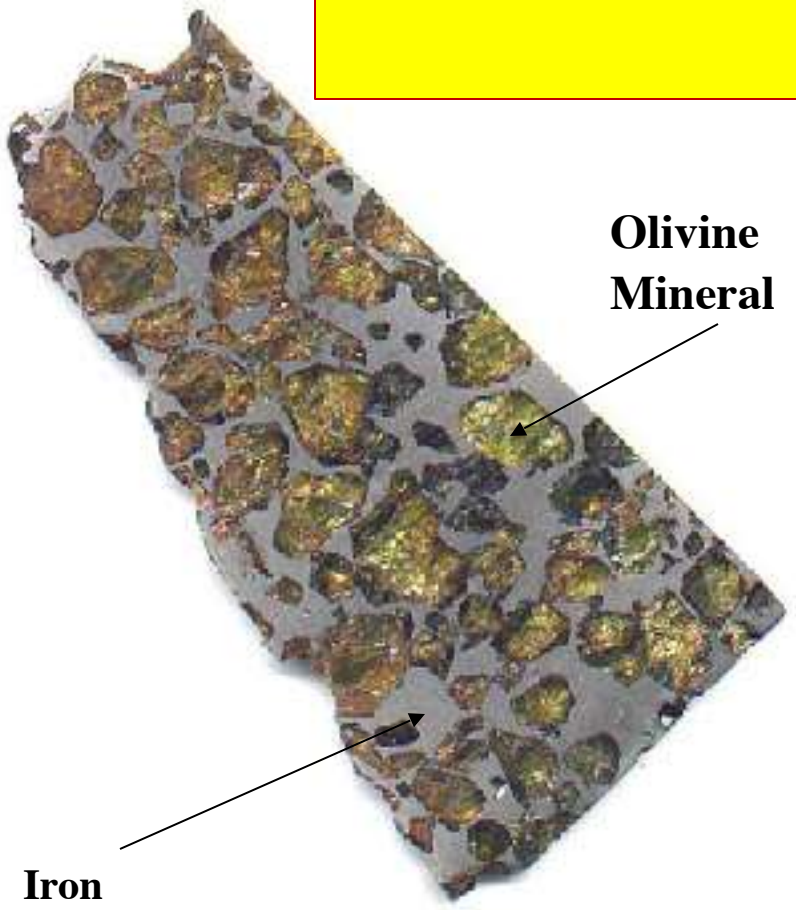
X-Ray Image

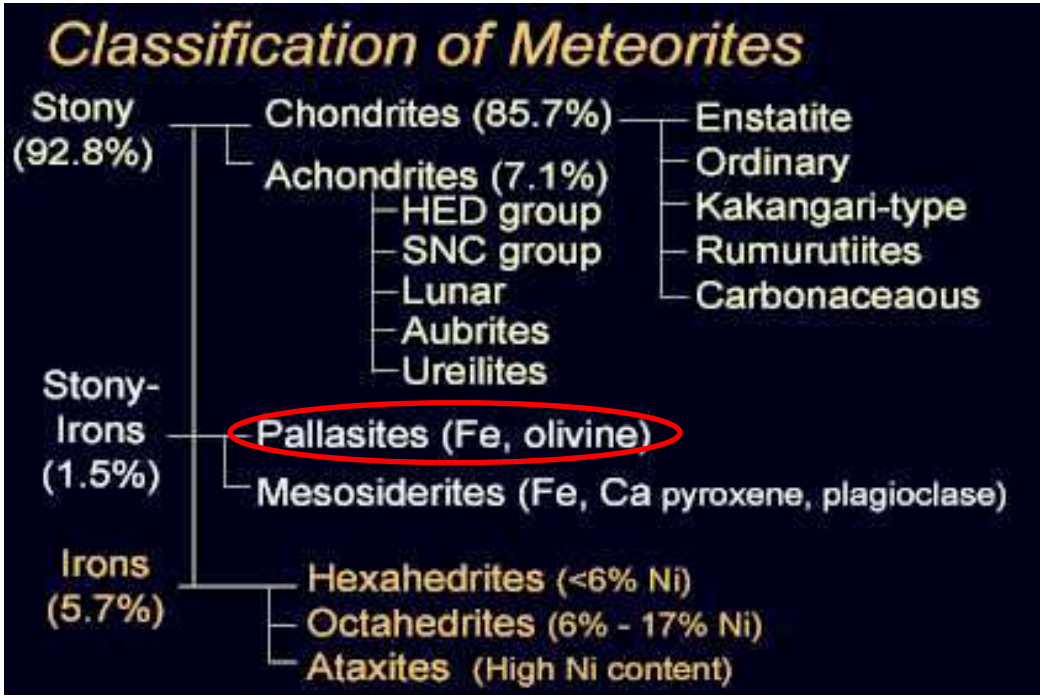
Achondrite - Stony Meteorite

A stone from the Stannern eucrite shower that fell over Moravia, Czech Republic in 1808.

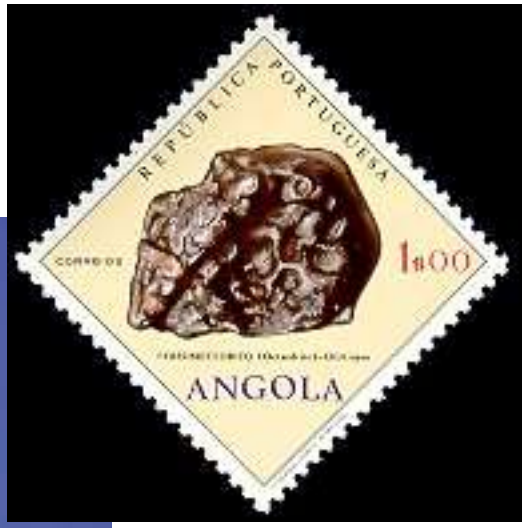


Stony-Iron: Palasite





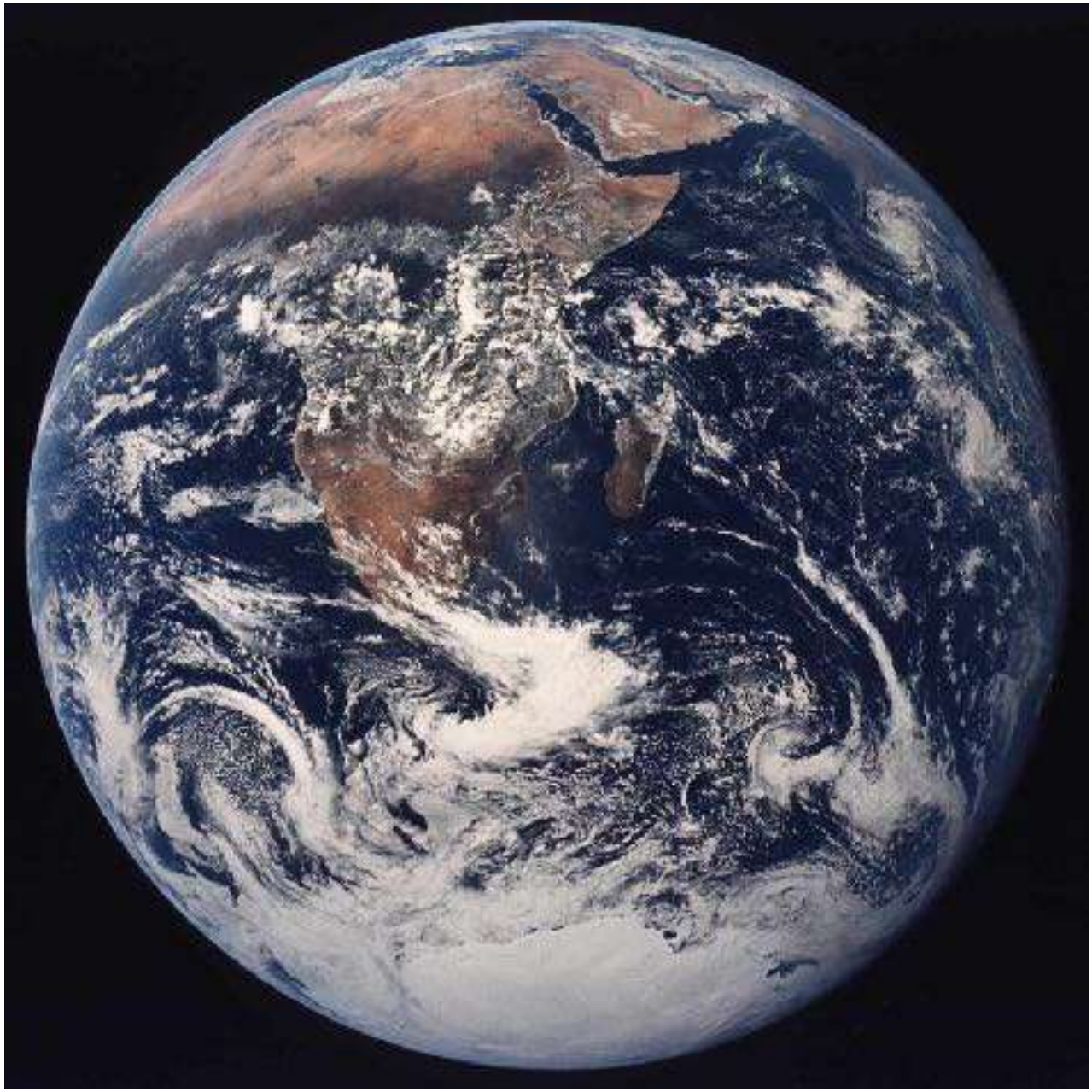
Iron Meteorite



Classification of Meteorites

- **Stony (92.8%)**
  - Chondrites (85.7%)
    - Enstatite
    - Ordinary
    - Kakangari-type
    - Rumurutiites
    - Carbonaceaous
  - Achondrites (7.1%)
    - HED group
    - SNC group
    - Lunar
    - Aubrites
    - Ureilites
- **Stony-Irons (1.5%)**
  - Pallasites (Fe, olivine)
  - Mesosiderites (Fe, Ca pyroxene, plagioclase)
- **Irons (5.7%)**
  - Hexahedrites (<6% Ni)
  - Octahedrites (6% - 17% Ni)
  - Ataxites (High Ni content)

Our Home



Phases of the Moon over 28 Days

The Moon seems to grow bigger until half of its round shape shows (TOP ROW, LEFT TO RIGHT). This is called the moon's first quarter. It grows larger until we see the full moon. The full moon shines for a night or two. Then it looks smaller bit by bit, until we see the last quarter (THIRD ROW FROM TOP). Finally, the crescent disappears into a new moon.

Origin of Solar System : NEBULA hypothesis

(A) A slowly rotating portion of a large nebula becomes a distinct globule as a mostly gaseous cloud collapses by gravitational attraction.

(B) Rotation of the cloud prevents collapse of the equatorial disk while a dense central mass forms.

(C) A protostar "ignites" and warms the inner part of the nebula, possibly vaporizing preexisting dust. As the nebula cools, condensation produces solid grains that settle to the central plane of the nebula.

(D) The dusty nebula clears by dust aggregation into planetesimals or by ejection during a T-Tauri stage of the star's evolution. A star and a system of cold bodies remains. Gravitational accretion of these small bodies leads to the development of a small number of major planets.

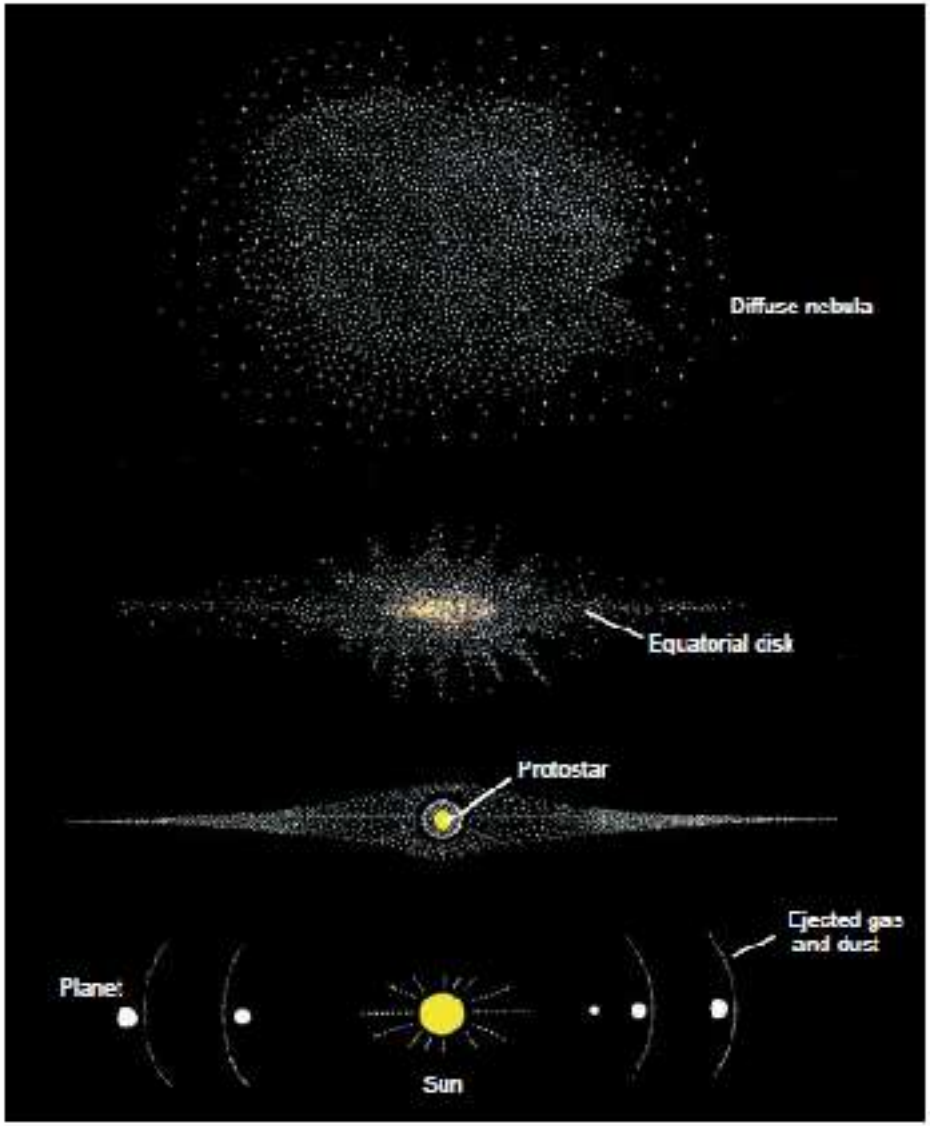
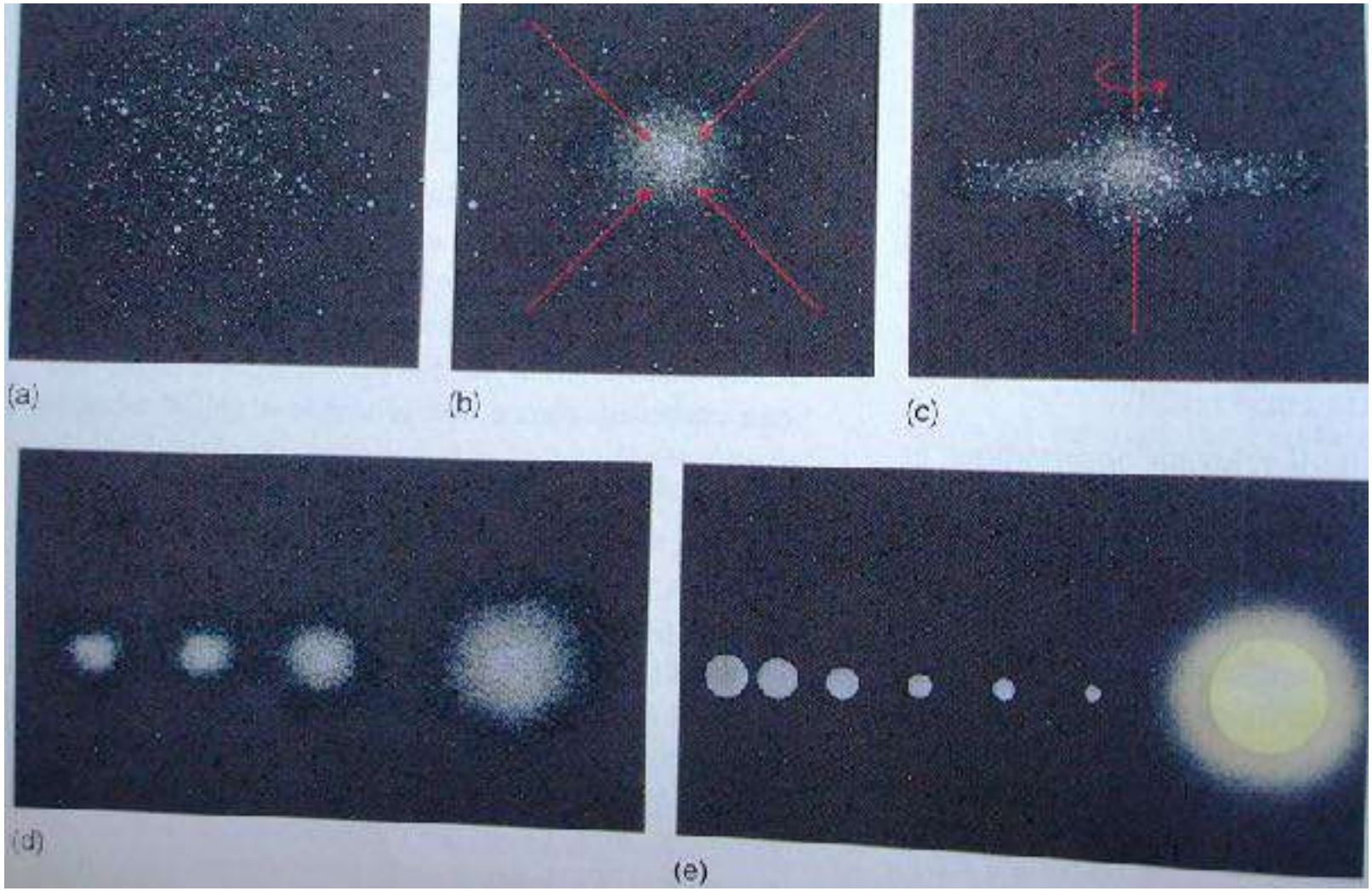


FIGURE 25.26 **The evolution of a dusty nebula** to a star with a surrounding system of orbiting planets.

(Hamblin & Christiansen, 2009)

Origin of Solar System : NEBULA hypothesis



Origin of the MOON

Impact Origin of the Moon. In the last 10 years, an exciting new hypothesis for the origin of the Moon has gained scientific respect (Figure 25.27). A glancing collision of Earth with a Mars-sized object would have vaporized and ejected material from the already differentiated Earth. The refractory silicate portion of this material could have become solid again and accreted while in orbit around Earth to create a small water- and iron-poor natural satellite—the Moon.

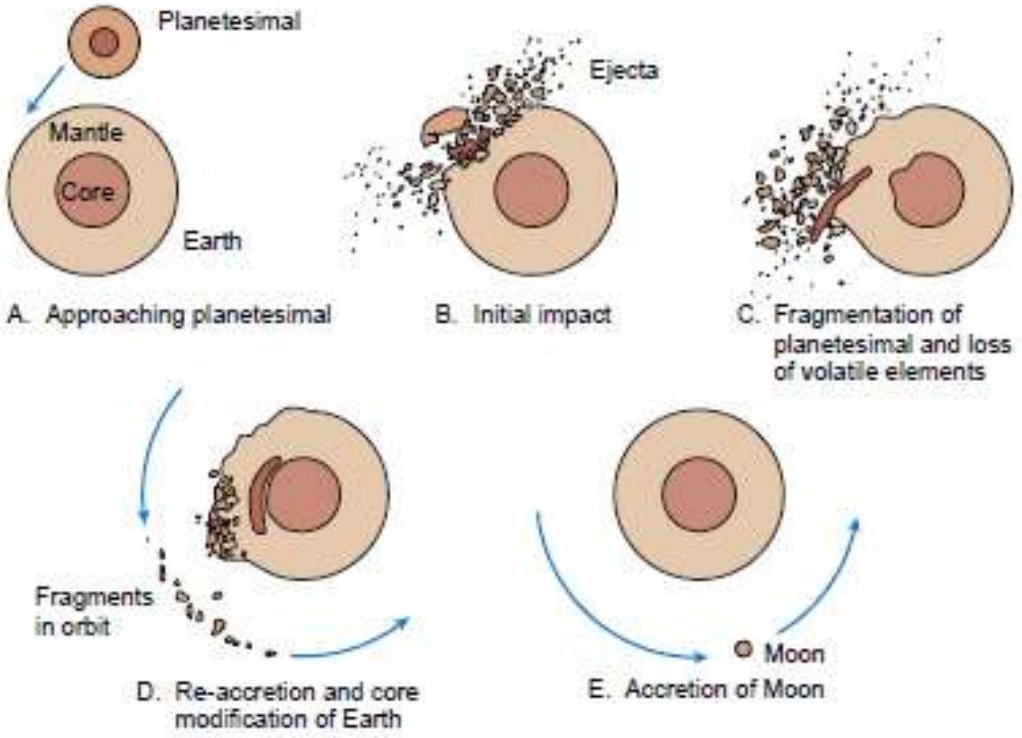


FIGURE 25.27 A giant collision of the early Earth with a body the size of Mars may have ejected material into orbit, where it accreted to form the Moon. The iron core of the impacting body would have plunged through Earth's mantle and merged with the already formed core. Earth may have been stripped of its primordial atmosphere and been left with a globe-encircling ocean of magma.

(Hamblin & Christiansen, 2009)