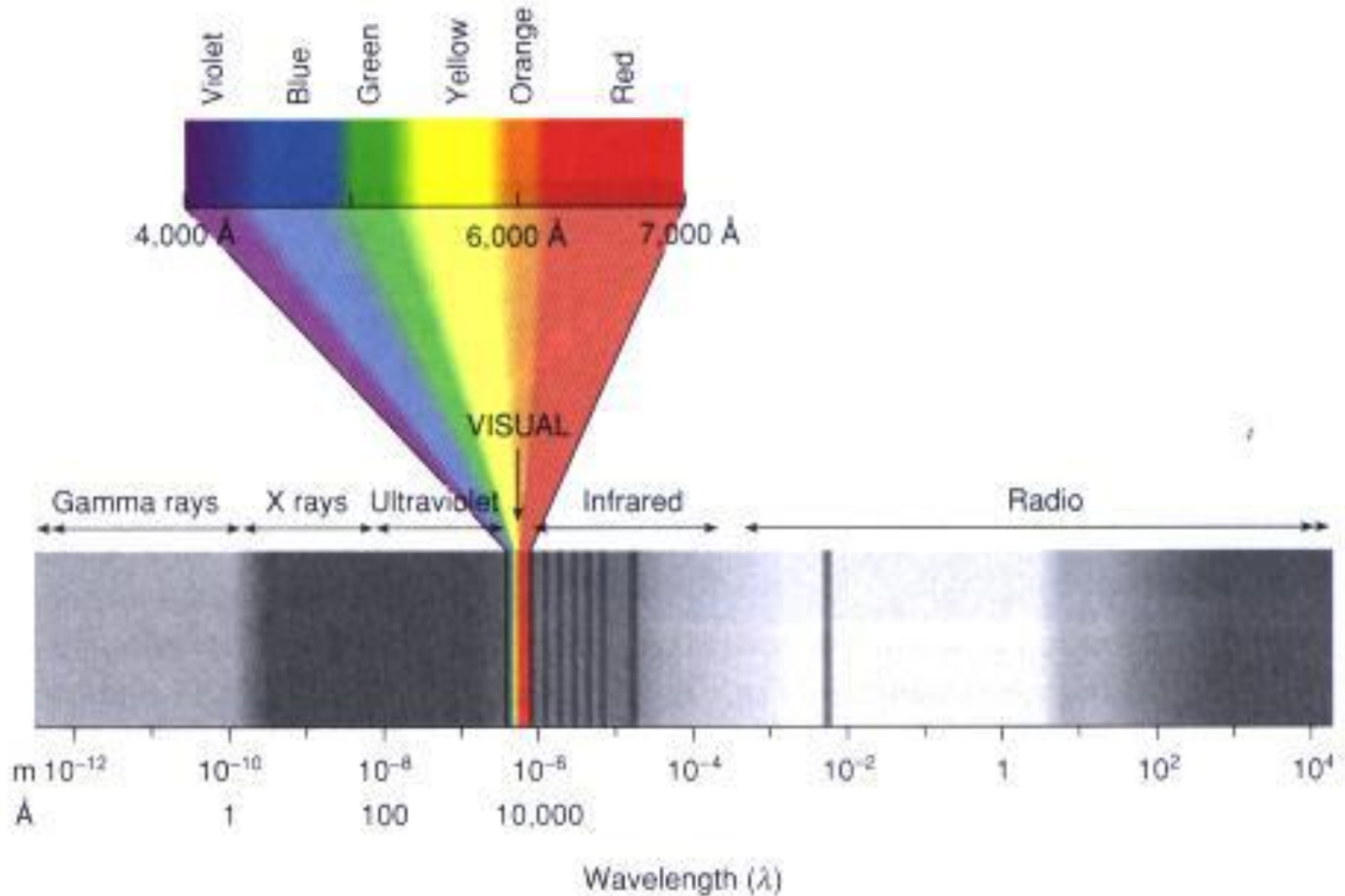


# Exploring Space



# Electromagnetic spectrum



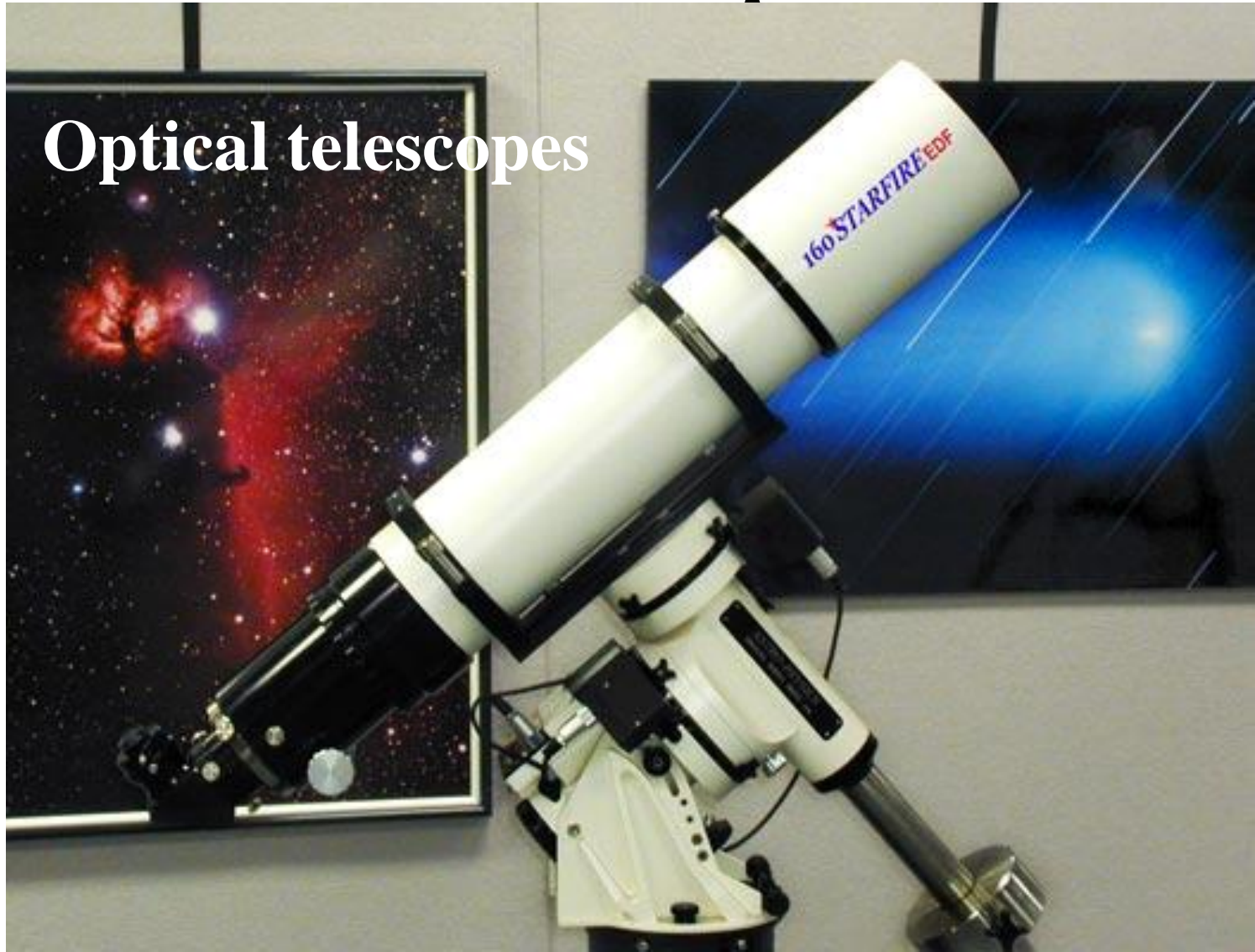
# Astronomy

- scientific study of the sun, moon, planets, & stars



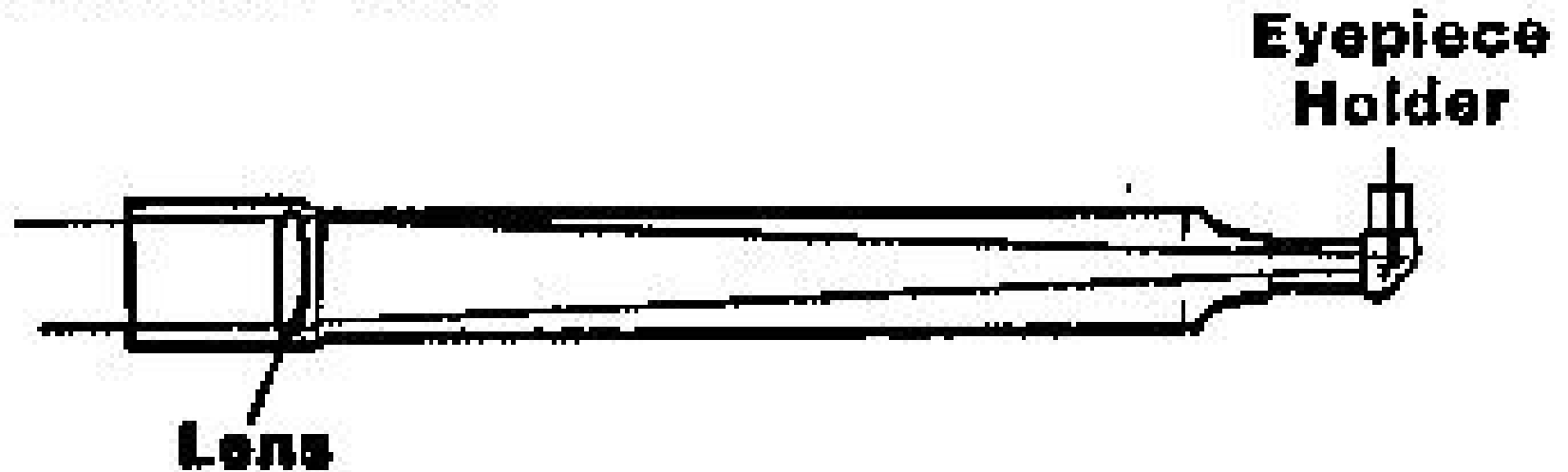
# Telescopes

Optical telescopes





# REFRACTOR



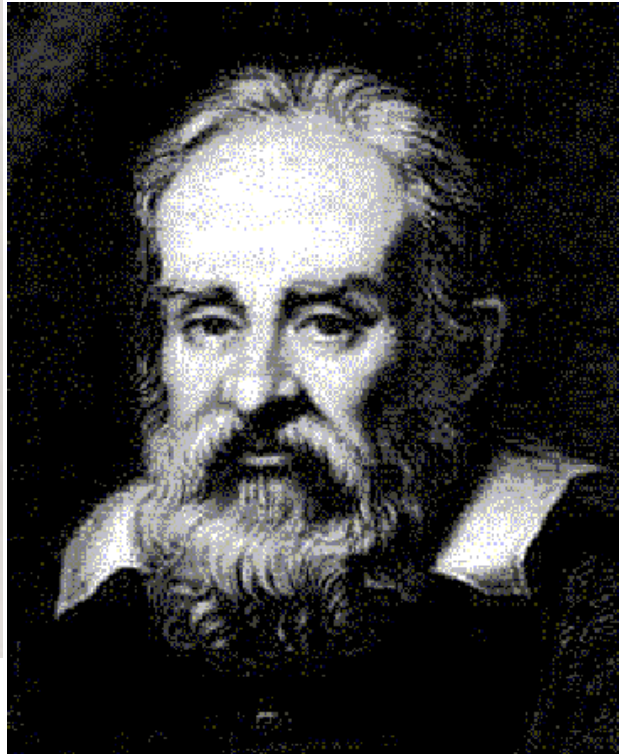
# NEWTONIAN REFLECTOR



# Refractor telescope

## Uses two convex lenses

- **First built by Galileo**



# Reflector telescope

- Uses mirrors and lenses
- First built by Isaac Newton





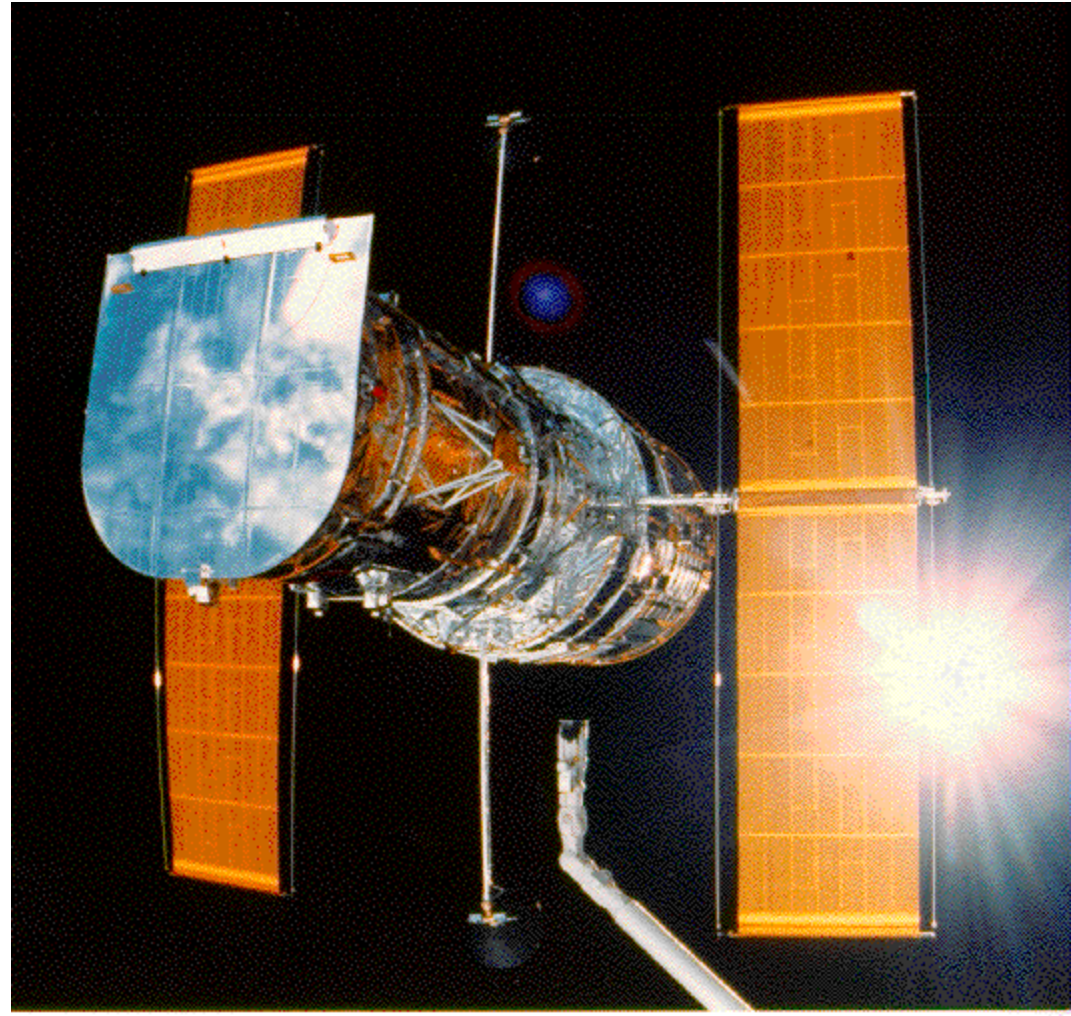
# Radio Telescopes

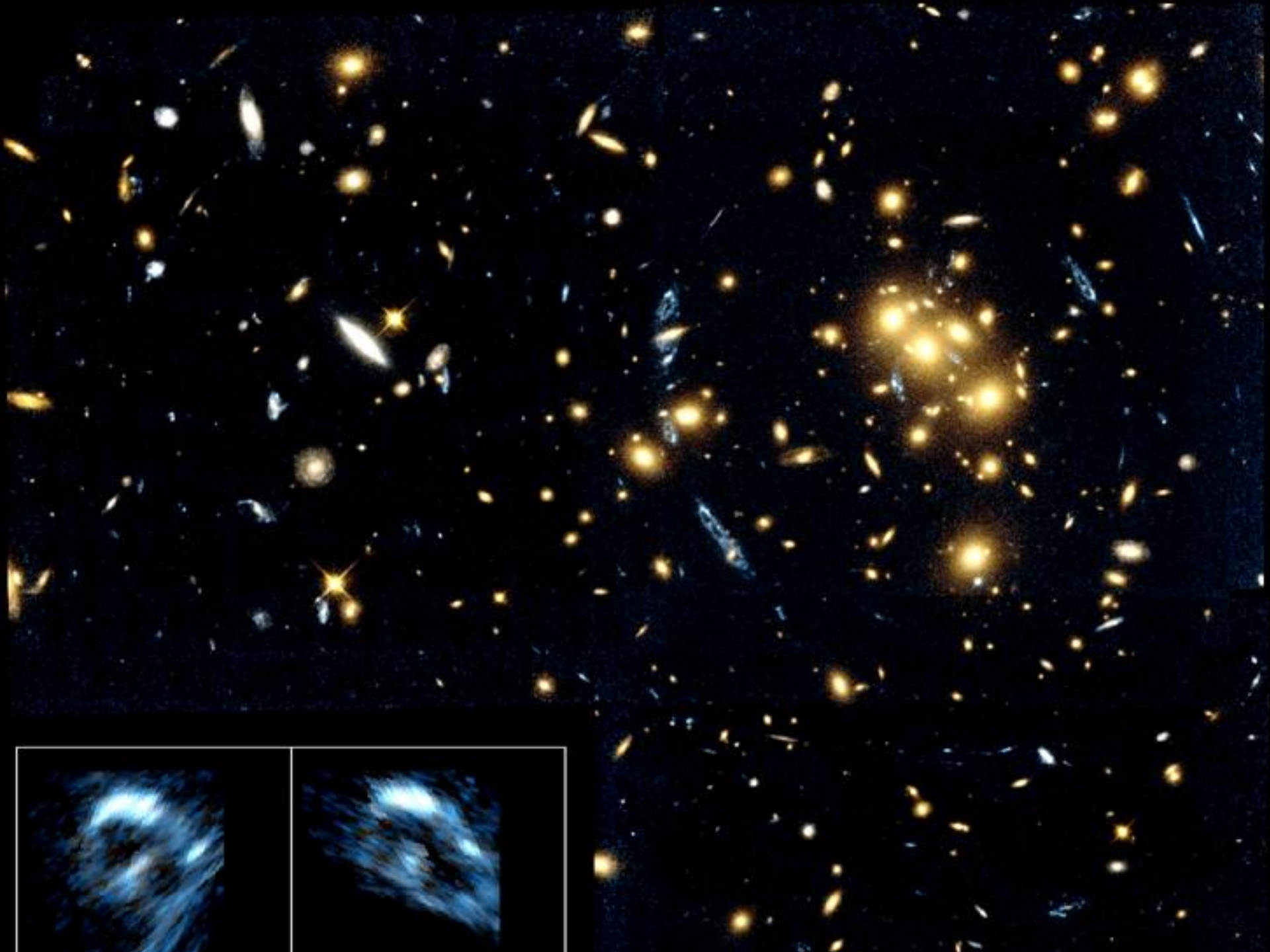
- Picks up radio waves from outer space



# Hubble space telescope

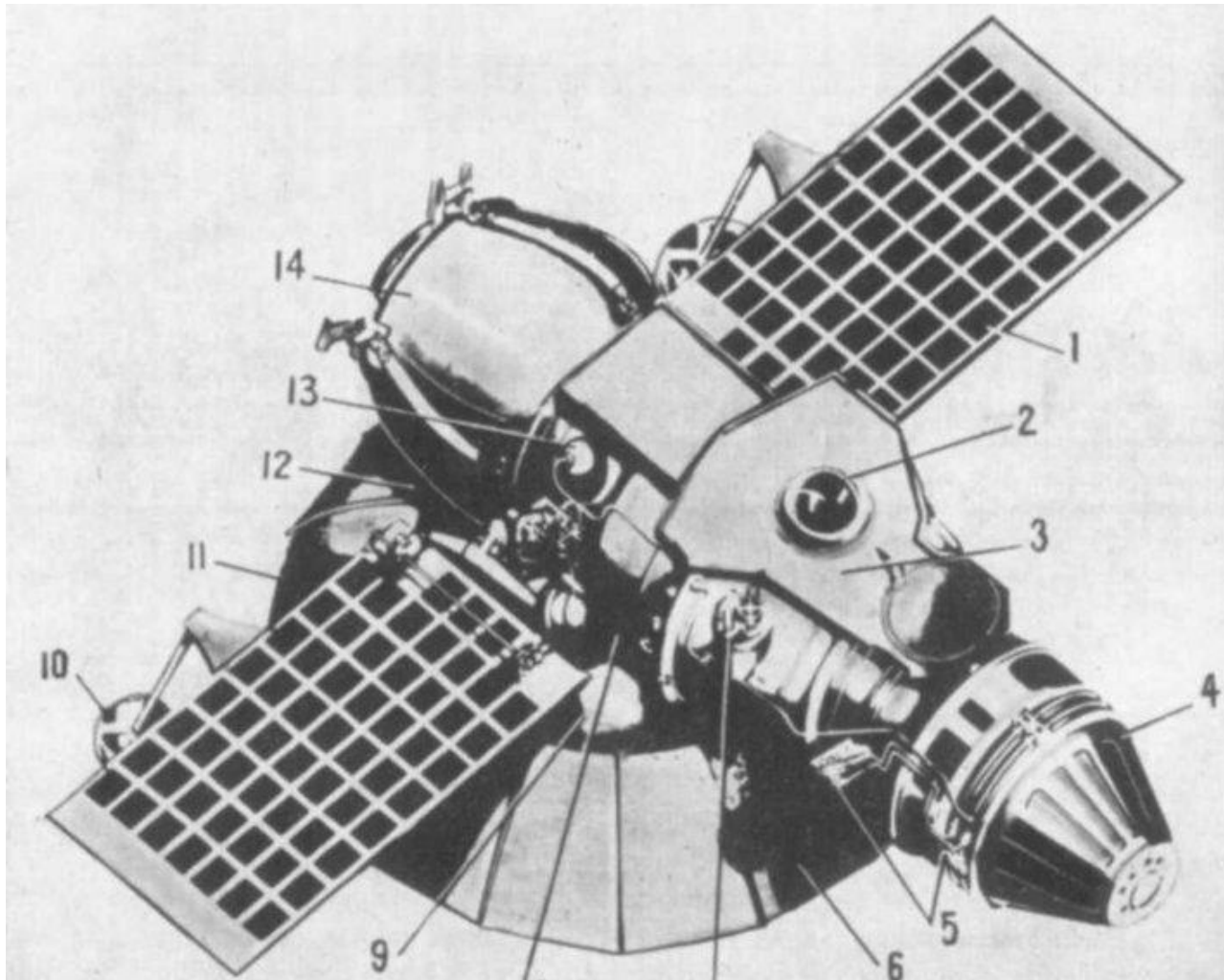
- **Satellite**





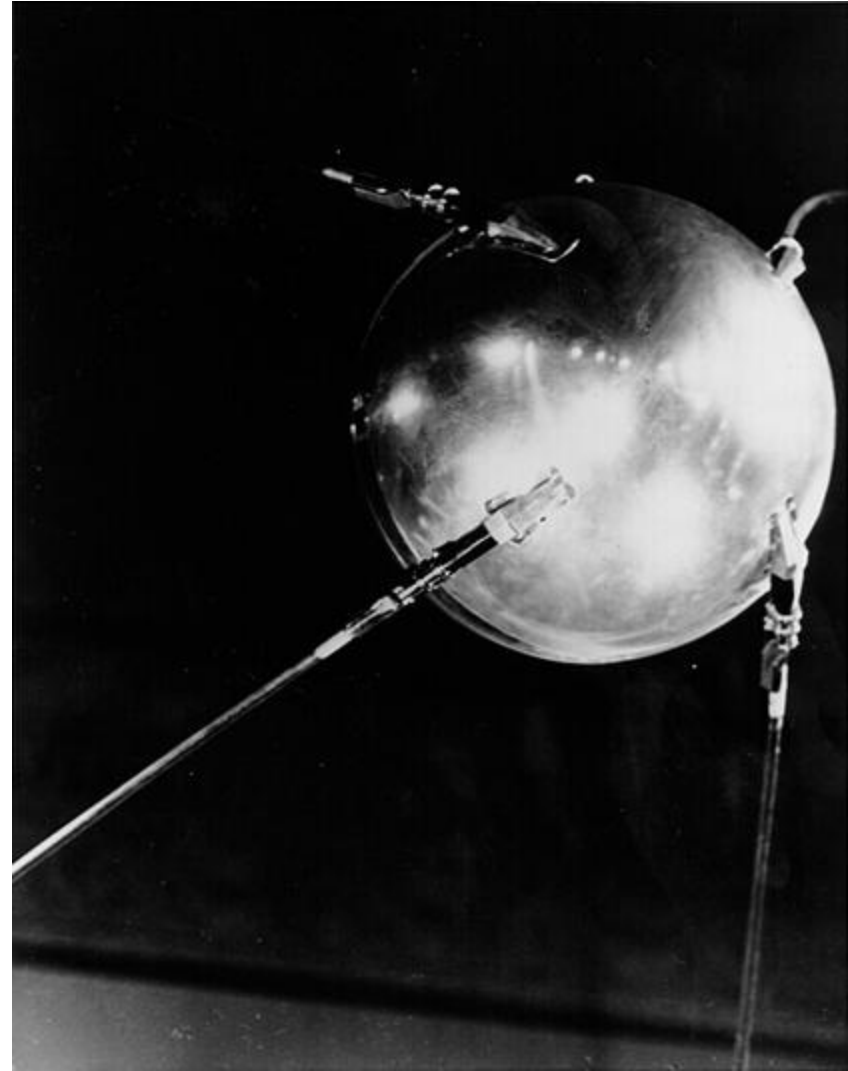


# Artificial satellites and space probes



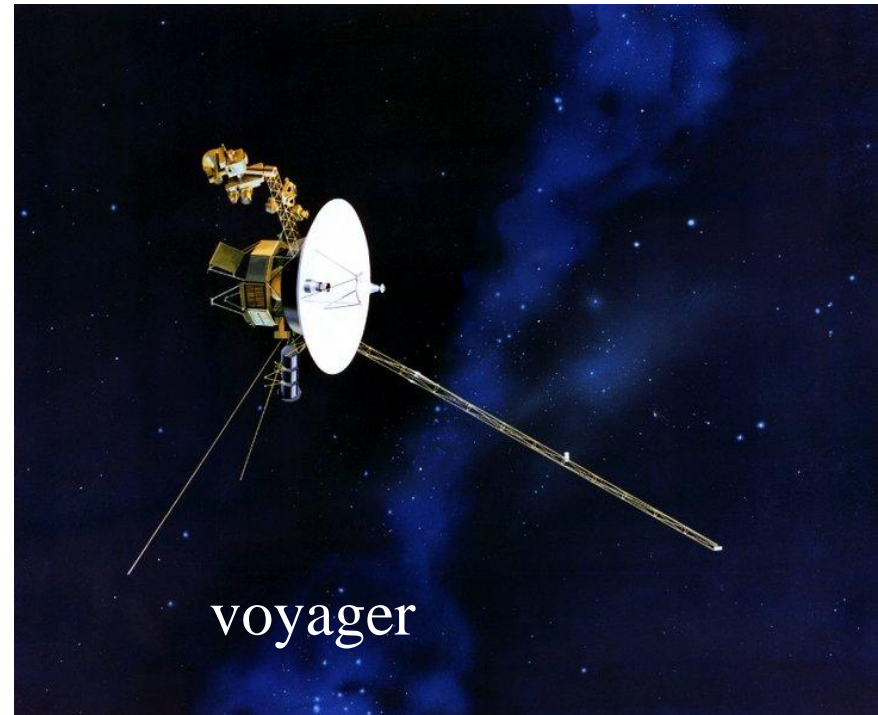
# Satellite – orbits the planet

- **Artificial – manmade**
- **The first was sputnik I  
1957**



# Space probes

- **Travel out into the solar system**
  - **Mariner 1- 10 1973**
    - Mars Venus Mercury
  - **Voyager 1977**
    - I – Jupiter & Saturn
    - II – Jupiter, Saturn, Uranus & Neptune
  - **Galileo 1989– traveled to mars and Jupiter**
  - **Viking 1976**
  - Mars
  - **Pathfinder 1996**
    - Sojourner mars vehicle





**NASA National Aeronautical  
and Space Administration**



# Space race

- The *Space Race* grew out of the Cold War between the United States and the Soviet Union, the most powerful nations after World War II.
- For a half-century, the two superpowers competed for primacy in a global struggle pitting a democratic society against totalitarian communism.

# The Race is on

- *What makes the Soviet threat unique in history is its all-inclusiveness. Every human activity is pressed into service as a weapon of expansion. Trade, economic development, military power, arts, science, education, the whole world of ideas.... The Soviets are, in short, waging total cold war.* President Dwight D. Eisenhower, 1958

- *Finally, if we are to win the battle that is now going on around the world between freedom and tyranny, the dramatic achievements in space which occurred in recent weeks should have made clear to us all, as did the Sputnik in 1957, the impact of this adventure on the minds of men everywhere....*

President John F. Kennedy, 1961

- *We have a long way to go in the space race. We started late. But this is the new ocean, and I believe the United States must sail on it and be in a position second to none.*

President John F. Kennedy, 1962



# Race to the moon

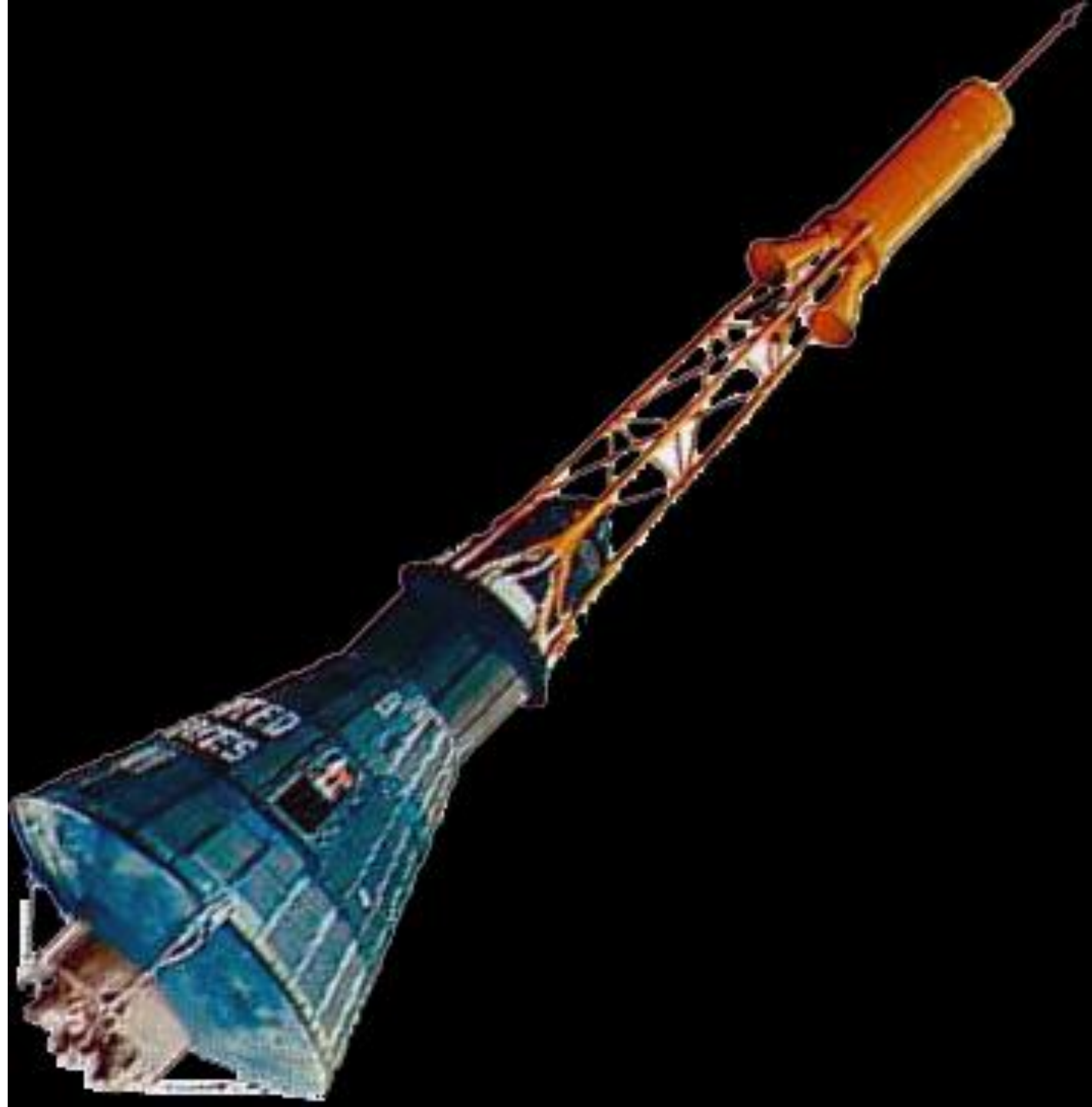
- **Sputnik I 1957**
- **Yuri A Gagarin 1961**  
**first human in space**



# US began mercury project in 1961

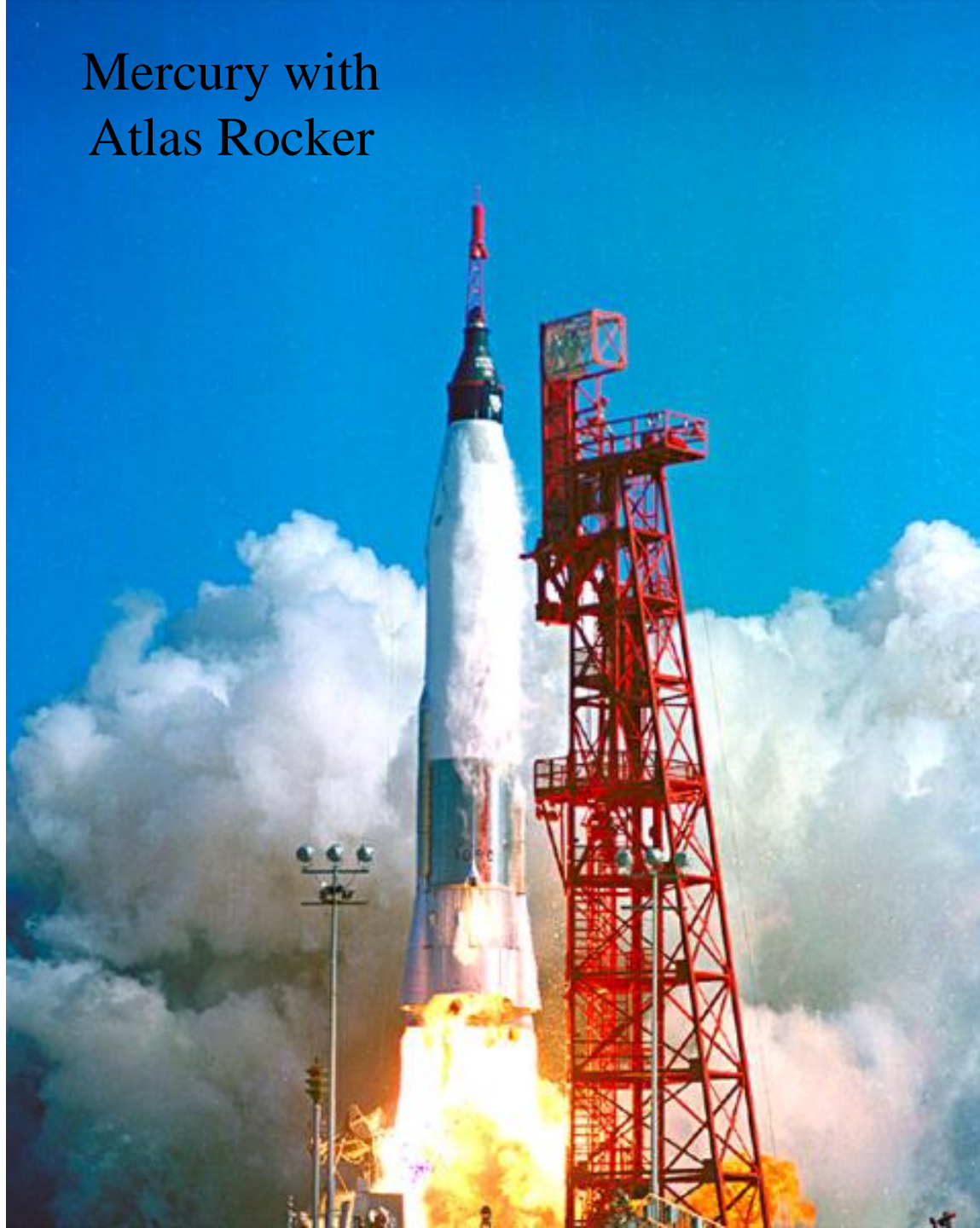
- May 5, 1961 Alan B. Shepard was the first US in space
- 1962 John Glen was the first person to orbit earth







# Mercury with Atlas Rocker





# Mercury w/ Redstone Rocket









**1962 started project Gemini**





Project Gemini and the Titan Rocket







# Project Apollo



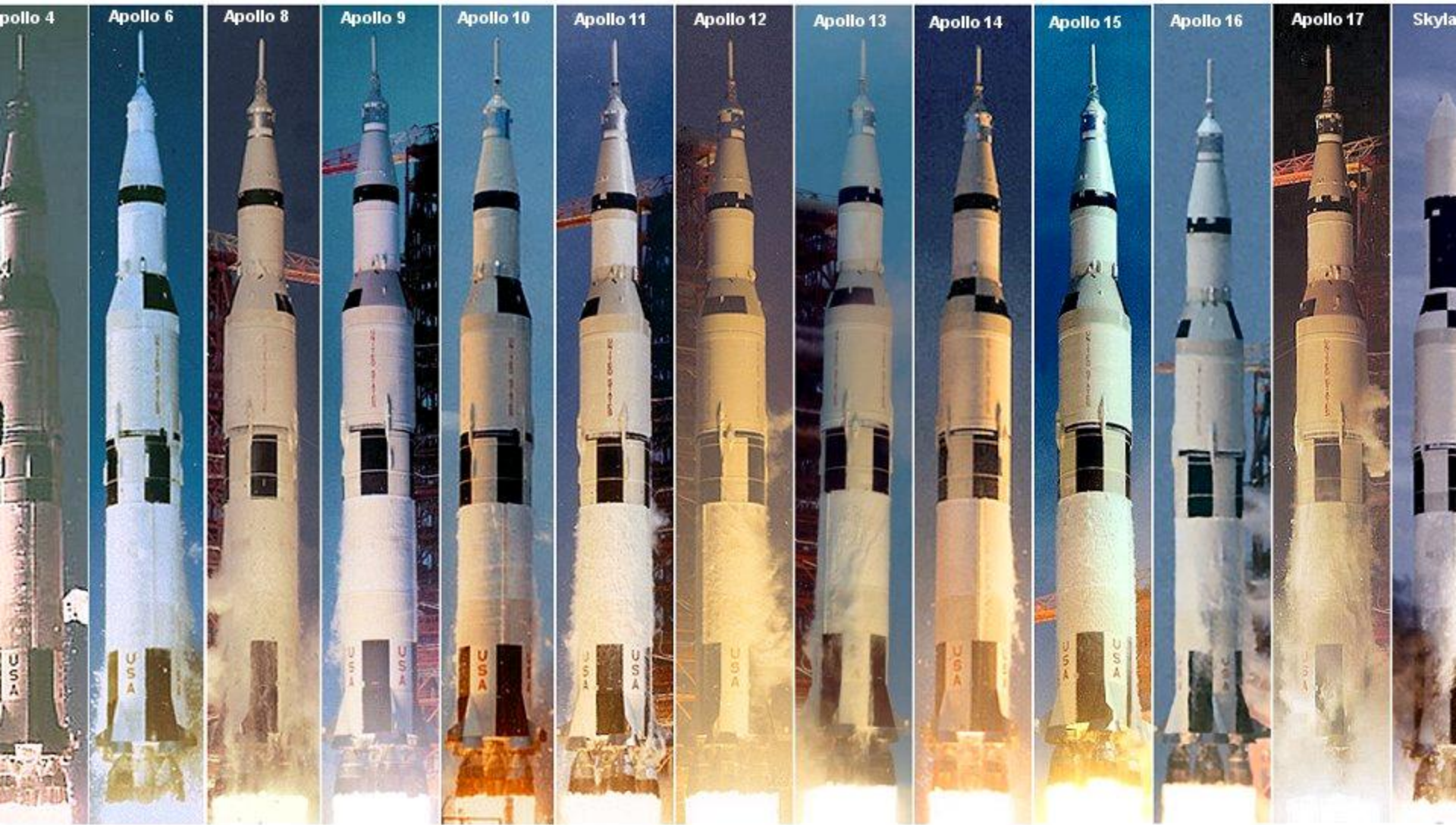
# Project Apollo to the moon

- **Went to the moon  
July 20, 1969**
- **Neil Armstrong was  
the first person to  
set foot on the moon**
- **Apollo program  
ended in 1972**









Apollo 4

Apollo 6

Apollo 8

Apollo 9

Apollo 10

Apollo 11

Apollo 12

Apollo 13

Apollo 14

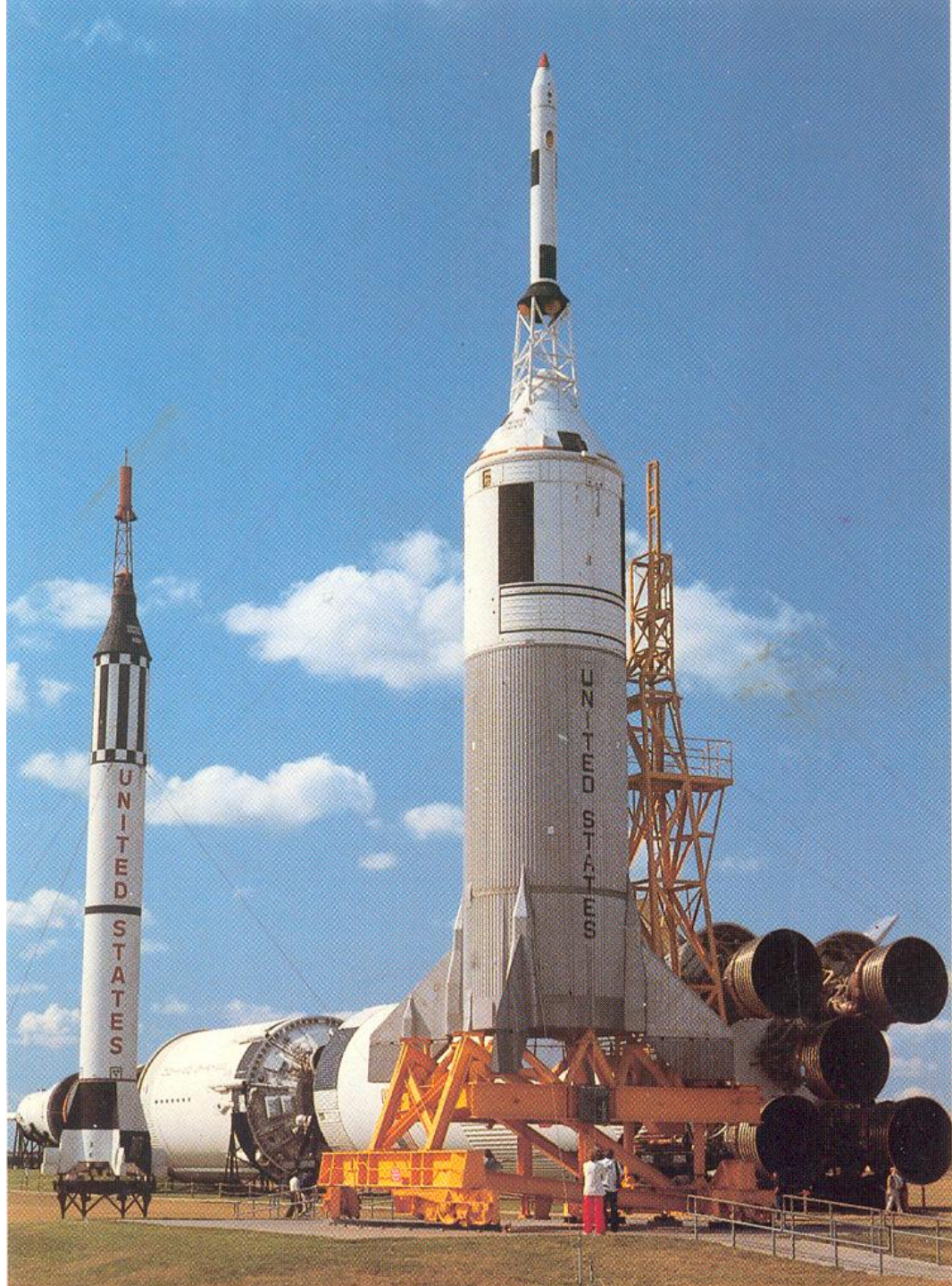
Apollo 15

Apollo 16

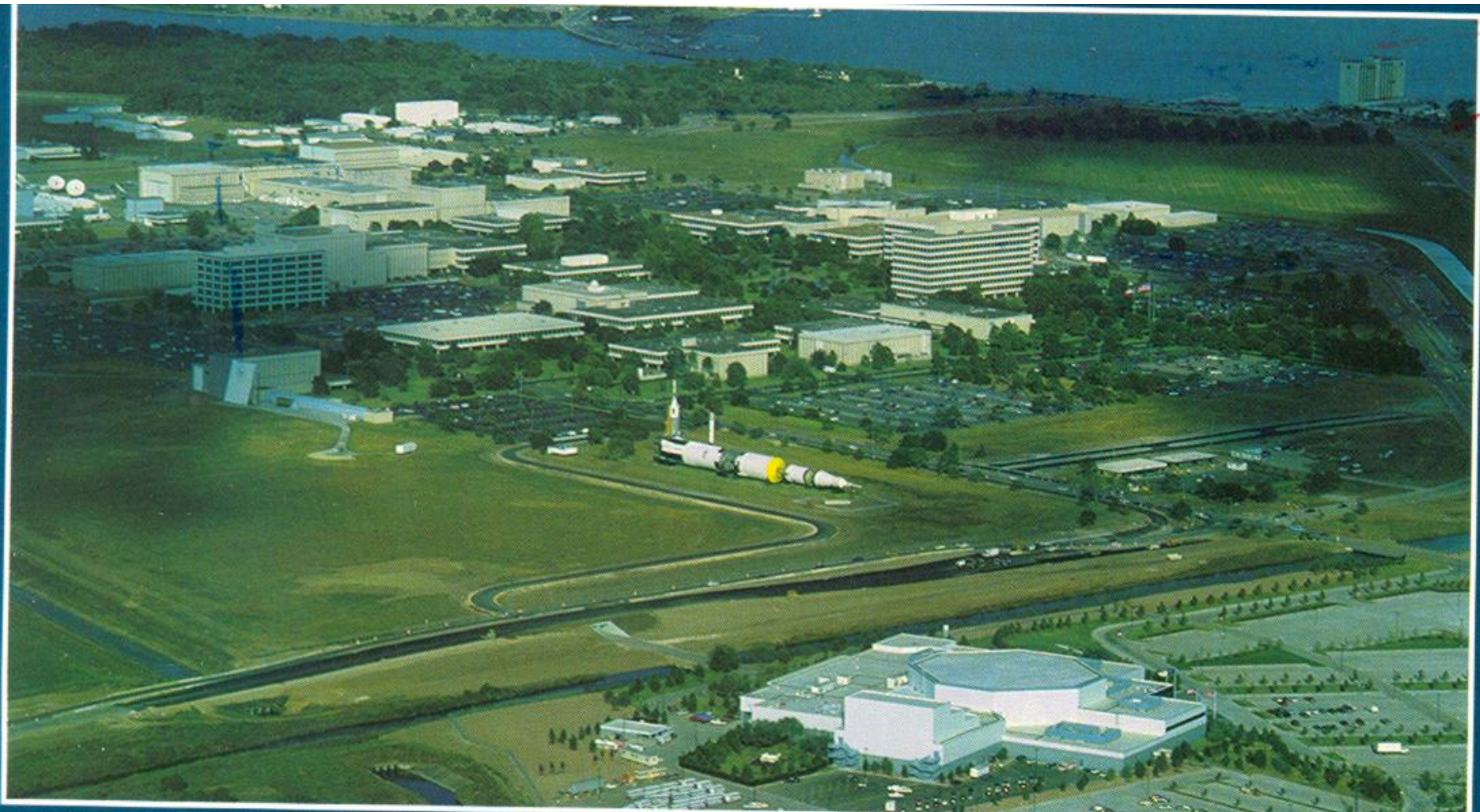
Apollo 17

Skylab







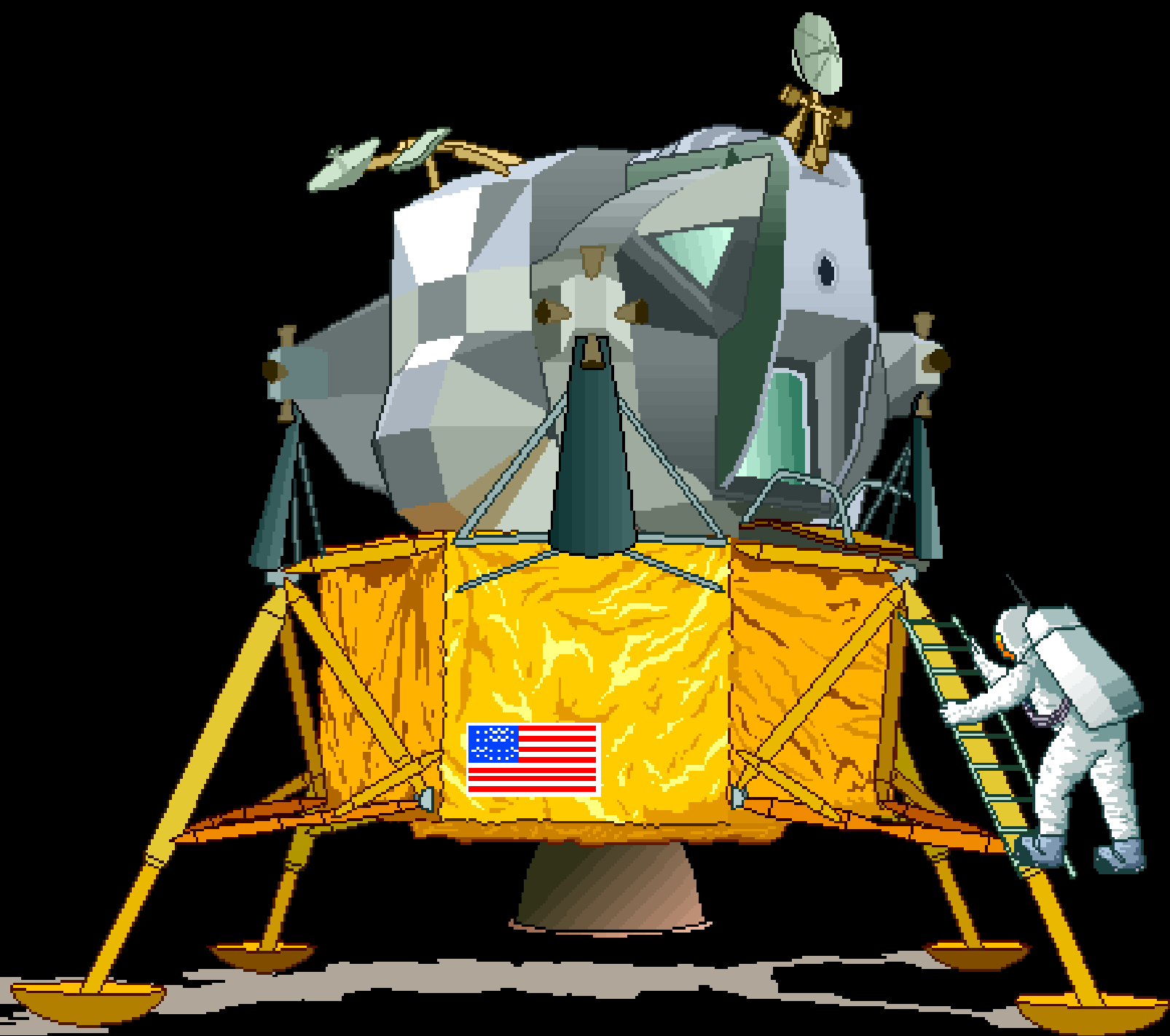




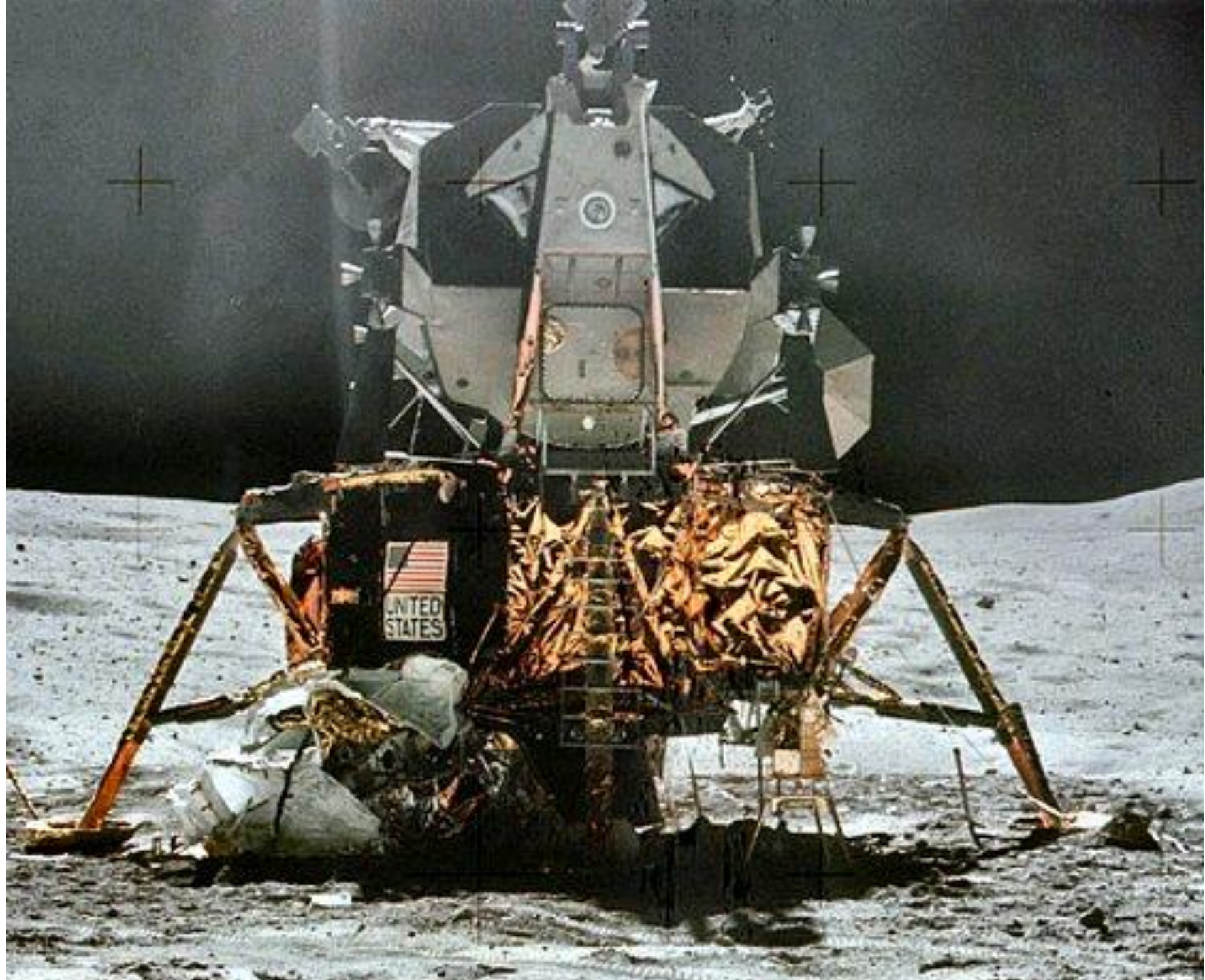


Neil Armstrong, Michael Collins, and Buzz Aldrin  
Apollo 11 Crew







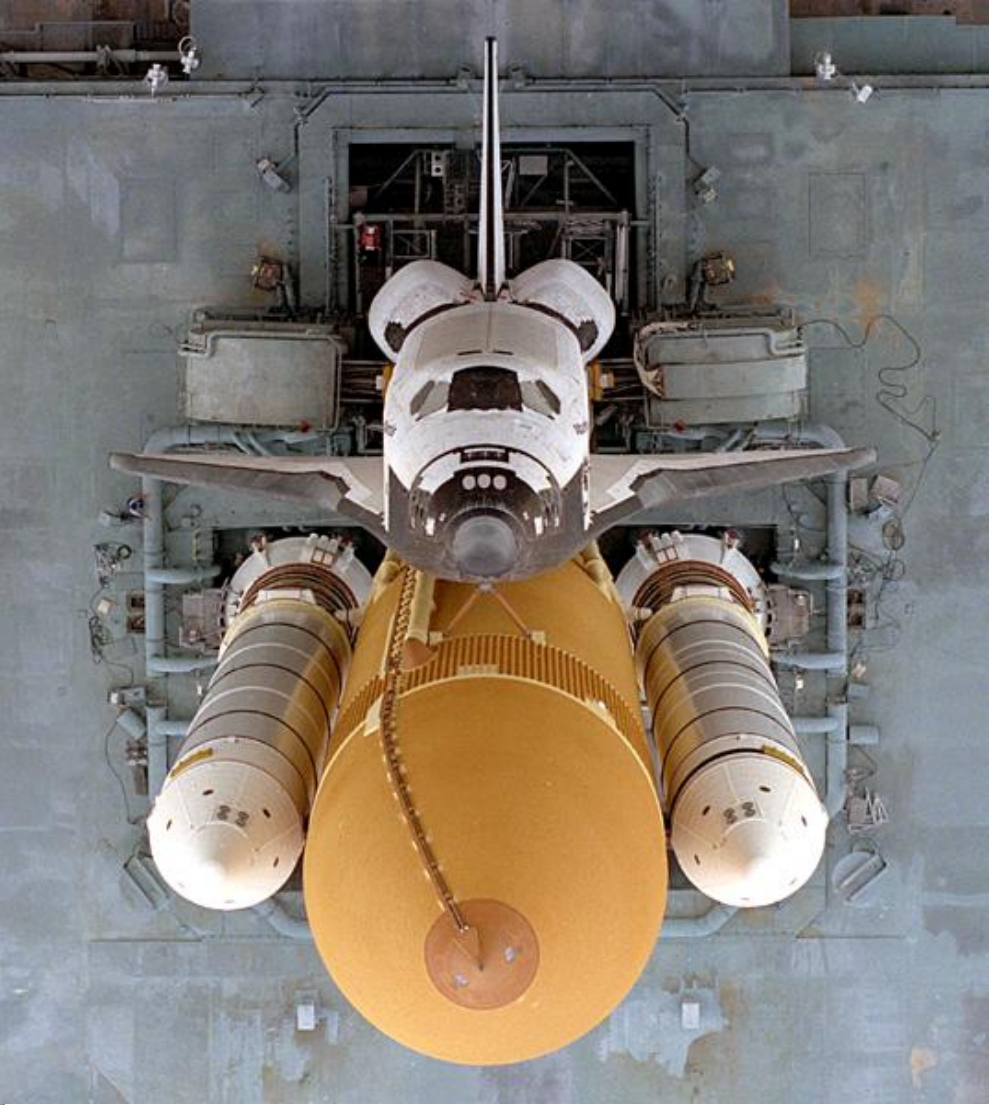


# The space shuttle program

- Reusable spacecraft
- space transportation system STS















# Space Stations

- Skylab 1973 –fell in 1979



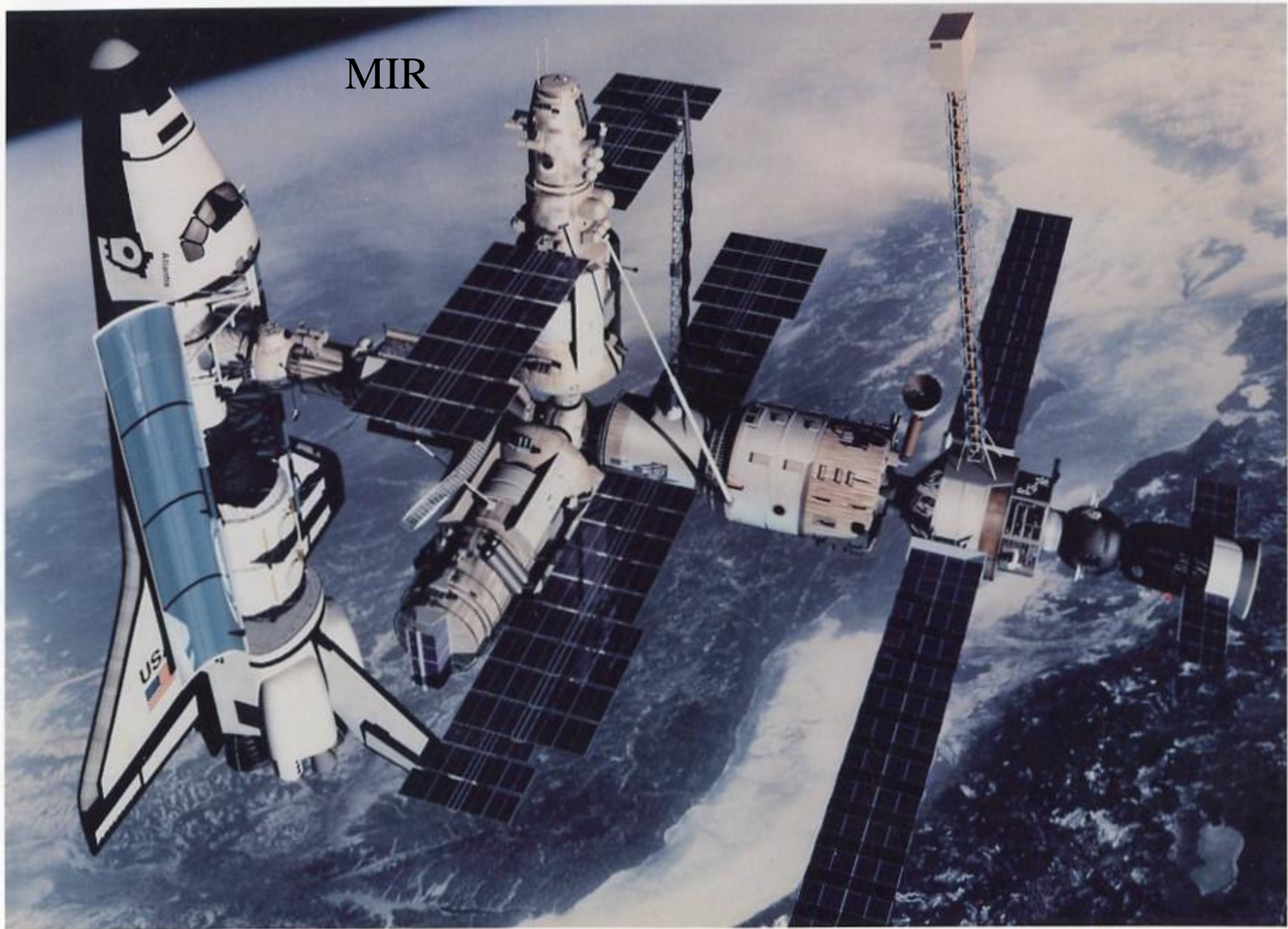


# MIR





MIR



# International Space Station 1997

- **Permanent laboratory in space**





# Flight Director









A large, bright orange and yellow sun with a textured surface, set against a dark red background. The sun's surface is covered in numerous small, bright spots and larger, irregular patches of white and yellow, giving it a granular appearance. The background is a deep, dark red color with some lighter, hazy areas, suggesting a nebula or a similar celestial environment.

# **The Sun – Earth – Moon System**



# Planet Earth







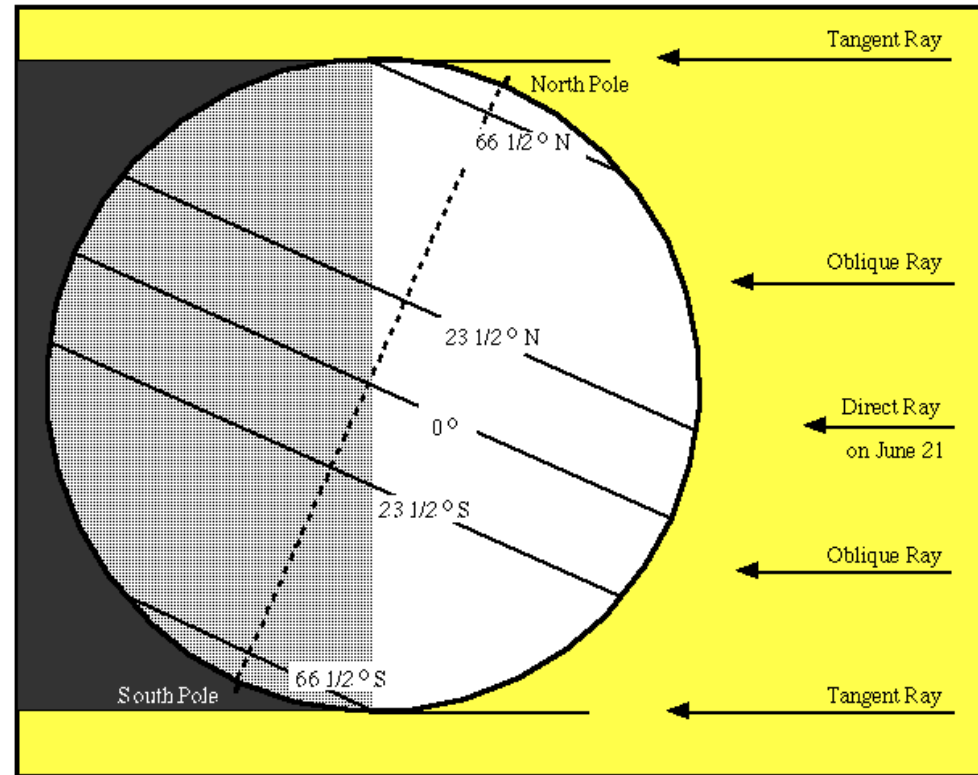
**Shape**

**Spherical**

**Oval shaped**

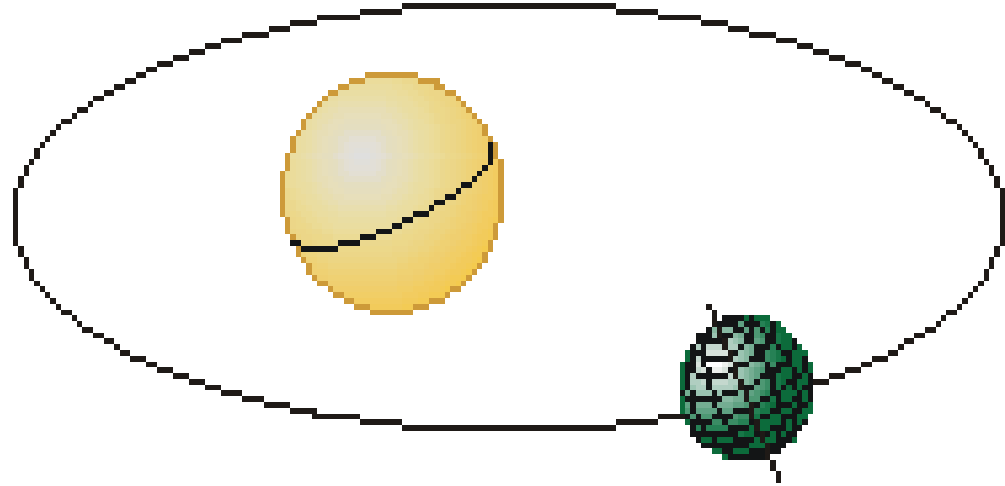
# Rotation

- **West to east\***
- **Fifteen degree /hour\***
- **Rotation is just less than 24 hours**
- **Magnetic field**
  - **North and south magnetic poles**
  - **Protect the earth from solar wind\***



# Earth's revolution\*

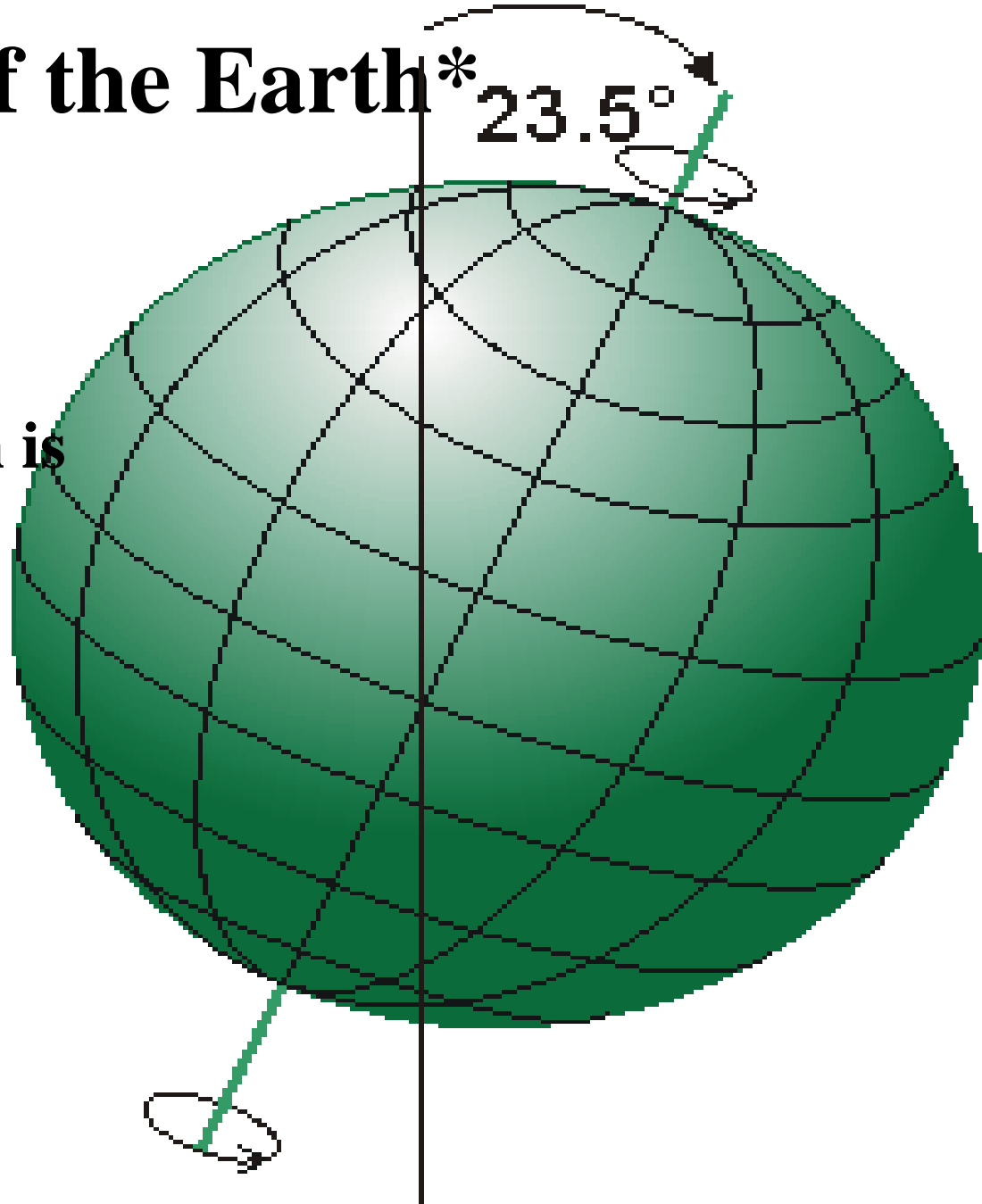
- **Earth's orbit around the sun**
- **Shape is elliptical**
- **365.25 days**
- **Closest to the sun on January 3**
- **Farthest from the sun on July 4**





# Tilt of the Earth\* $23.5^\circ$

- Tilts on its axis 23.5 degrees
- This tilt of the earth is what causes the seasons



# Equinox\*

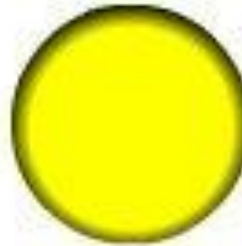
- Autumnal Equinox

9/22 or 9/23

- Spring Equinox

3/20  
or 3/21

March 21



Sept. 23



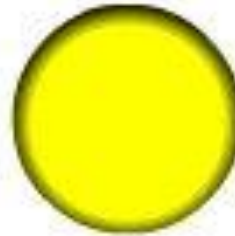


# Solstice\*

- **Summer 6/21 or 6/22**
- **Winter 12/21 or 12/22**



**June 22**



**Dec 22**



# Quiz

1. How much does the earth tilt on its axes?
2. What direction does the earth rotate?
3. When is the earth closest to the sun?
4. What season does the solstice start when the sun is pointing at the tropic of cancer?
5. Which equinox starts the first day of Spring?

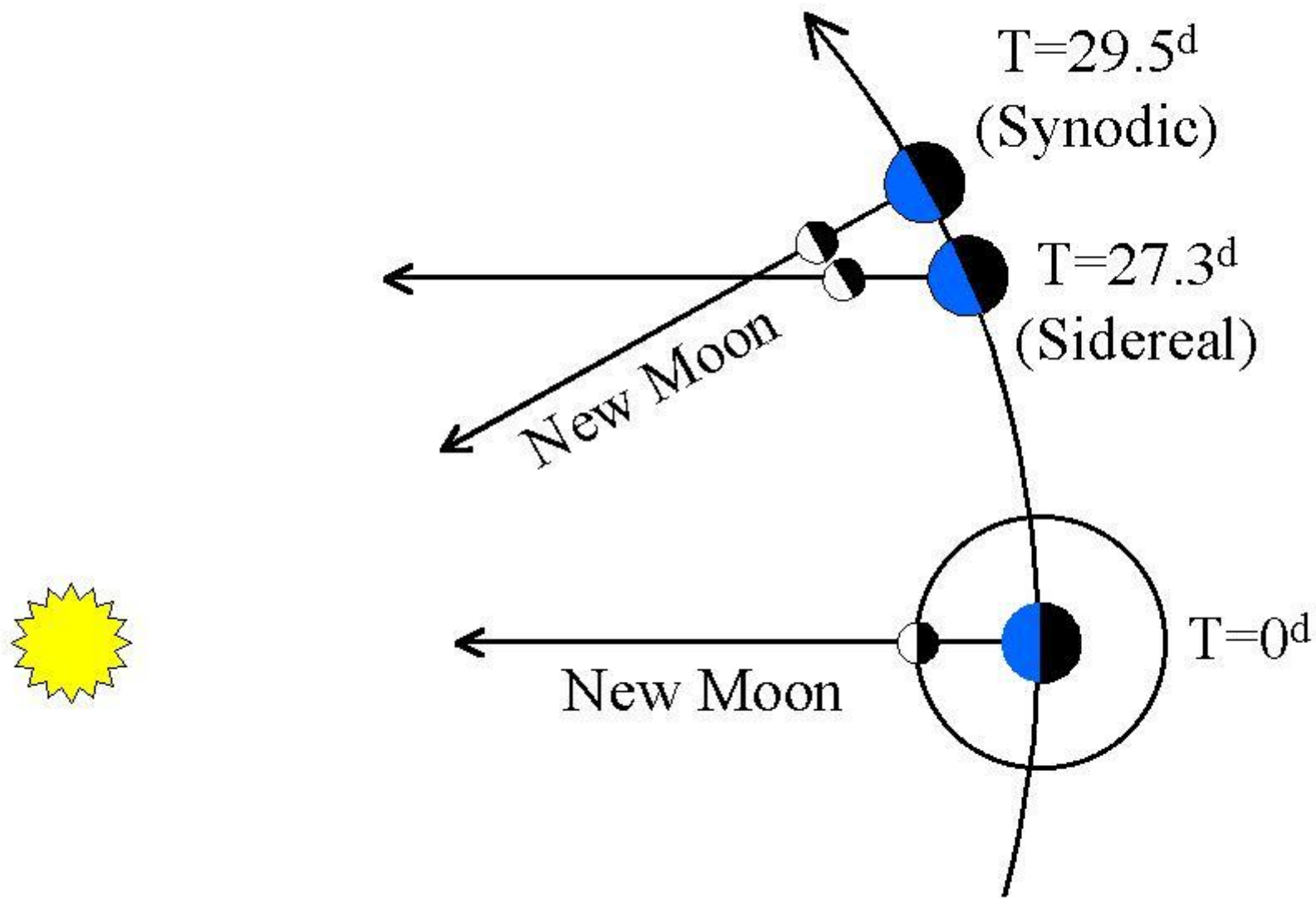
- **Space object nearest to earth**
- **Romans called it Luna which means shining**
- **From the word Luna we get the word lunar, which refers to the moon**





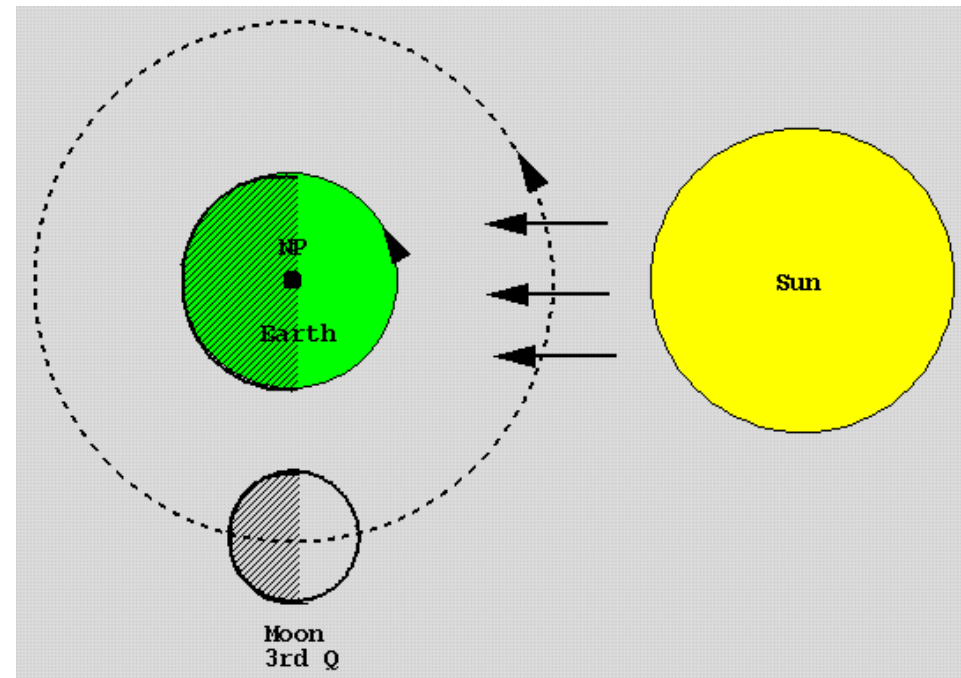
# Features of the moon

- **Diameter – 3,476 km in diameter**
- **Distance from earth - 384,400 km**
- **Gravity 1/6 that of earth**
- **Moon's motion**
  - **Moon revolves around the earth in  $27 \frac{1}{3}$  earth days\* Sidereal Day**
  - **Moon revolution 29.5 synodic days**
  - **Moon rotates on its axis**  
**1 moon day =  $27 \frac{1}{3}$  earth days\***



# Phases of the moon

- The moon is  $\frac{1}{2}$  illuminated most of the time (except during a lunar eclipse)
- The moon phases we see depend on how much of the illuminated side we see, not on how much is illuminated\*
- The moon revolves from west to east at 13° / day
  - This causes the moon to come up 50 minutes later each 24 hour period\*

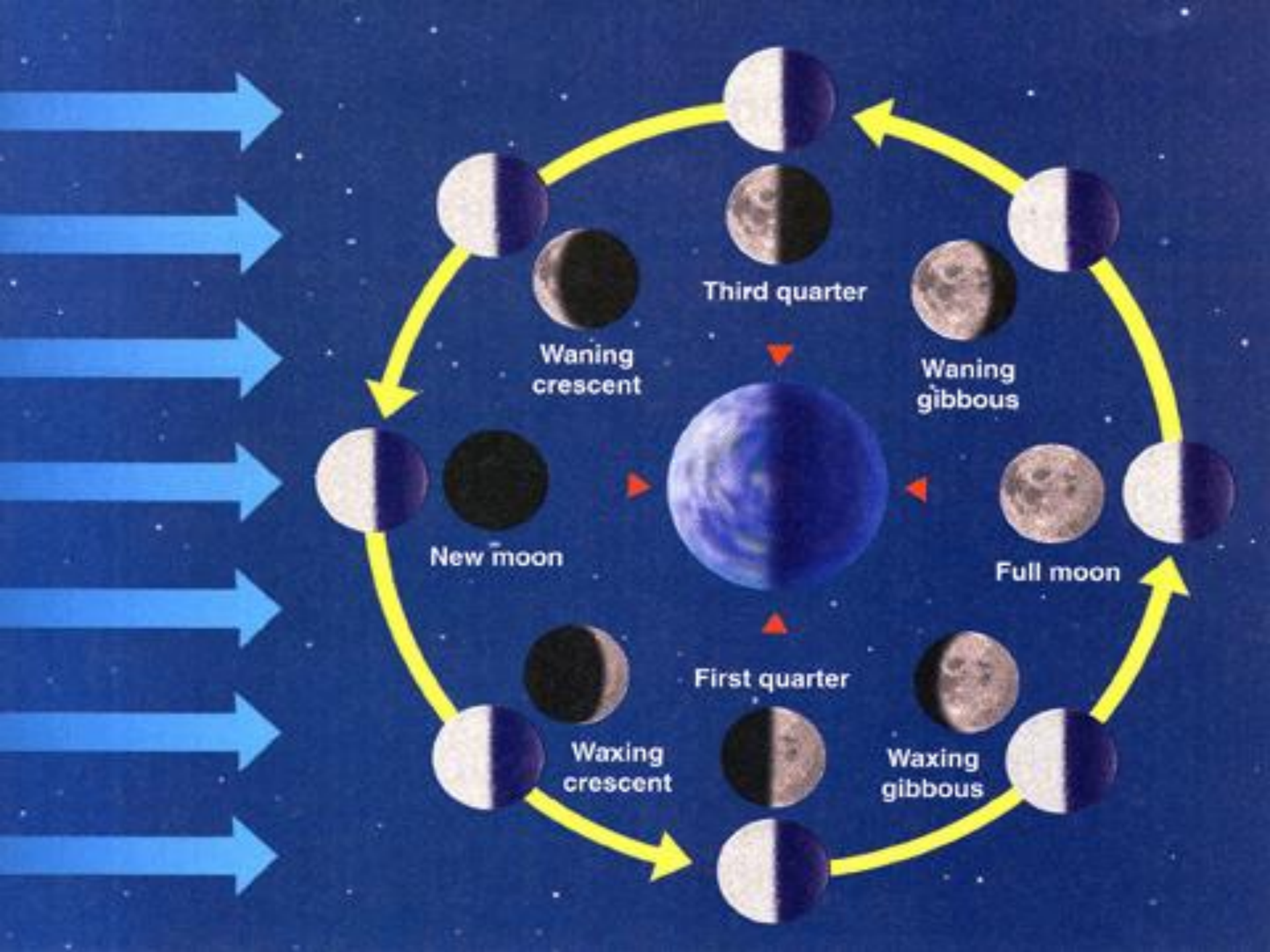




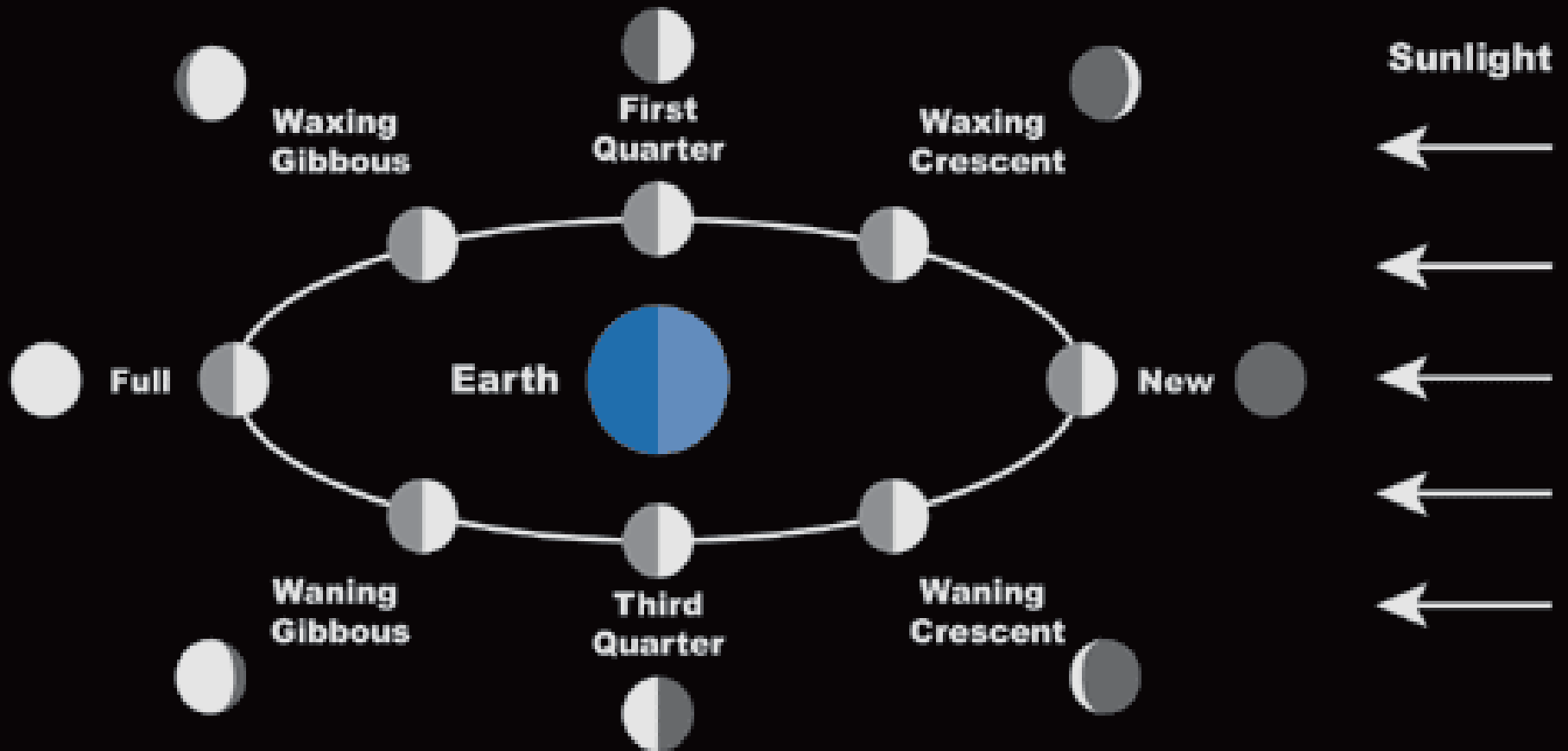
# Phases of the Moon

- **The movement of the earth and moon are the reason the moon appears to have phases**
- **The names of the moon phases using the (DOC)\* Method**
- **New moon – the moon is between the sun & earth**
- **Waxing Crescent moon**
- **First Quarter is  $\frac{1}{2}$  of the moon showing**
- **Waxing Gibbous**
- **Full**
- **Waning gibbous**
- **Last quarter**
- **Waning crescent**

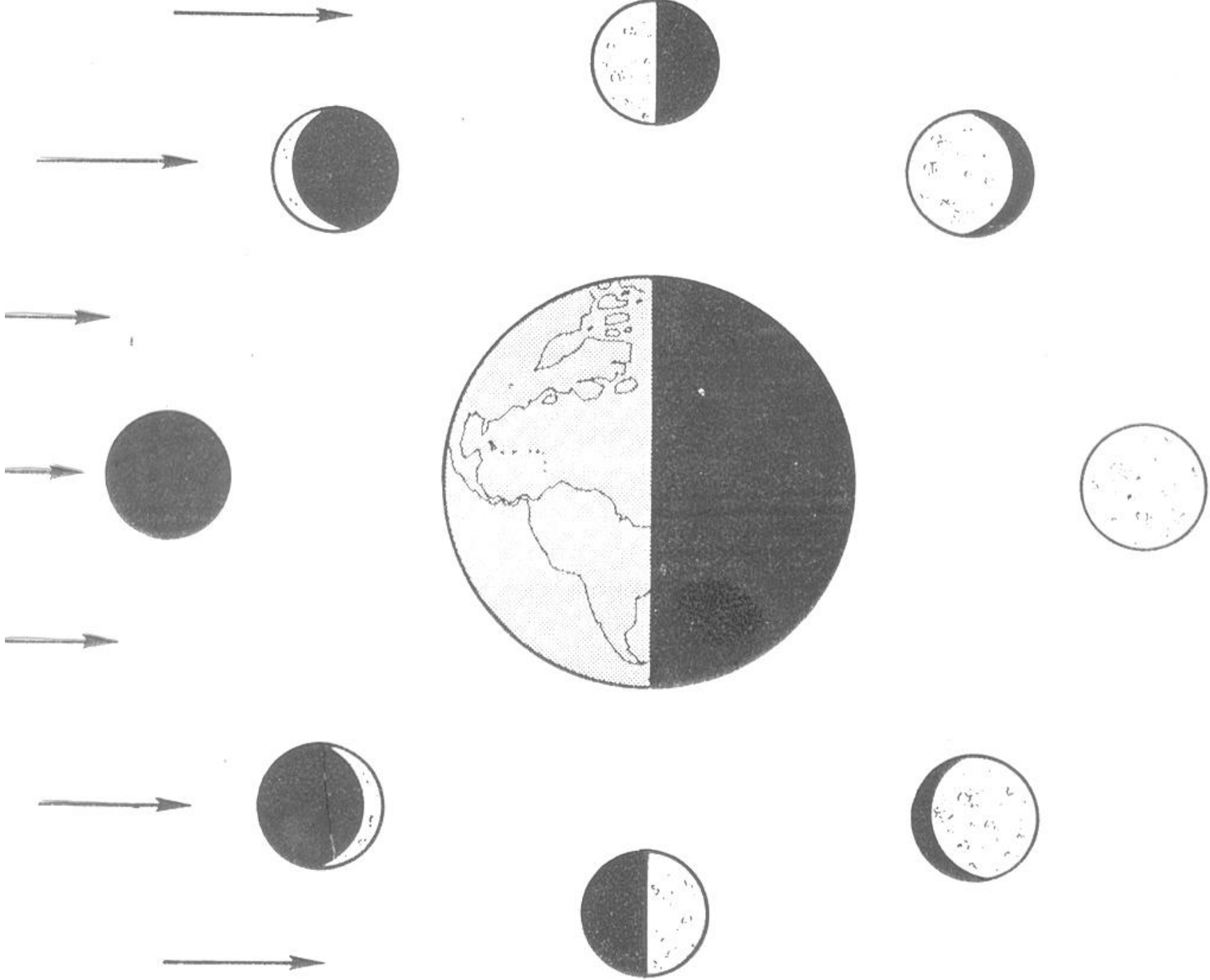


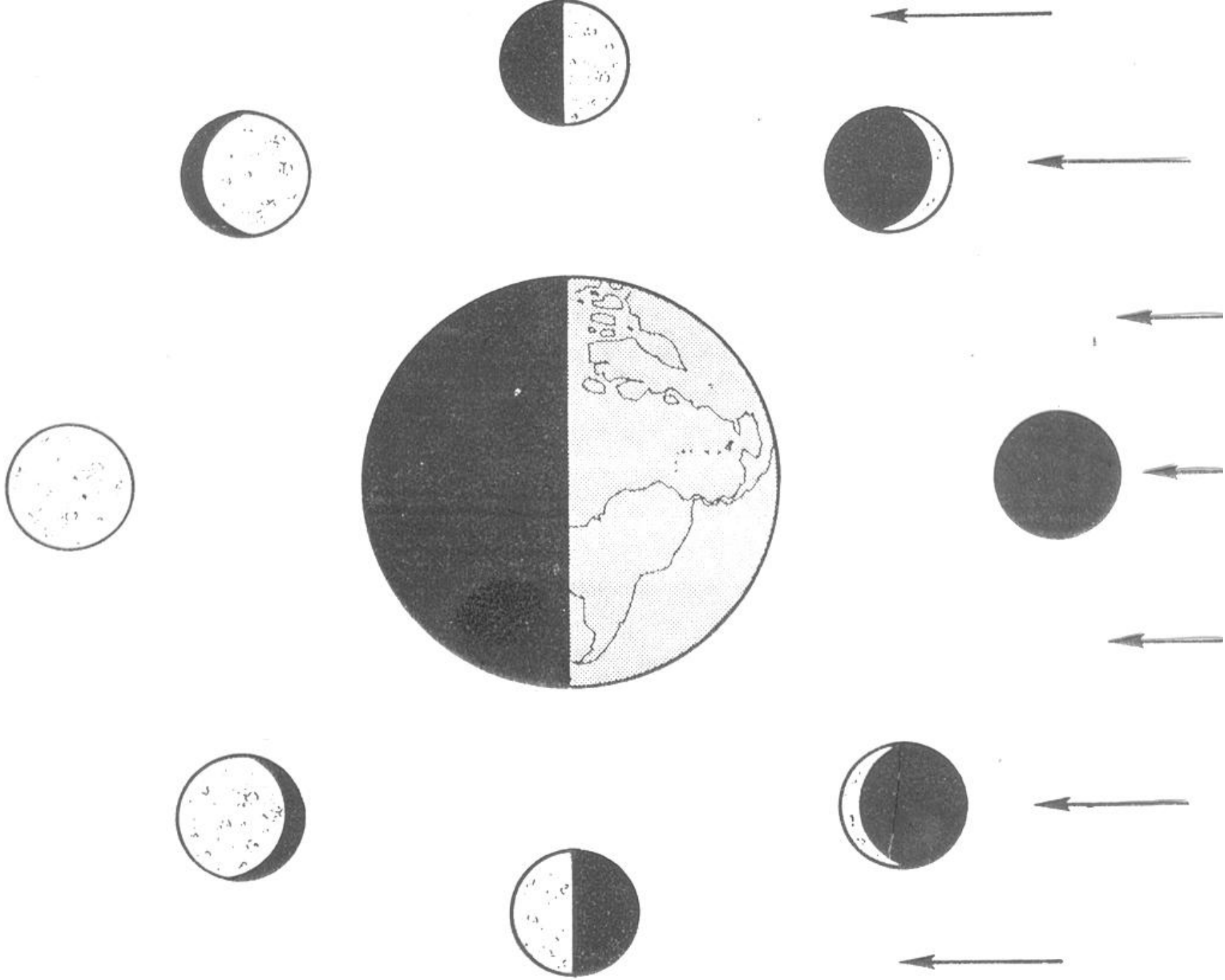


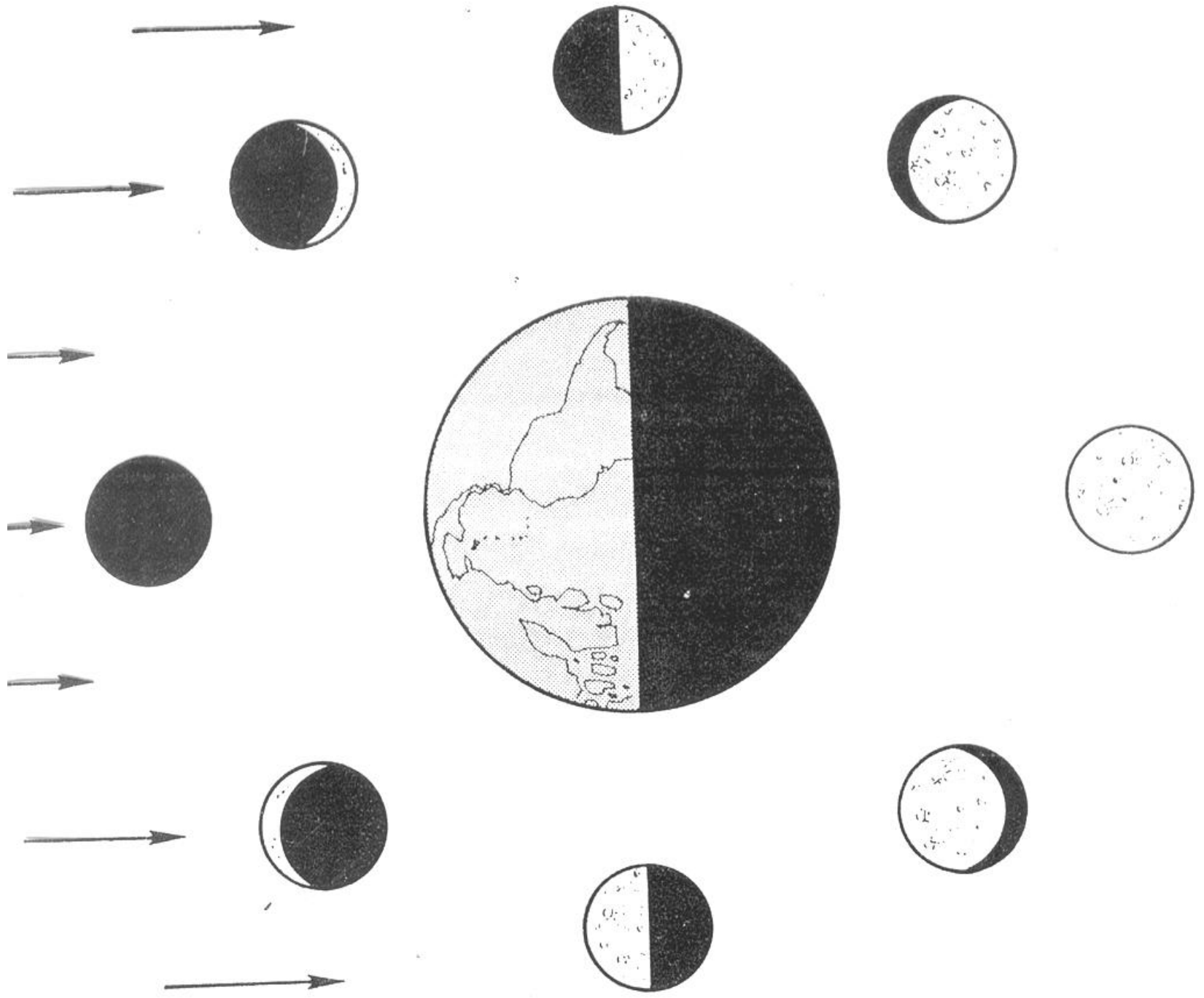
# Phases of the Moon



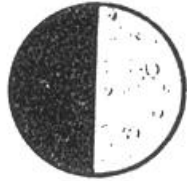
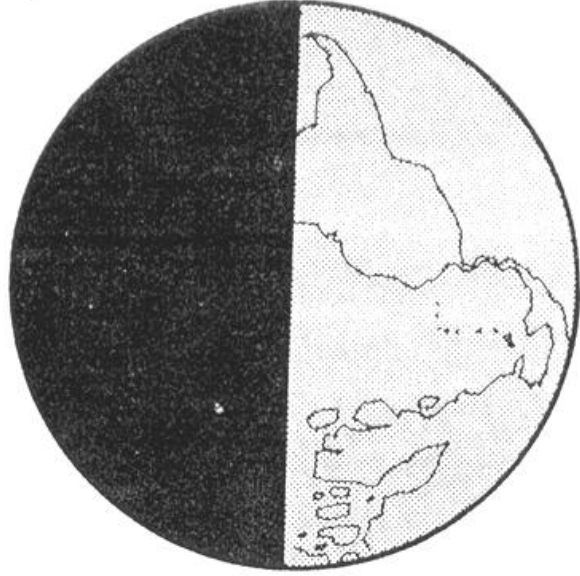












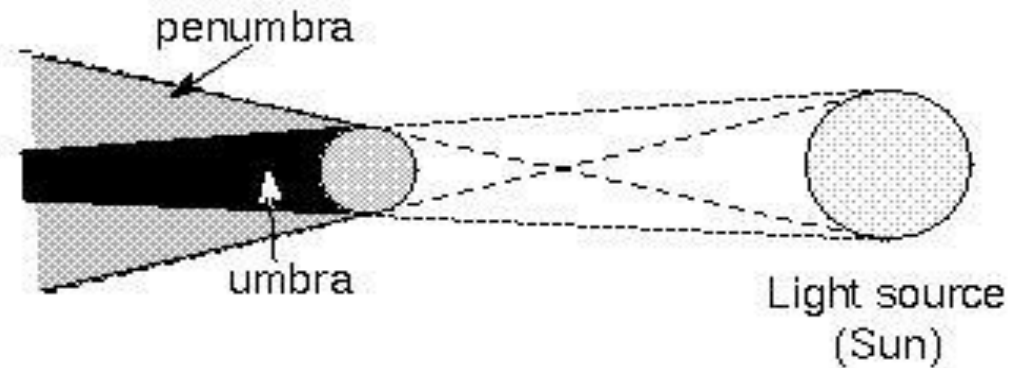
# Eclipses

- **The result of shadows cast by the earth and the moon**
- **There is a main shadow and a partial shadow**
  - **The main shadow is the umbra\***
  - **The partial shadow is the penumbra\***



# Lunar eclipse

- **When the moon moves into the earth's shadow**  
**Umbra**



**The moon is darkened**

**The moon looks like a copper red disc**

**The red tone of the moon is caused by the atmosphere of the earth bending the sun rays**

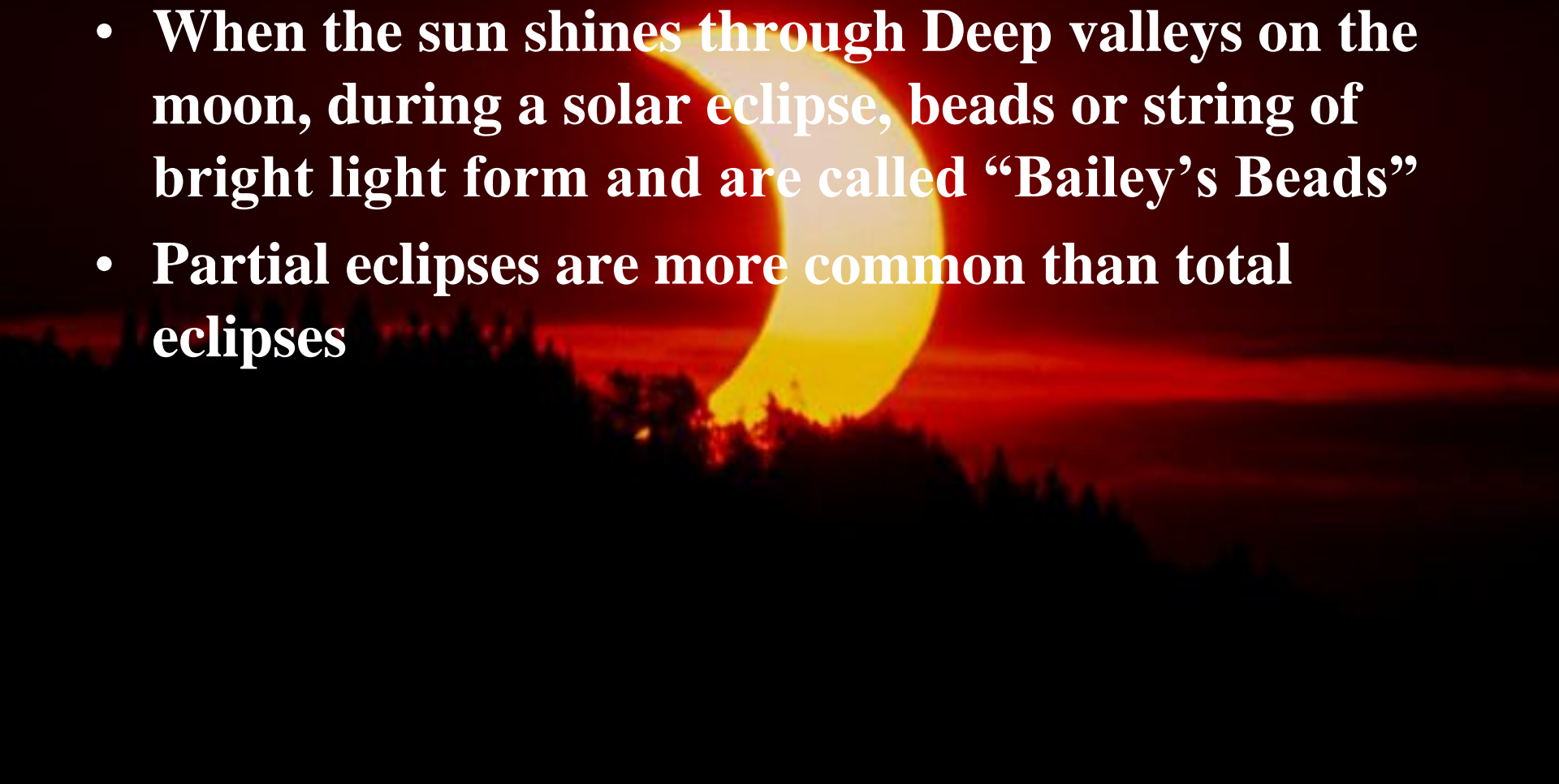


# Lunar Eclipse



# **Solar Eclipse –**

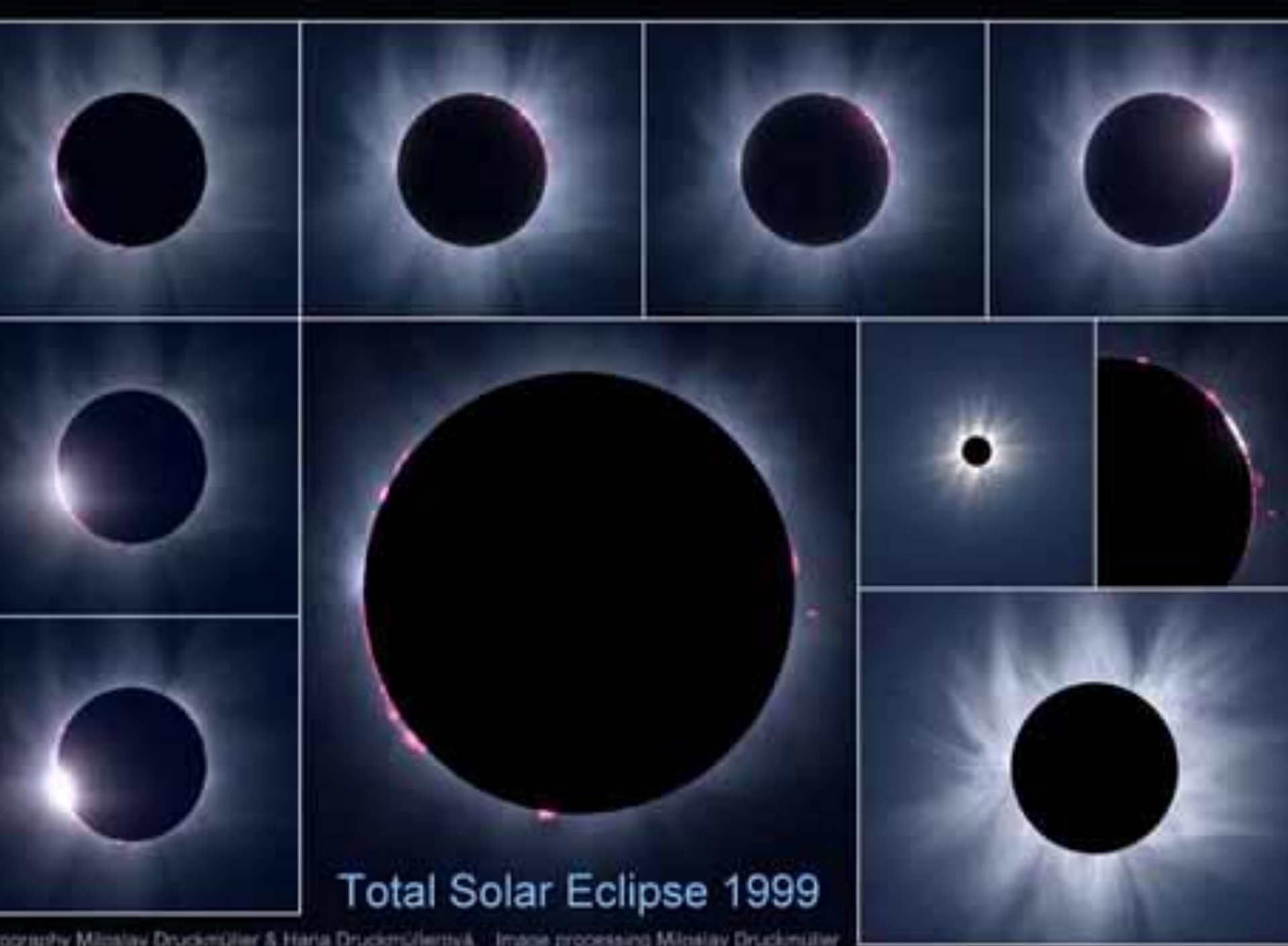
- **when the earth moves into the moons shadow**
- **Solar eclipse is longest at the equator 7.5 minutes**
- **When the sun shines through Deep valleys on the moon, during a solar eclipse, beads or string of bright light form and are called “Bailey’s Beads”**
- **Partial eclipses are more common than total eclipses**



# Solar Eclipse







## Total Solar Eclipse 1999



*Photo: Oddleiv Skilbrei*



# Eclipses

- How can an object the size of the moon cover an object the size of the sun?
  - The sun is 400 times larger than the moon
  - Sun diameter 1 392 000 km
  - Moon's diameter 3 476 km
  - The sun is also 400 times farther away
  - Sun's distance from earth 149,000,000 km
  - Moon's distance from earth 384,400 km



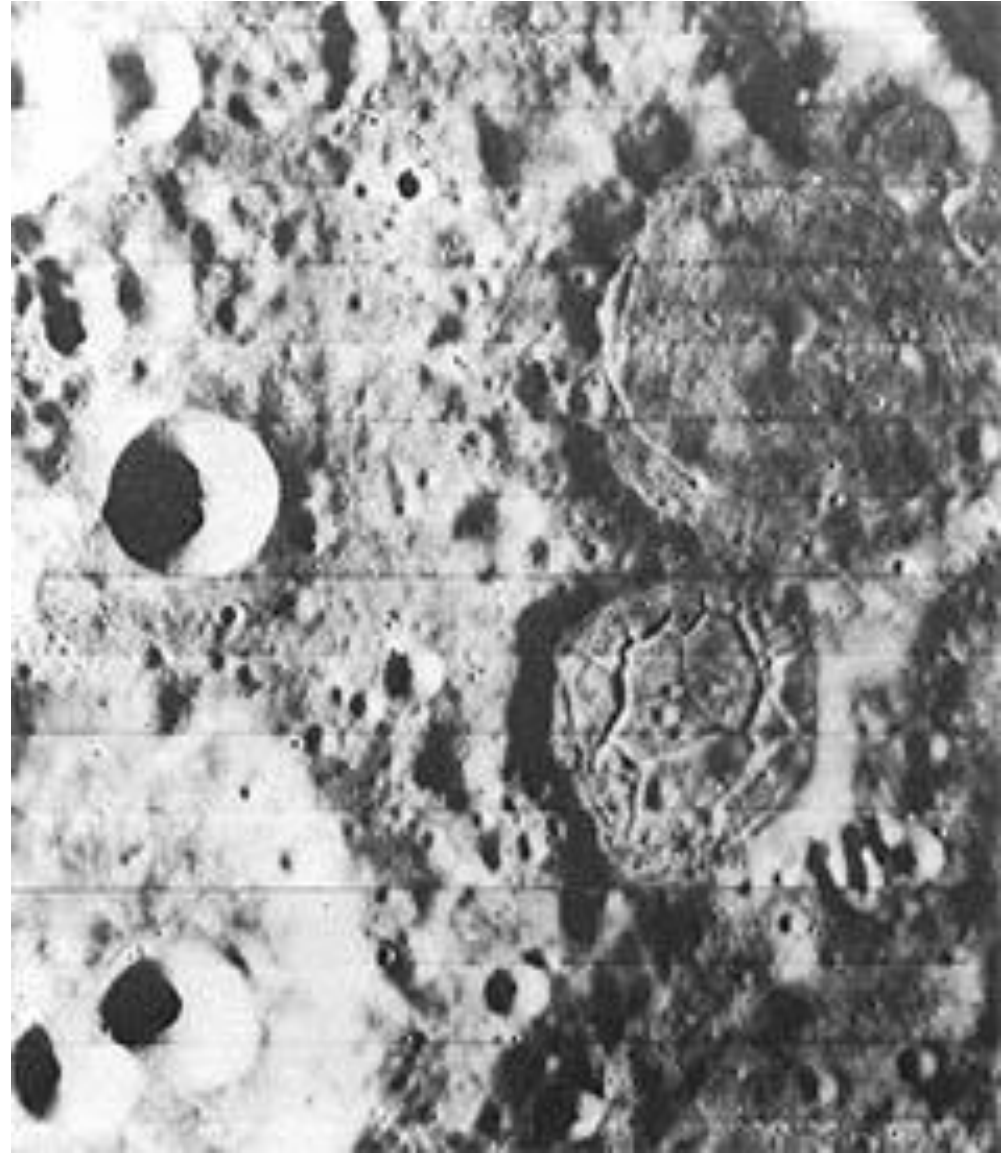


# Lunar Surface and composition

- Surface solid rock covered with dust
- The moon has no atmosphere
- Because of no atmosphere temperatures vary from 130o C to -170oC in the shadows
- Moon's crust is 1 to 300 km thick
- Pieces of rock from space bombard the surface since there is no atmosphere to burn up those things falling toward its surface.

# Craters

- **The results of the meteorites hitting the surface of the moon**
- **30,000 named craters on the moon**  
**Copernicus is 91 km from rim to rim**



# Lunar Surface

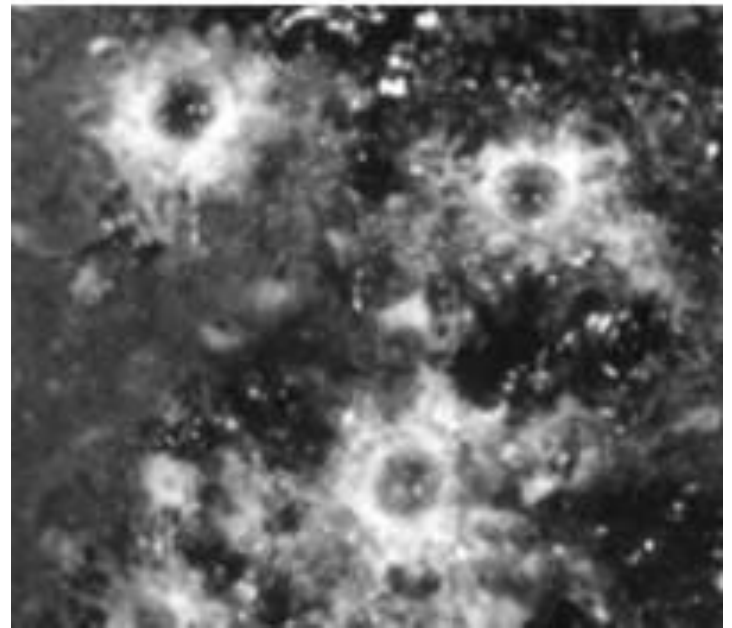
- **The moon plain is called Maria (the dark areas)**
  - **Maria is Latin for sea**
  - **Maria is formed from hardened lava**
- **Lunar Highlands (the light areas)**
  - **mountains formed from huge chunks of rock hitting the moons surface**
  - **Mountains are as high as 5 km above the moons surface**





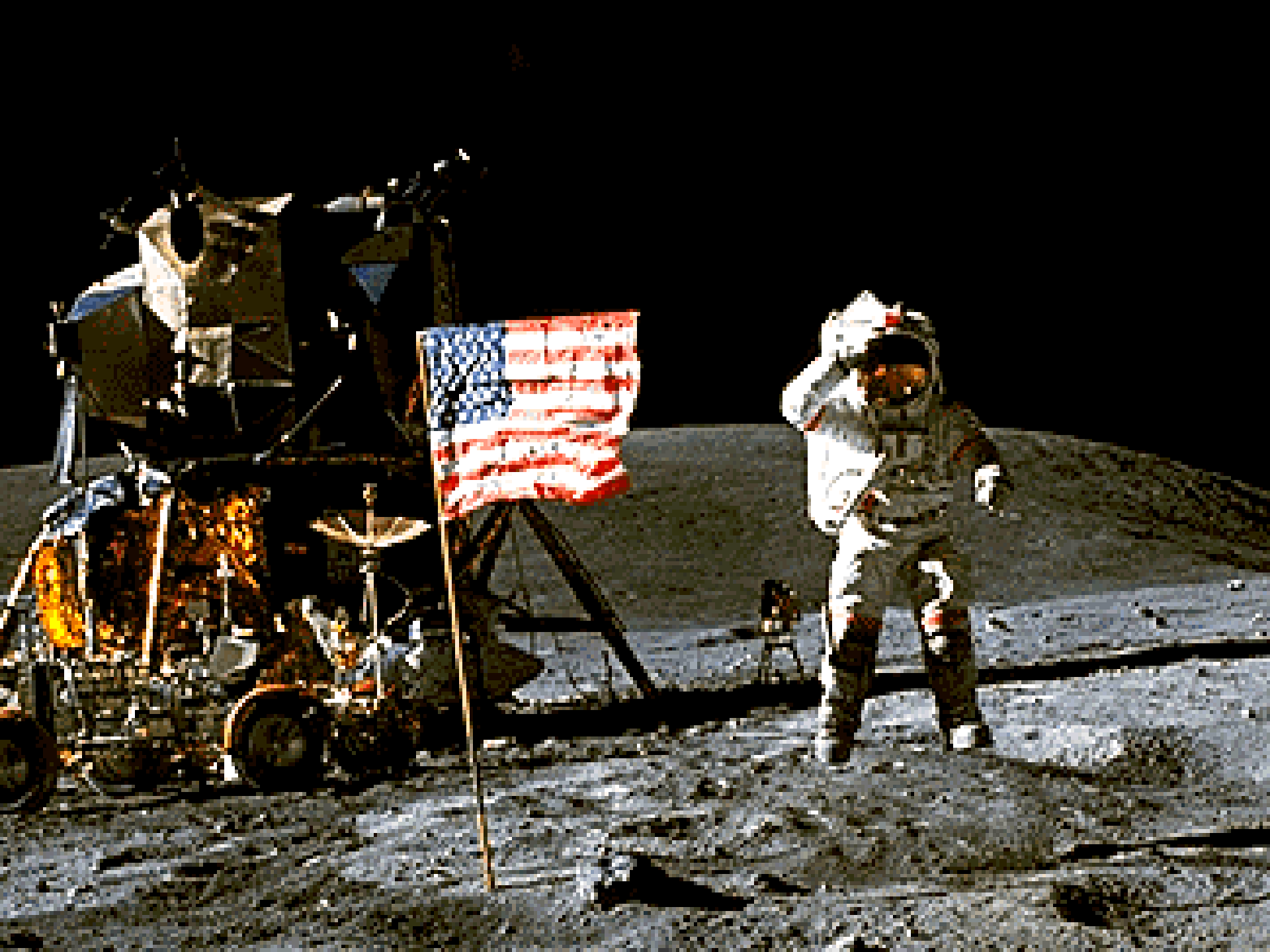
# Moons composition

- **Rocks brought from the moon by**
- **Apollo astronauts show composition much like earth**
- **Moon's crust oxygen, silicon aluminum, Iron, calcium**
- **Moon dust is much like our sand**



# Origin of the moon

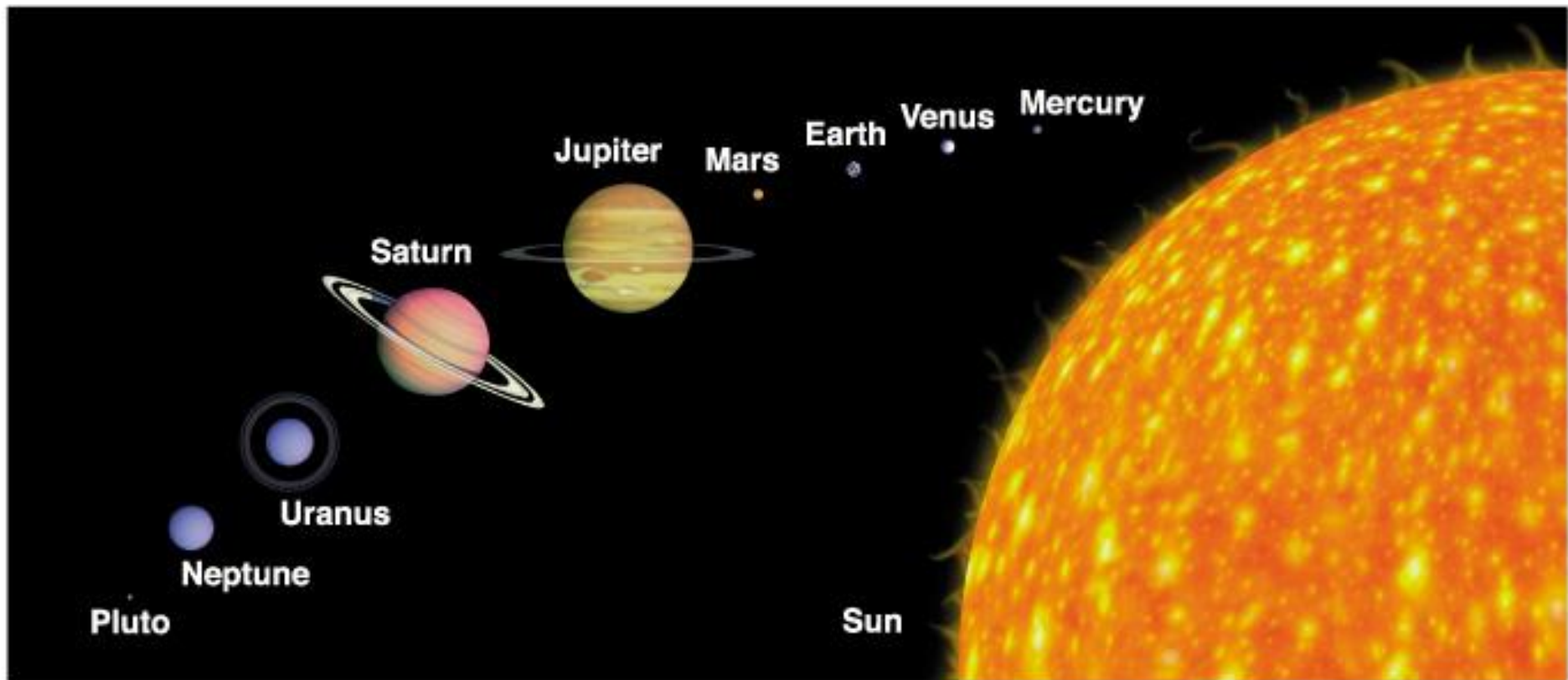
- **Appears to be the same age as earth**
- **No signs of past life**
- **One theory is moon another planet pulled in by earth's gravity**
- **Another theory is that the moon and earth formed from the same dust within gravitational pull.**
- **Another theory is that during earth's formation a piece was flung free from the earth**
- **Impact theory- collision of mars sized object with earth**







# Our Solar system



# Motion of the planets

- **Our solar system is made up of the sun and the 9 planets that revolve around the sun**
- **Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune & Pluto (maybe?)**





Sun



Jupiter



Pluto

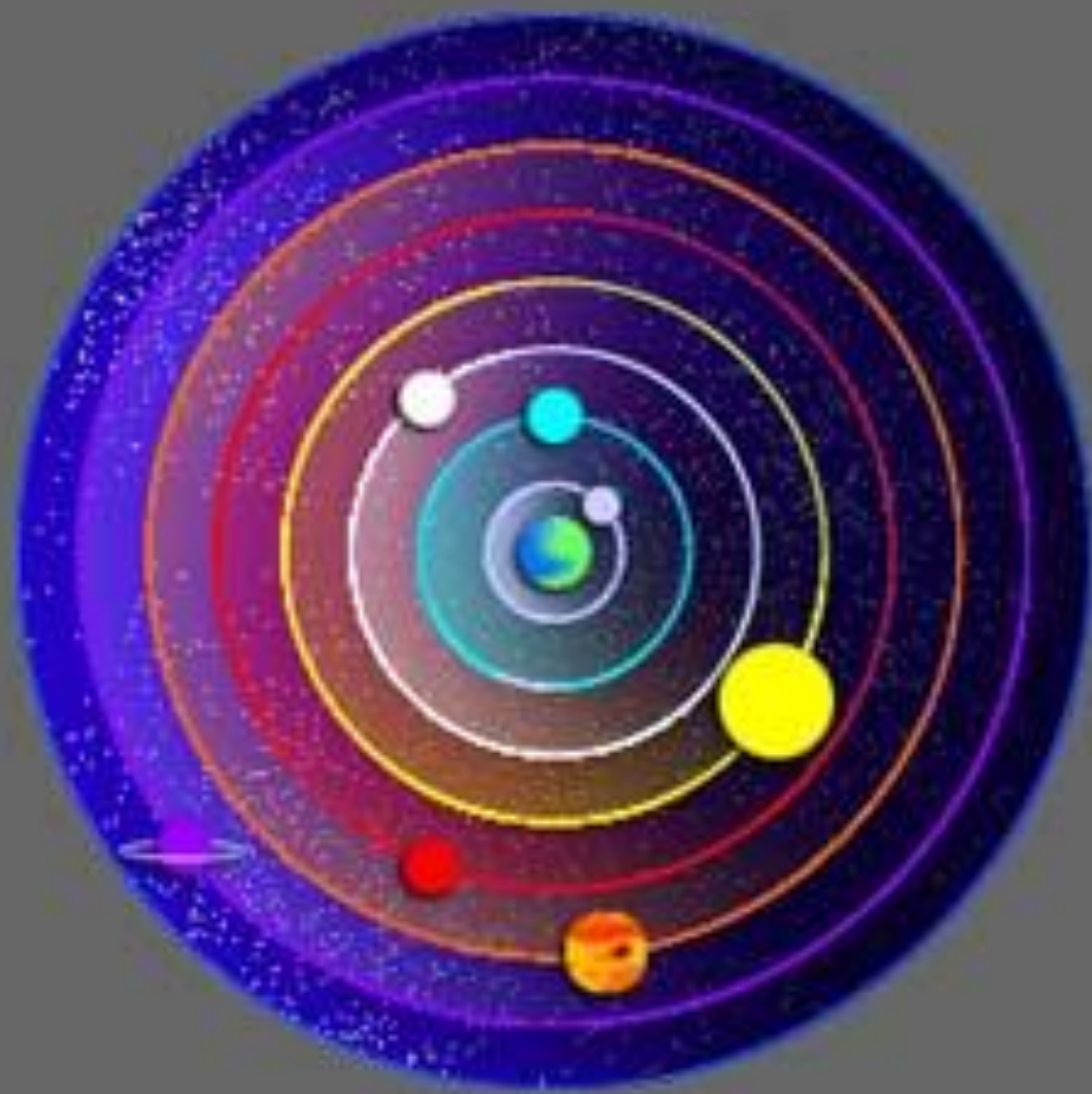
Earth



# Early Beliefs about the Solar System

- **Greek astronomers believed that the earth was the center of the universe**
- **Ptolemy believed this 150 AD**  
**Polish astronomer**







**Copernicus  
believed that the  
sun was the center  
and the planets  
orbited in a perfect  
circle around it  
1500 AD**



**Nicolaus Copernicus  
(1473-1543)**





# Johannes Kepler

- **Established some laws of planetary motion based on mathematical findings 1600 AD**



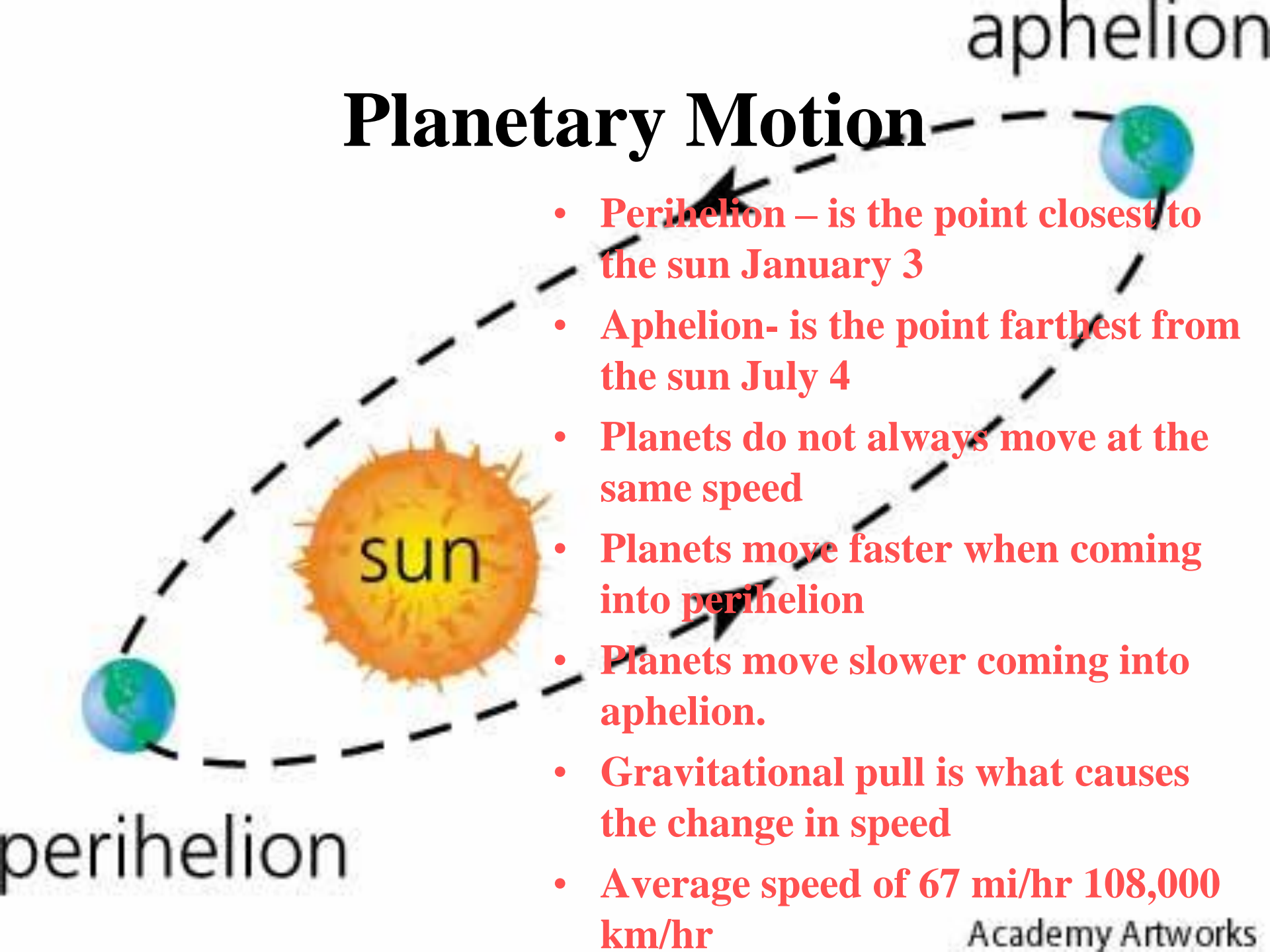


# Kepler's Laws

- **Planets orbits are elliptical thus planets are not the same distance from the sun at all times**
- **Planets do not always move at the same speed**
- **The time it takes a planet to make 1 revolution depends on the planets distance form the sun**

*\*you must know Kepler's three laws.*

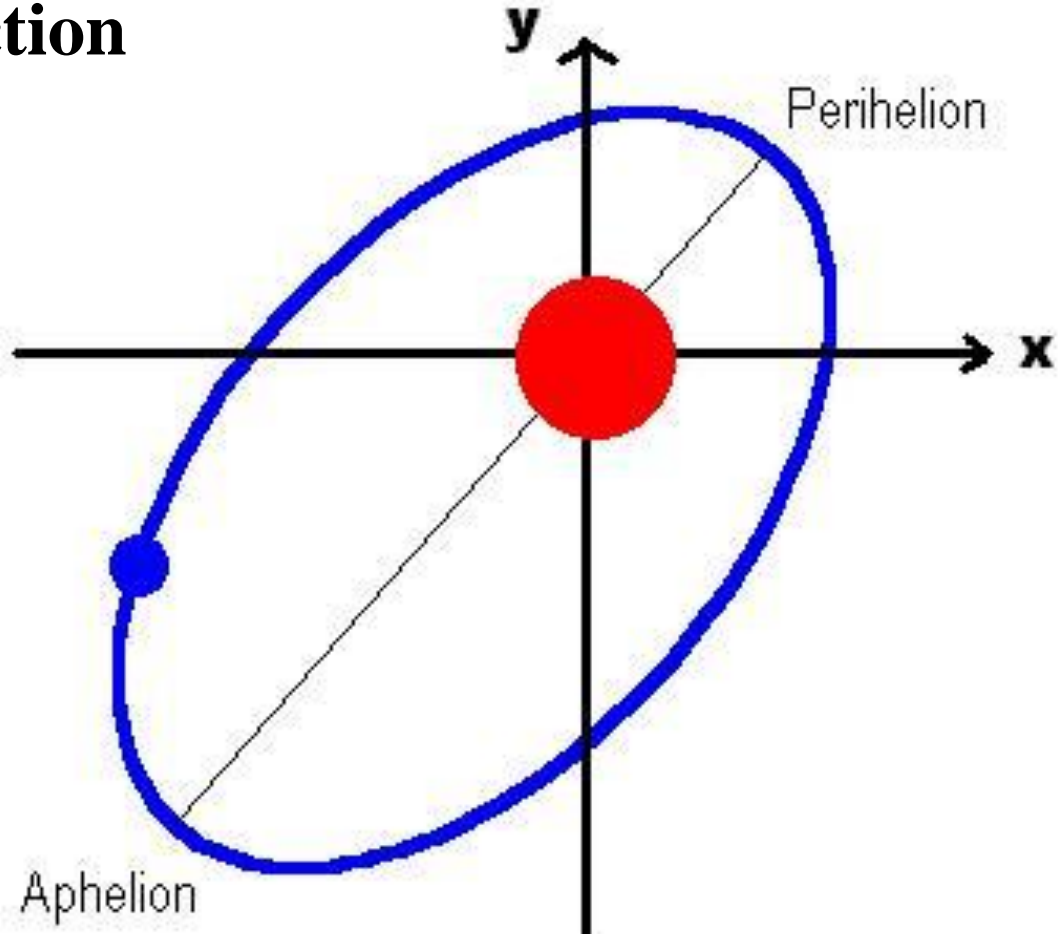
# Planetary Motion



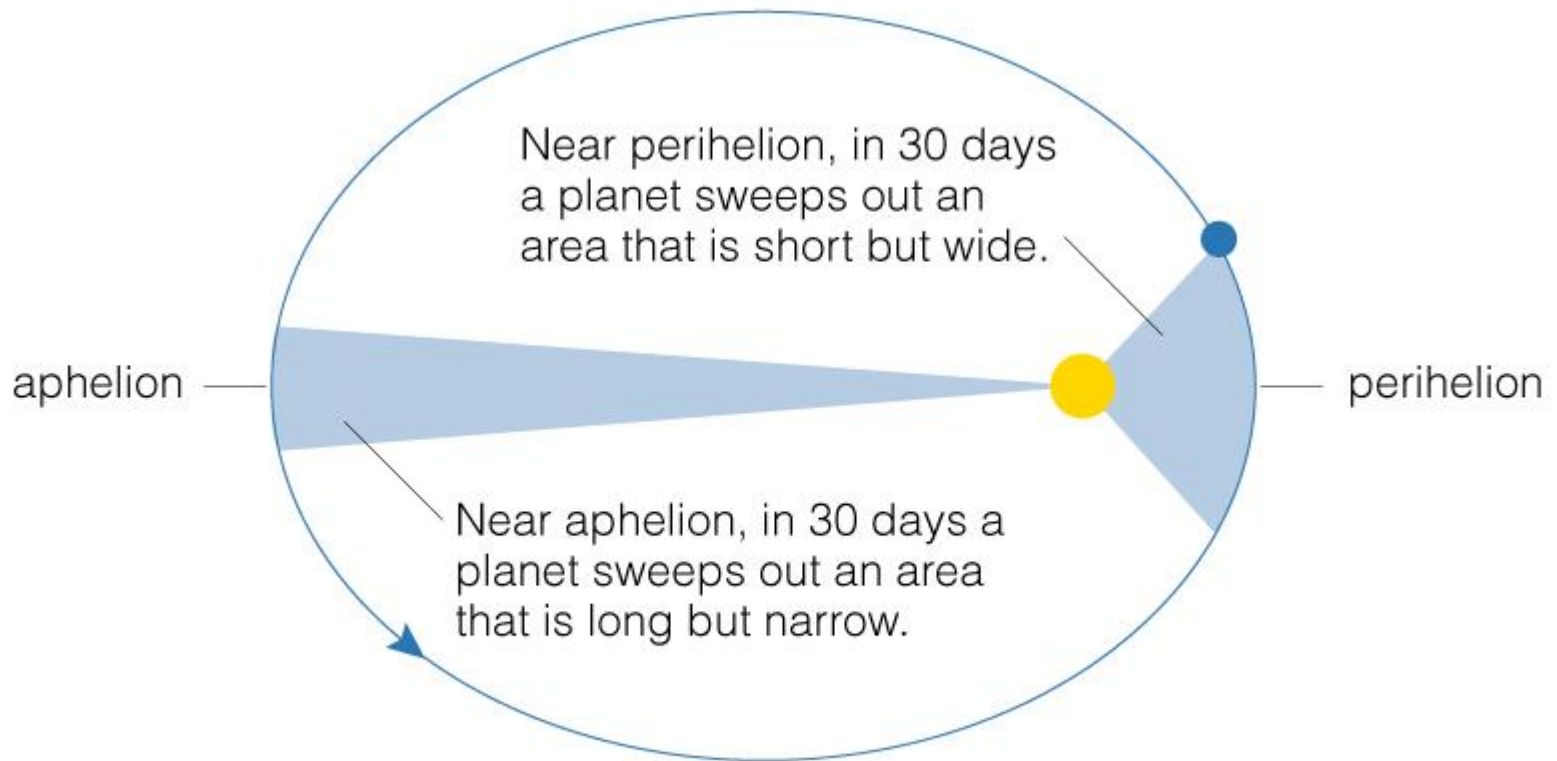
- **Perihelion – is the point closest to the sun January 3**
- **Aphelion- is the point farthest from the sun July 4**
- **Planets do not always move at the same speed**
- **Planets move faster when coming into perihelion**
- **Planets move slower coming into aphelion.**
- **Gravitational pull is what causes the change in speed**
- **Average speed of 67 mi/hr 108,000 km/hr**

# Planetary Motion

- **Inertia and gravity are what keep planets in orbit**
- **Inertia is the tendency of an object to keep its speed and direction**





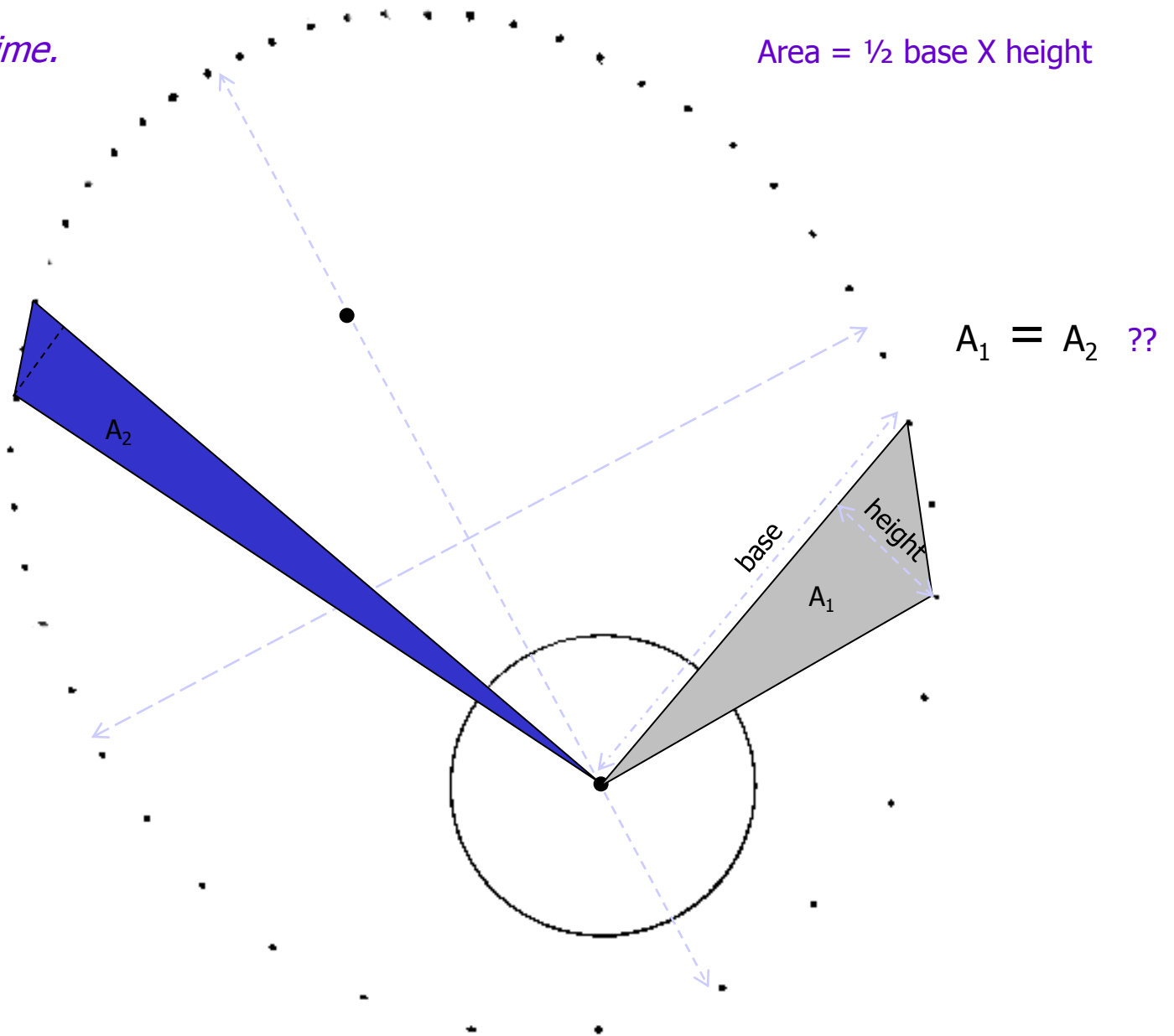


The areas swept out in 30-day periods are all equal.

# Verifying Kepler's 2<sup>nd</sup>

*Equal area in equal time.*

Area =  $\frac{1}{2}$  base X height



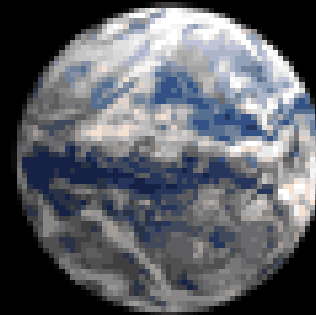
# Iron Oxide (FeO) Concentrations of the Inner Planets



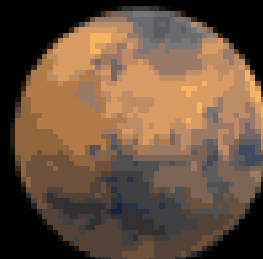
Mercury  
2-3 wt%



Venus  
7-8 wt%



Earth  
8 wt%



Mars  
18 wt%

**The inner planets**



Earth



Venus



Mars



Mercury



Pluto

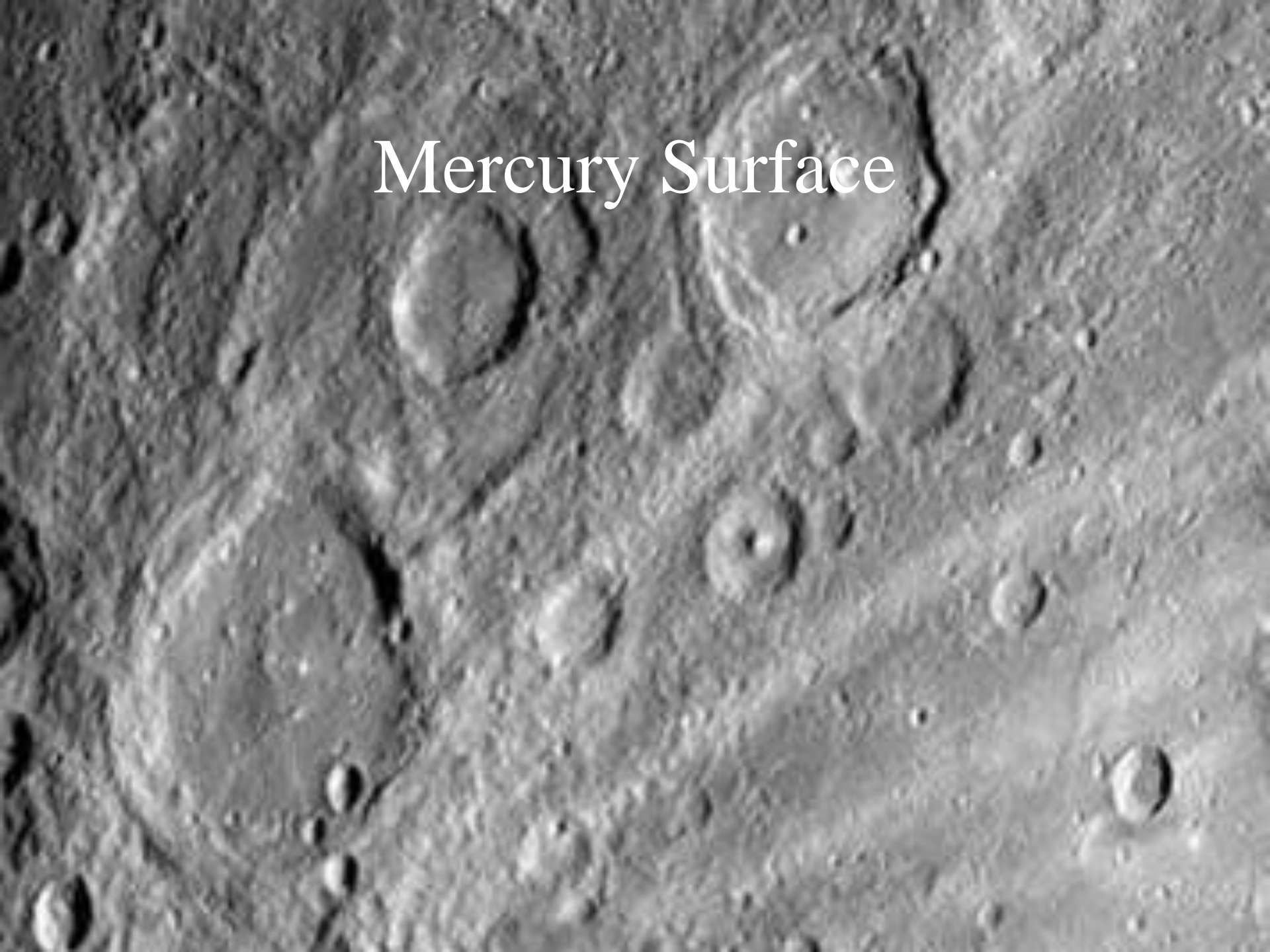
# Mercury

- planet closest to the sun
- Diameter of 4880 km about 1/3 that of earth
- A Mercury year is 88 earth days
- A mercury day is about 59 earth days
- Temperature on mercury ranges from 450 °C during the day to -170 °C at night
- Mercury has iron core which gives it a magnetic field and holds a thin veil of gases
- Mercury is only visible just before sun rise or just after sunset
- Seventh brightest object in the sky

• Diameter	4878 km
• Average Distance from Sun	57.8 million km
• Size compared to Earth	0.4x
• Gravity compared to Earth	0.38
• Surface Temperature	Max Day Side 467°C Min Night Side -183°C
• Length of day	58 Earth days 16 hours
• Length of year	87.9 days
• Eccentricity of Orbit	0.206
• Density	5.43 g/cm <sup>3</sup>
• Atmosphere	Oxygen - 56% Sodium - 35% Helium - 8% Potassium & Hydrogen - 1%

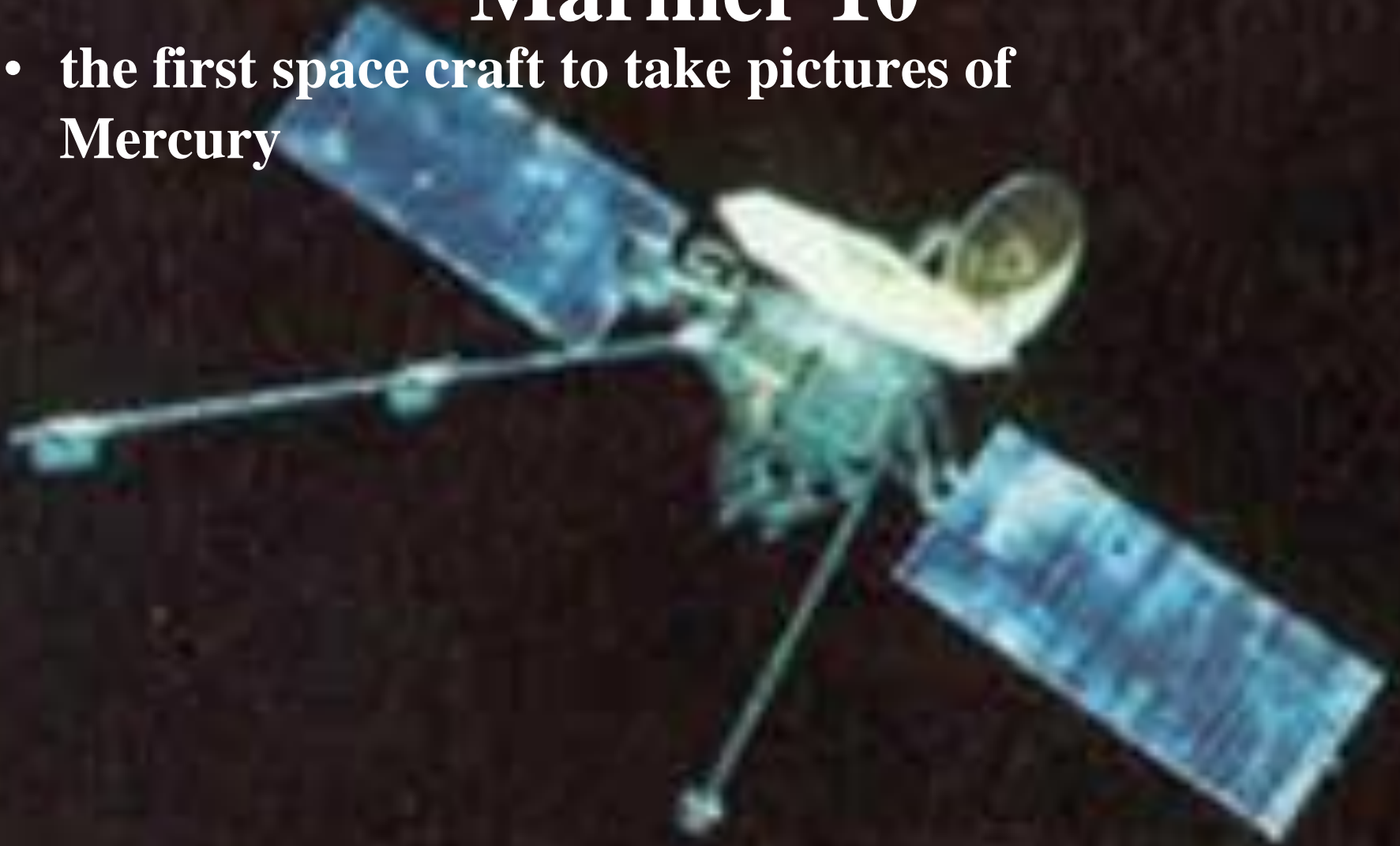


# Mercury Surface



# Mariner 10

- the first space craft to take pictures of Mercury



# Venus

- The planet between Mercury and Earth
- Venus' diameter is 12100 km so it is about the size of earth
- Venus is earth's closest neighbor
- Venus rotates from east to west opposite of earth's rotation
- A Venus day is 243 earth days
- A Venus year is 225 Earth days



# Venus' surface

- **Temperature averages about 470 °C**
- **The pressure of the atmosphere is 90 x that of earth**
- **Venus has craters, active volcanoes, mountains, valleys and plains**
- **The large amounts of CO<sub>2</sub> in Venus atmosphere trap and hold heat**

# Earth

- **The only planet that supports life**
- **Average temperature 14 °C**
- **70 % of earth surface is covered by water**
- **Diameter is 12,756 km**
- **Constant change on the surface of earth**



# Mars

- **visible from earth without a telescope**
- **Mars has a diameter of 6794 km (about 1/2 of earth's)**
- **Mars' day is 24 hours, 37 minutes**
- **Mars' year is 687 earth days**
- **Mars has 2 moons that are not round**
  - **Phobos – diameter 27 km**
  - **Deimos – diameter 15 km**



# Mars



- appears to have seasons represented by expansion and retreating of the ice caps  
The north cap is frozen water  
The south cap is frozen CO<sub>2</sub>
- Mars contains the same elements as earth, the coating of iron oxide makes mars appear red
- Mars has huge craters and inactive volcanoes and huge canyons.
- Mountains on mars are higher and canyons deeper than on Earth.
- Temperature ranges from 35 °C to -170 °C

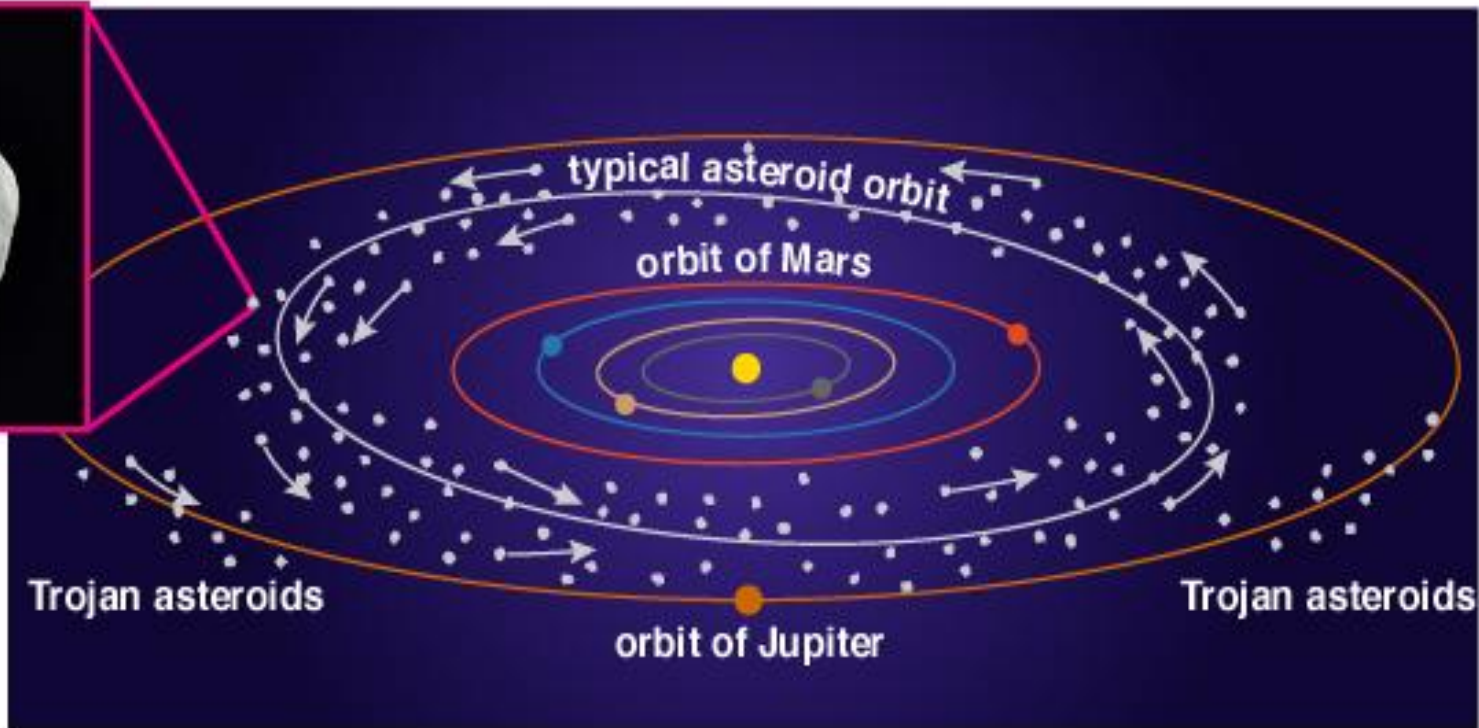
# Quiz

1. What was Ptolemy's idea of the solar systems order?
2. Give Kepler's three laws.
3. What was Copernicus's belief about the planets orbit and order of the solar system?
4. What is perihelion and what time of year is the earth's perihelion?
5. Name the inner planets.
6. What two things are responsible for keeping a planet in orbit?
7. Give the order of the planets from the sun outward.
8. Which planets appear as bright objects in the morning and evening sky?
9. What part of the orbit is a planet moving its fastest?

# Asteroids and Meteoroids

- Asteroids are minor planets that orbit the sun  
Asteroids are in a band between Mars and Jupiter  
Asteroids range in diameter from 16 km to 160 km  
Asteroids theories  
Asteroids are pieces of another planet  
Asteroids maybe pieces of two planets that collided  
Bits that did not ever fuse to form planets





# Meteoroids, meteors and meteorites

- **Meteoroids are pieces of rock or metal in outer space**
- **Meteor – when a meteoroid starts glowing because it has entered the earth atmosphere**
- **Meteorite – is the result of a meteor hitting the earth surface**
- **Millions of meteoroids approach the earth's surface each day**



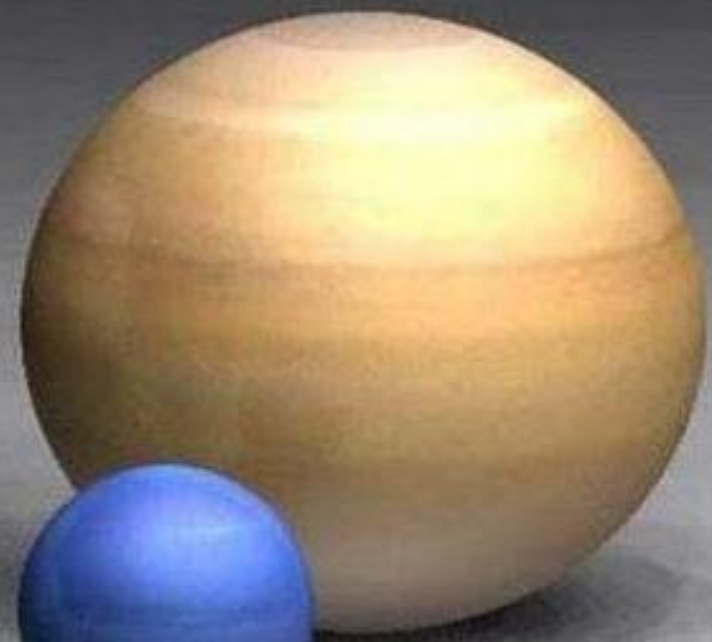
# The outer planets





Jupiter

Saturn



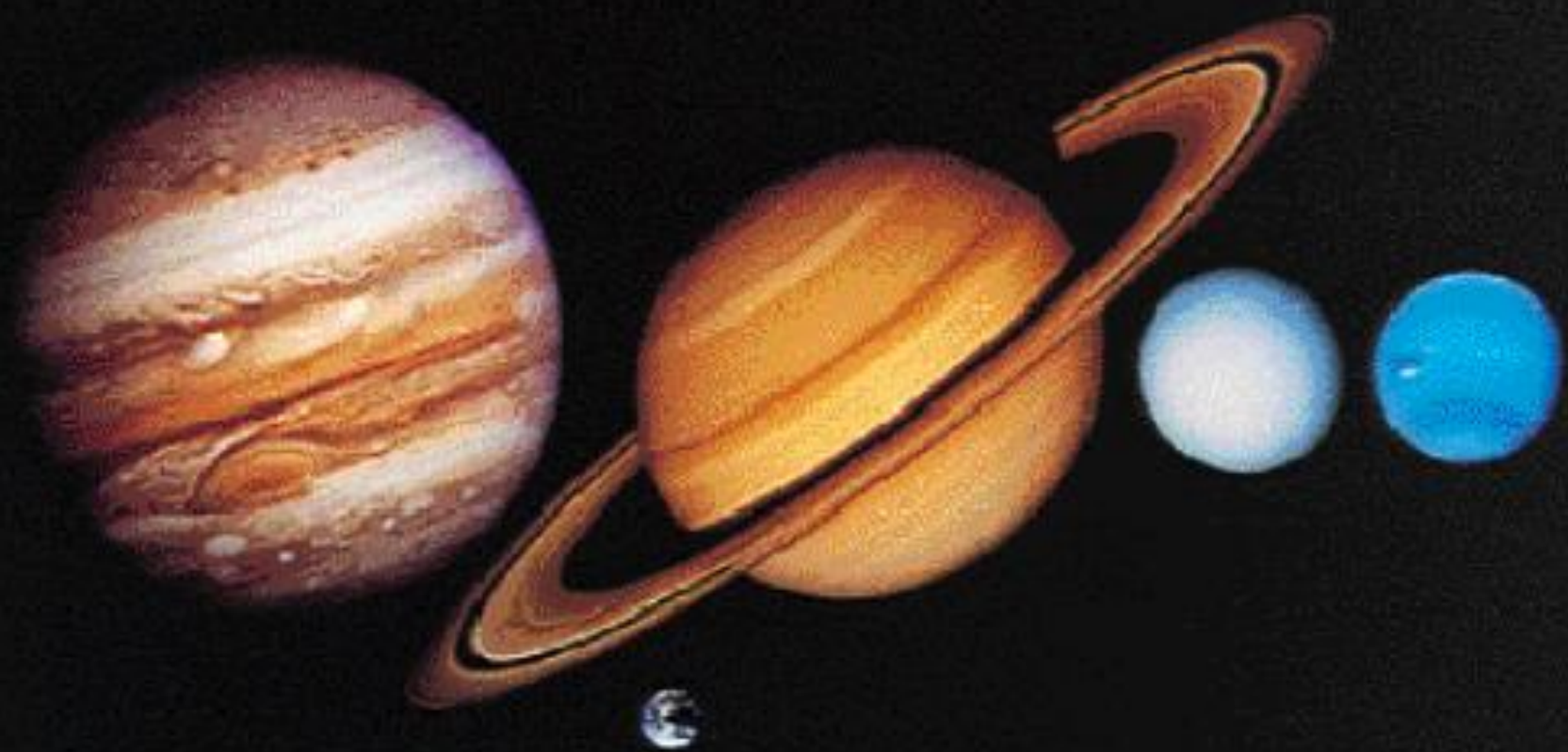
Uranus

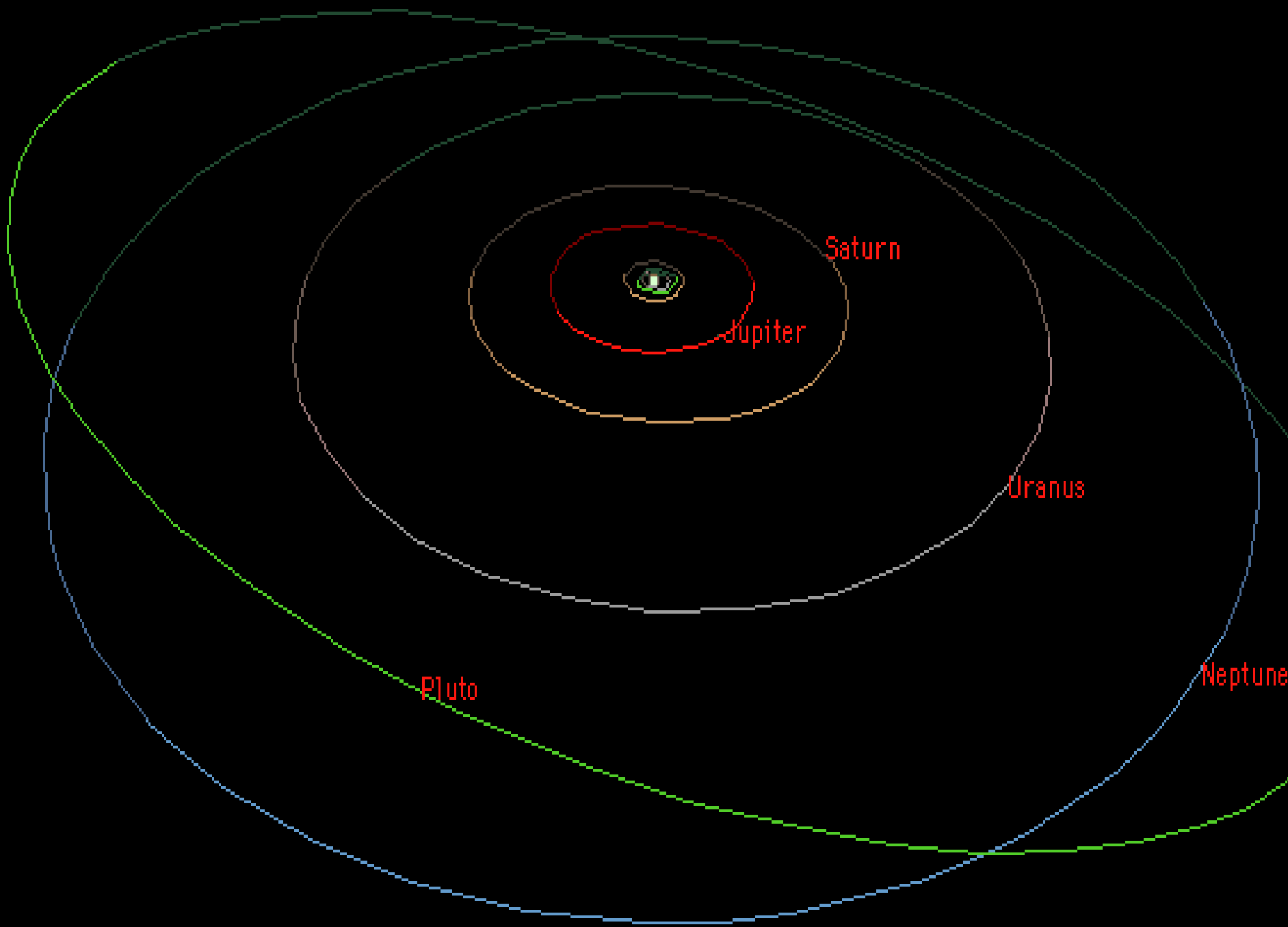
Neptune

Earth →

← Pluto









# Jupiter



- **Diameter – 143,200 km, 11 x that of earth**
- **Mass causes gravity to be 2.5 times that of earth**
- **Jupiter rotates once every 9 hours and 55 minutes**
- **The speed of Jupiter's rotation causes it be elliptical**
- **Its revolution around the sun takes 11.9 Earth years**

# Jupiter

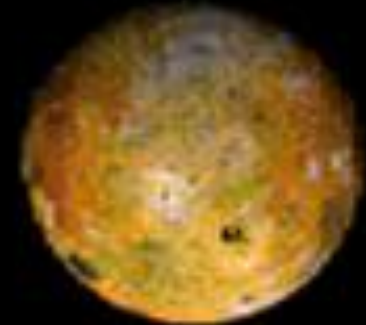
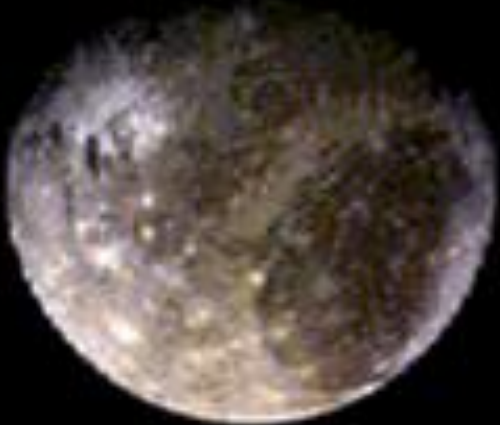
A circular image of the planet Jupiter, showing its characteristic banded atmosphere and the Great Red Spot. The image is centered on the planet, with the Great Red Spot visible as a large, reddish-orange oval in the lower right quadrant. The background is black.

- **Jupiter's atmosphere is composed of several layers**
  - The outer layer is frozen ammonia
  - The inner layer mostly hydrogen and helium
- **Surface of Jupiter**
  - Possibly liquid hydrogen with a mote dense layer of hydrogen underneath
  - The core is thought to be iron and silicone
- **Jupiter emits twice as much energy as it receives from the sun**
- **Jupiter's great red spot is a swirling mass of gasses**



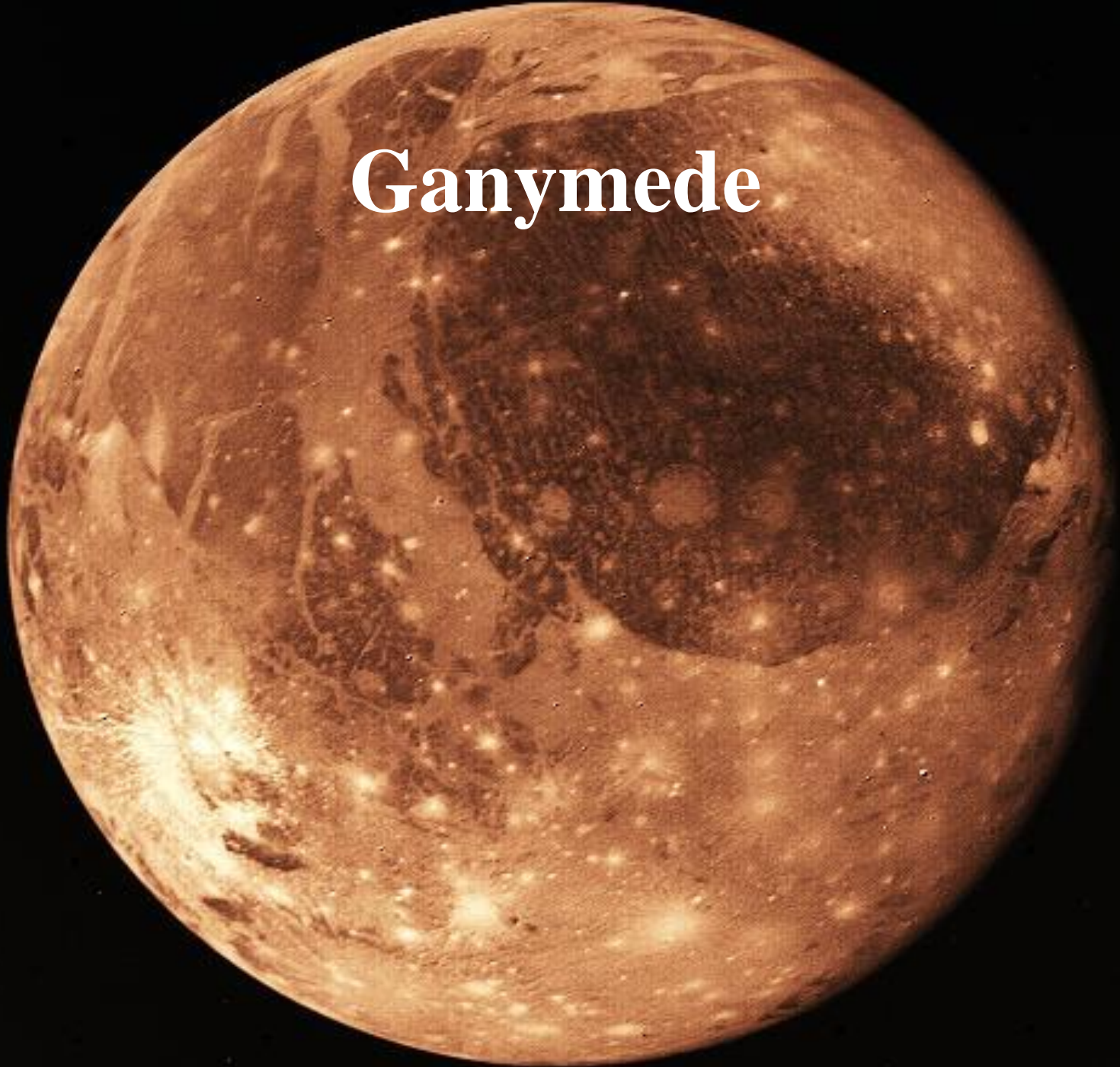
# Jupiter has 16 moons

- **Ganymede's diameter 5275 km**
- **Callisto's diameter 4820 km (rings)**
- **Europa's diameter 3130 km (Cracked egg look)**
- **IO Diameter 3630 km – has active volcanoes**





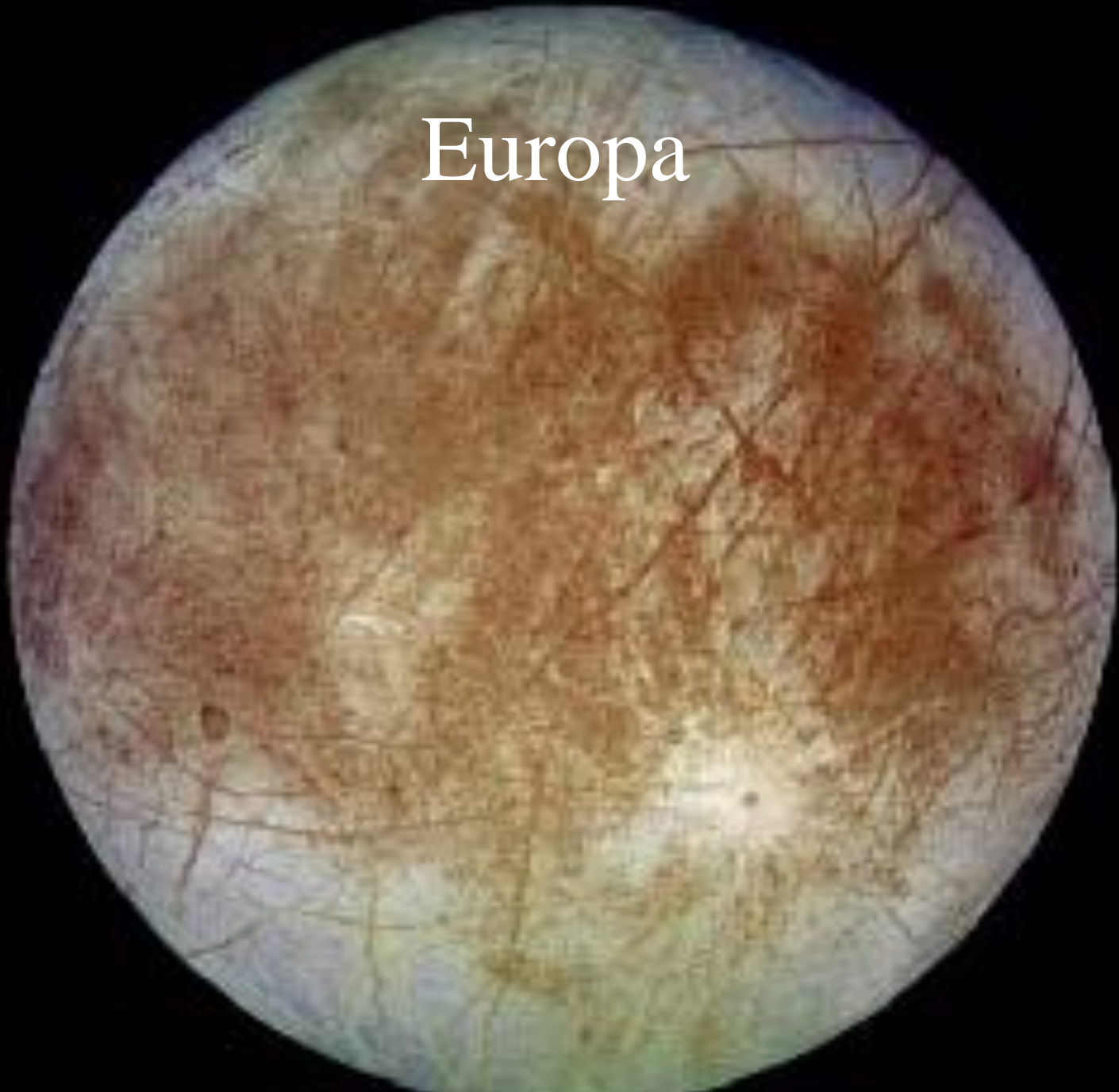
# Ganymede



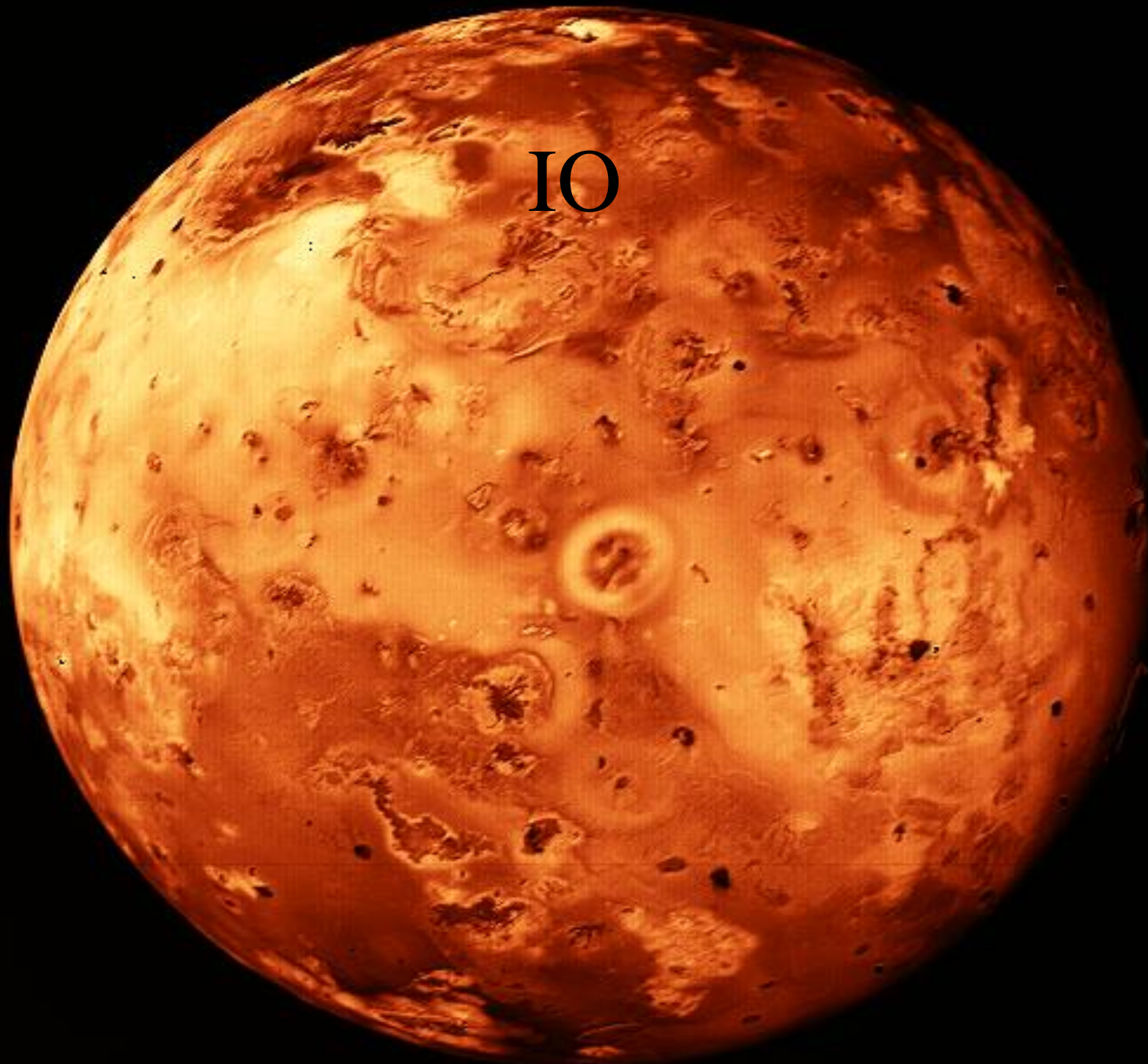
# Callisto



Europa



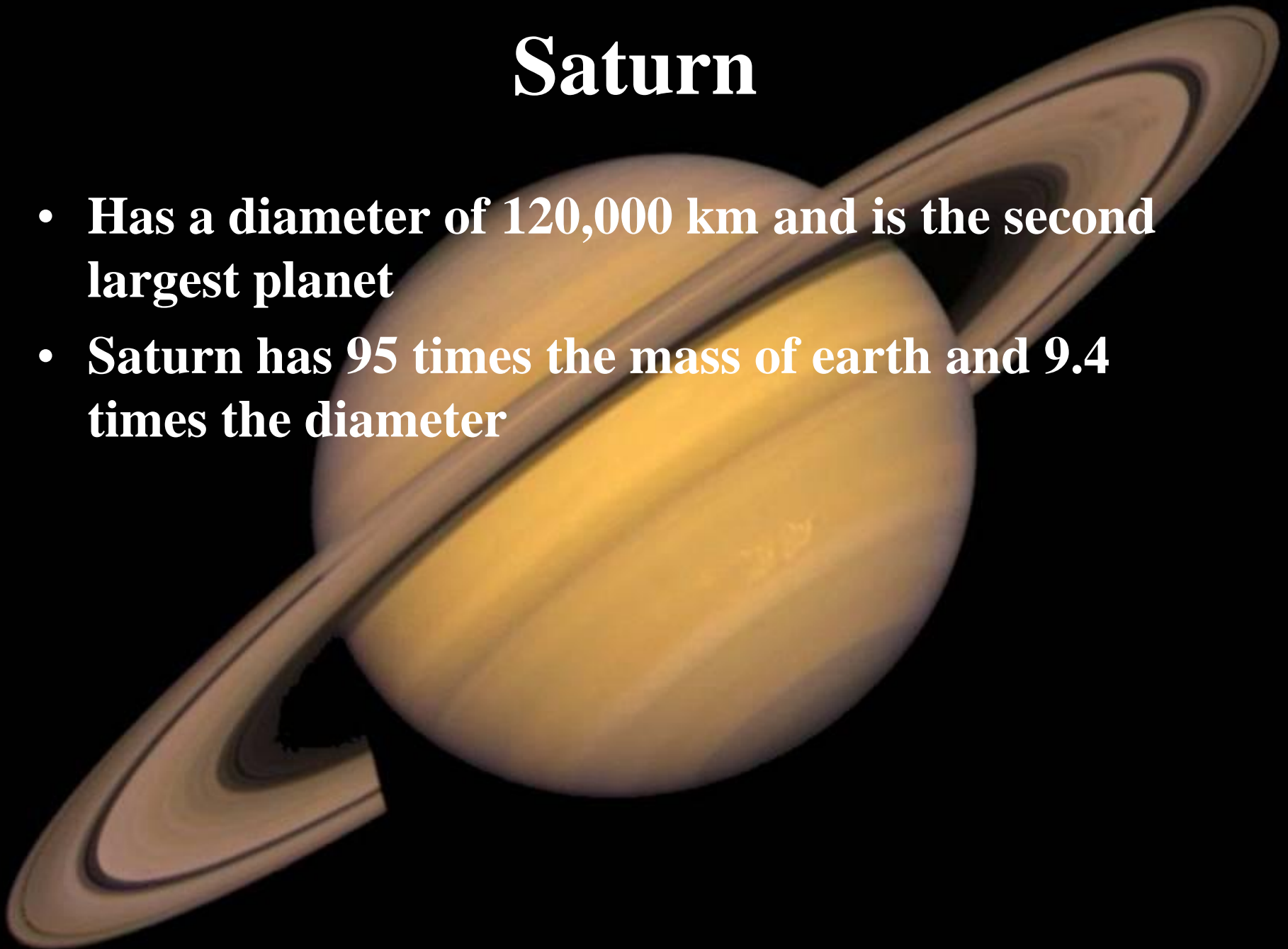




IO

# Saturn

- **Has a diameter of 120,000 km and is the second largest planet**
- **Saturn has 95 times the mass of earth and 9.4 times the diameter**



# Saturn



- **series of rings that revolve around the planet**
  - The rings are composed of frozen chunks of materials
  - Outer ring diameter is 275,000
- **Saturn has 18 moons**
- **Saturn rotates in 10 hours and 40 minutes**
- **Saturn revolves in 29.46 earth years**
- **Titan is Saturn's largest moon, 5,800 km and an atmosphere of methane**



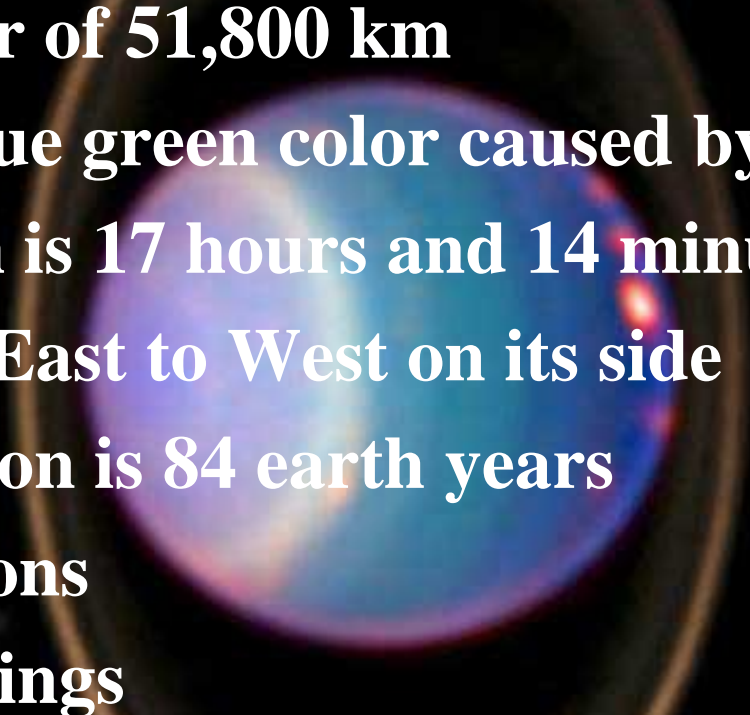


Titan

**Titan**

© Copyright 1998 by  
Calvin J. Hamilton

# Uranus

- **Diameter of 51,800 km**
  - **Has a blue green color caused by methane**
  - **Rotation is 17 hours and 14 minutes**
  - **Rotates East to West on its side**
  - **Revolution is 84 earth years**
  - **Five moons**
  - **Has 11 rings**
- 

# Neptune



- **Pale blue in color**
- **Diameter of 49,500**
- **Rotation is 16 hours and 10 minutes**
- **Revolution is 165 earth years**
- **Two known moons**
- **Atmosphere is helium and hydrogen**



# Pluto



- **The last known planet**
- **Occasionally Neptune is farther from the sun than Pluto**
- **Pluto diameter is 3000 km**
- **Rotation 153 hours**
- **Revolution is 248 earth years**
- **Pluto has a moon Charon that is almost as large as itself**
- **Sometimes are considered a double planet**

# Comets

- **Comets are space objects made of minerals dust gas and ice**
- **Comet means long hair**
- **Comets have a head and tail**

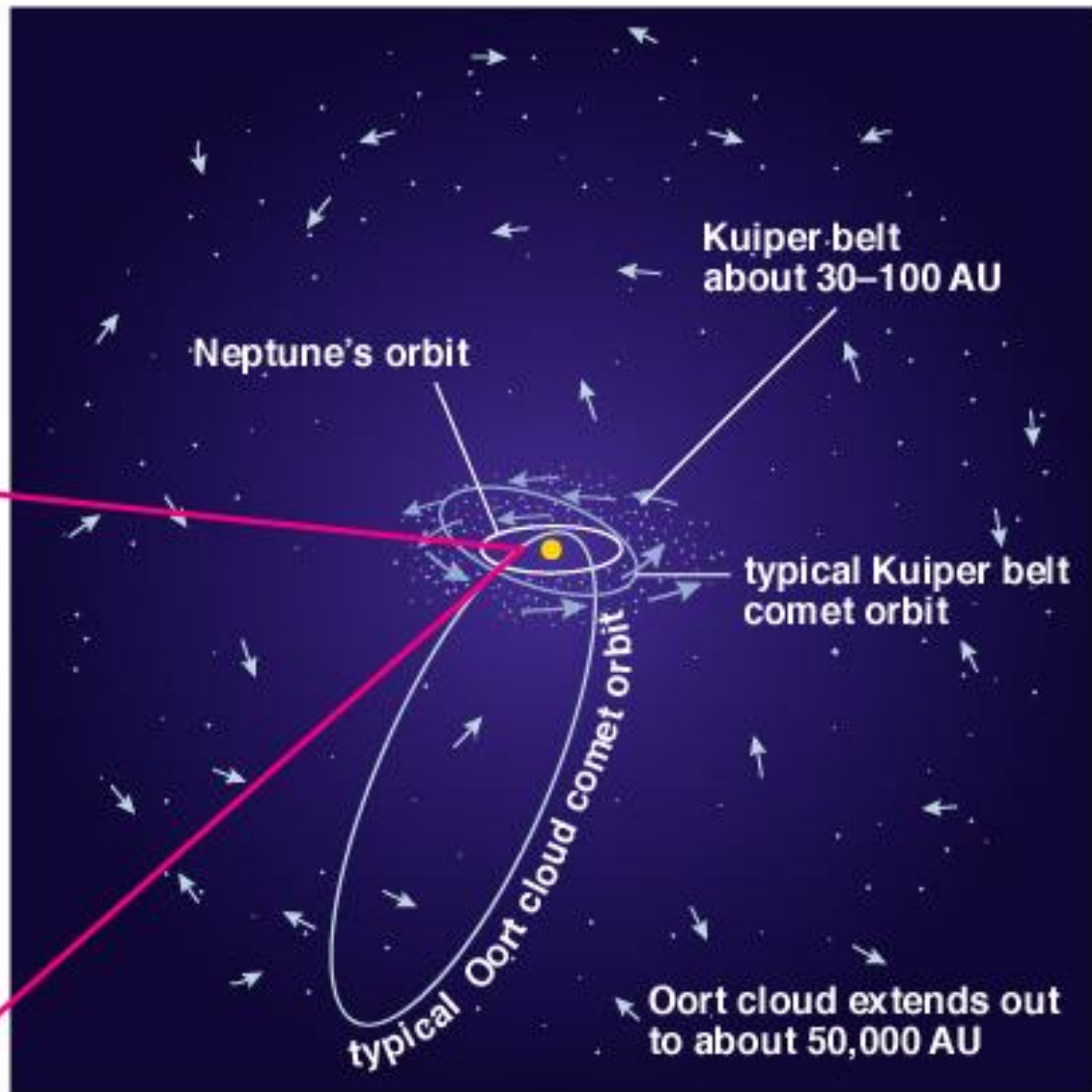


# Comets

- **The head contains most of the matter**
  - Coma
- **The tail always points away from the sun and reflects sunlight**
- **Solar wind keeps the comet tail pointing away from the sun**
- **Comets have a regular orbit pattern**
- **Haley's comet comes every 76 years**
- **Comet's orbits are very elliptical compared to a planet**



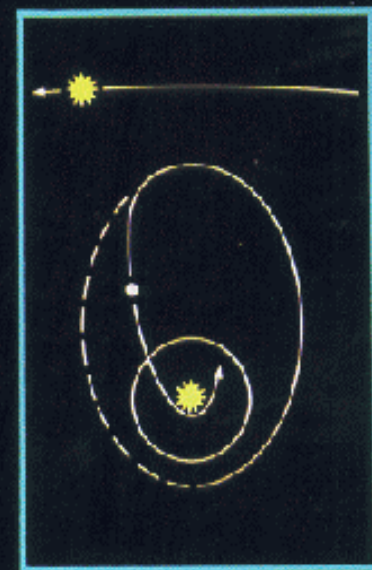
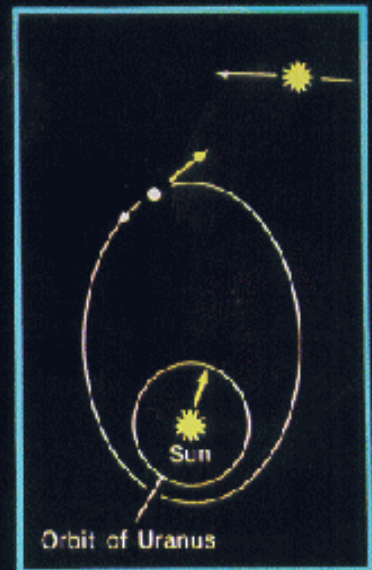






50,000 a.u.

A scale bar indicating a distance of 50,000 astronomical units (a.u.).



# The Oort Comet Cloud

To Galactic Pole

An arrow pointing towards the Galactic Pole.

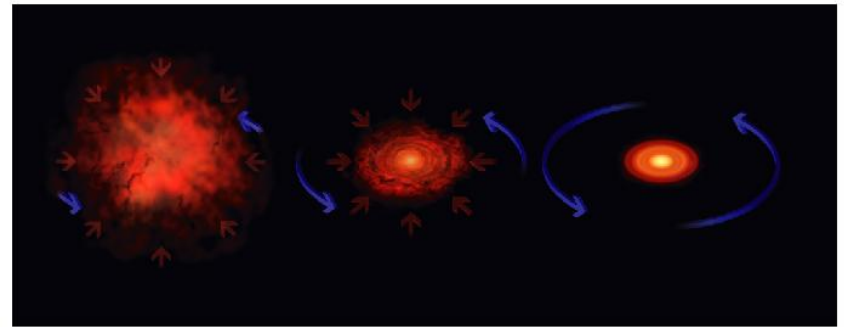


# Origin of the solar system

- **Two main theories**
  - One is the “**Companion Star Theory**”
  - The other is the “**Dust Cloud Theory**”



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# Review

1. What is the difference between a meteoroid, meteor and a meteorite?
2. What planets make up the inner planets?
3. Which inner planet rotate from east to west?
4. Which planet has the shortest orbital period?
5. Which planet is nearest to the earth?
6. Which planet has a high temperature and pressure?
7. Which planet has a volcano three times as tall as Mt. Everest?
8. This planet has cloud layers composed of sulfuric acid.
9. This planet other than earth has a north and south polar ice cap.
10. This planet supports life.



# Stars & Galaxies

# Stars

A black and white photograph of a starry night sky. The stars are of various sizes and brightness, scattered across the dark background. A faint constellation is visible, with several bright stars forming a pattern. The overall scene is a vast field of stars.

- **Ancient Greeks believed that stars were burning objects**



# Stars

- Stars give off a lot of heat by Nuclear fusion  
There are more than 200,000 stars in our galaxy that have been seen and catalogued

What is the energy source  
behind star light?\*

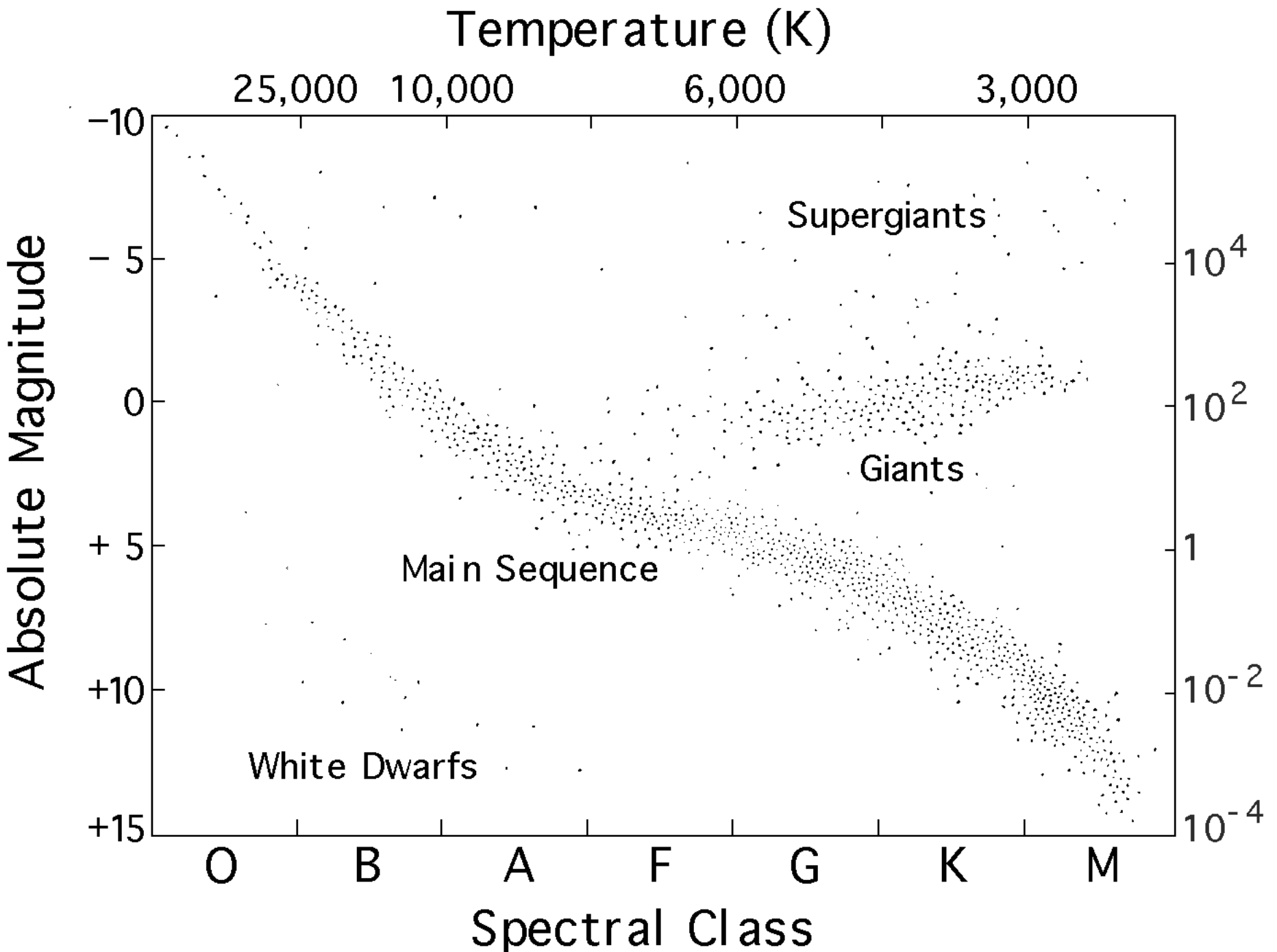
# Not All Shiny Objects are Stars

- Some bright points of light that can be seen in the sky may planets such as Venus, Mars, Jupiter, Saturn and Mercury
- Planets have a more steady glow, while stars twinkle because it is refracted as it comes through the earths atmosphere

# Stars Brightness

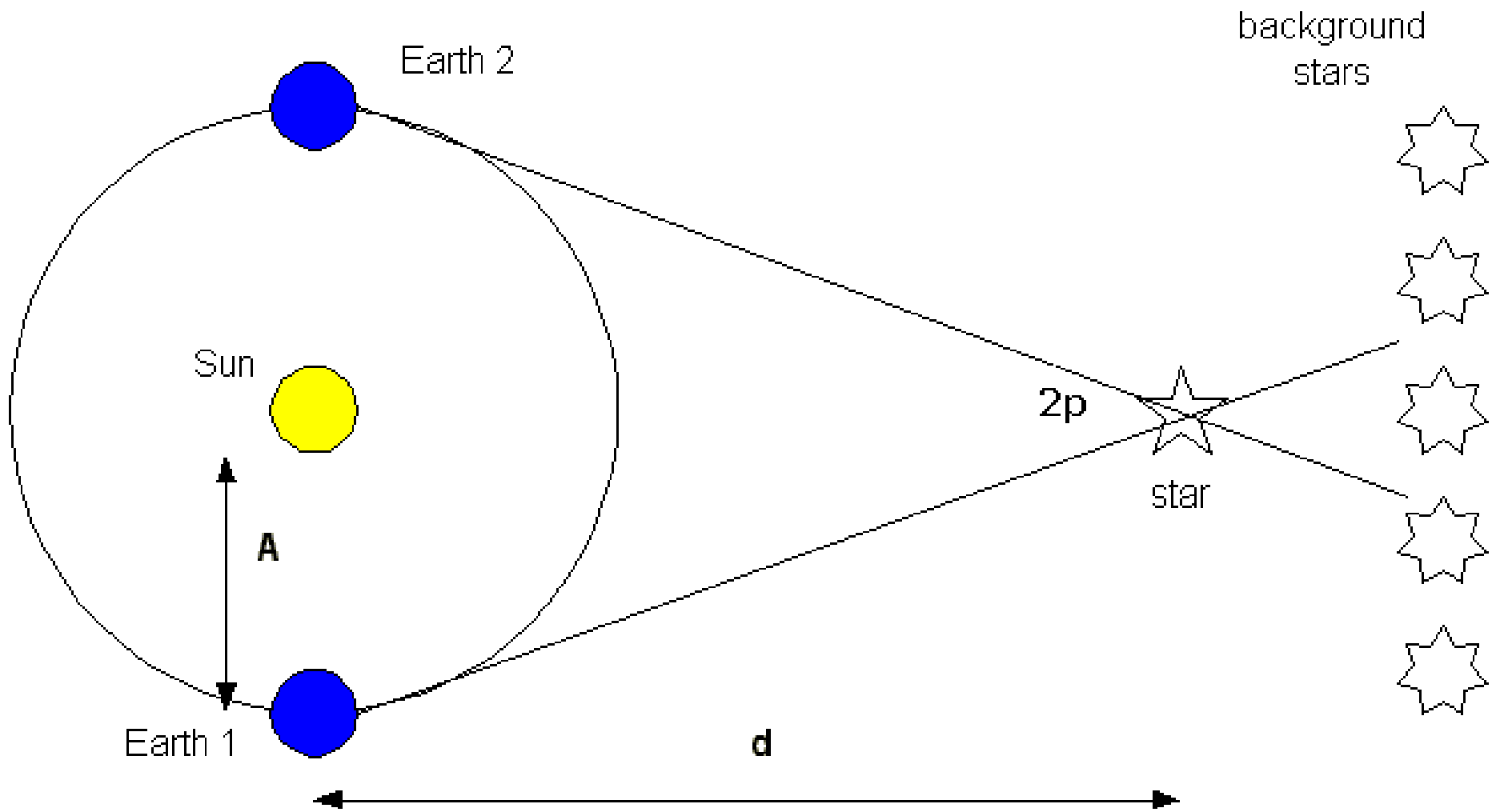
- A stars brightness as seen from earth is called its **apparent magnitude**
- **Apparent magnitude depend on the size distance and color**
- **Apparent magnitude differs from actual magnitude**





# Stellar distance

- **the distance of a star from earth**
- **Stellar distance can be measured by parallax**
  - **Parallax is an apparent change in position caused by the earth's motion**
  - **Parallax is then calculated to determine the stars distance from earth**
  - **Parallax decreases with distance**





# Light Year

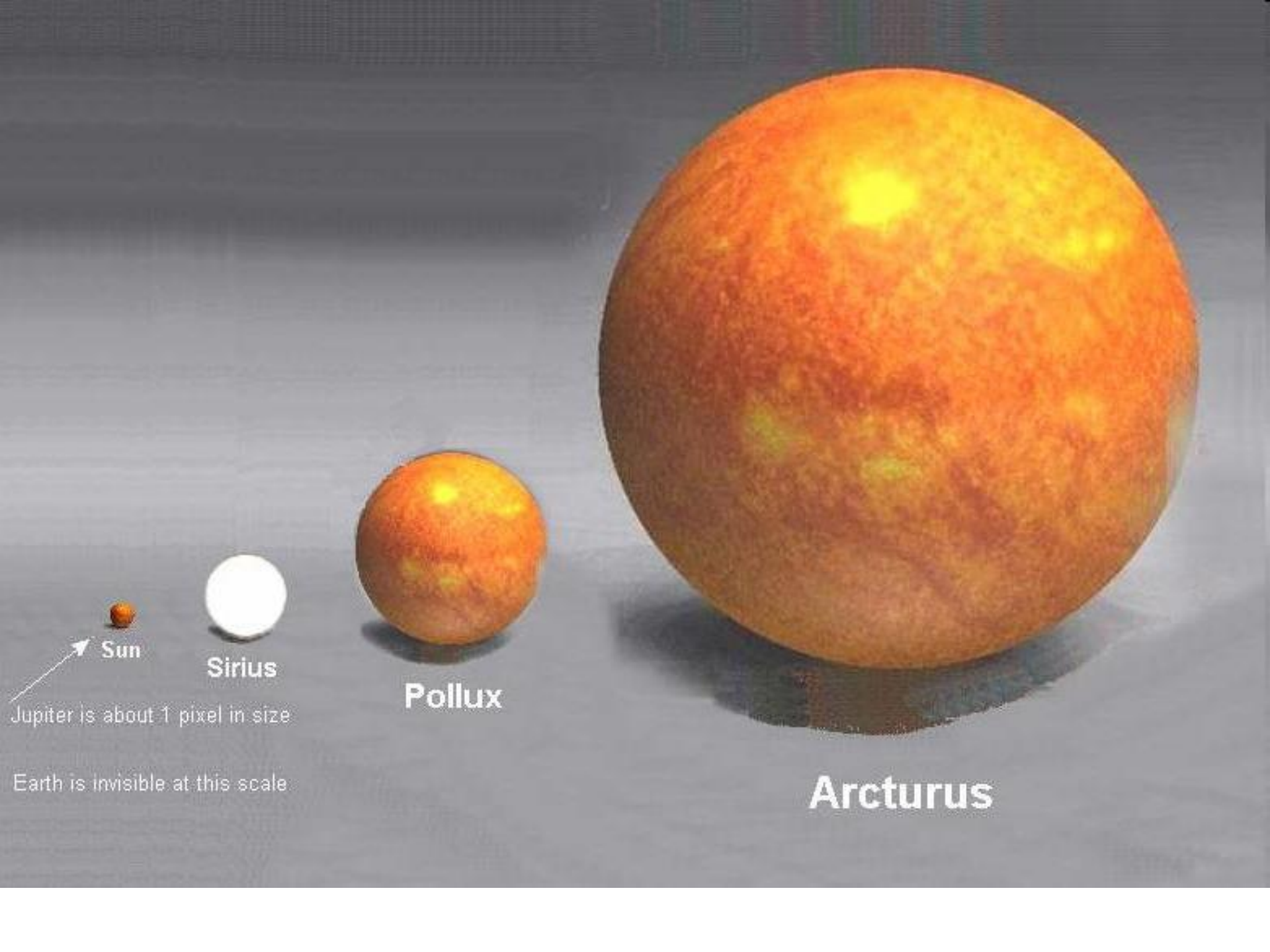
The background of the slide is a deep space image. It features a dark, star-filled sky. In the upper right, there is a bright, glowing galaxy with a central core and a diffuse, purple-tinged halo. In the lower right, another galaxy is visible, showing a more defined spiral structure with a bright core. On the left side, a long, narrow, vertical galaxy is visible, appearing as a thin, glowing purple line. Numerous individual stars of varying brightness are scattered across the field of view.

- Astronomers work with very large numbers.
- The closest star to earth is 38,000,000,000,000 km away from the sun  $3.8 \times 10^{13}$
- Light travels at 9.5 trillion km/year



# The Sun

- The sun is a star (average in size)
  - The sun is a sphere of hot glowing gas
  - The sun contains more than 99% of the solar system's mass
  - The sun is about 150,000,000 km from the earth about 8minutes at the speed of light
  - The sun's radius is about 696,000 km, 109x that of earth
- The sun rotates on its axis



Sun

Sirius

Pollux

Arcturus

Jupiter is about 1 pixel in size

Earth is invisible at this scale





Betelgeuse



Antares

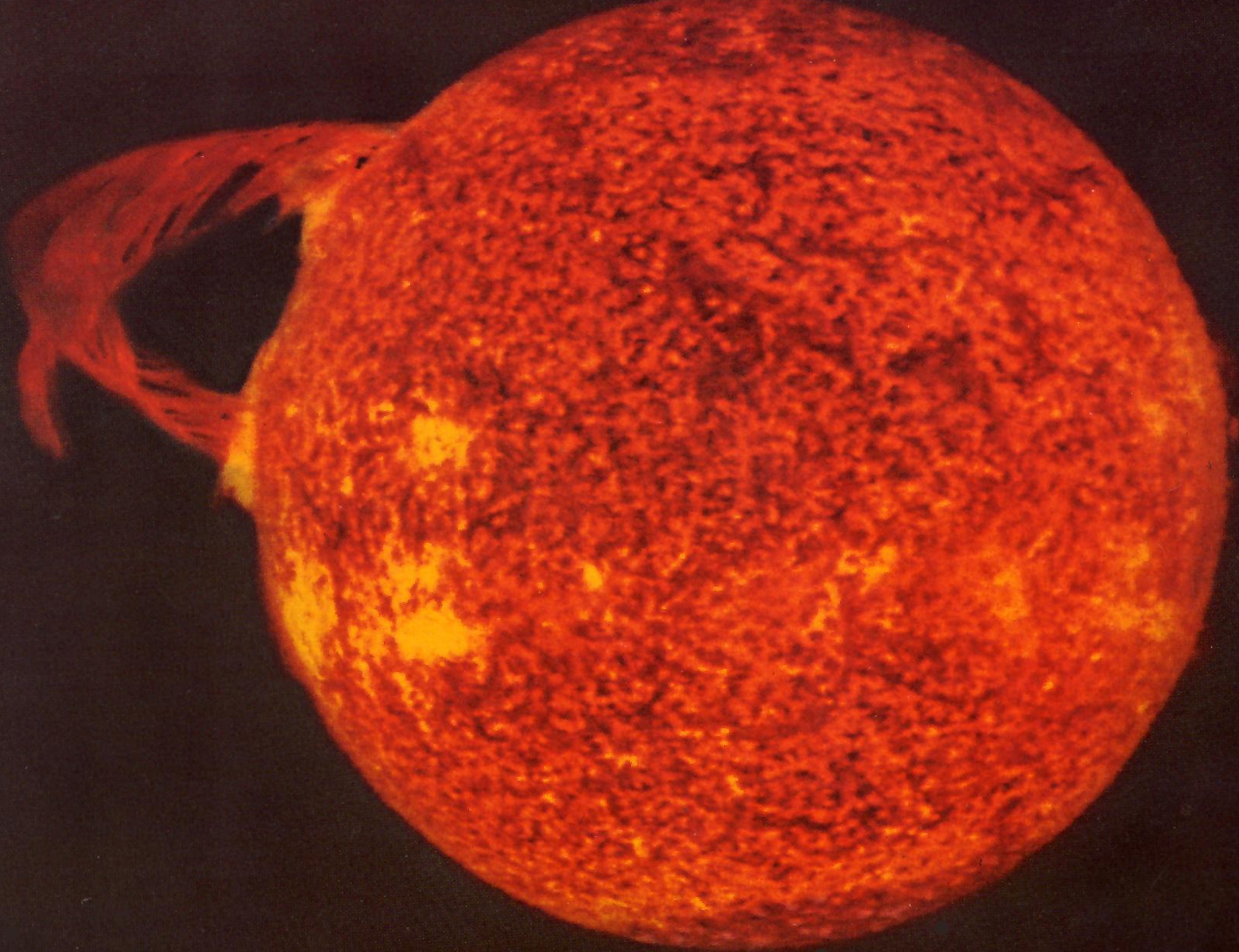
Jupiter is invisible at this scale



Rigel



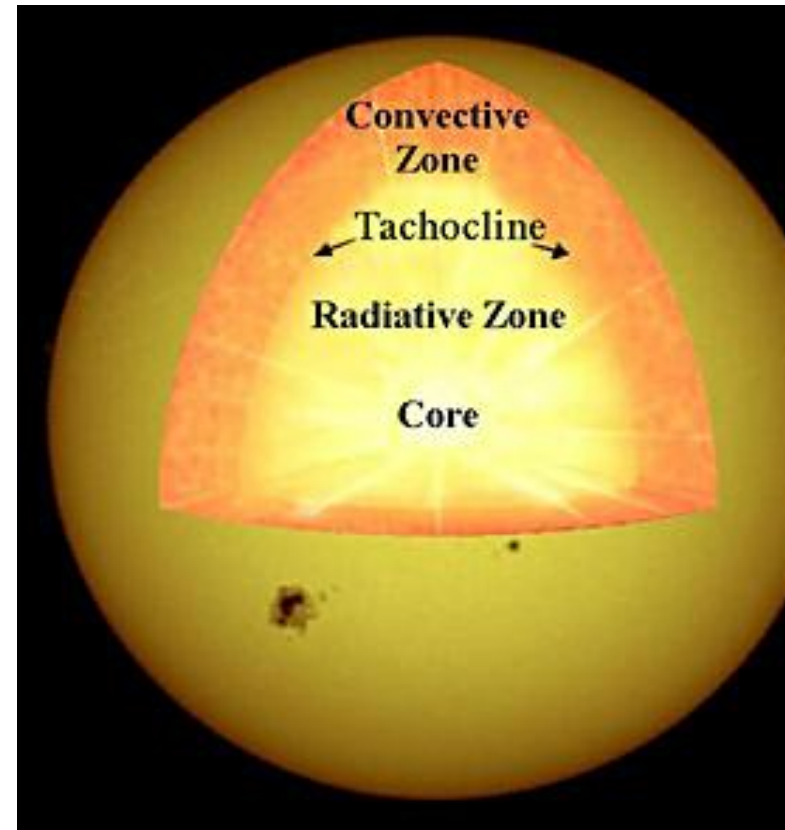
Aldebaran



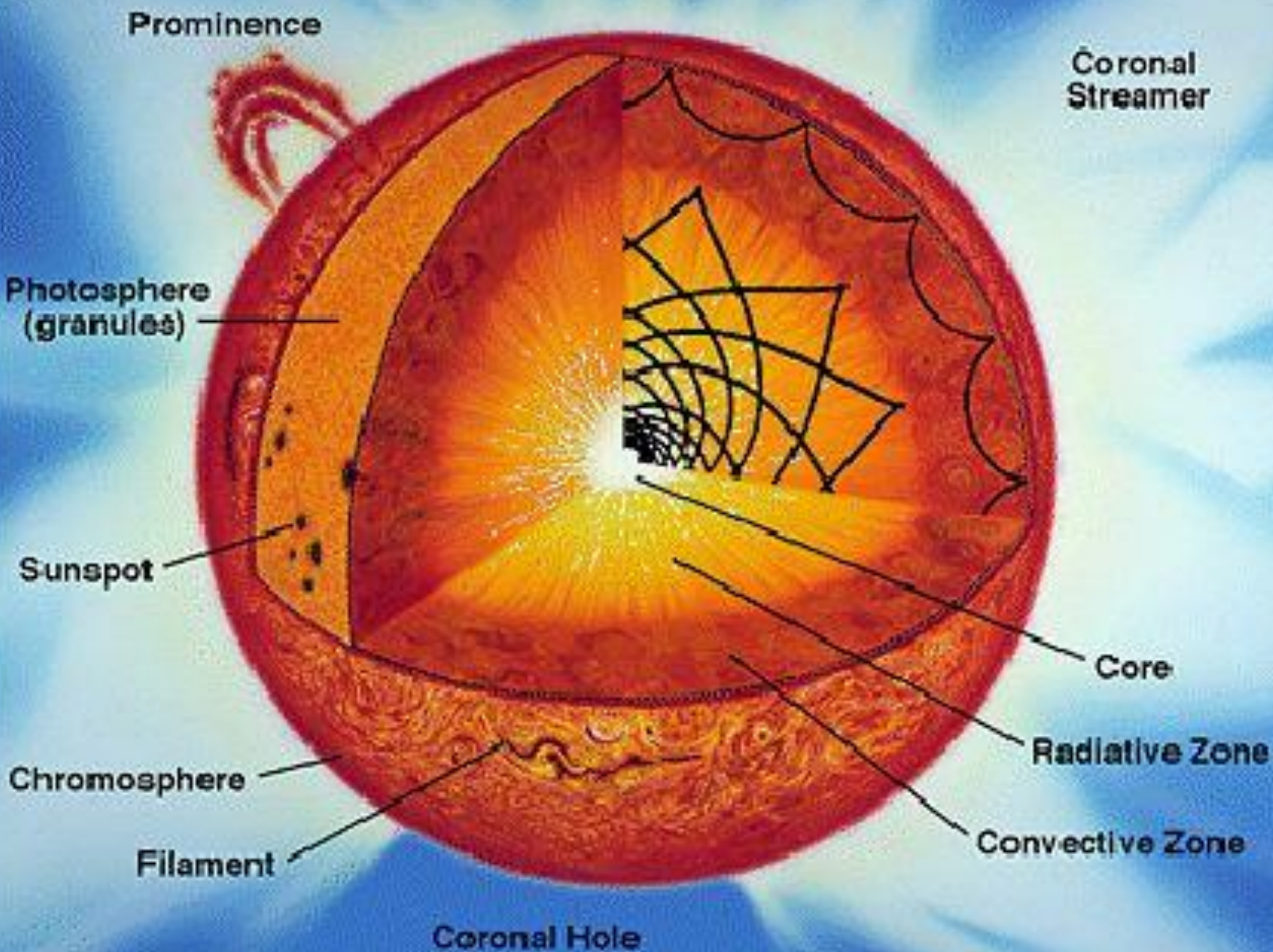


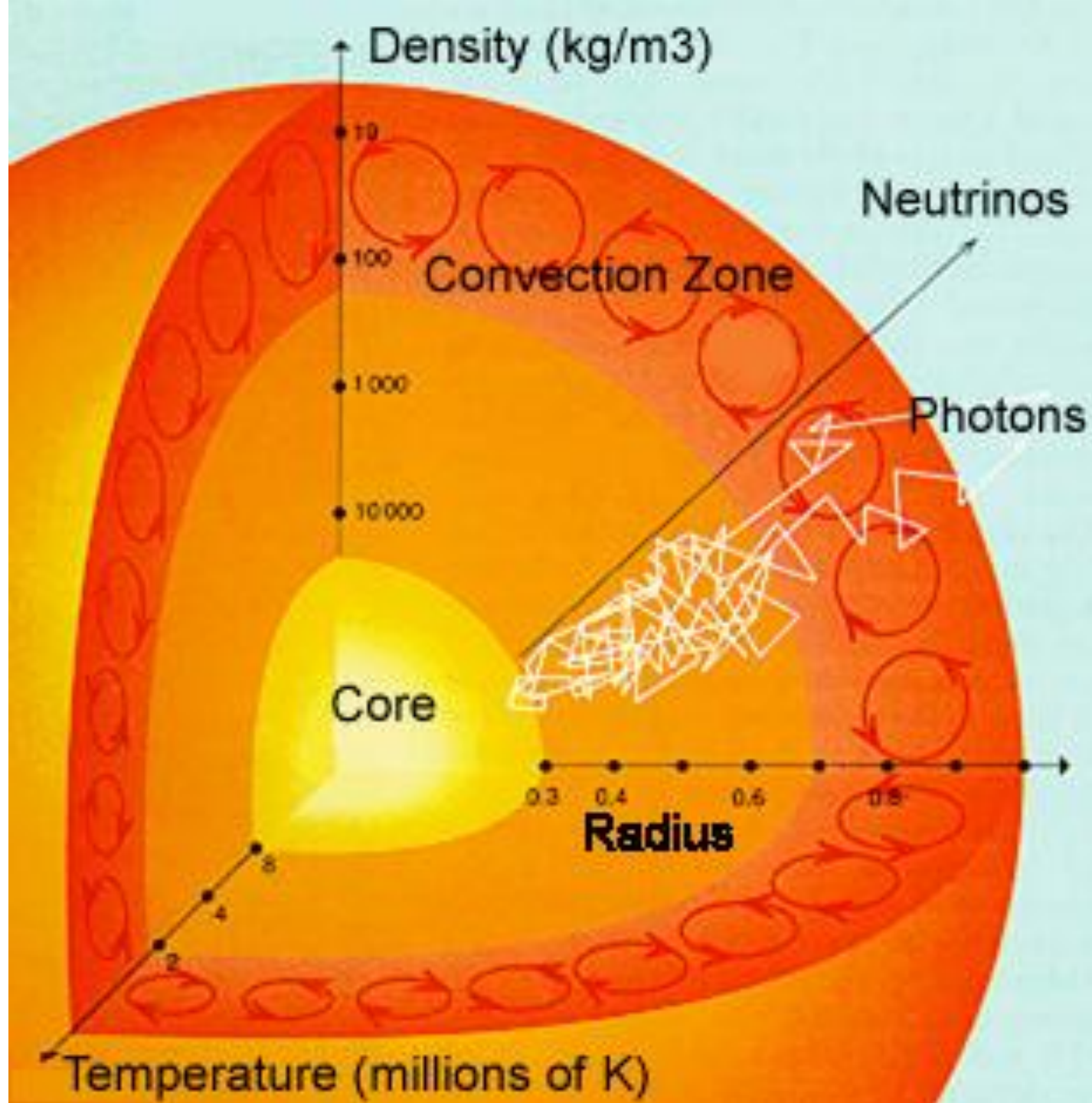
# Regions of the sun

- **The Core is made of dense helium and hydrogen about 15 million °C**
- **The radiative layer is warmed by the core 3 million °C**
- **Convective layer**
- **Sun's atmosphere has 3 parts**
  - **Photosphere – is the layer we see when we look at the sun**
  - **Chromosphere is the middle layer of the atmosphere and is about 2500 km thick**
  - **Corona extends above the Chromosphere Visible during total solar eclipse**



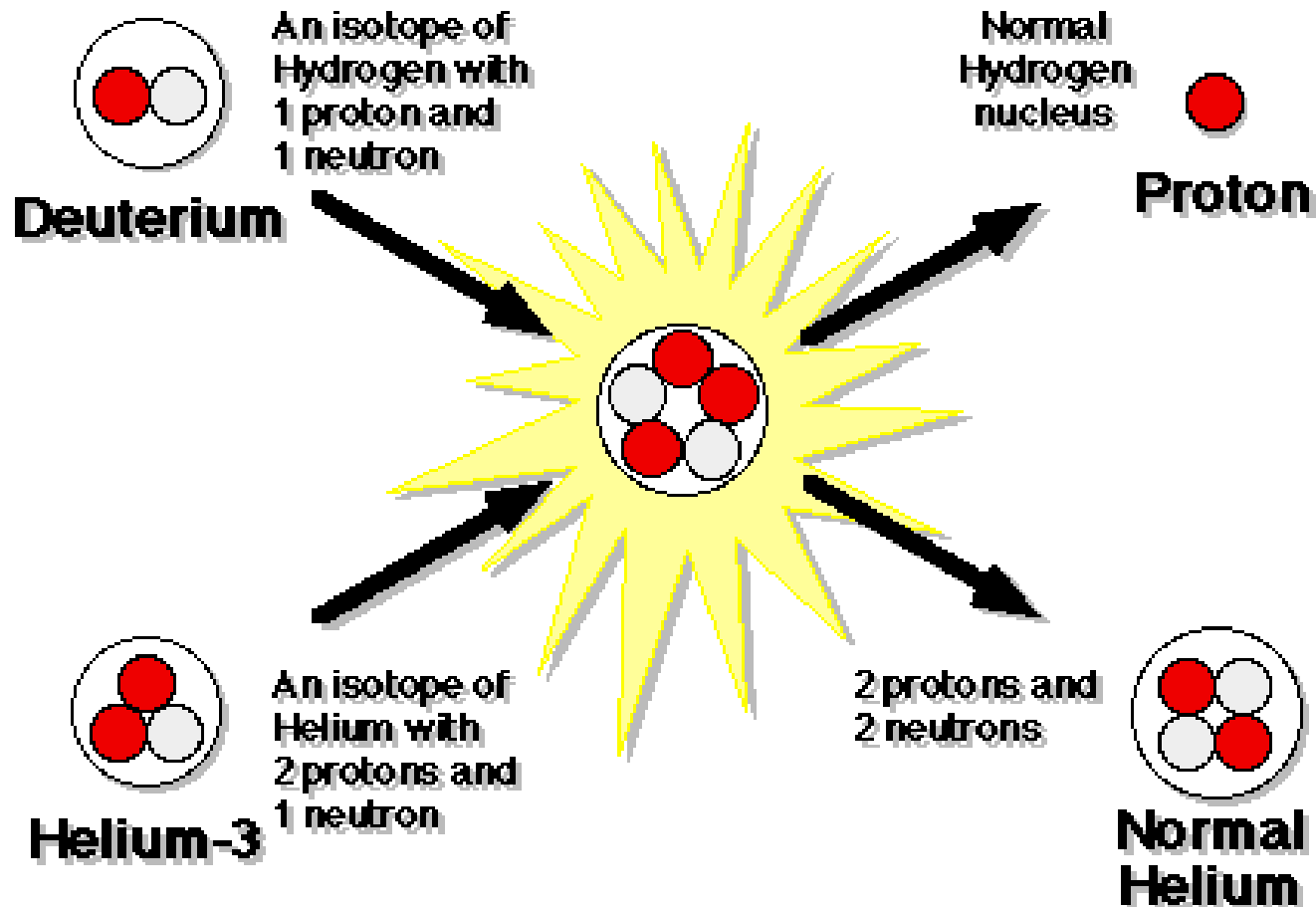






# The suns energy

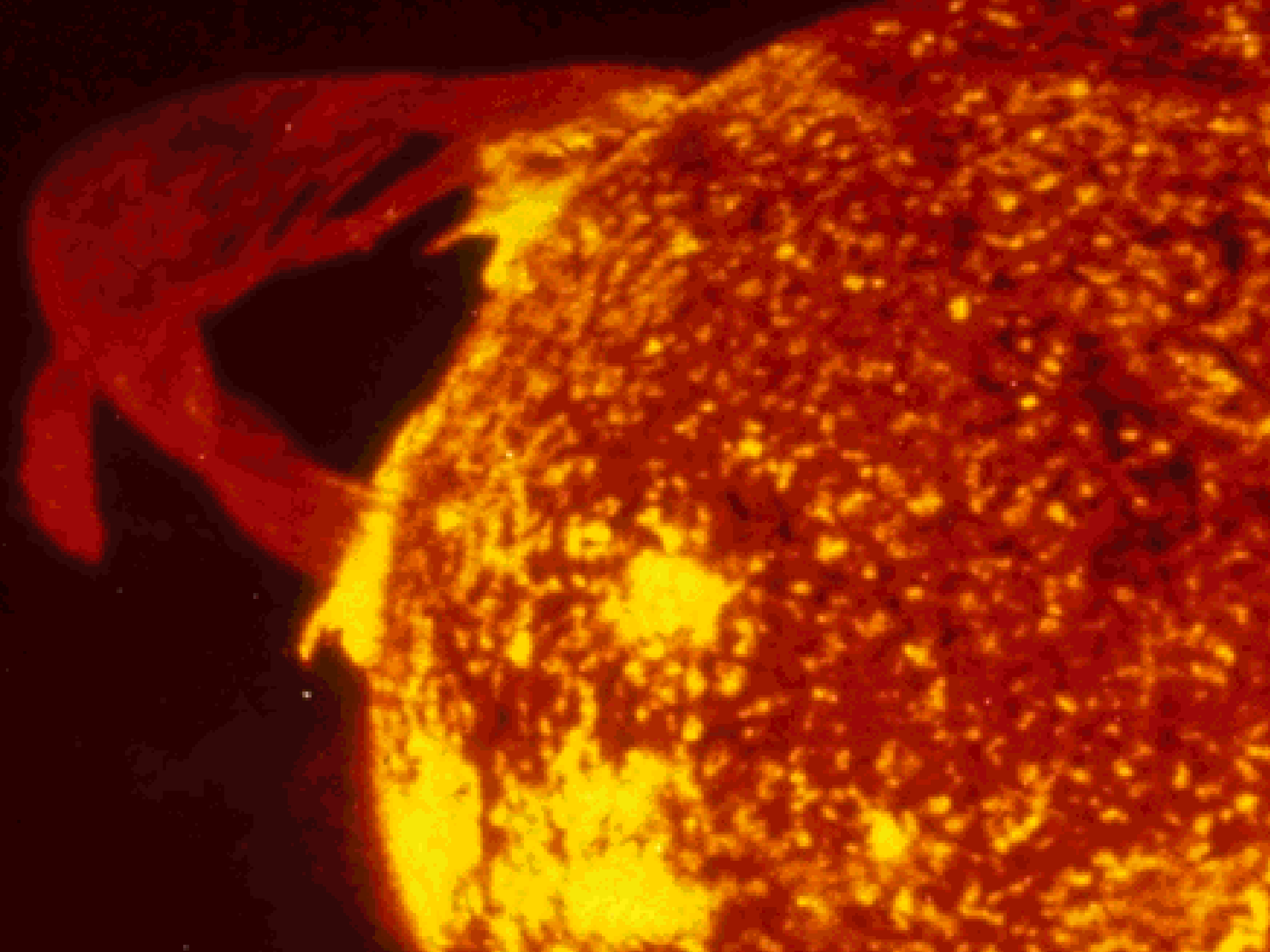
- is fueled by nuclear fusion
- Hydrogen fusing to form helium





# Sunspots, Solar Flares, & Solar wind

- Sunspots are cooler dark areas in the photosphere
- Sunspots are the result of magnetic storms on the sun
- Galileo studied sunspots in 1612
- Sunspots have a strong magnetic field
- Most sunspots last from 1-7 days
- Sunspots go in an eleven year cycle
- During active periods of the sun glaciers retreat and global temperatures are warmer
- When the sun is not as active global temperatures are colder
- Solar wind is produced during active phases of the sun



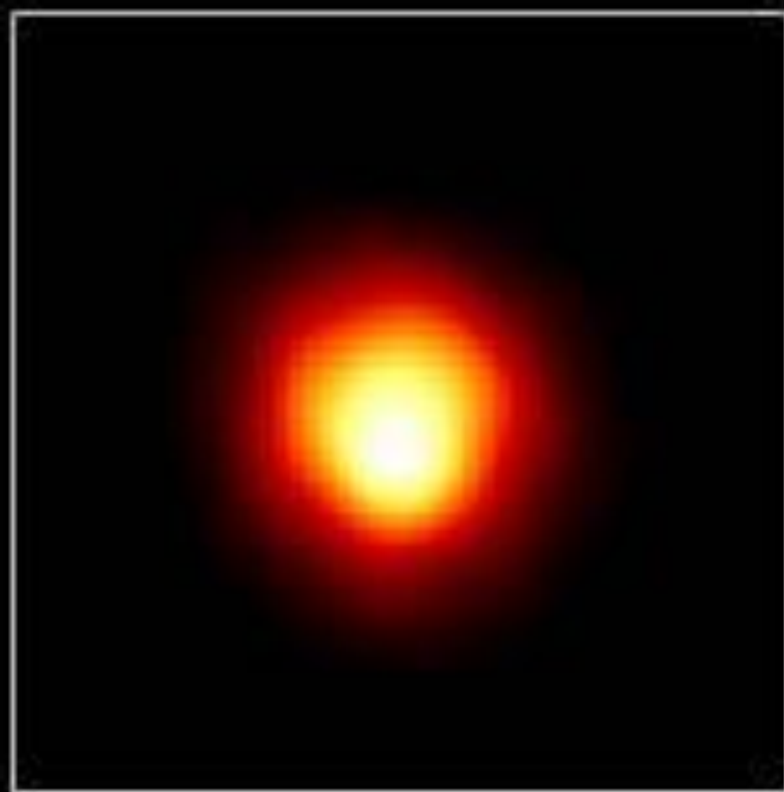
# Classifying the stars

- Stars can be classified by color
- Blue - white are hot stars
- Yellow orange and red are cooler stars, red is the coolest
- Stars are also classified according to their actual brightness



# Star Classification

- **Most stars fit in to the group called the main sequence stars**
- **Stars that do not fit into this category are giants, dwarfs, and super giants**



Size of Star

Size of Earth's Orbit

Size of Jupiter's Orbit



## Atmosphere of Betelgeuse

HST • M

# Evolution of stars

- **Early stages of a star**
- **A star begins when matter in a region of space of gas and dust, called nebulae**
- **Gas and dust is pulled together by gravity into a spinning cloud**
- **The increase of matter and gravitational pull cause the particles to collide which causes increased heat along with increased pressure**



# Crab Nebula

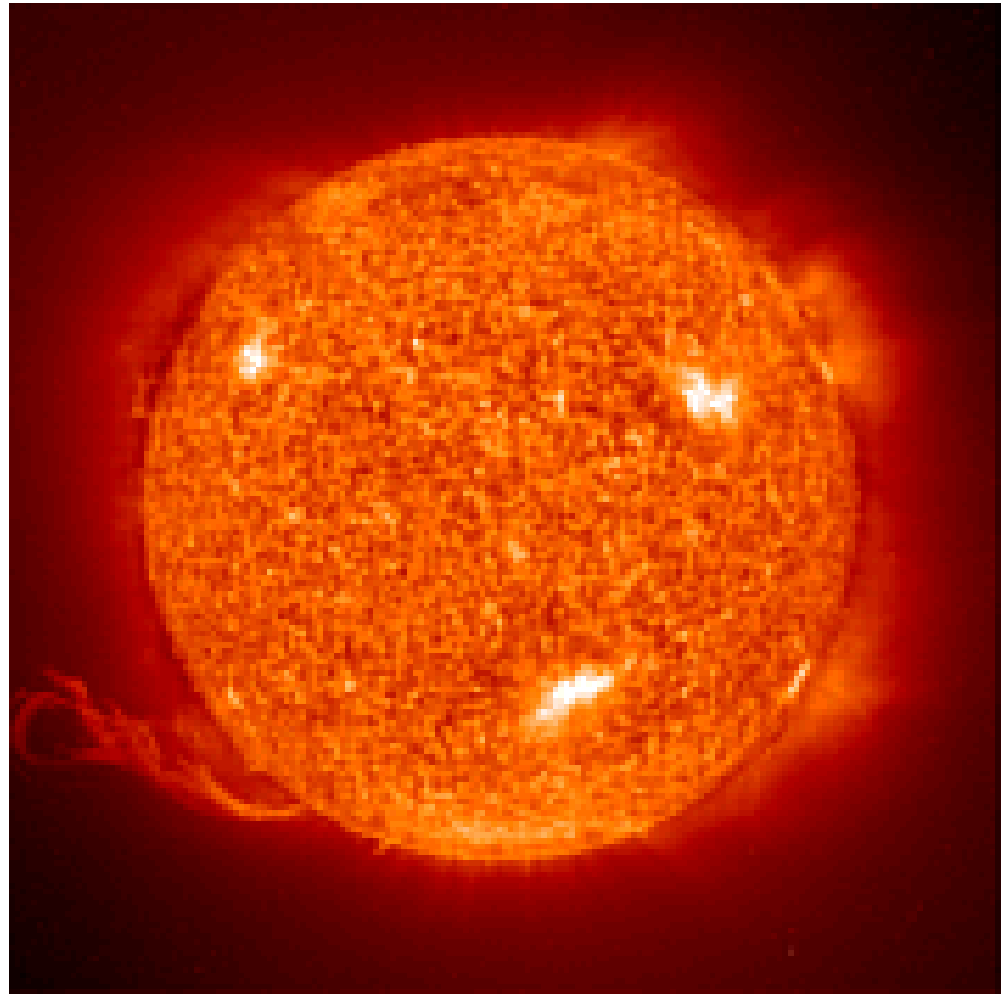


# Evolution of Stars

- **As the amount of matter is increased to the it no longer falls toward the center**
- **Through this slow process matter is added to the outer layer of the star**
- **Much time must pass before the energy released by the matter raises to fusion point in the core**
- **Fusion point is about 10,000,000 °C**



- **This results in a main sequence star**  
**The life of a star depends on its mass**

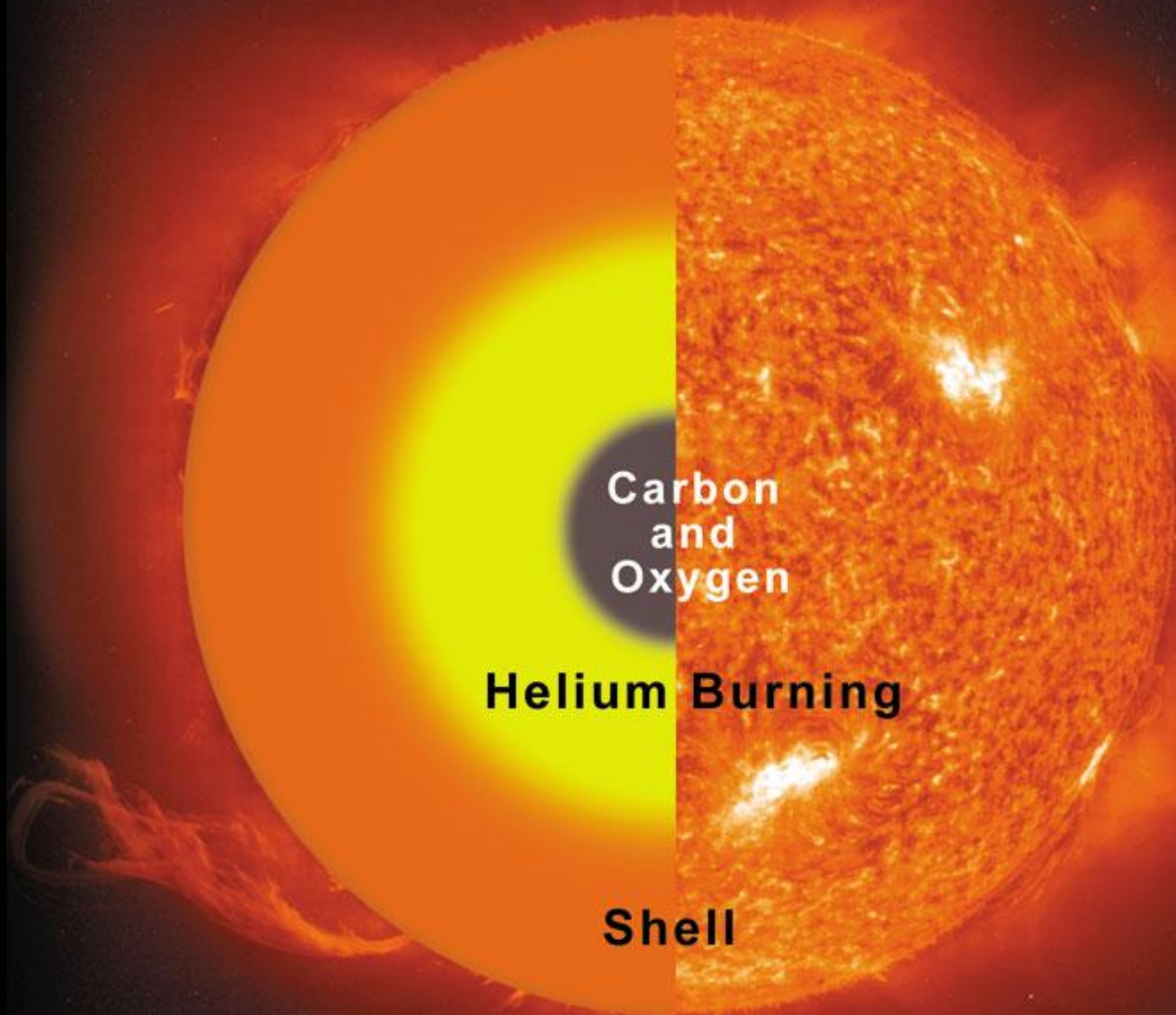




# Death of a star

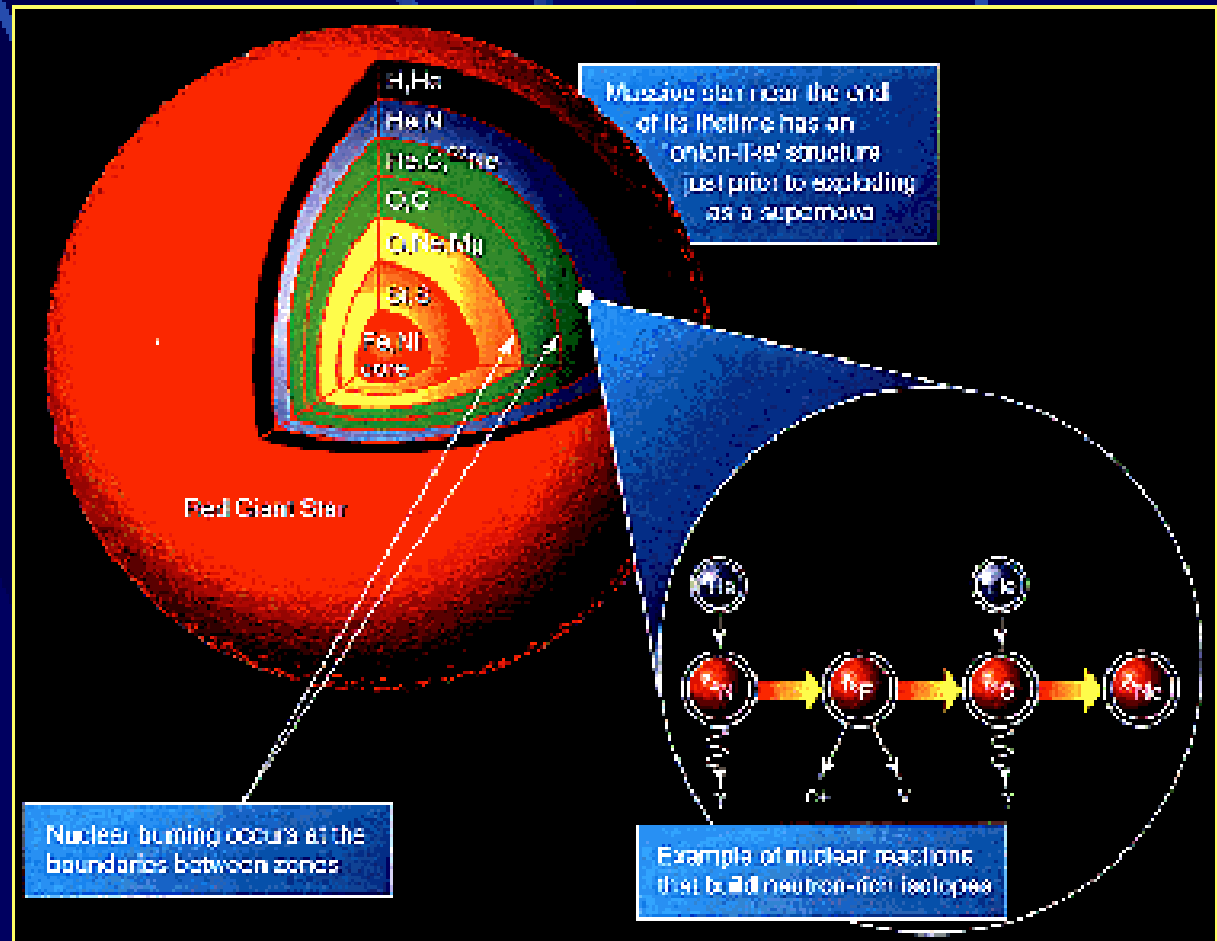
- **When all the hydrogen fuses to helium the star begins the next stage**
- **The core then contracts and the outer regions expand**
- **The amount of light the star produces changes by decreasing and increasing**
- **The outer region will begin to cool causing the star to become red**
- **This stage is called a red giant**

# Red Giant Star



# Red Giants and Supergiants

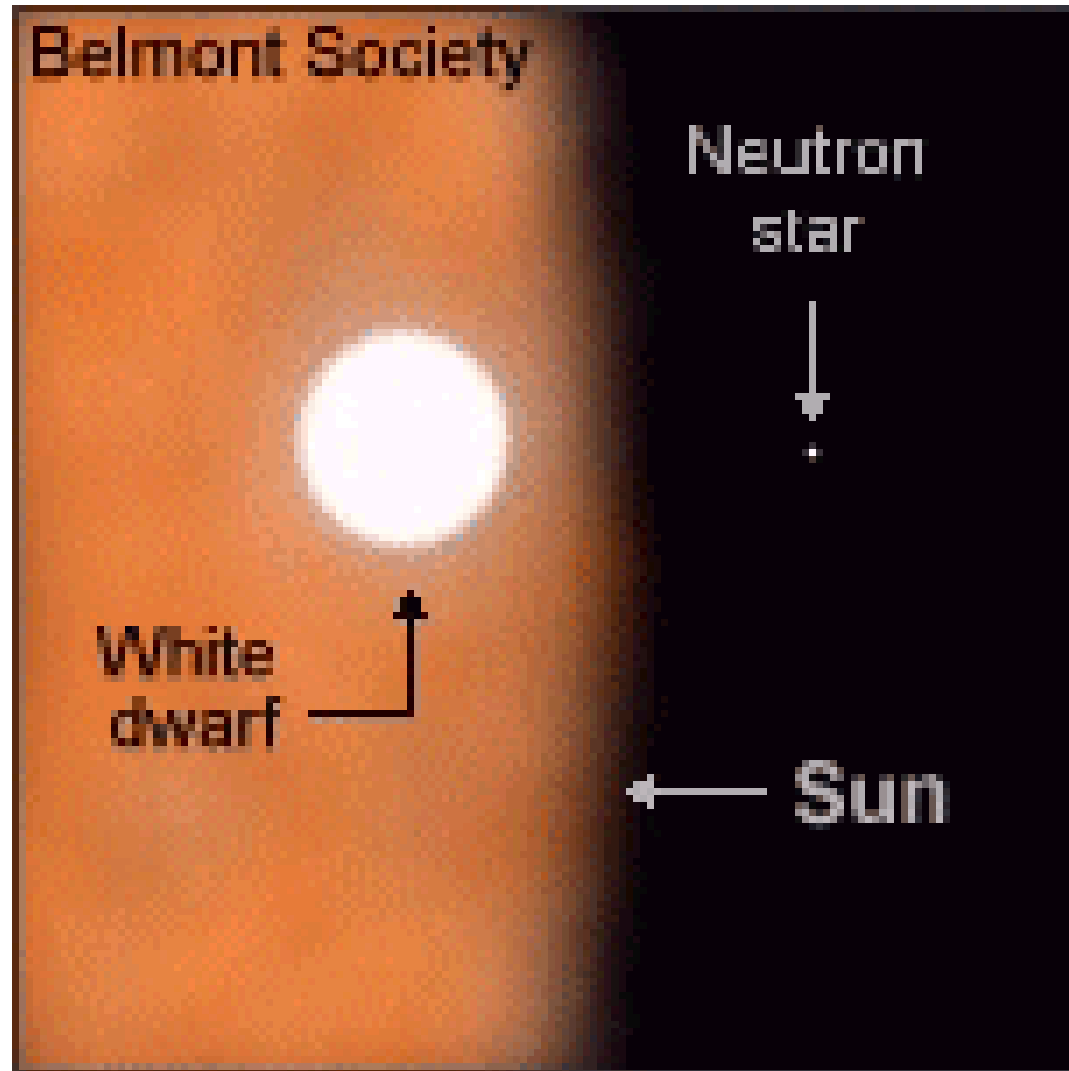
- Hydrogen burns in outer shell around the core
- Heavier elements burn in inner shells





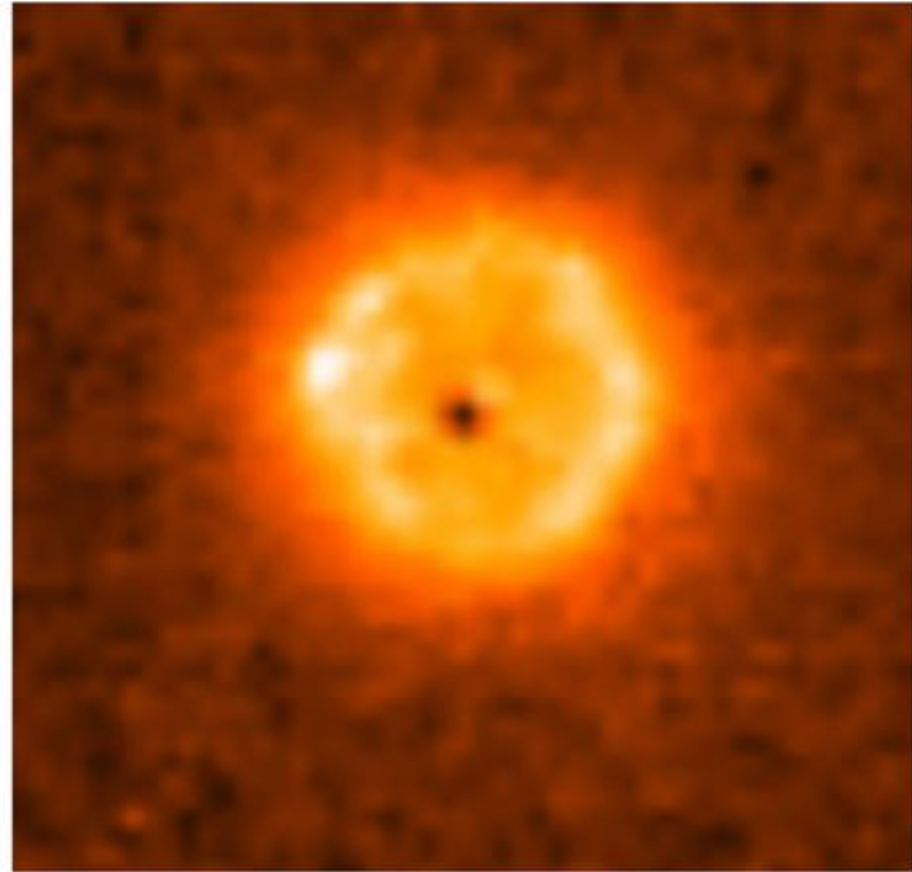
# Final stages

- Once the nuclear fuel runs out the star collapses and become a dense ball of shining matter called a white dwarf
- A white dwarf will shine for many years



# Final Stages continued

- **Some stars must eject some mass before they can become a white dwarf**
- **When a star does this it is called a nova**
- **When a nova ejects this mass it becomes many times brighter than before and after days or weeks becomes very faint**
- **Ancient Chinese called novas guest stars**
- **A Supernova is an exploding star**



*Nova QUVul (Univ. of Wyoming / Space Telescope Science Institute)*

# Supernova

- **When a supernova occurs the star may become 100,000,000 times brighter**
- **The result of a supernova is gas and dust scattered in space**
- **The Crab Nebula is the result of a supernova**

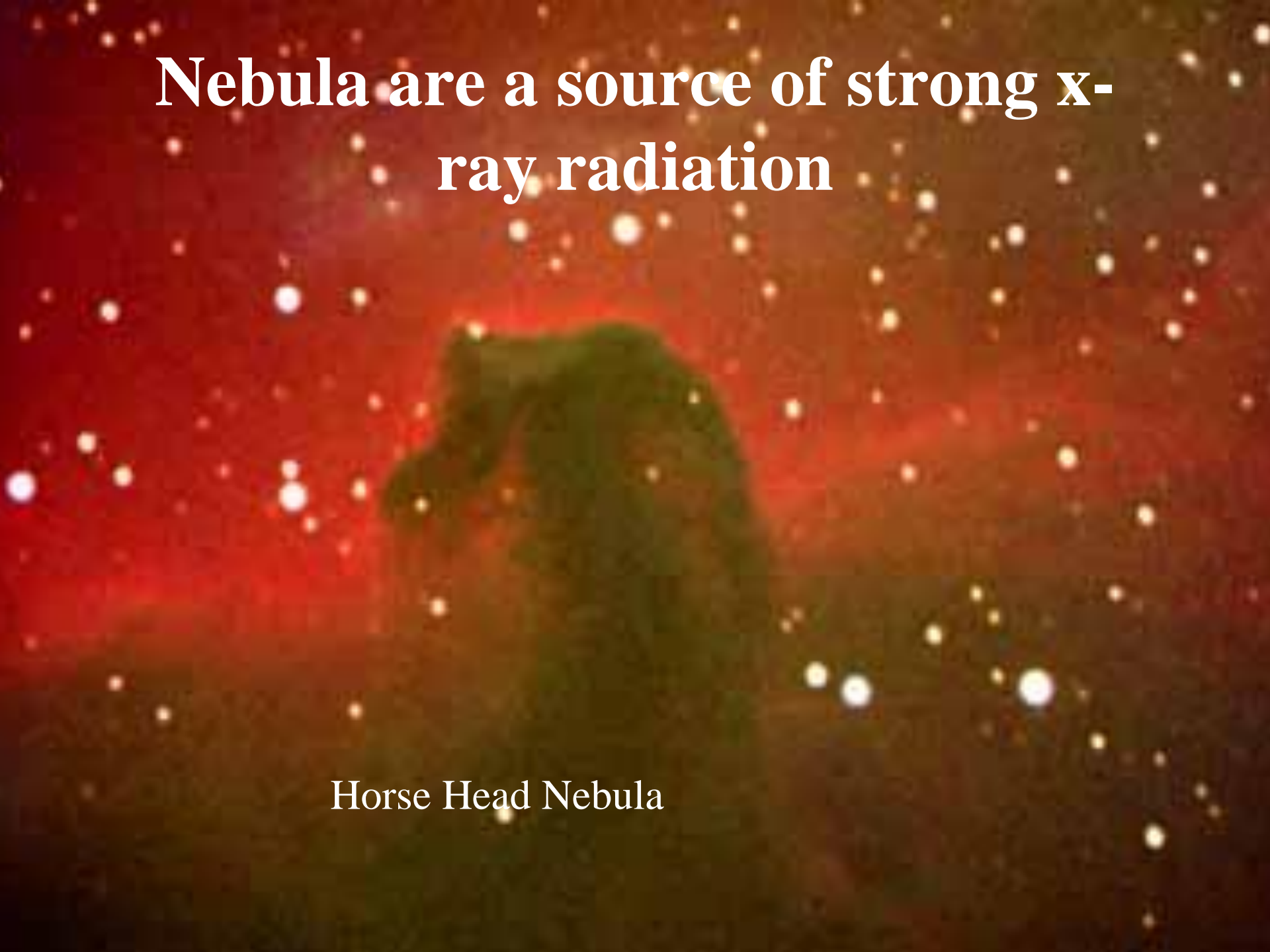






**Nebula are a source of strong x-ray radiation**

Horse Head Nebula



# A neutron star

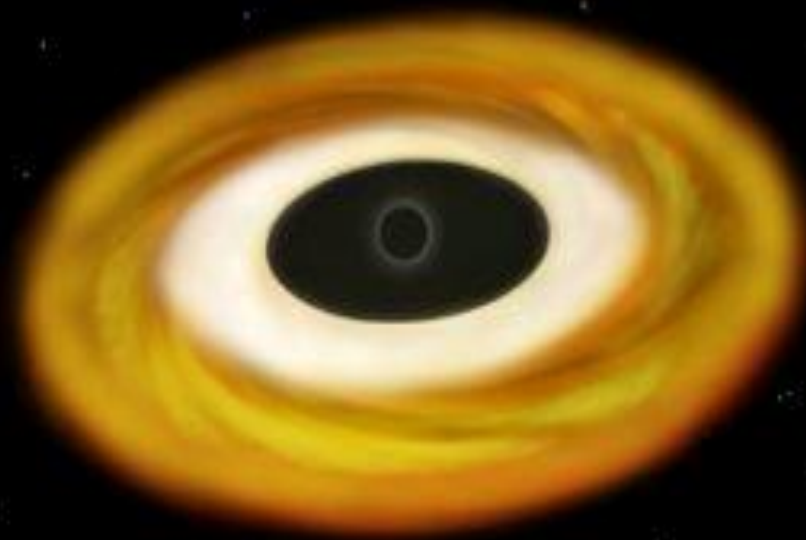
- A star that the electrons are forced into the protons so they become neutrons. Thus all matter in the star becomes neutrons
- A neutron star is very small
- A neutron star with the same mass of the sun has a diameter of 10 km
- A neutron star spins very rapidly releasing energy as they spin
- Spinning neutron stars are called pulsars which eventually stop spinning



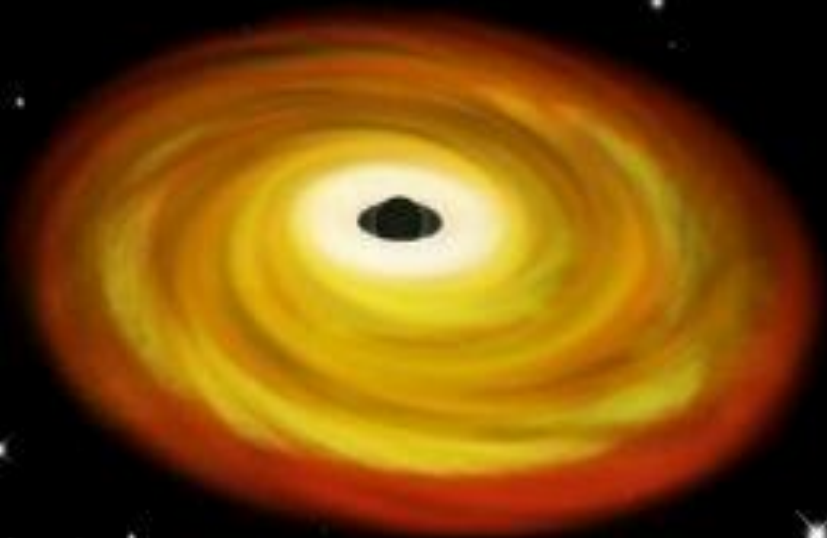
# A black hole

A black hole is depicted as a bright, glowing orange and yellow sphere at the center, surrounded by a thick, multi-layered accretion disk. The inner disk is a vibrant orange, while the outer layers transition to a deep red and finally a dark, almost black color. Two powerful jets of blue and white light extend from the poles of the black hole, reaching towards the top and bottom of the frame. The background is a dark, starry space with a subtle reddish-brown hue.

- **An area in space where gravitation is so strong that light cannot escape**
- **Black holes could be the result of a neutrons star disappearing within itself**



NON-SPINNING BLACK HOLE



SPINNING BLACK HOLE

# **The Sun's lifespan**


- **A main sequence yellow star**
- **Scientist estimate that the hydrogen will change to helium in the sun in the next 5 billion years**
- **When 98% of the hydrogen turns to helium the sun will turn into a red giant and increase in size enough to engulf mercury and maybe earth**
- **The sun would be 1000 times brighter**
- **From this point the sun will slowly cool and collapse into a white dwarf and eventually into a neutron star and a black hole**



# Interstellar space

- The area between the stars and galaxies is not empty
- Nebulas exist between stars
- The main gasses in space are hydrogen and helium
- Large amounts of dust around a star can make it appear red and absorb most of the radiation from the star.
- Galaxies

# The Milky Way galaxy

- The one that the solar system is in
  - It is 100,000 light years across
- 
- In the center of our galaxy is the galactic nucleus maybe a black hole
  - Everything revolves around the galactic nucleus
  - It takes our sun 230 million years to make one revolution around the nucleus



# Galaxies

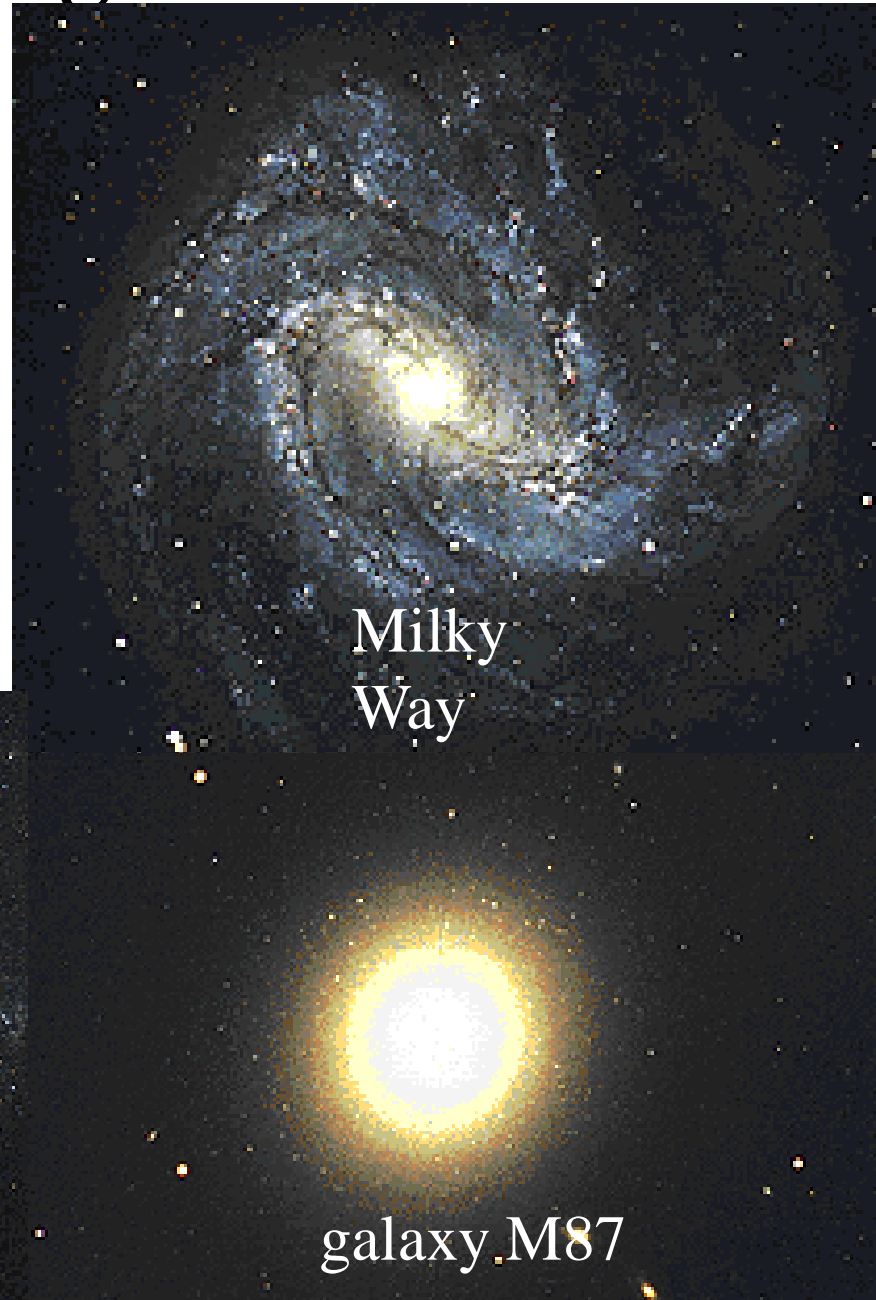


- **There are 16 galaxies within 3,000,000 light years of the Milky Way**
- **Andromeda is another spiral galaxy two times the size of ours about 2,000,000**



# Three types of galaxies

- **Spiral with arms that radiate from the nucleus**
- **Irregular, which has no specific shape.**
- **Elliptical which look like a slightly flattened sphere**



Milky  
Way



Magellenic  
Cloud

galaxy M87

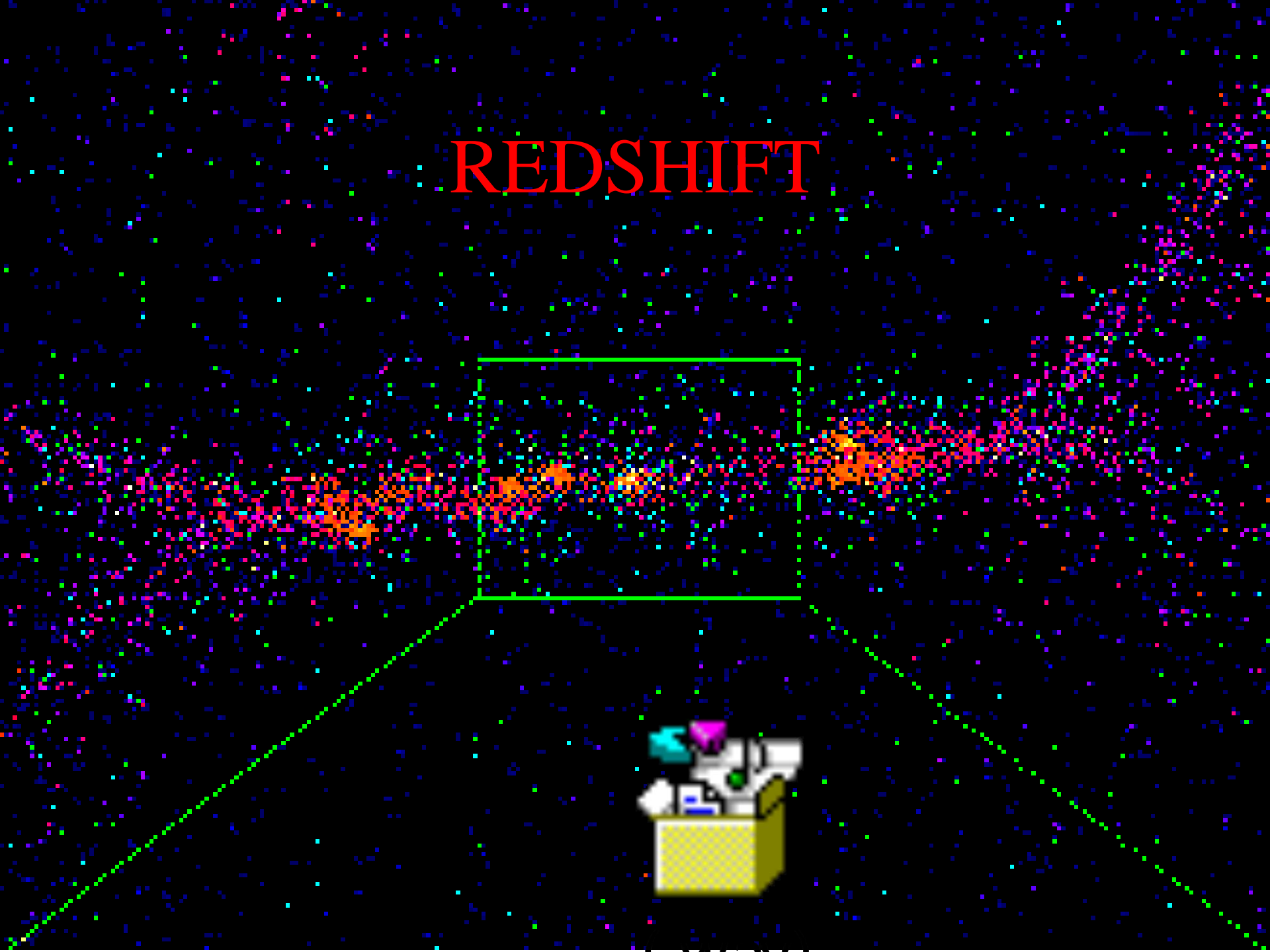


# Galactic Movement

- **Galaxies appear to be moving away from each other**
- **When light from other galaxies there is a shift to the red end of the light spectrum called the red shift**
- **This supports the idea that the galaxies are moving away from each other**



# REDSHIFT



# **Origin to the universe**

- **Three theories**
  - **Big bang**
  - **Study State**
  - **Creator Designer**



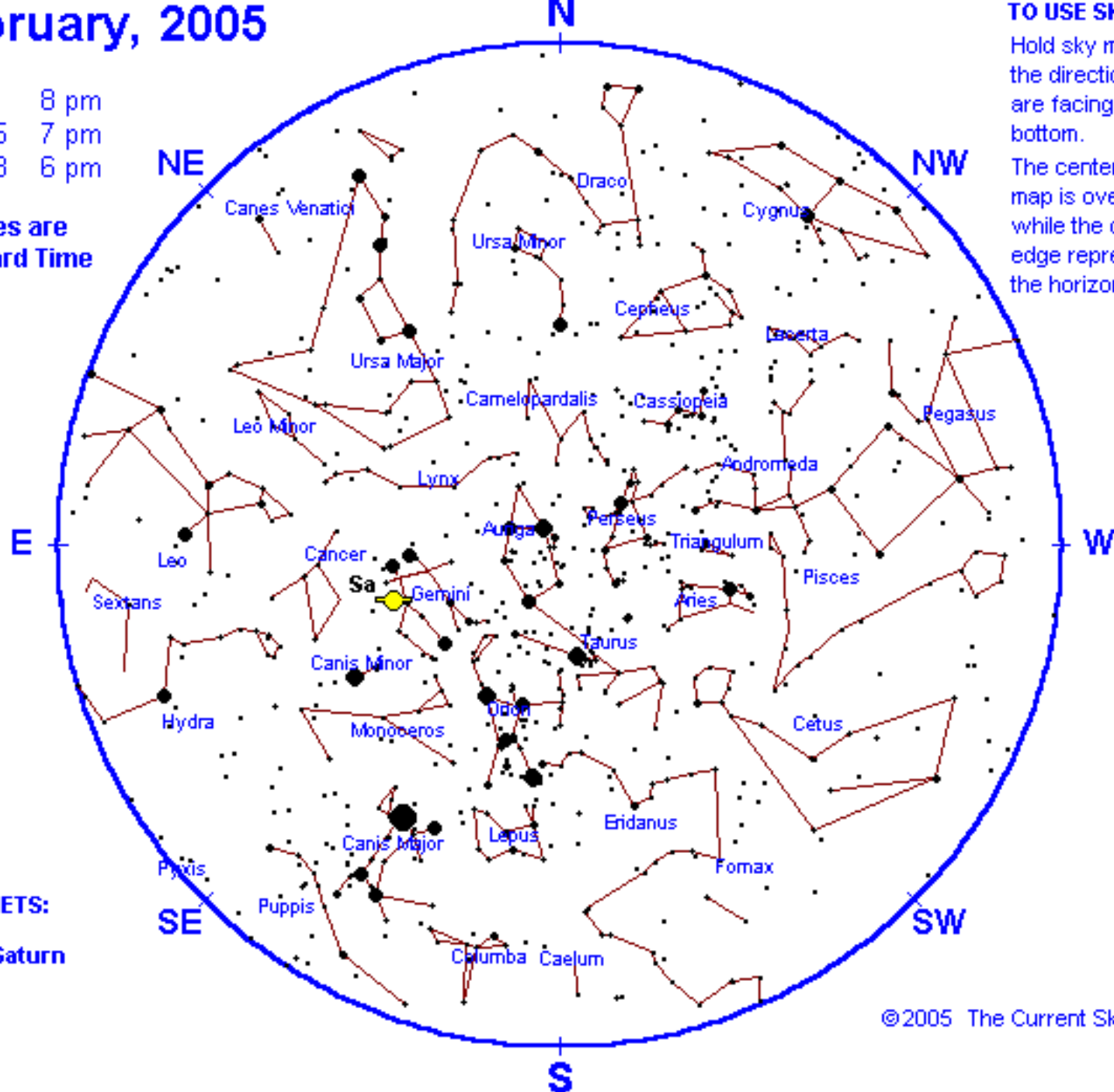
# Constellations



# February, 2005

Feb 1 8 pm  
Feb 15 7 pm  
Feb 28 6 pm

All times are  
Standard Time



**TO USE SKY MAP:**  
Hold sky map with  
the direction you  
are facing at the  
bottom.

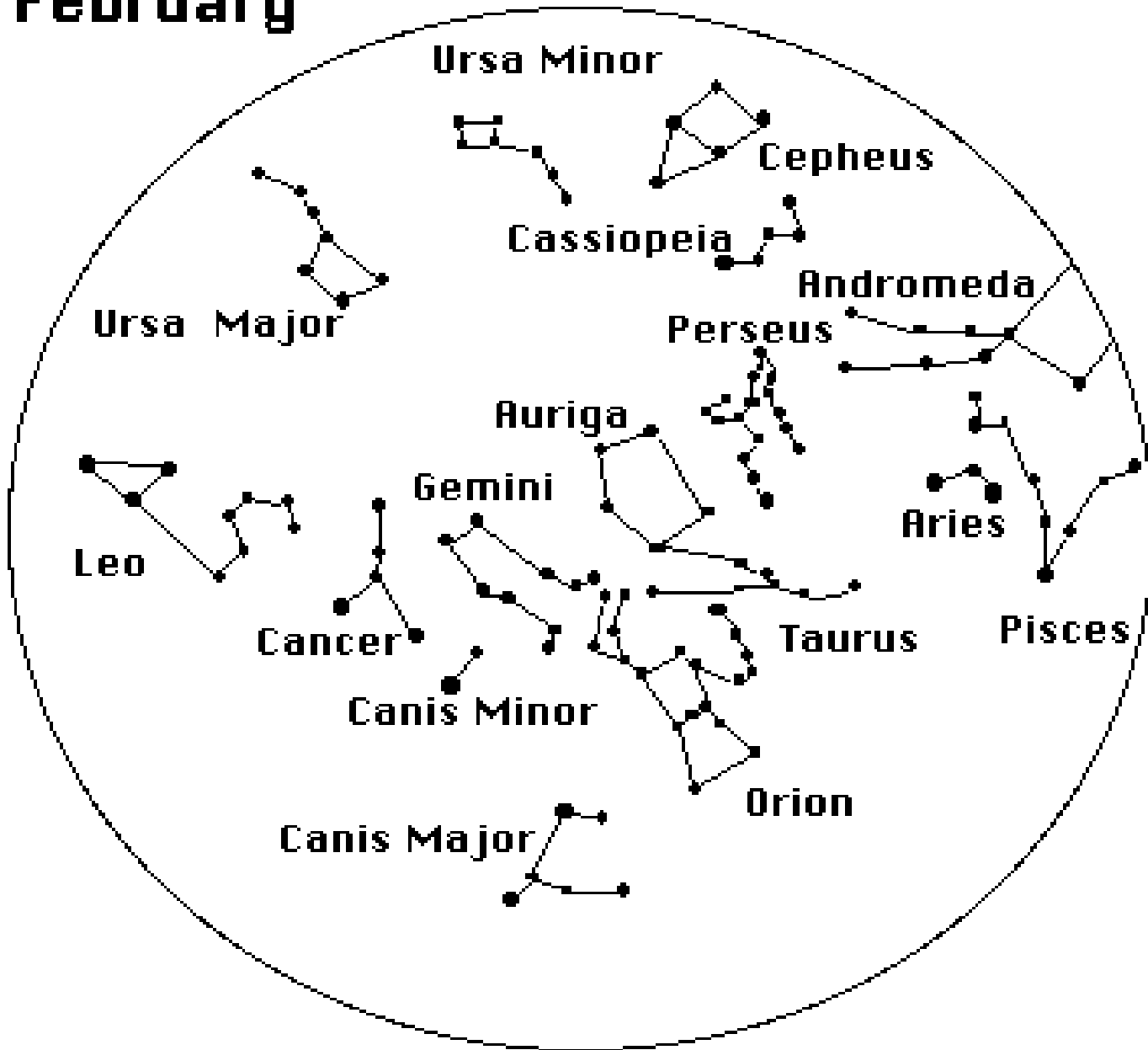
The center of the  
map is overhead  
while the circular  
edge represents  
the horizon.

**PLANETS:**

Sa = Saturn

# February

North



West

East

South

**March**

**North**

**Cepheus**

**Ursa Minor**

**Andromeda**

**Cassiopeia**

**Ursa Minor**

**Perseus**

**Aries**

**Bootes**

**Auriga**

**Taurus**

**East**

**Gemini**

**West**

**Virgo**

**Leo**

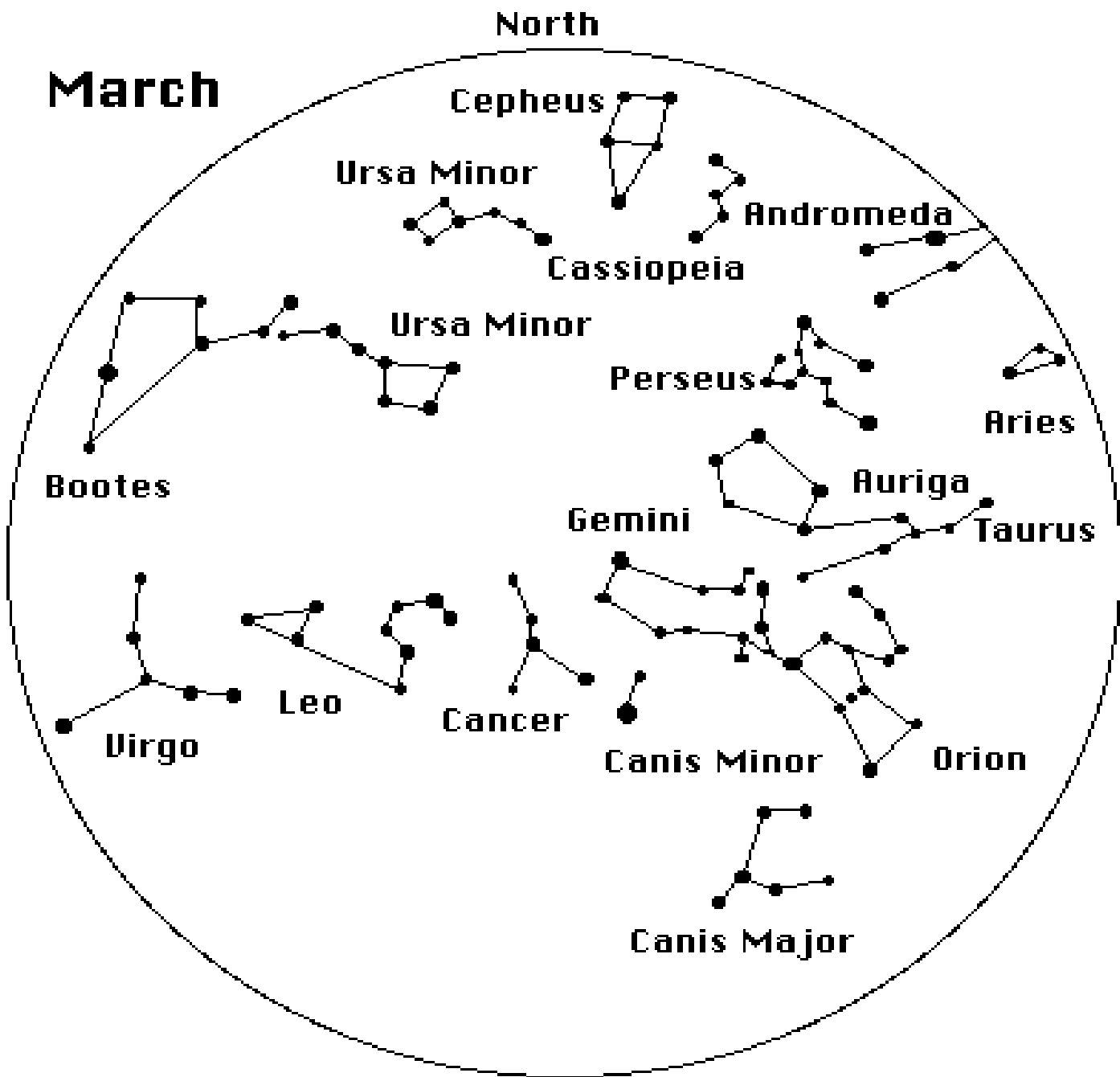
**Cancer**

**Canis Minor**

**Orion**

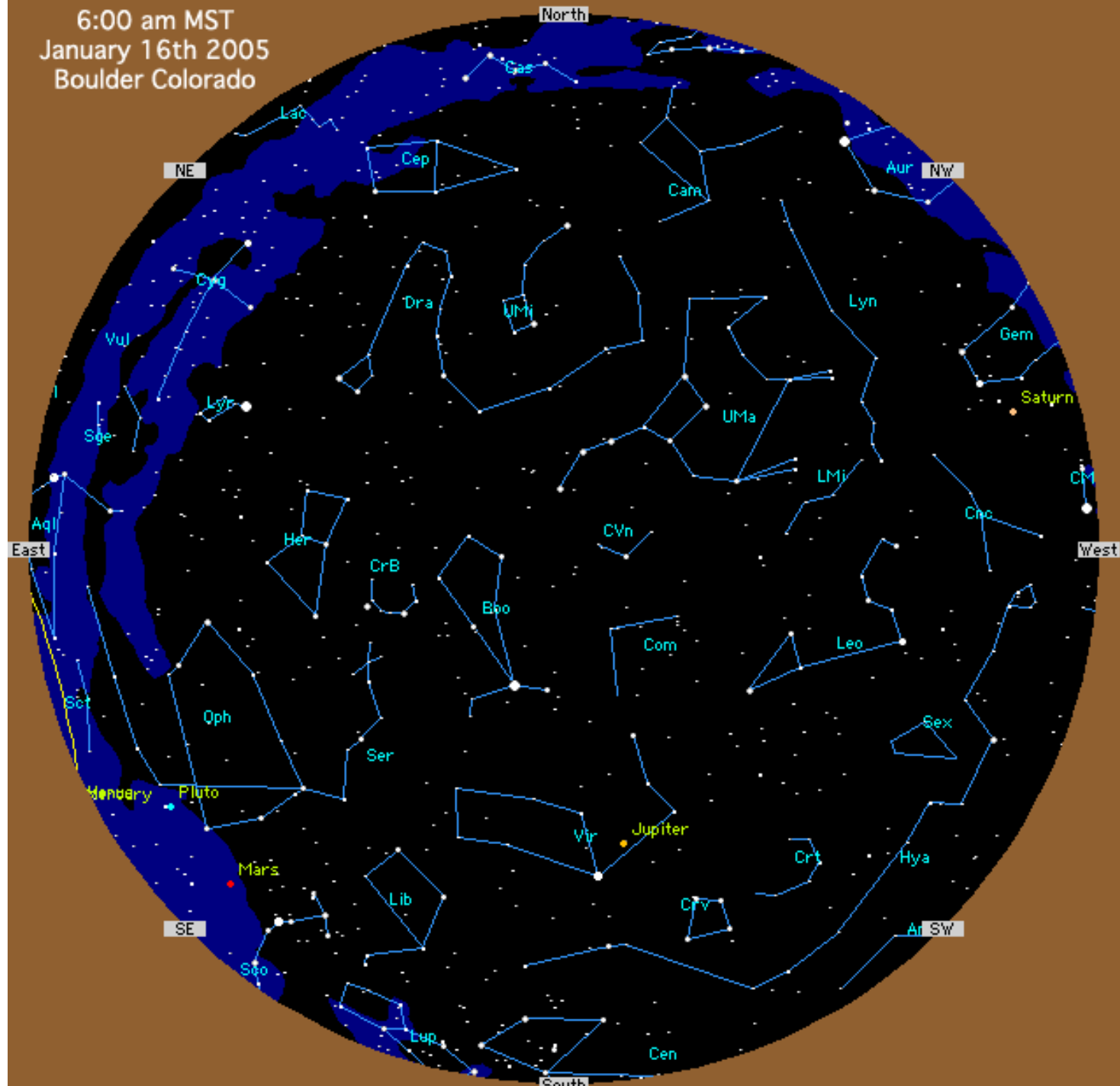
**Canis Major**

**South**





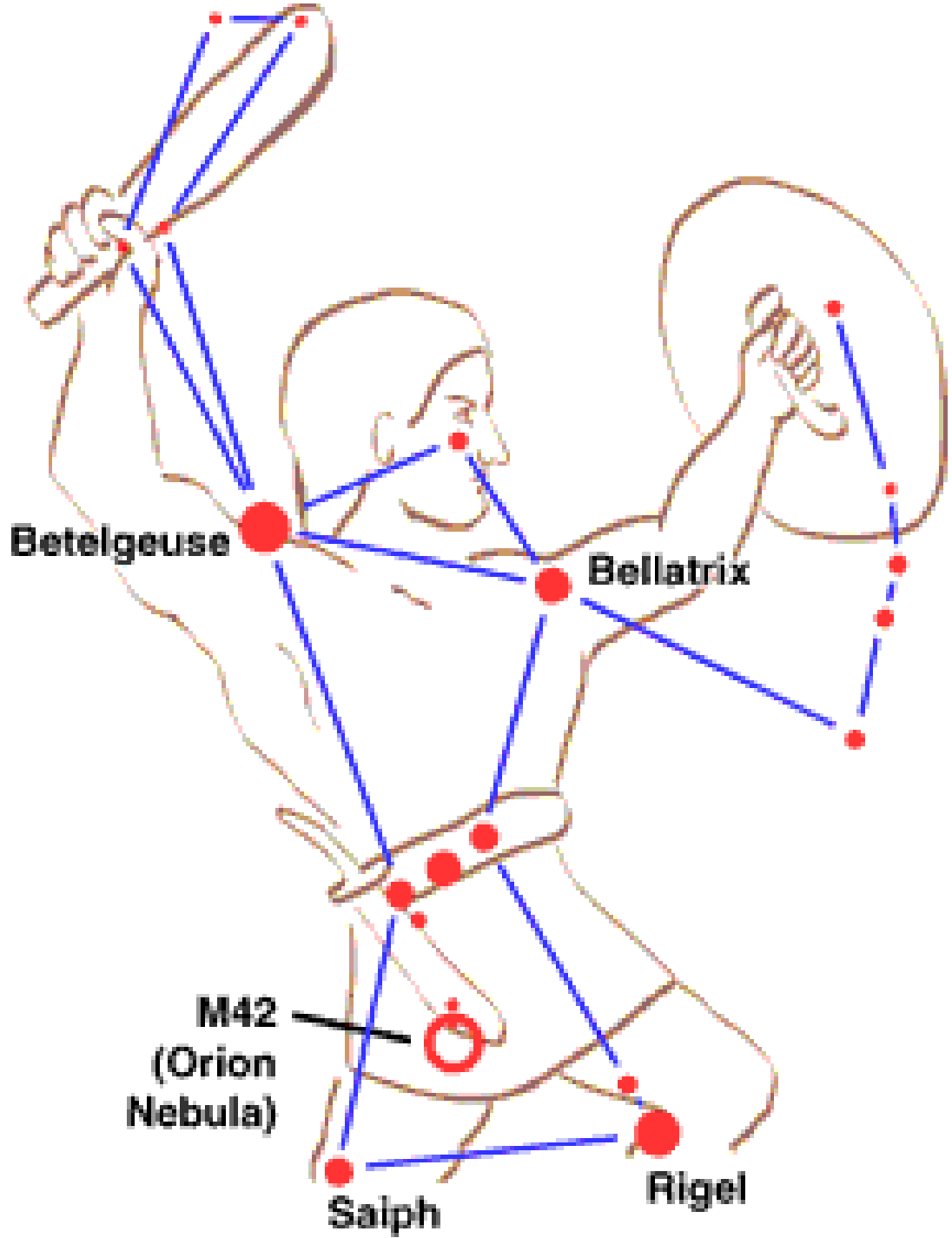
6:00 am MST  
January 16th 2005  
Boulder Colorado





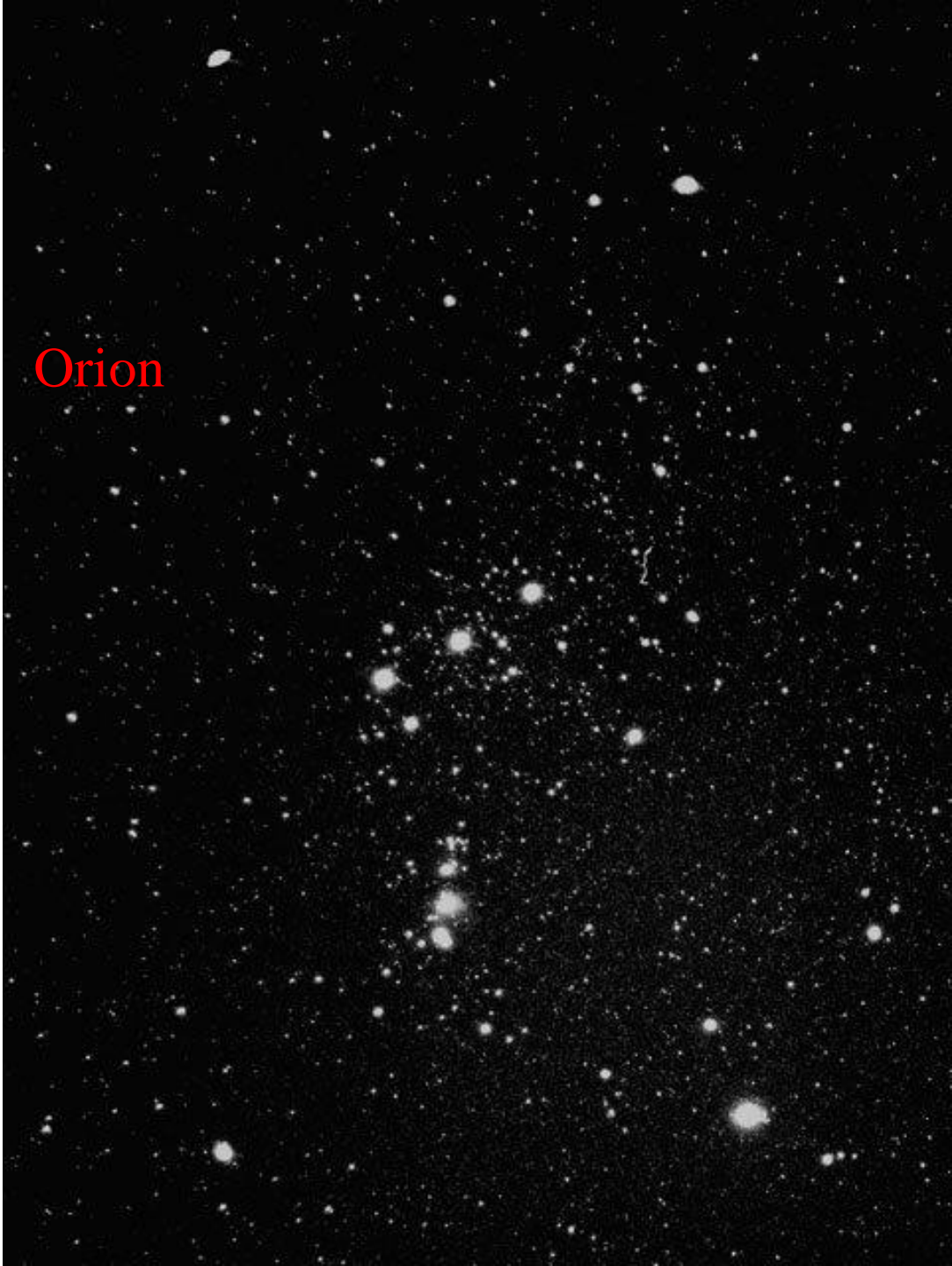


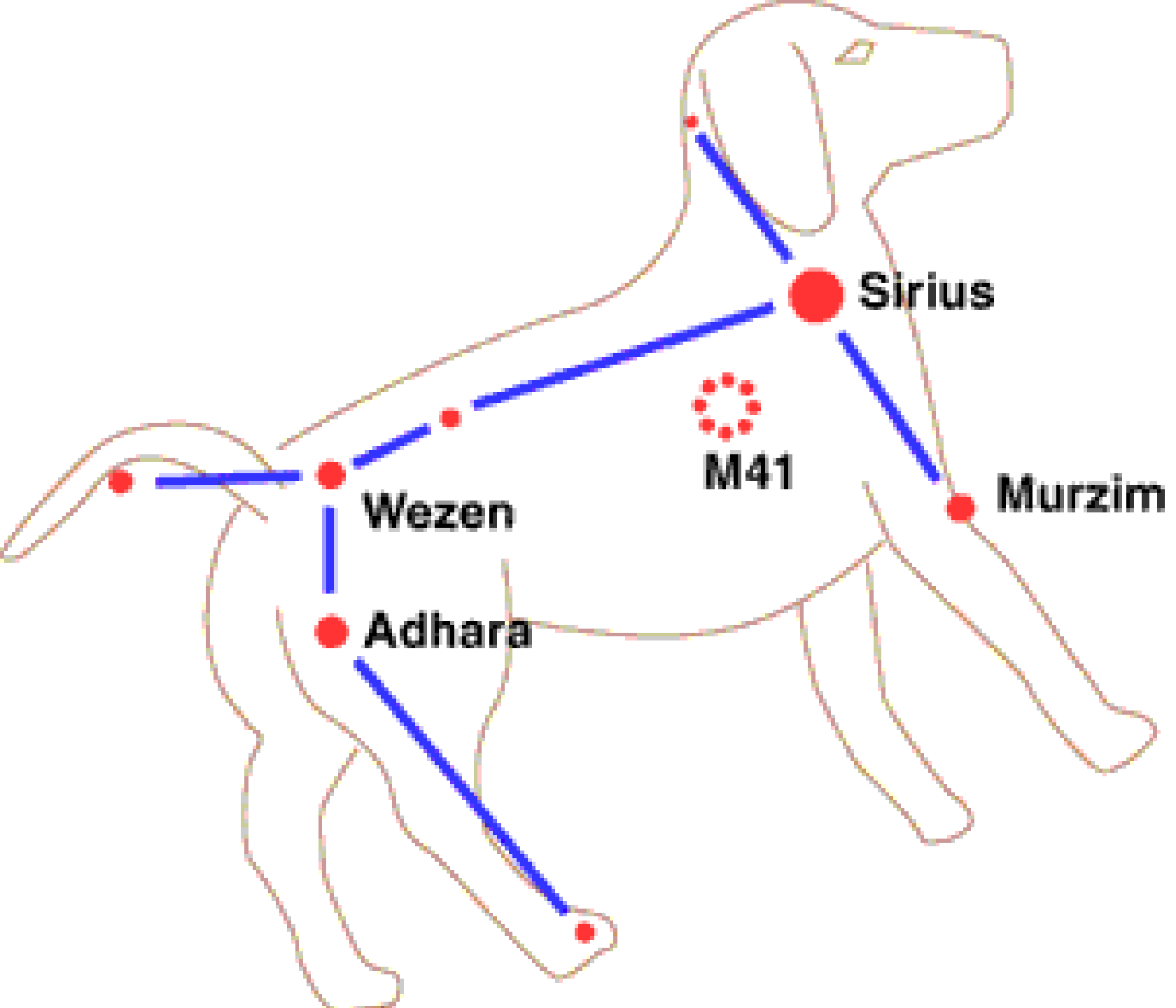
Taurus





Orion









Pleiades







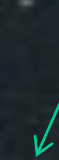






# Ursa Minor

polaris



Leo the  
lion

Denebola

Algieba

Regulus







# Auriga







