Module 3 – Nautical Science

Unit 4 – Astronomy

Chapter 15 - The Planets

Section 1 – Planets Overview, Mercury & Venus

What You Will Learn to Do

Demonstrate understanding of astronomy and how it pertains to our solar system and its related bodies: Moon, Sun, stars and planets

Objectives

1. Describe the solar system in which we live
2. Identify the major characteristics of the planet Mercury
3. Describe special features of Venus as it related to our solar system

Key Terms

CPS Key Term
Questions 1 - 9

Key Terms

Planet -	A heavenly body that revolves around a star
Dwarf Planet -	A spherical celestial body revolving about the sun but not large enough to gravitationally clear it's orbital region of most or all celestial bodies. Pluto is a dwarf planet

Key Terms

Ephemeris -	An astronomical almanac containing tables showing the positions of a heavenly body on a number of dates in a regular sequence
Almanac (celestial) -	A publication containing astronomical information, usually including future positions of celestial objects, star magnitudes, and culmination dates of constellations

Key Terms

Retrograde Motion -	Moving backward; having a backward motion or direction
Orbital Period -	The time it takes an orbiting body to go around the Sun
Ellipse -	A conic section formed by the intersection of a right circular cone by a plane that cuts the axis and the surface of the cone

Key Terms

Plane of the Ecliptic -	Earth's orbit about the Sun, called the plane of the ecliptic, is the usual reference to which the orbital planes of all the other bodies in the solar system are compared
Orbital Inclination -	The angle between the plane of the orbit and the plane of the ecliptic stated in degrees

Opening Question

Name the eight traditional, or “classical,” planets in order from the Sun.

1.

2.

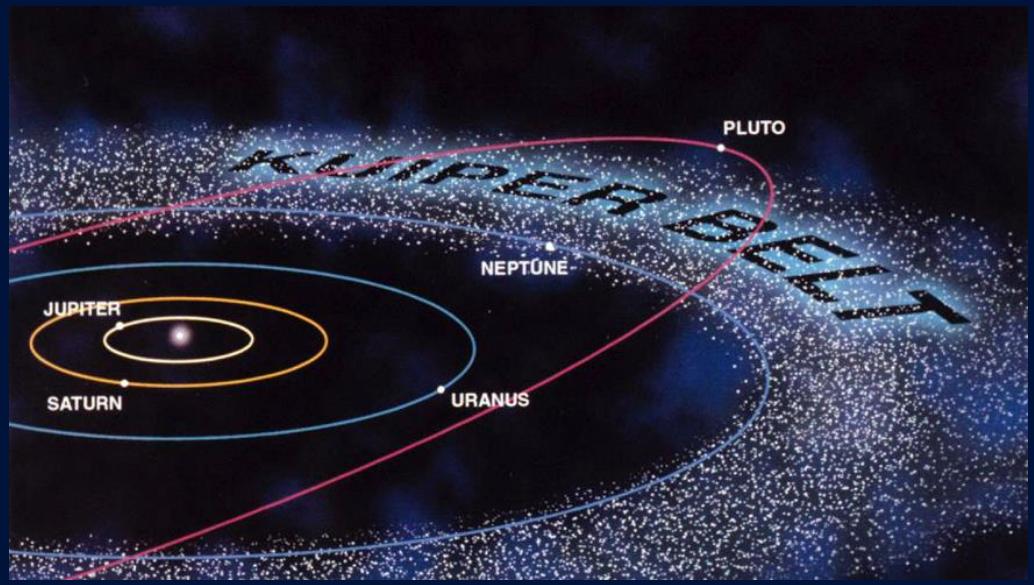
3.

(Use CPS “Pick a Student” for this question.)

Introduction

Up until 2006, there were nine planets in our solar system with Pluto being the farthest from the Sun.

In the late 1990s, bodies were discovered beyond Pluto, in the Kuiper Belt, at least the size of Pluto.



Were these to be considered planets as well?

Introduction

In 2006 the International Astronomical Union (IAU) defined a planet as having to satisfy all 3 criteria:

1. A planet is a body that orbits the Sun
2. Is massive enough for its own gravity to make it round
3. “Cleared its neighborhood“ of smaller objects around its orbit

Introduction

Under this definition, Pluto and the newly discovered bodies of comparable size beyond Pluto were not planets since they did not satisfy the third criterion.

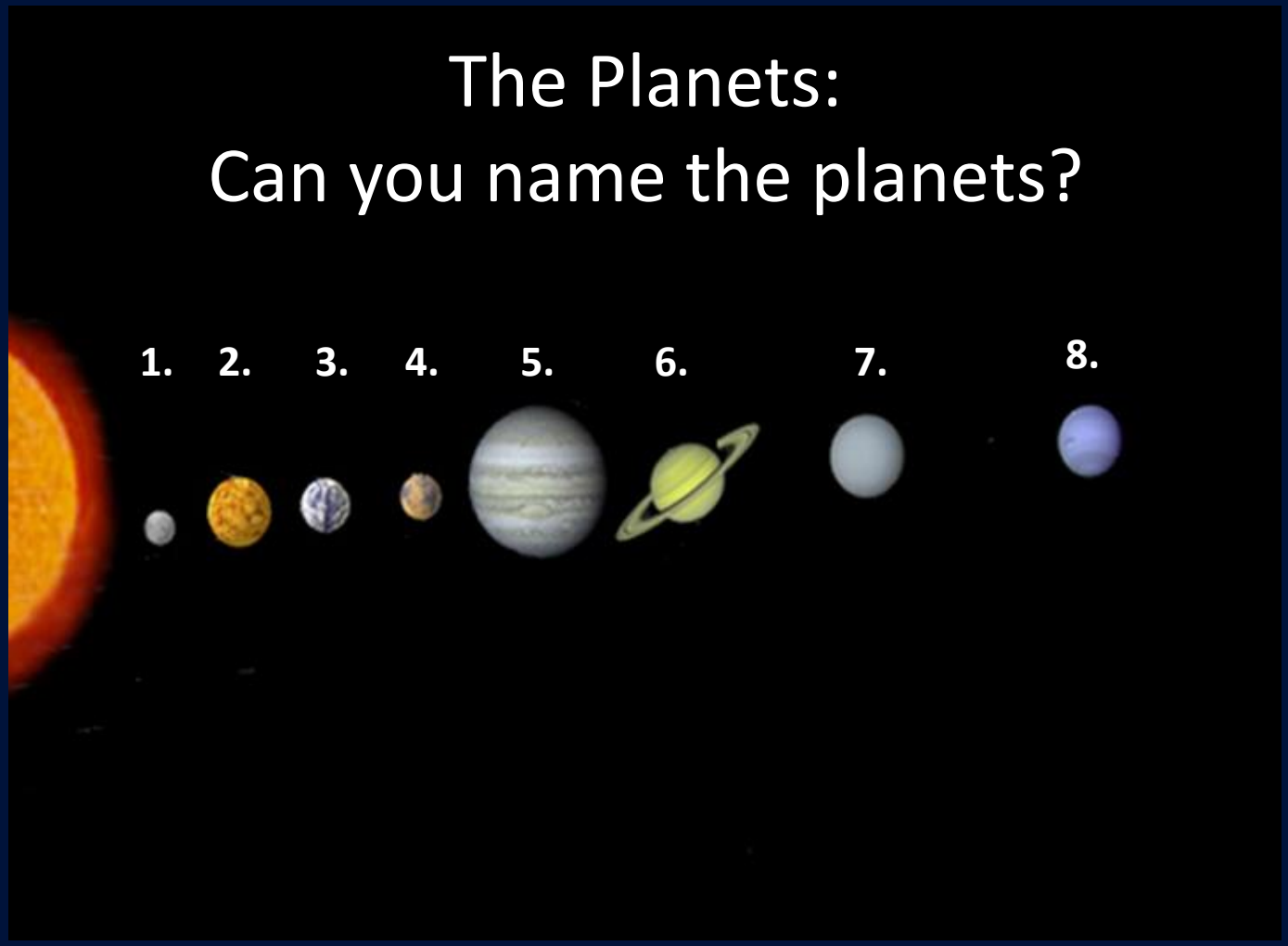
They were reclassified into a new category called dwarf planets.

Introduction

Traditional and Dwarf Planets

Under the new definition there are now considered to be eight traditional or “classical” planets in our solar system, plus Pluto and four other dwarf planets in its outer regions.

Traditional and Dwarf Planets



Traditional and Dwarf Planets

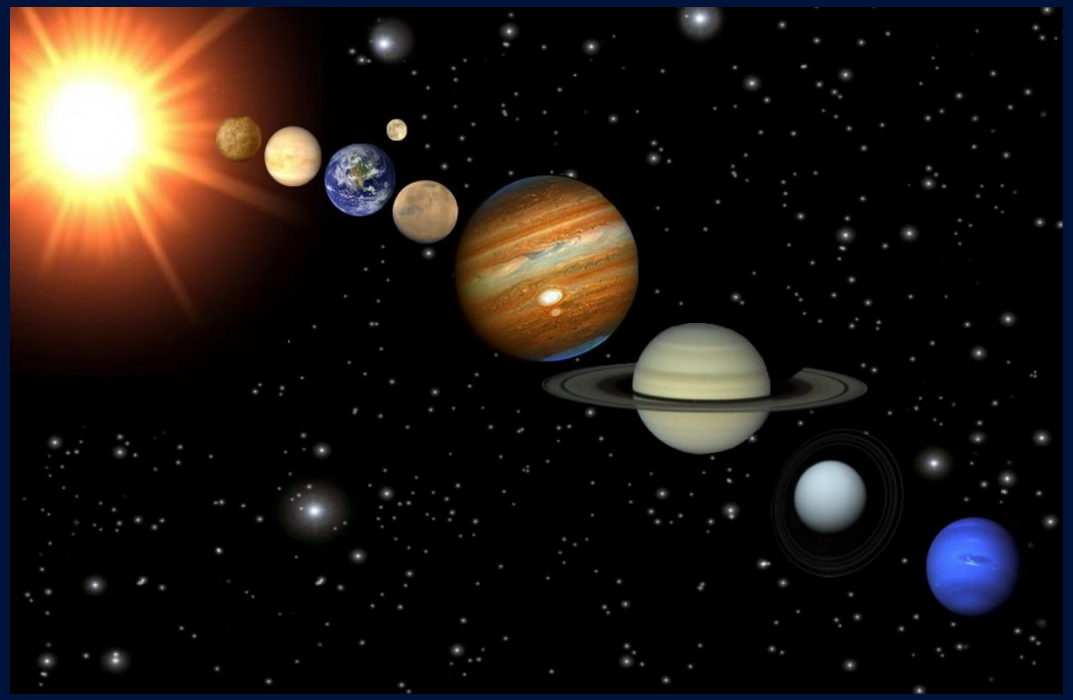
Answers to naming the planets:

1. Mercury
2. Venus
3. Earth
4. Mars
5. Jupiter
6. Saturn
7. Uranus
8. Neptune

Traditional and Dwarf Planets

Mercury scorches under the intense rays of the Sun. Venus and Mars have some similarities to Earth.

Jupiter, Saturn, and Neptune are strange, cold, and composed of poisonous gases and chemical compounds uncommon on Earth.

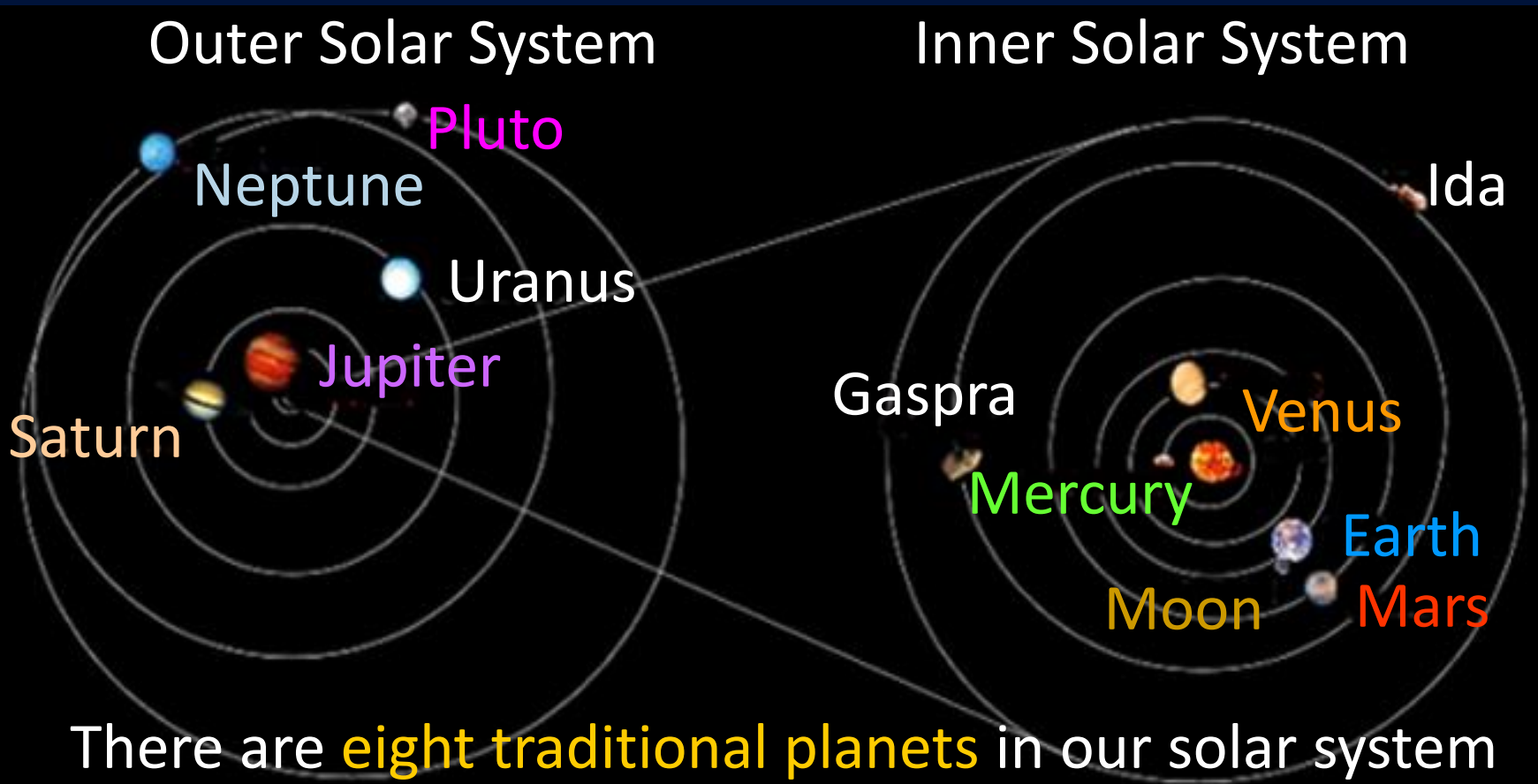


Traditional and Dwarf Planets

The dwarf planets are small, cold, rocky bodies with tenuous if any atmospheres.

They are so far away and dimly lit that they can only be observed by very powerful telescopes.

Traditional and Dwarf Planets



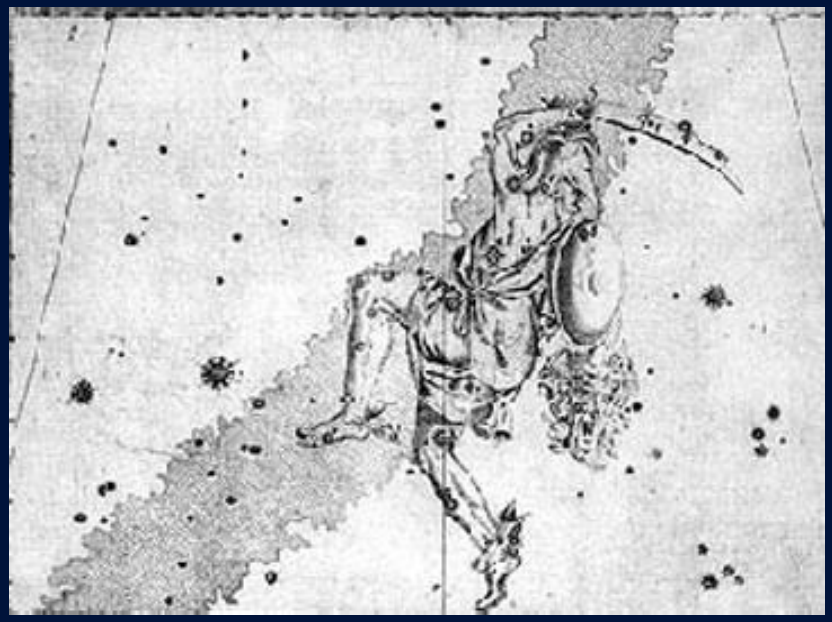
There are eight traditional planets in our solar system which circle the Sun in regular orbits.

Traditional and Dwarf Planets

Ancient Star Chart

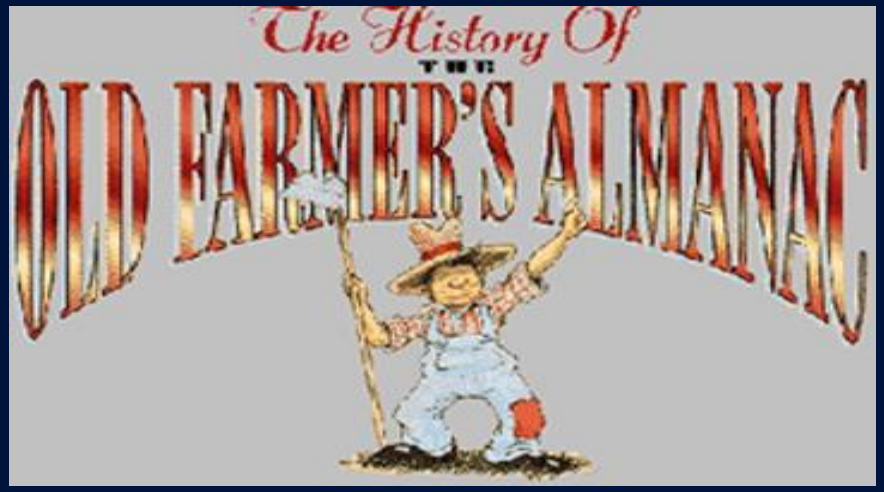
Ca. 940 A.D.

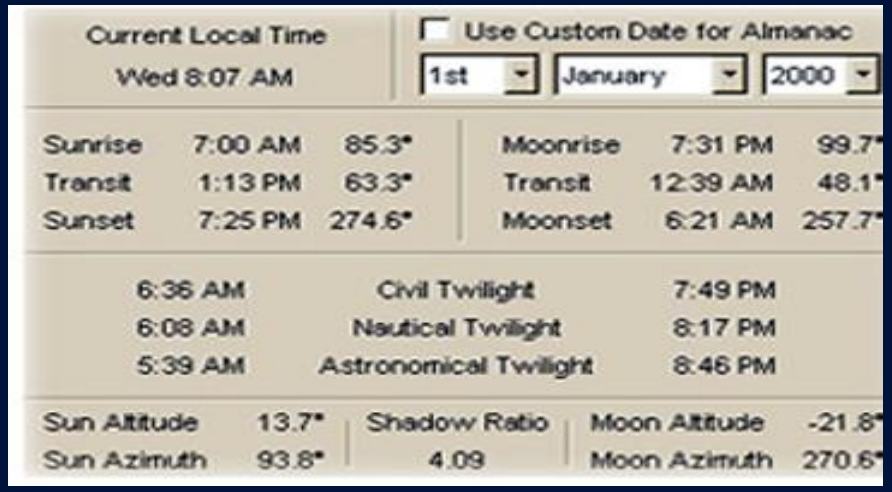
1600s

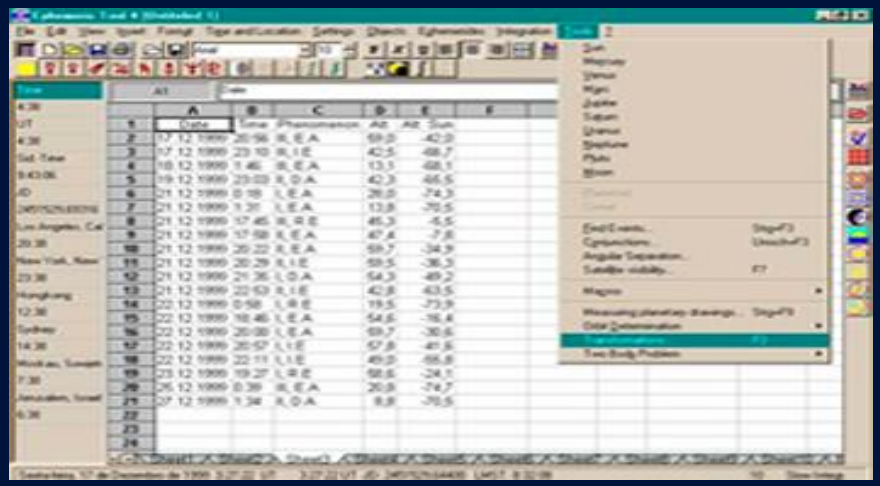


The word planet means “wanderer.”

Traditional and Dwarf Planets



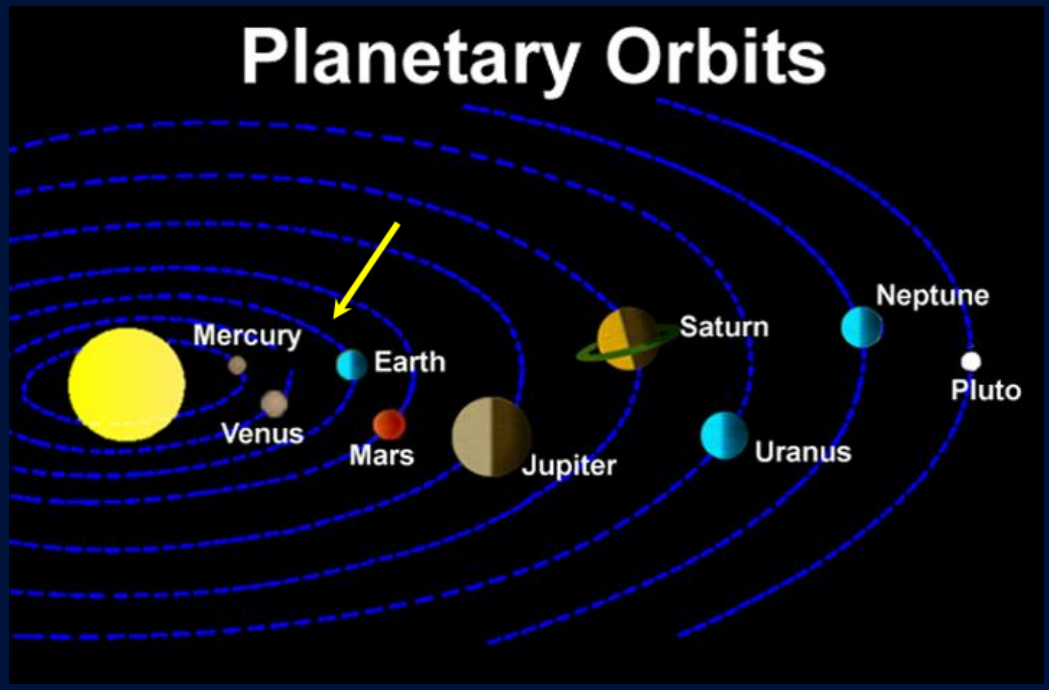




Since the planets are constantly moving, it is difficult to keep track of them without some sort of chart, like an almanac or ephemeris.

Traditional and Dwarf Planets

The traditional and dwarf planets all orbit the Sun in the same direction and generally in the same plane.



The Earth's orbit around the Sun is called the plane of the ecliptic to which the orbital planes of all the other bodies in the solar system are compared.

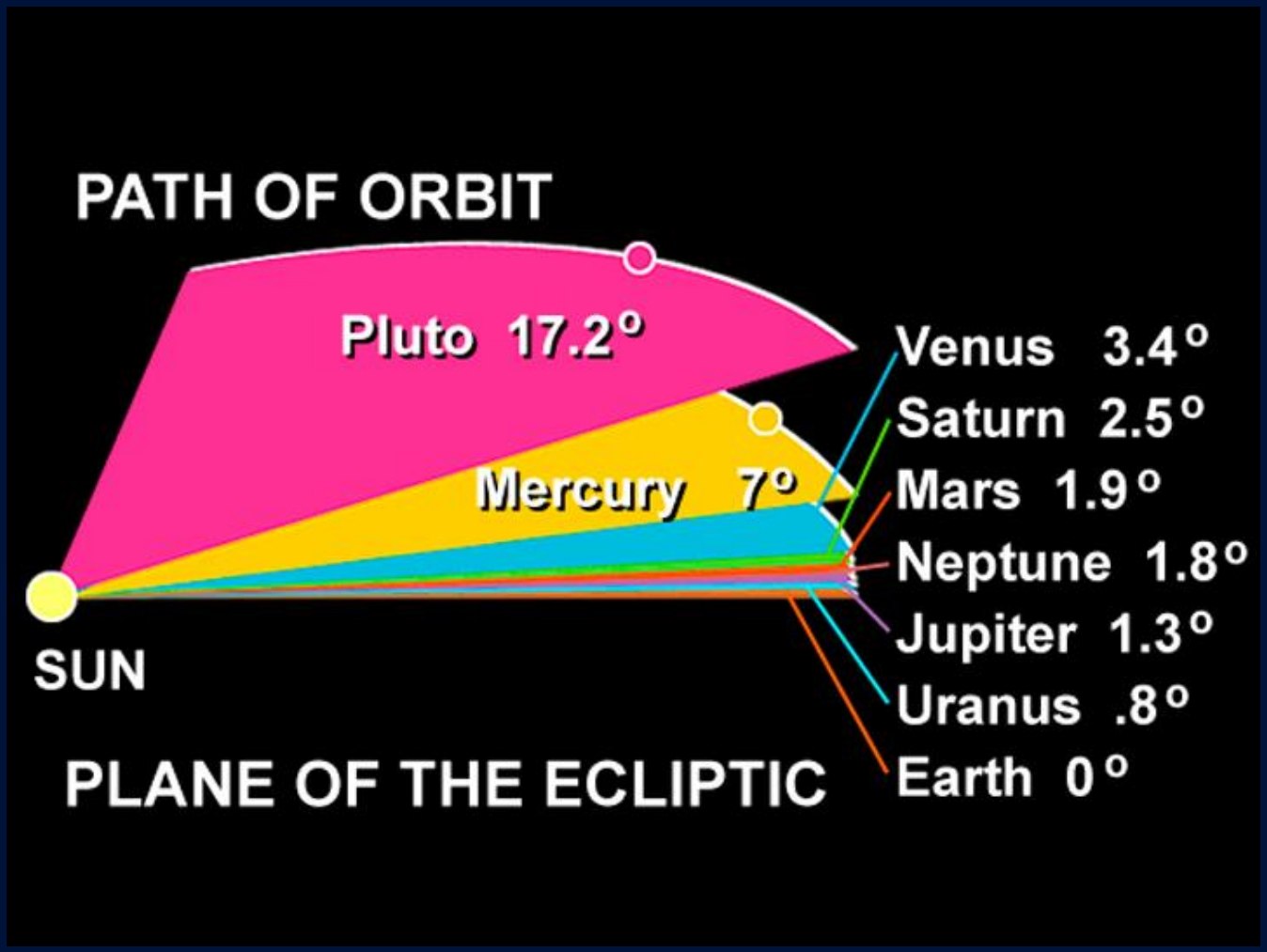
Check On Learning Questions

CPS Lesson

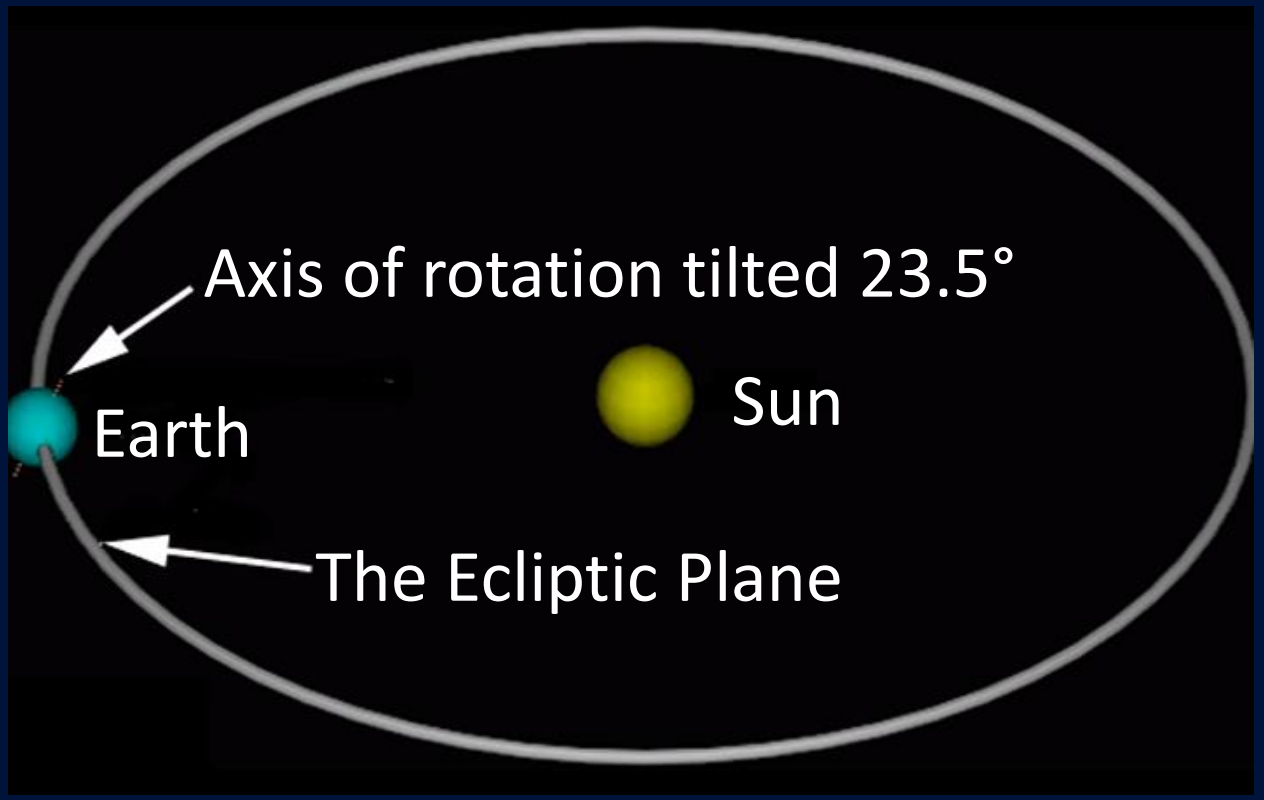
Question

3 - 4

Traditional and Dwarf Planets



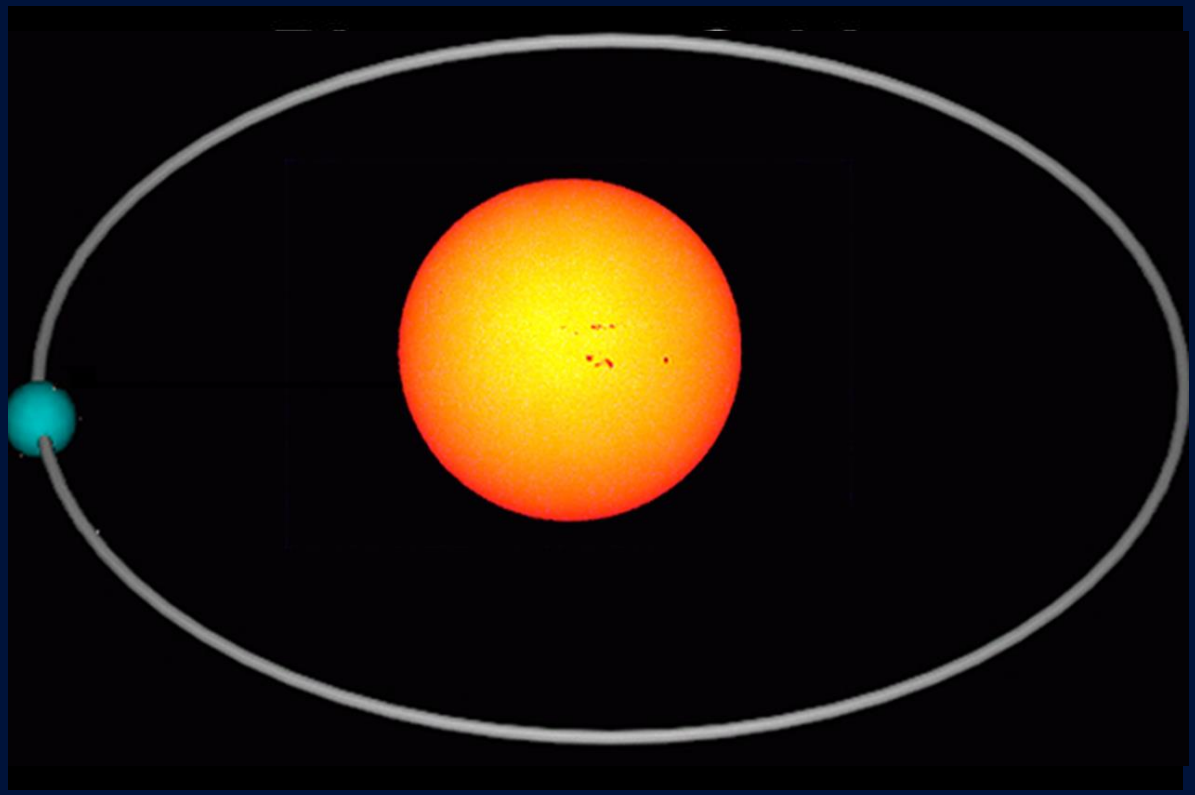
Traditional and Dwarf Planets



The Earth's average orbital radius is 93,000,000 miles and is called an astronomical unit.

Traditional and Dwarf Planets

The planets' orbits around the Sun are in an egg-shaped ellipse.

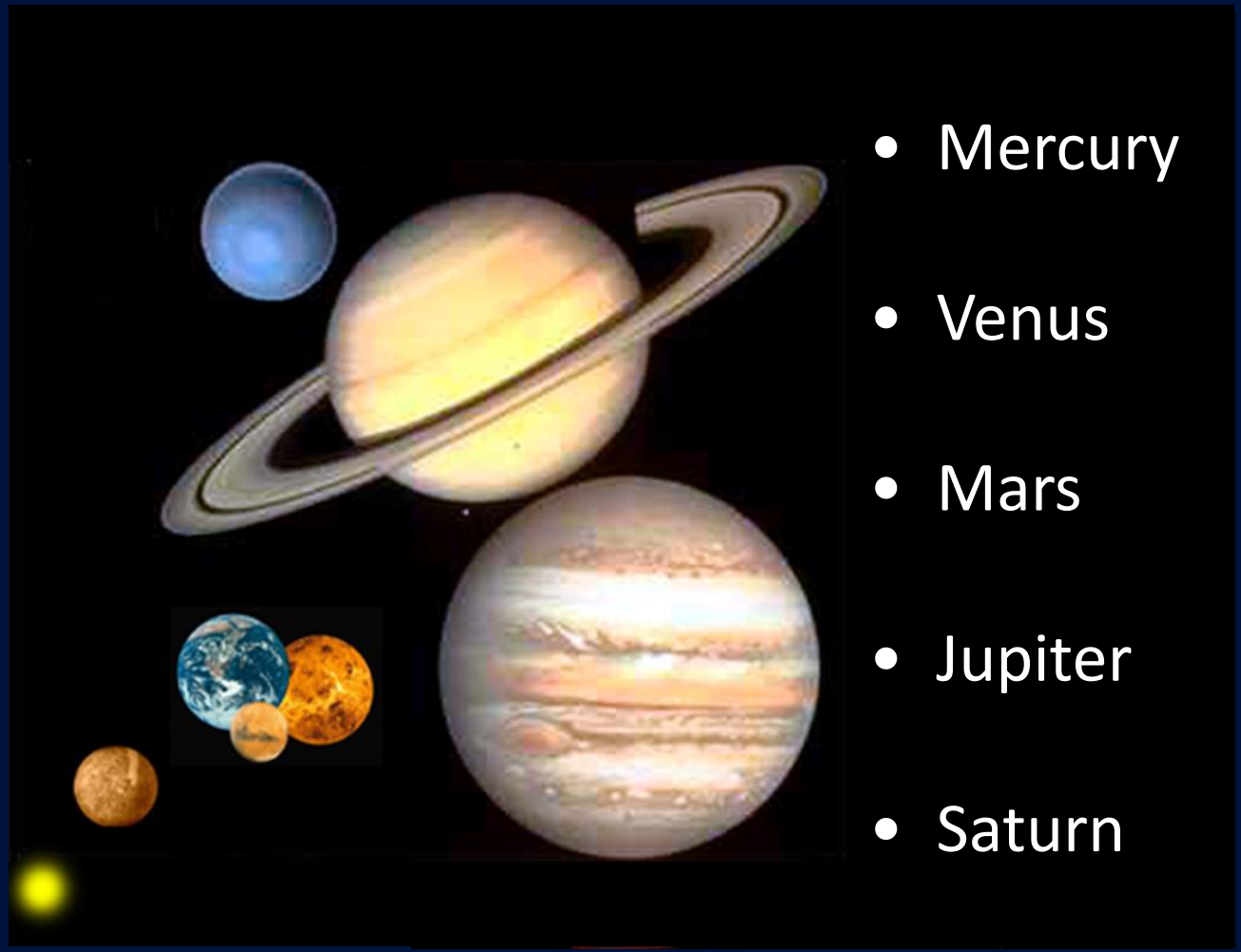


Planets travel in their elliptical paths, and travel faster when closer to the Sun and slower when farther away.

Traditional and Dwarf Planets

Size comparison of the eight planets

Five planets can be seen without the use of a telescope.

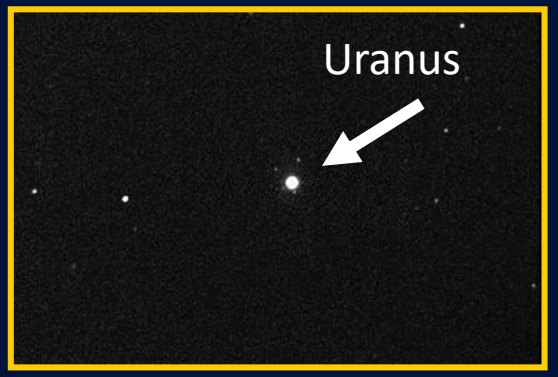


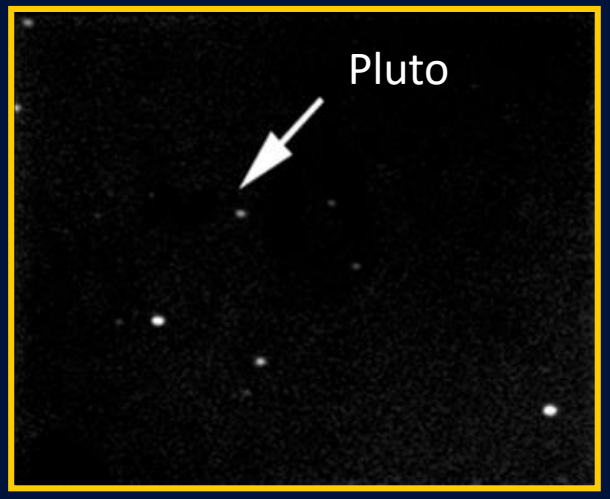
- Mercury
- Venus
- Mars
- Jupiter
- Saturn

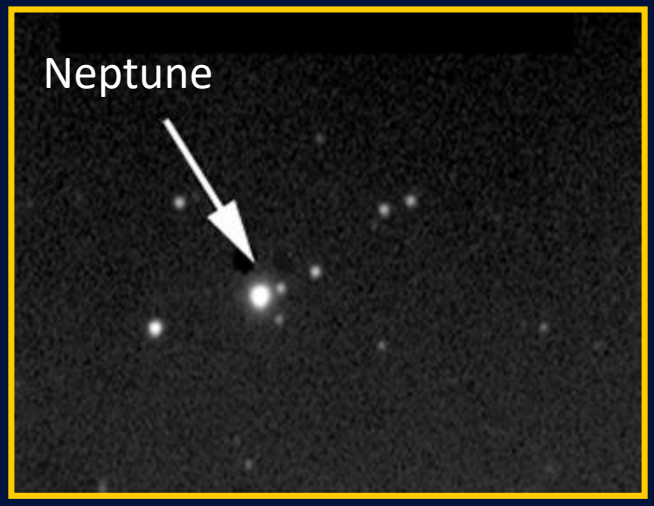
Traditional and Dwarf Planets
Uranus

Uranus is just at the limit of visibility.

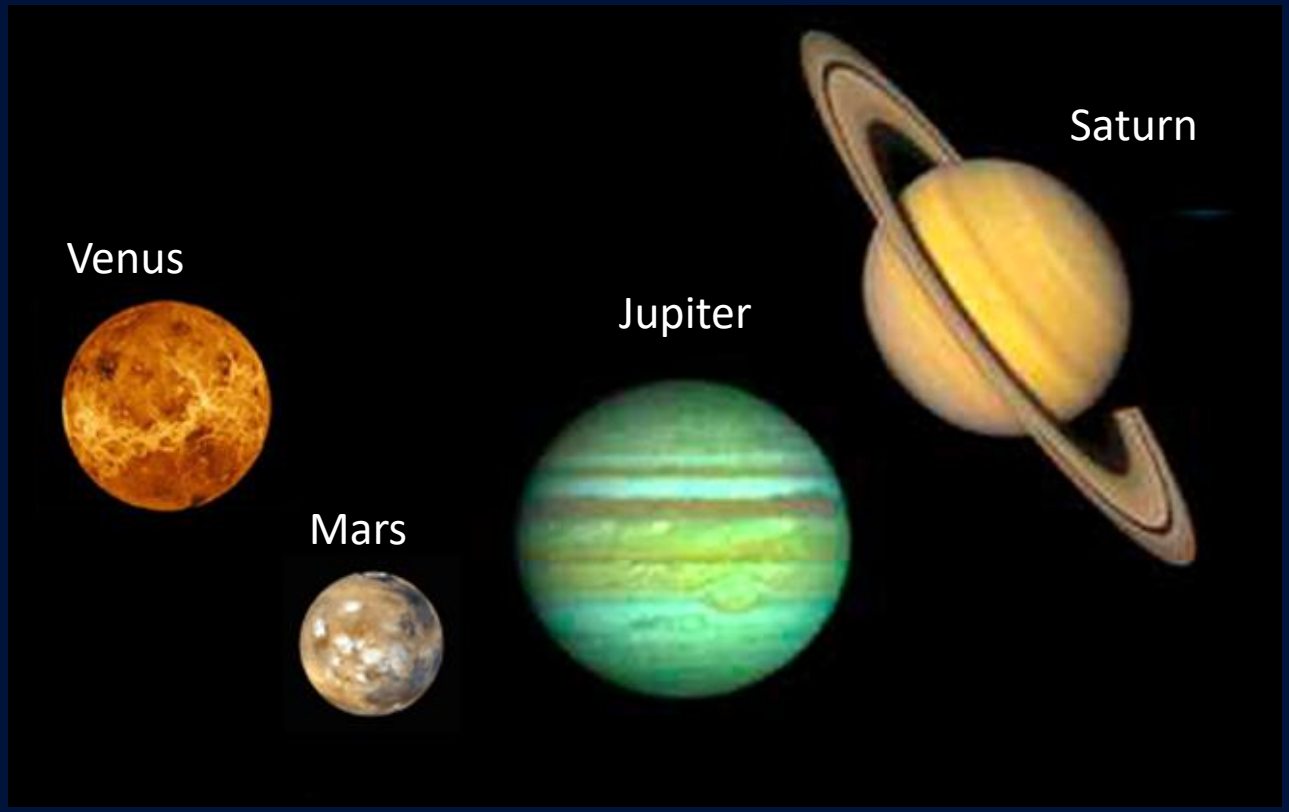
Neptune, Pluto, and the other dwarf planets can be seen only with a telescope.







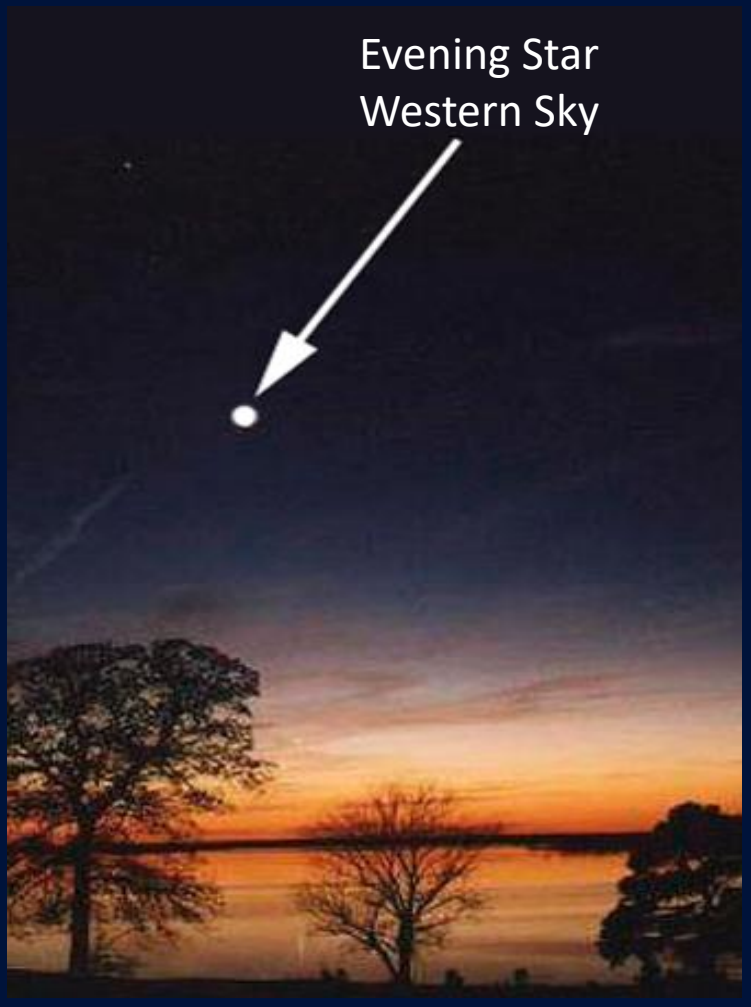
Traditional and Dwarf Planets



The planets Venus, Mars, Jupiter and Saturn are called the "Big Four" because they are so visible.

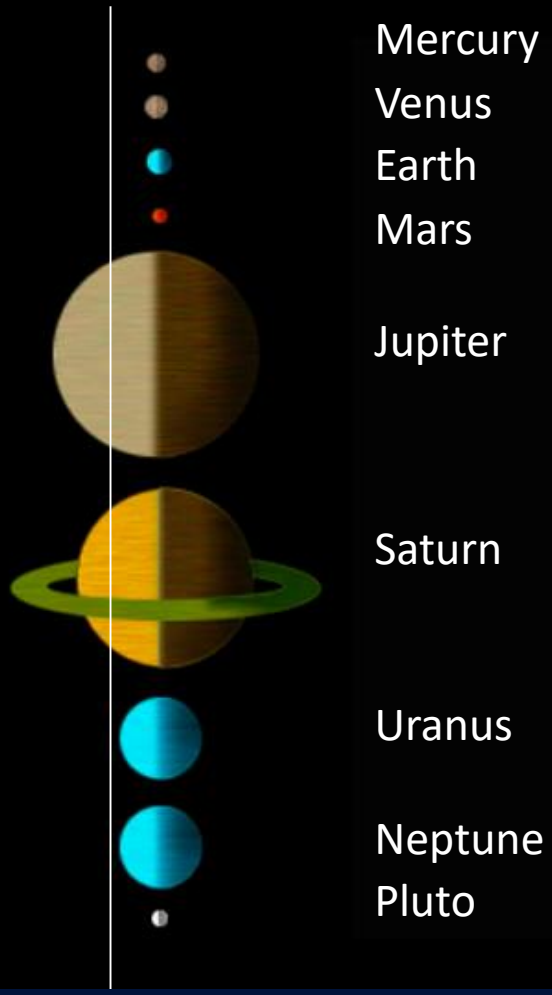
Traditional and Dwarf Planets

Venus can be seen only in the western sky just after sunset, or in the eastern sky just before sunrise. Thus it is called the evening star or the morning star.



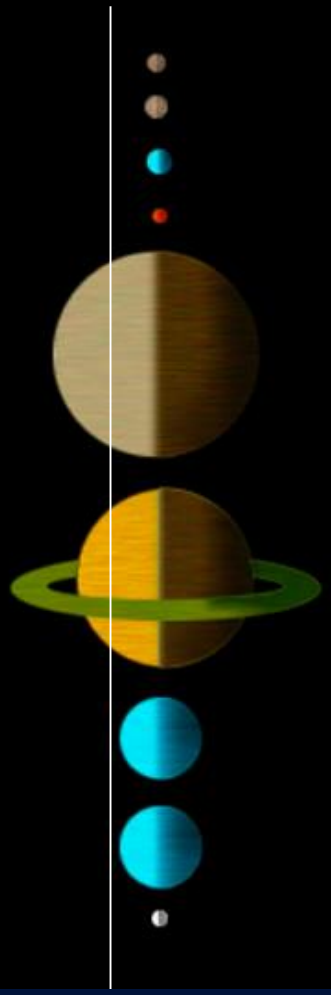
Traditional and Dwarf Planets

The following screens will compare statistics about each of the eight planets and the dwarf planet, Pluto.



Traditional and Dwarf Planets

Distance from the Sun in Astronomical Units



Mercury .387
Venus .723
Earth 1.000
Mars 1.524

Jupiter 5.203

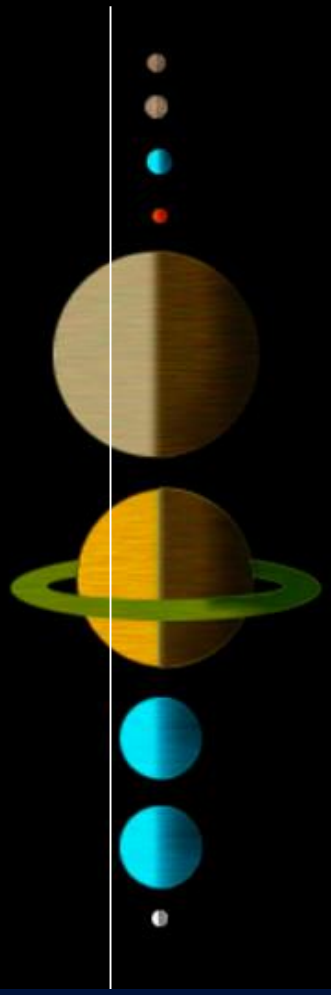
Saturn 9.539

Uranus 19.180

Neptune 30.060
Pluto 39.440

Traditional and Dwarf Planets

Planetary Diameter in Miles



Mercury 3,000
Venus 7,526
Earth 7,918
Mars 4,200

Jupiter 85,500

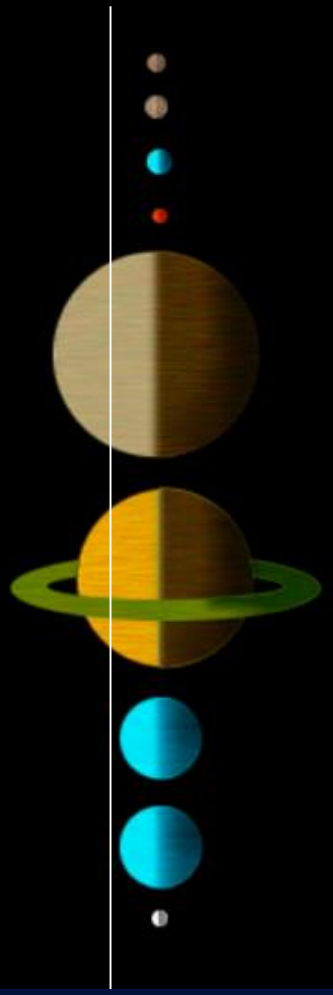
Saturn 71,400

Uranus 29,850

Neptune 31,250
Pluto 1,430

Traditional and Dwarf Planets

Mean Temperature in Degrees Celsius



Mercury 179
Venus 482
Earth 15
Mars -63

Jupiter -121

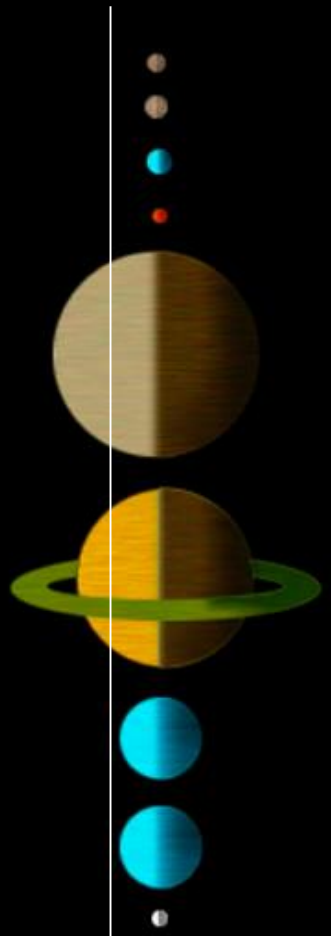
Saturn -125

Uranus -193

Neptune -173
Pluto -230

Traditional and Dwarf Planets

Number of Moons



Mercury 0
Venus 0
Earth 1
Mars 2

Jupiter 61

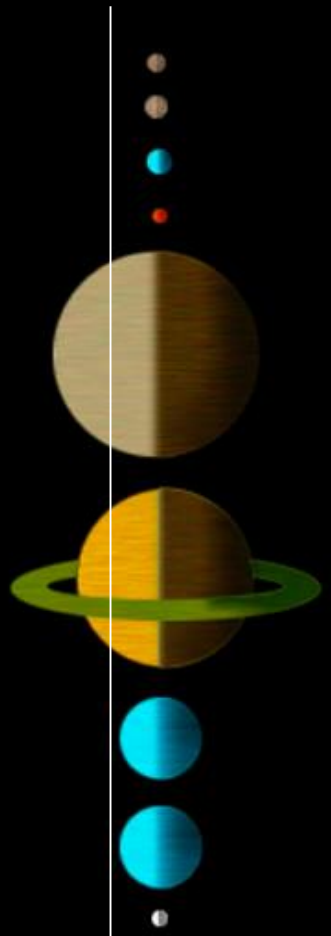
Saturn 31

Uranus 27

Neptune 13
Pluto 3

Traditional and Dwarf Planets

Orbital Period



Mercury 88 days
Venus 255 days
Earth 365 days
Mars 687 days

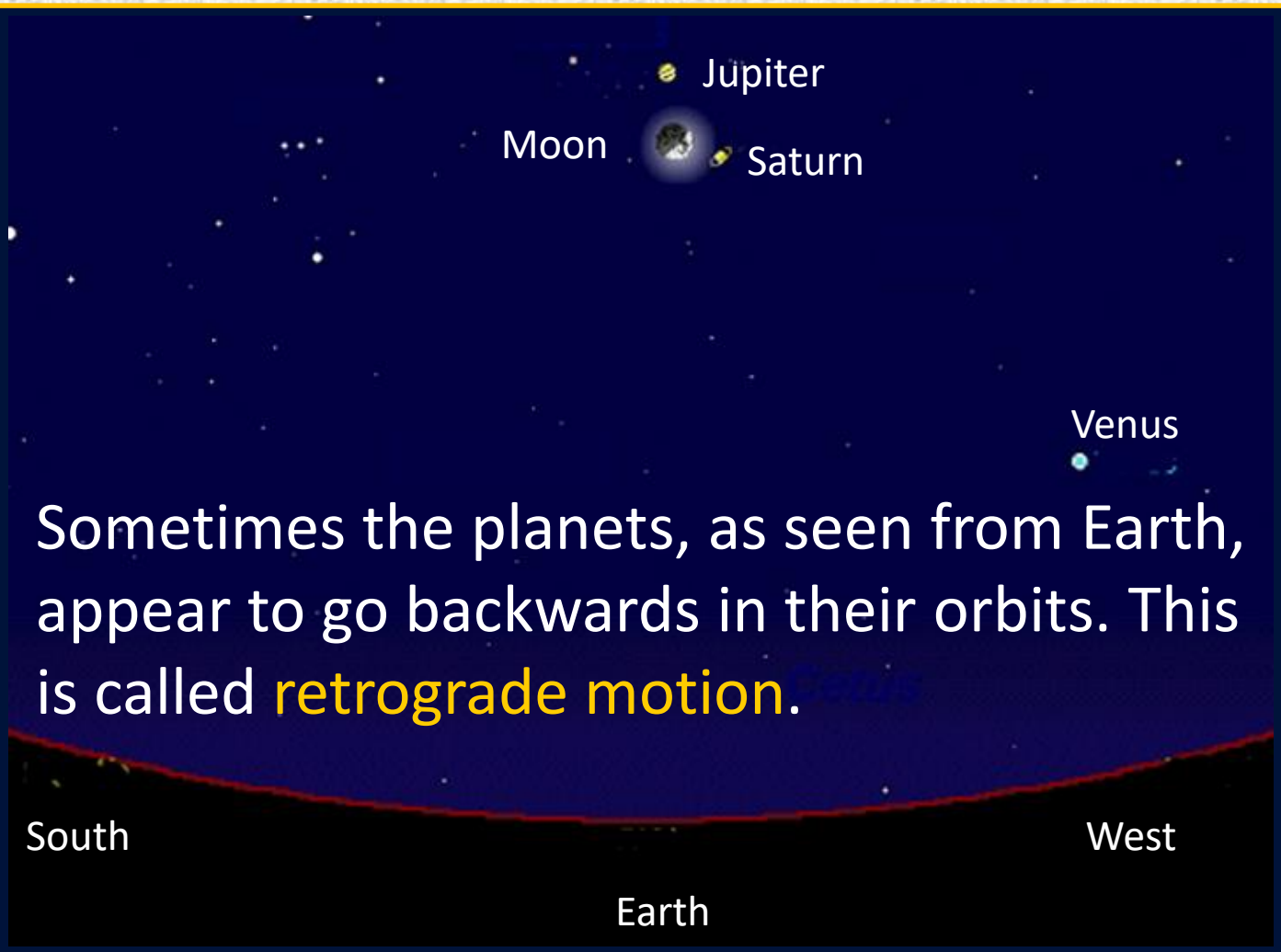
Jupiter 12 years

Saturn 29 years

Uranus 84 years

Neptune 165 years
Pluto 249 years

Traditional and Dwarf Planets



Sometimes the planets, as seen from Earth, appear to go backwards in their orbits. This is called retrograde motion.

Traditional and Dwarf Planets

Mercury and Venus are the only planets that do not have satellite moons.

All other planets, except Earth, have two or more.

Jupiter has a total of 61 known moons. The 4 largest moons are:

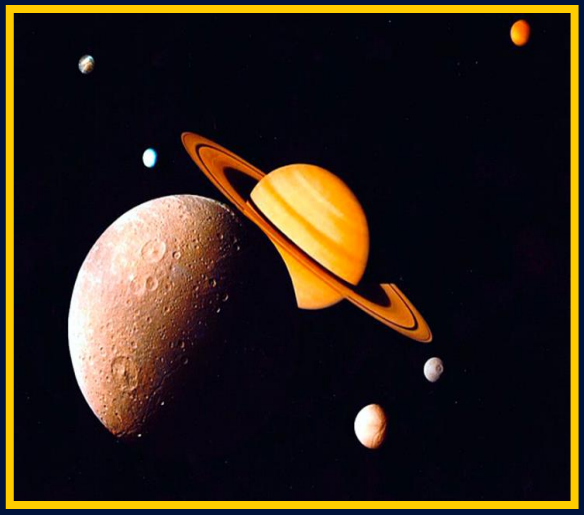
- Io
- Europa
- Ganymede
- Callisto

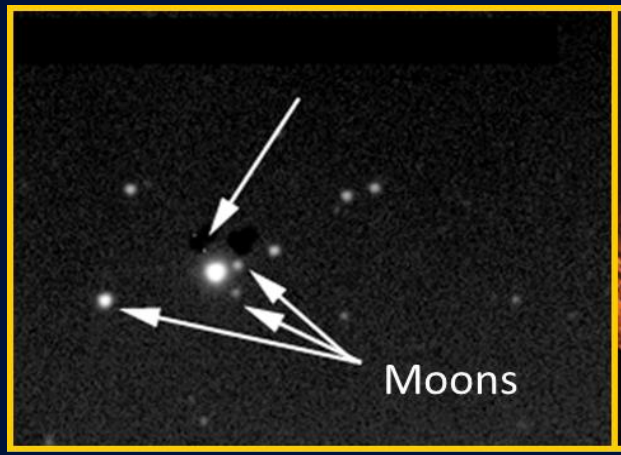
Traditional and Dwarf Planets

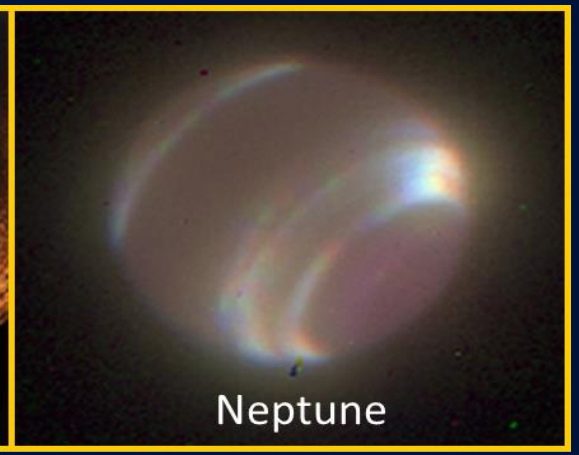
Uranus has 27 moons.

Saturn has 31 moons.

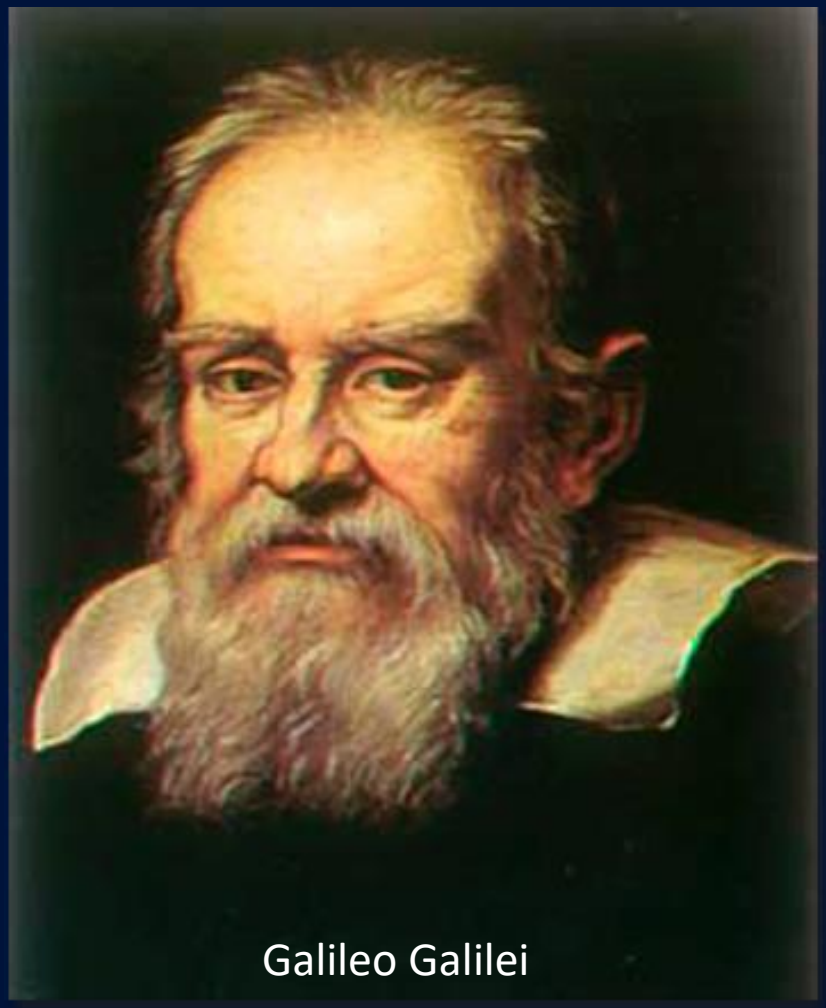
Neptune has 13 moons.







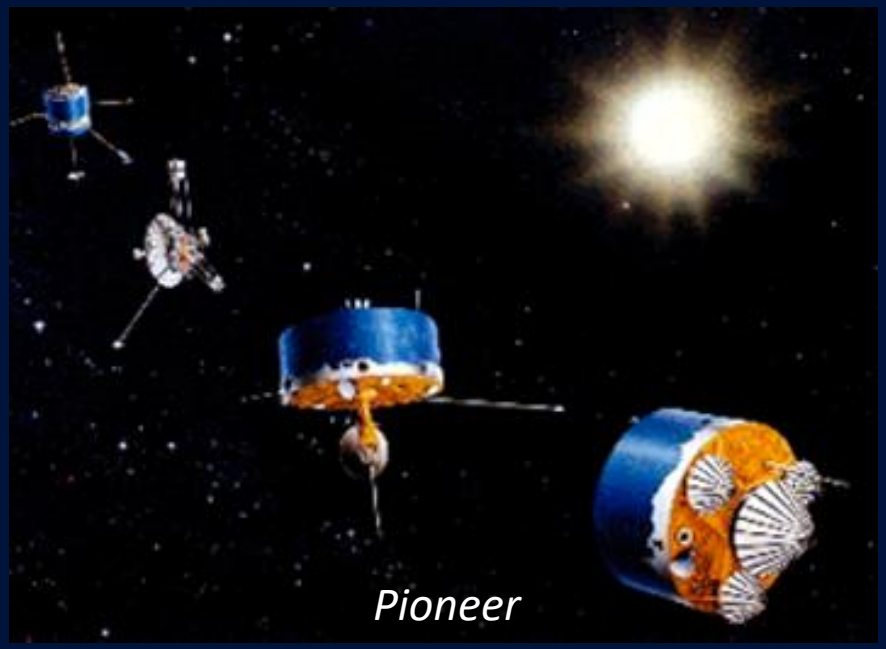
Traditional and Dwarf Planets



Galileo Galilei

Galileo discovered four of Jupiter's moons in 1610.

Traditional and Dwarf Planets

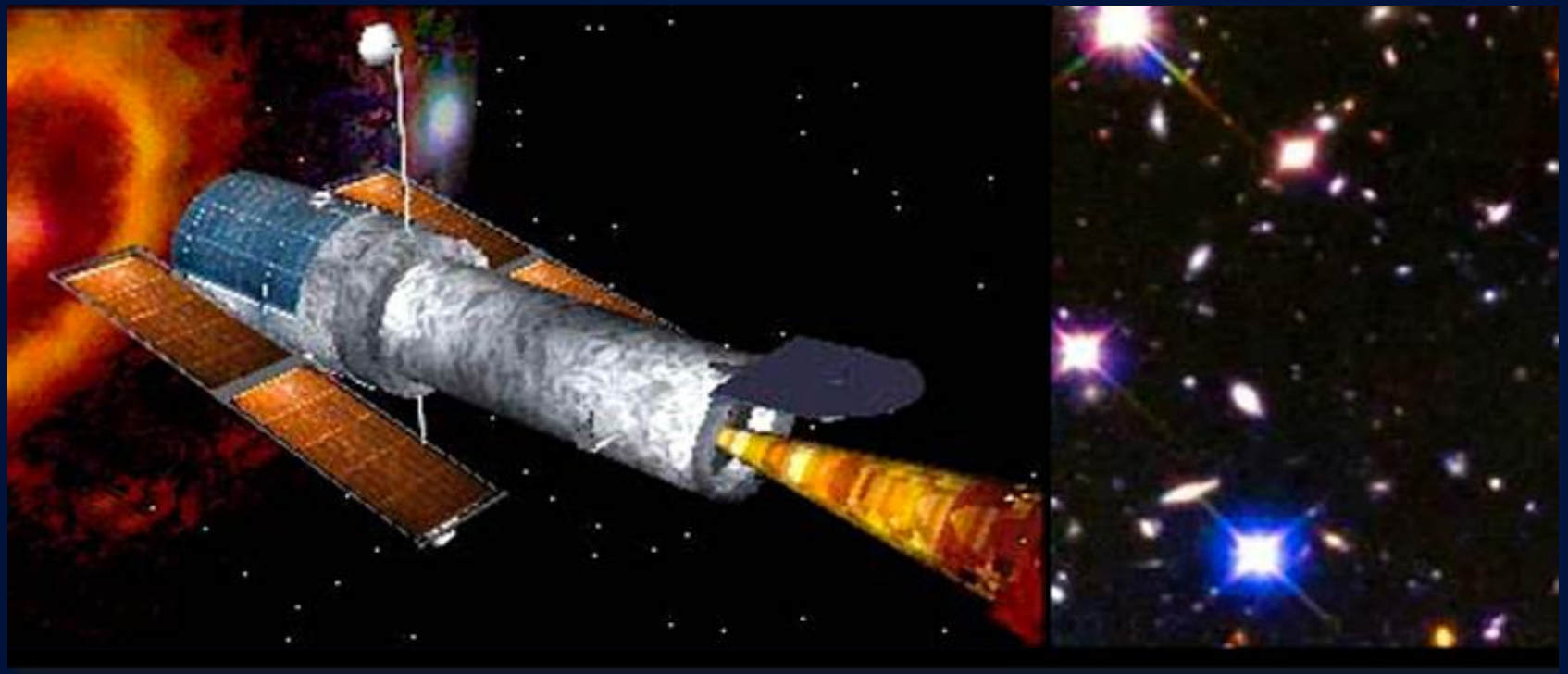


Pioneer

Voyager

In the 1980s, the *Pioneer* and *Voyager* spacecraft discovered previously unknown moons on flybys.

Traditional and Dwarf Planets



The *Hubble Space Telescope* has discovered many more moons including those orbiting the dwarf planets since it has been in orbit.

Check On Learning Questions

CPS Lesson

Question

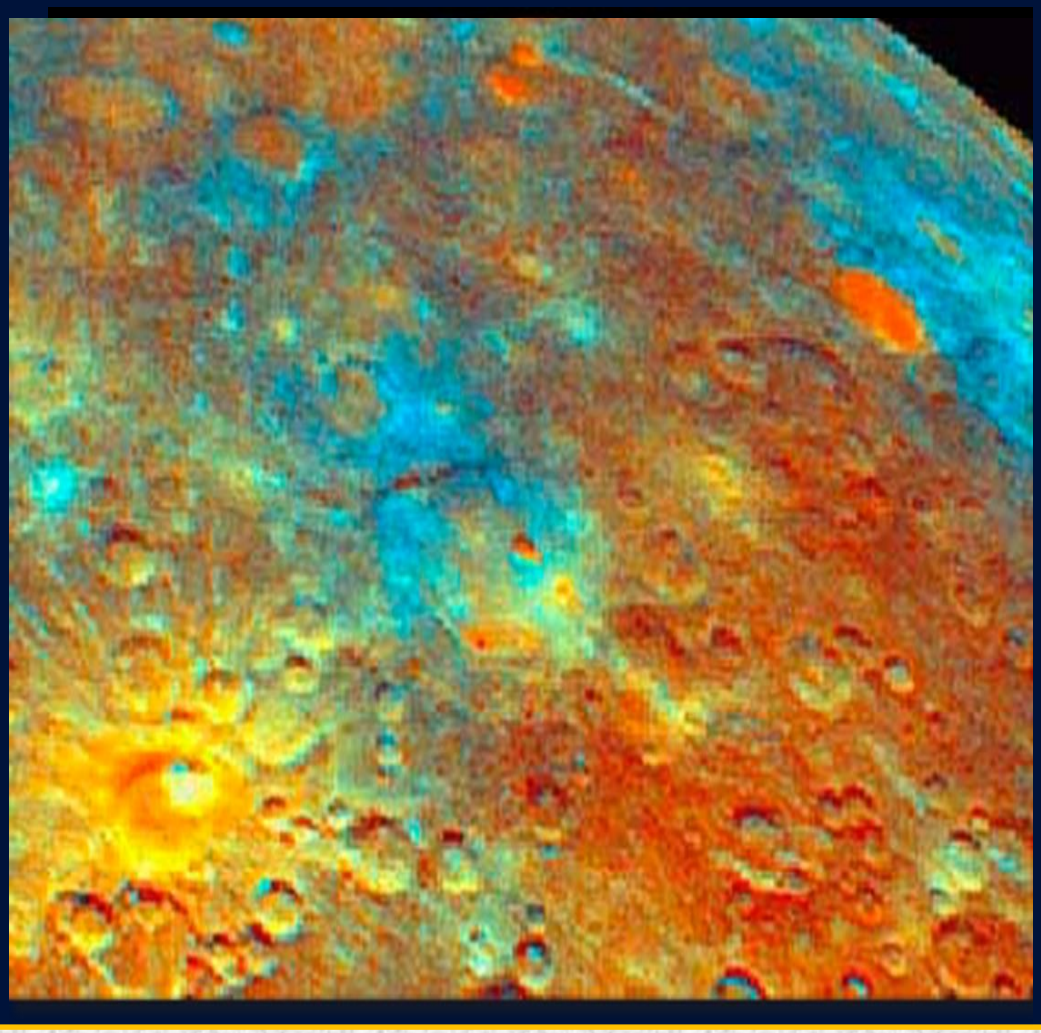
5 - 6

Mercury

Mercury

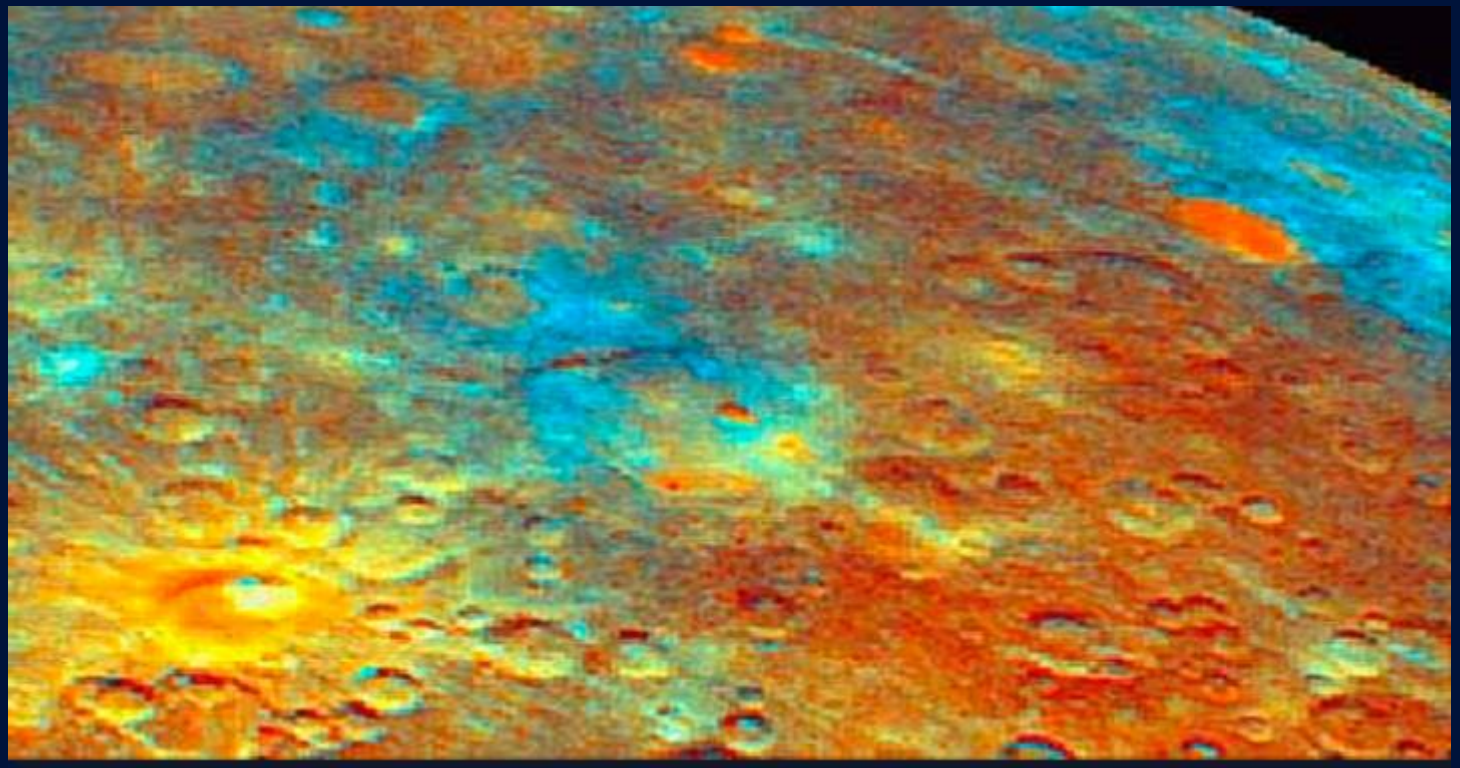
The smallest of the inner planets, Mercury has no atmosphere

Mercury's temperature is 800 °F on the lighted side and -300 °F on the dark side.



Mercury

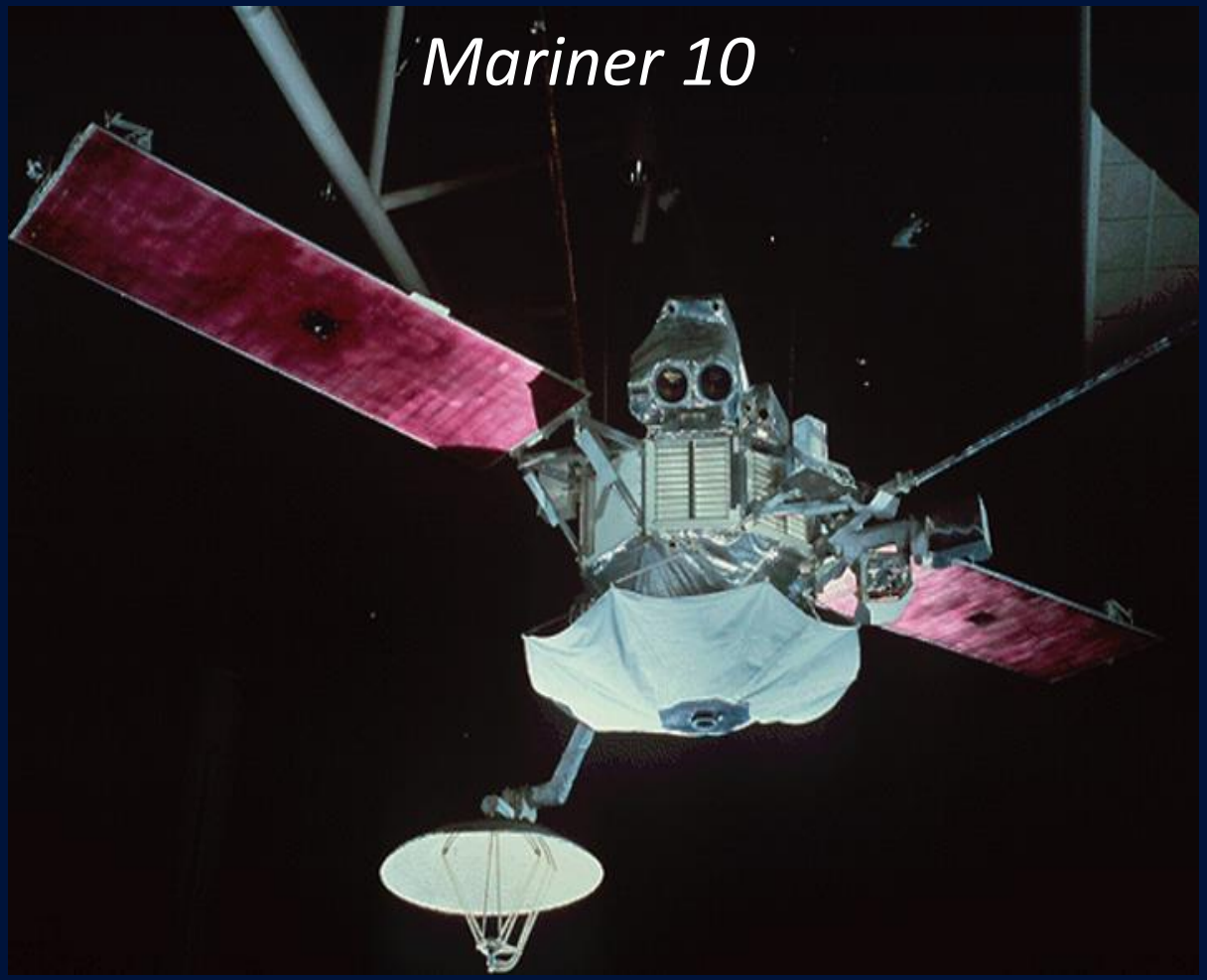
Mercury



Mercury's temperature is 800 °F on the lighted side and -300 °F on the dark side.

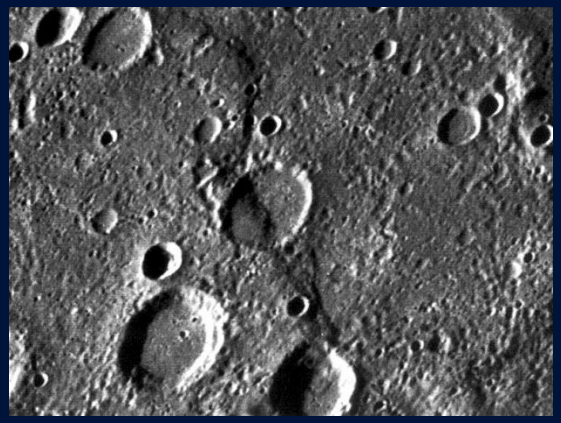
Mercury

The Mariner 10 spacecraft observed Mercury in 1974 and 1975.

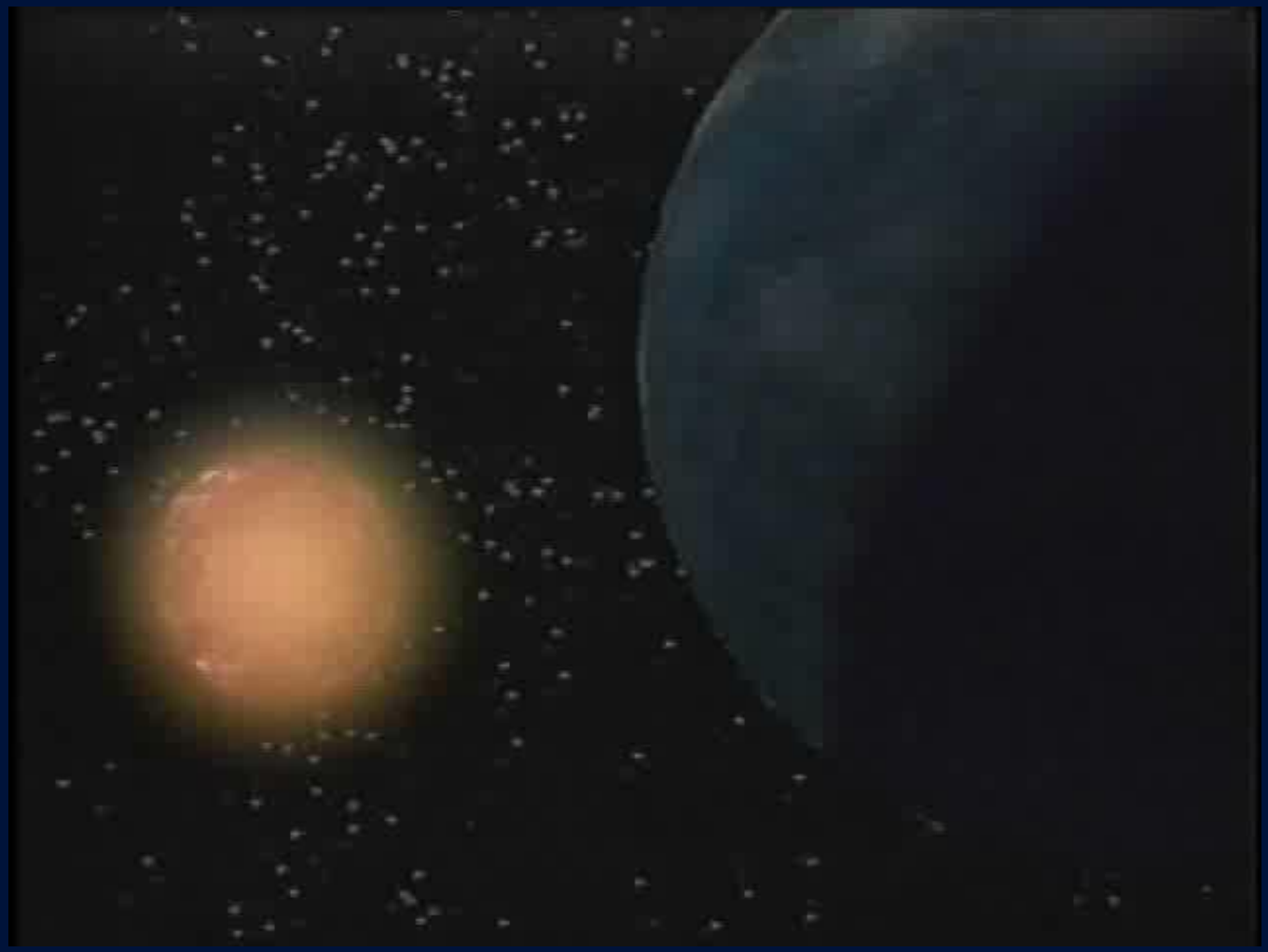


Mercury

Mercury's surface is dusty and heavily cratered like our Moon, with a large core of iron. Mercury has a series of cliffs, some 2 miles high, extending for hundreds of miles.

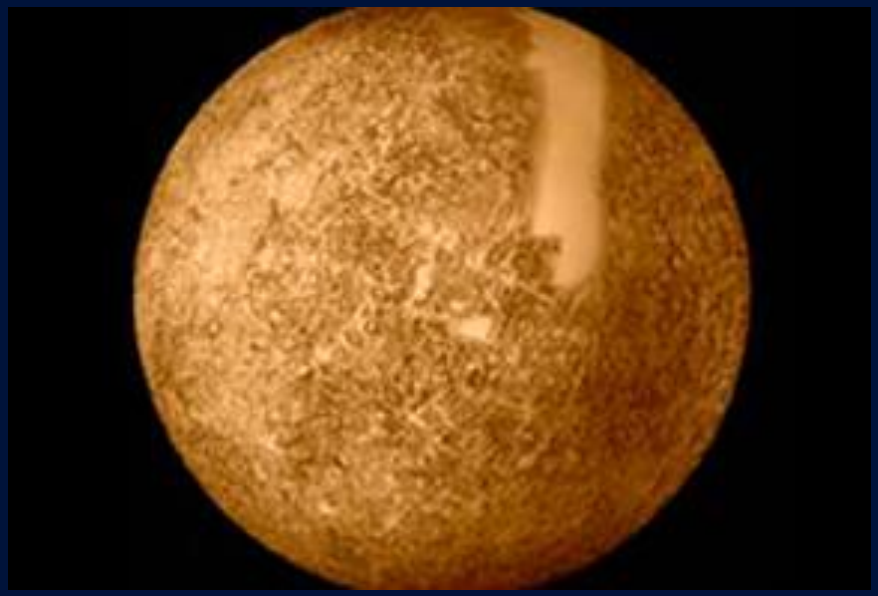


Mercury



Mercury

Named for the Roman god of speed, Mercury has the shortest period of revolution about the Sun - 88 Earth days.



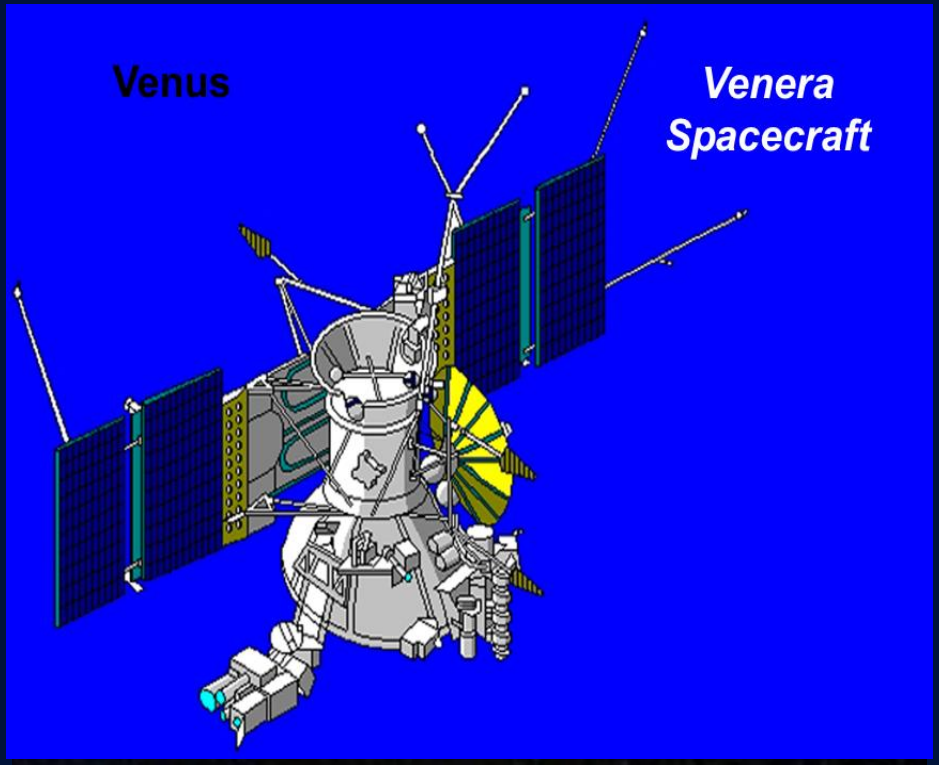
Hermes
(Roman Mercury)

Venus

Venus

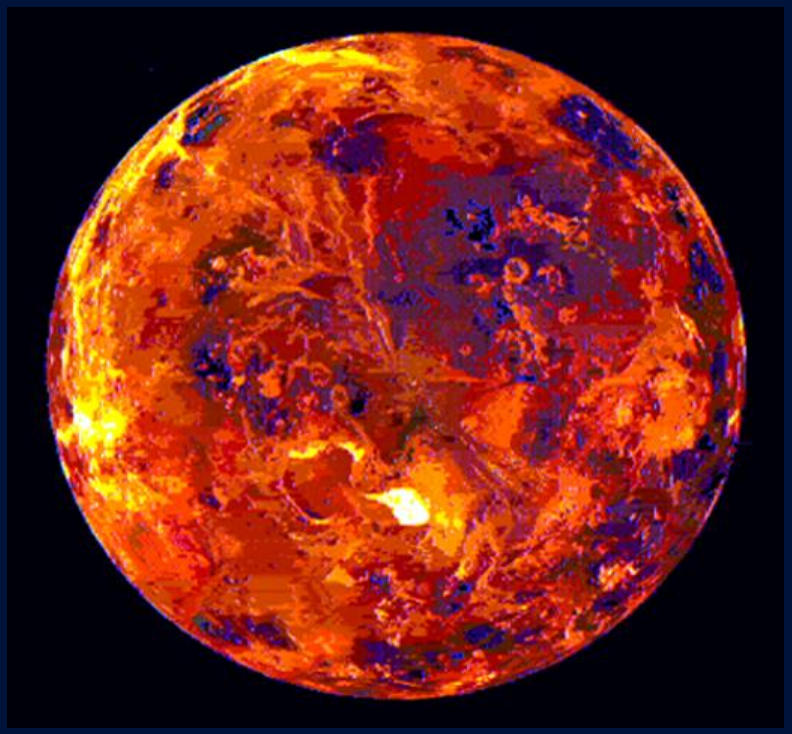
It was once believed that Venus was almost a twin to Earth, due to their nearness in size, mass, and density.

Since 1962, some 20 Soviet and U.S. spacecraft have explored Venus.

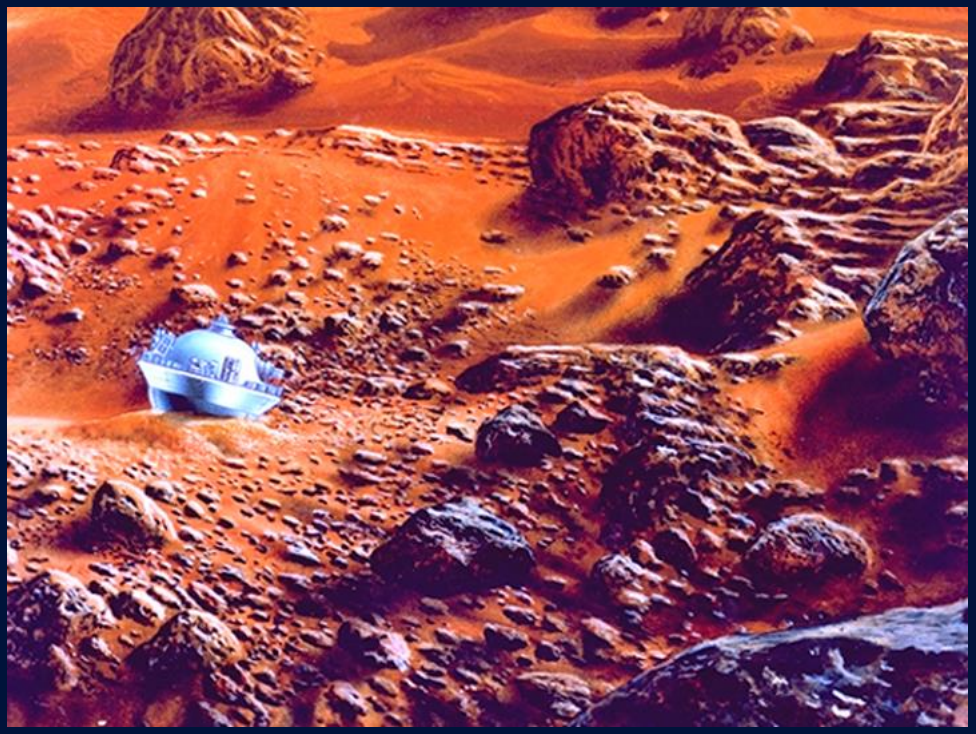


Venus

Venus

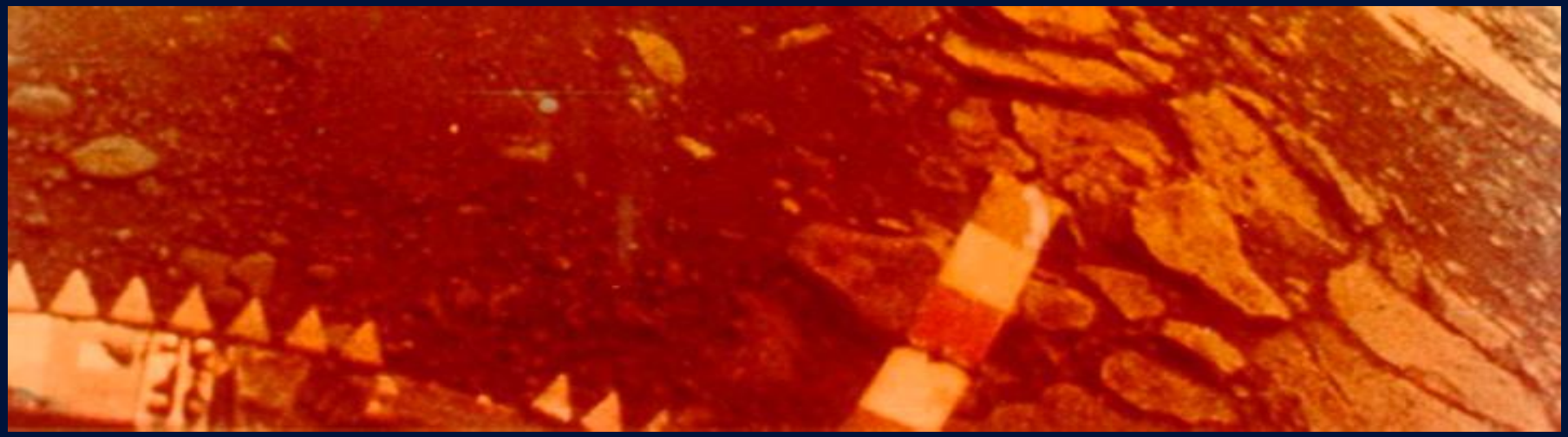


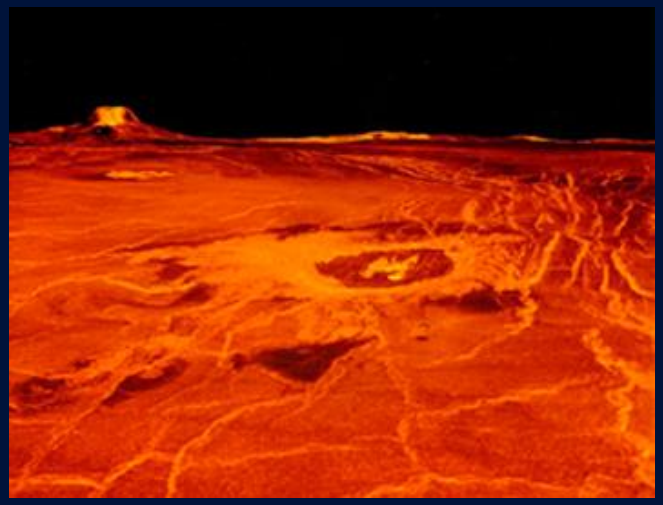
Surface temperatures of Venus reach 900 °F



A probe on the surface of Venus

Venus



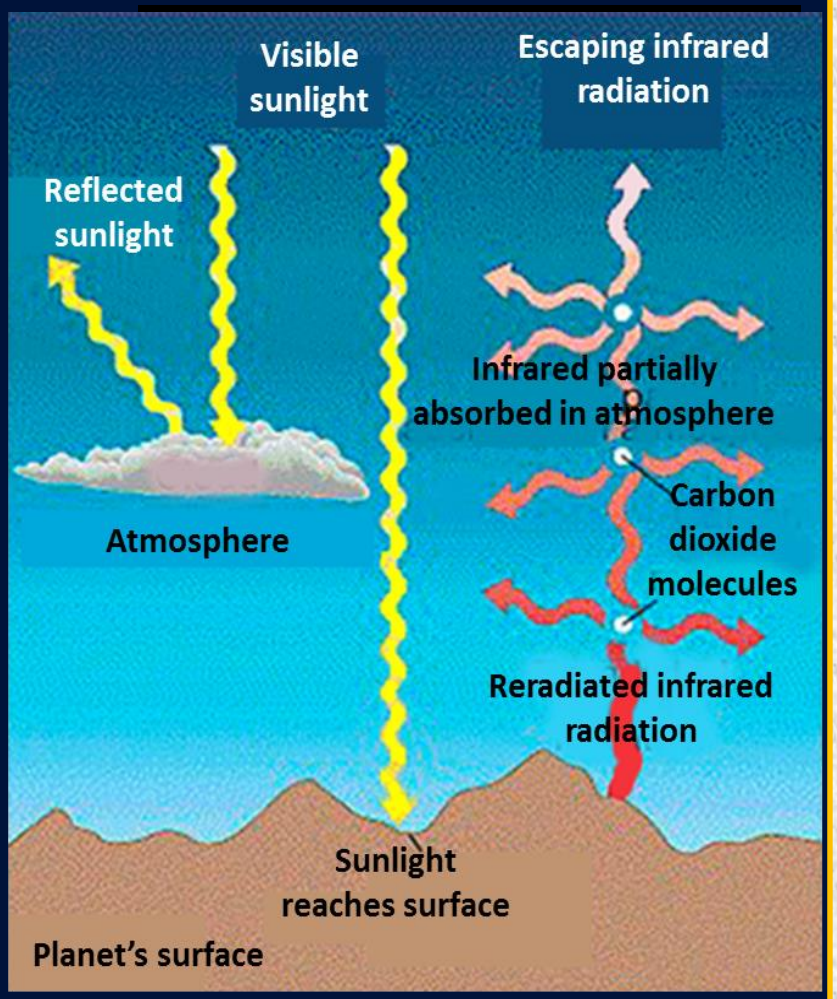


The Venusian surface is dusty and lunar-like.

Venus

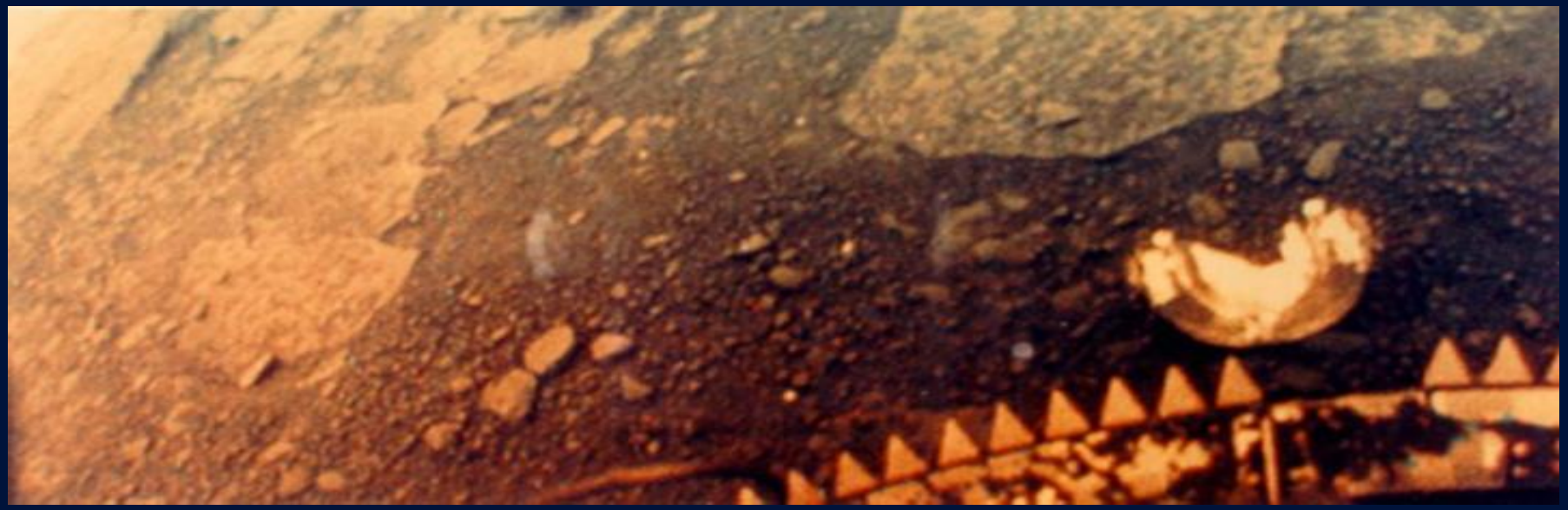
The Venusian atmosphere:

- Has no water or free oxygen
- Has a deep layer of carbon dioxide that creates a "greenhouse effect"
- Limits vision to a few hundred feet



Greenhouse Effect

Venus



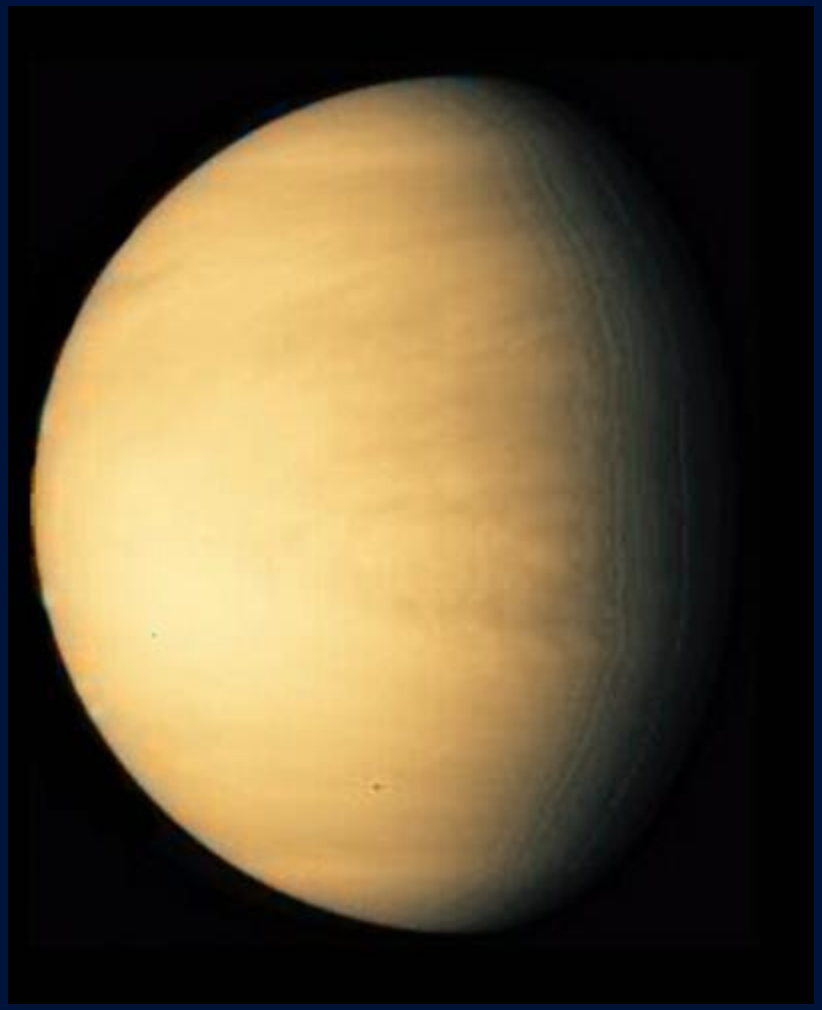
The surface where *Venera* spacecraft landed appears to be composed of loosely packed granite.

Venus

Venus

Venus

- Turns on its axis once in every 243 days
- Has a solar day of 117 days
- Unlike most planets, spins in a clockwise direction, opposite to its orbit around the Sun

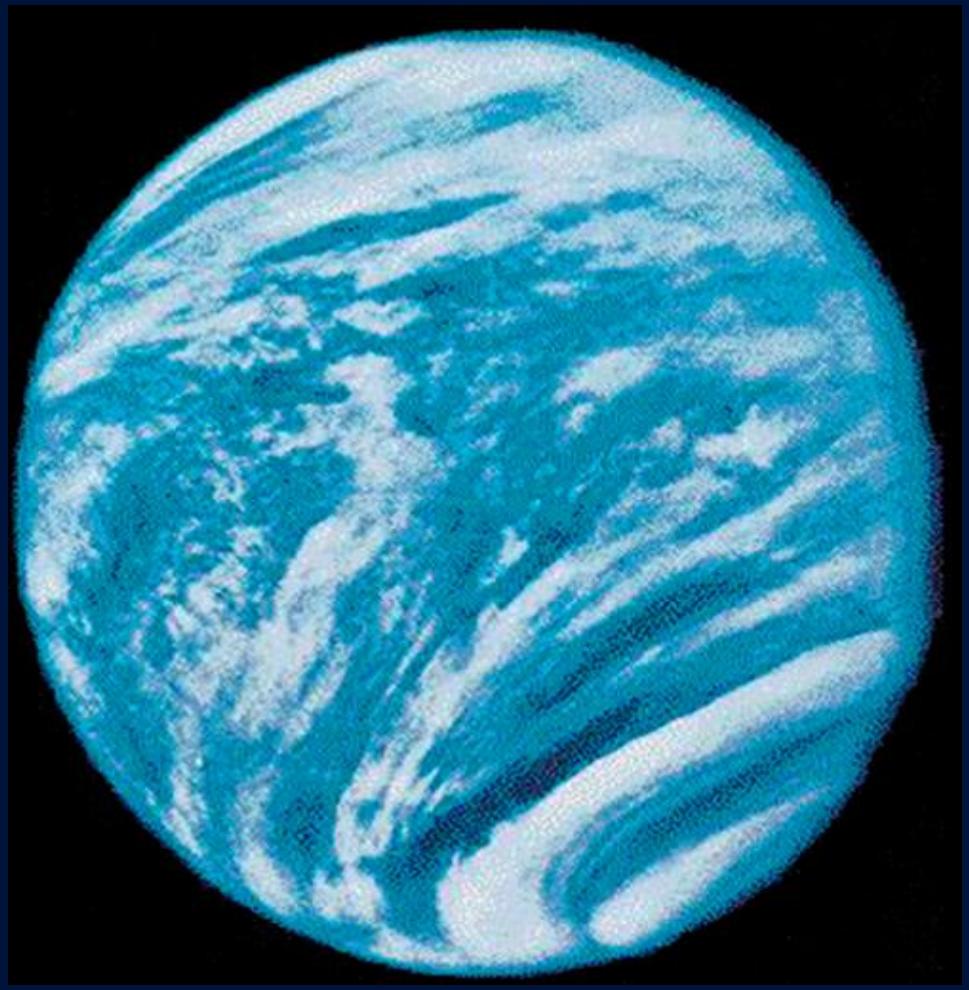


Venus

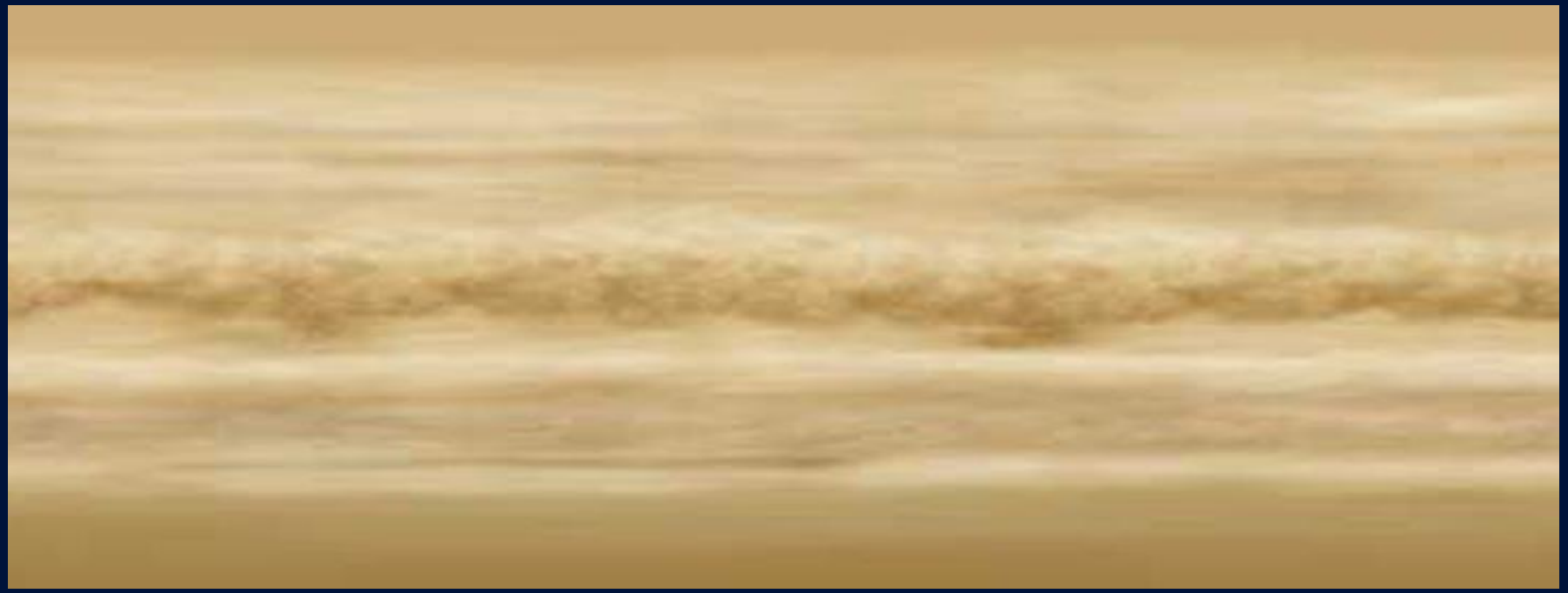
Venus

The clouds above Venus race more than 200 miles an hour from east to west.

They lie up to 40 miles above the surface.



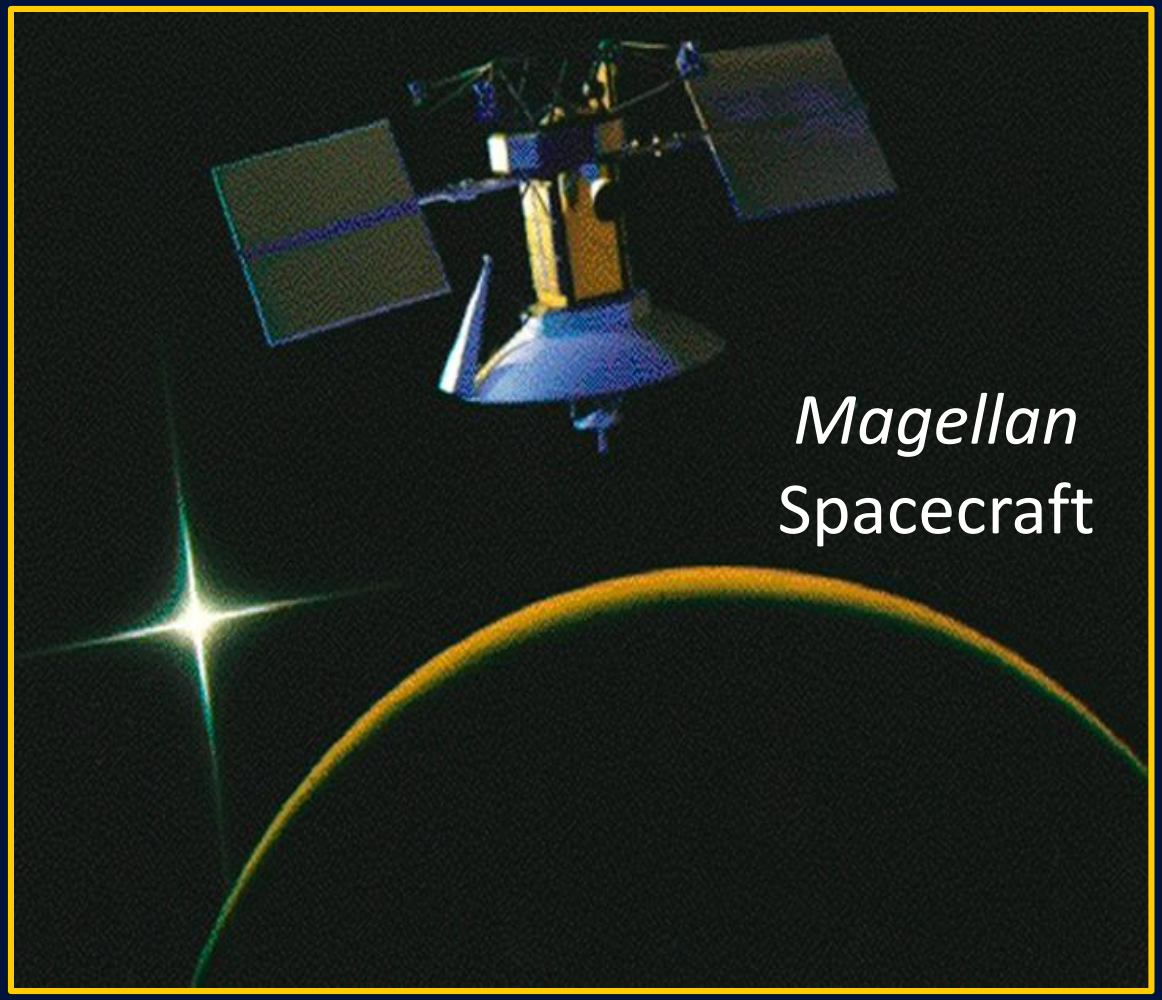
Venus



Extending above the clouds another 15 miles, is a haze, which seems to consist of fine sulfuric acid droplets.

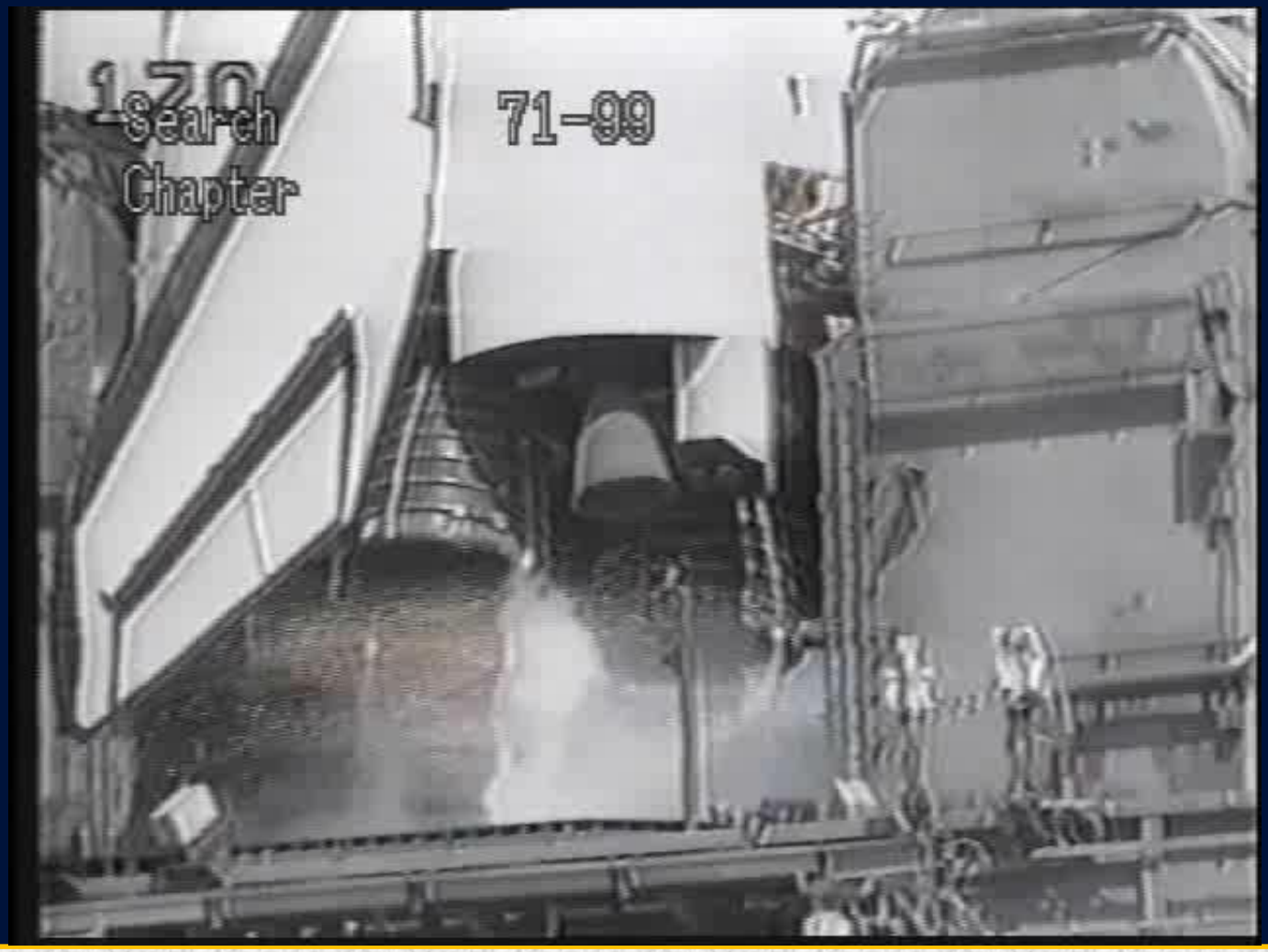
Venus

Launched in 1989 and reaching Venus in 1991, the *Magellan* spacecraft began an extended radar survey of the planet surface in strips 10 - 17 miles wide.

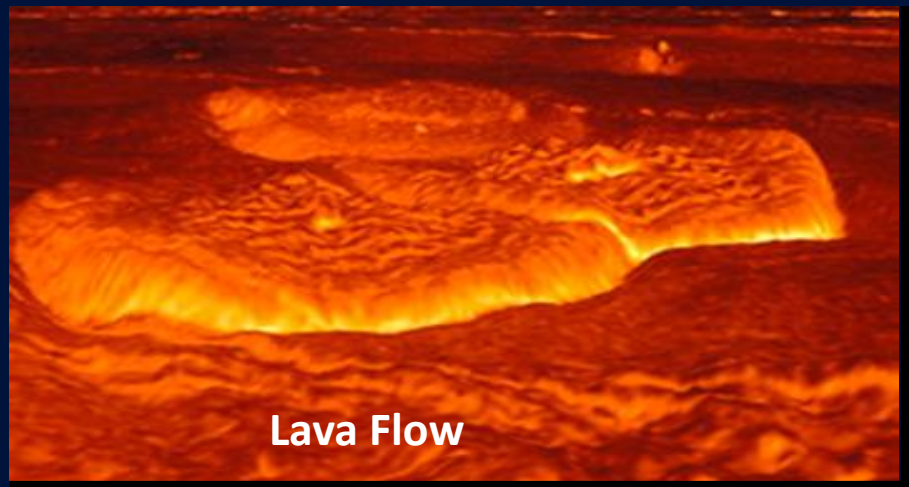


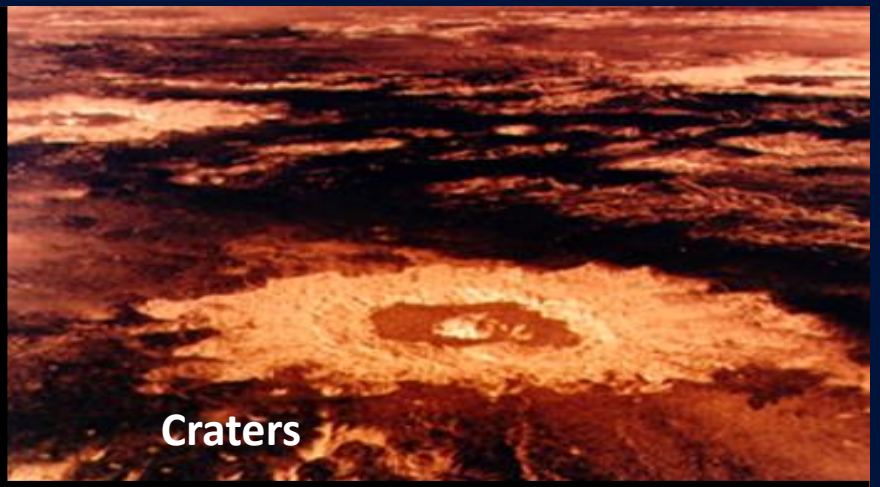
Magellan Spacecraft

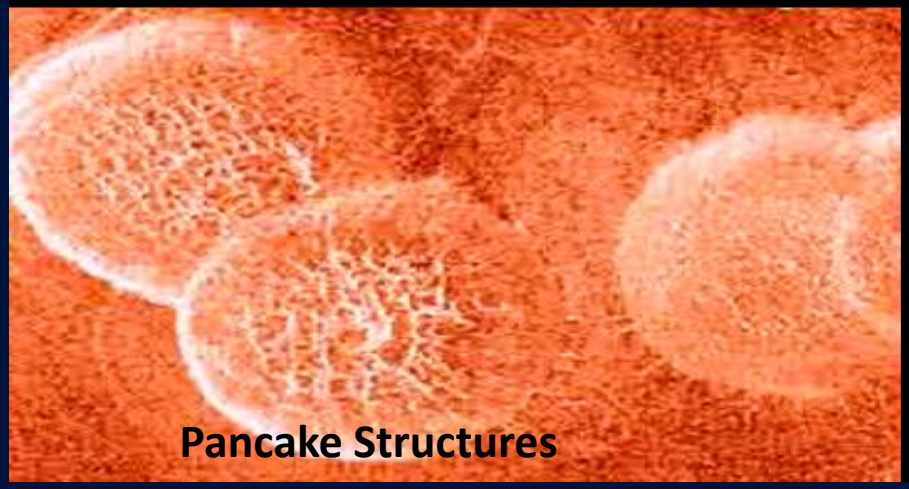
Venus



Venus


Lava Flow


Craters

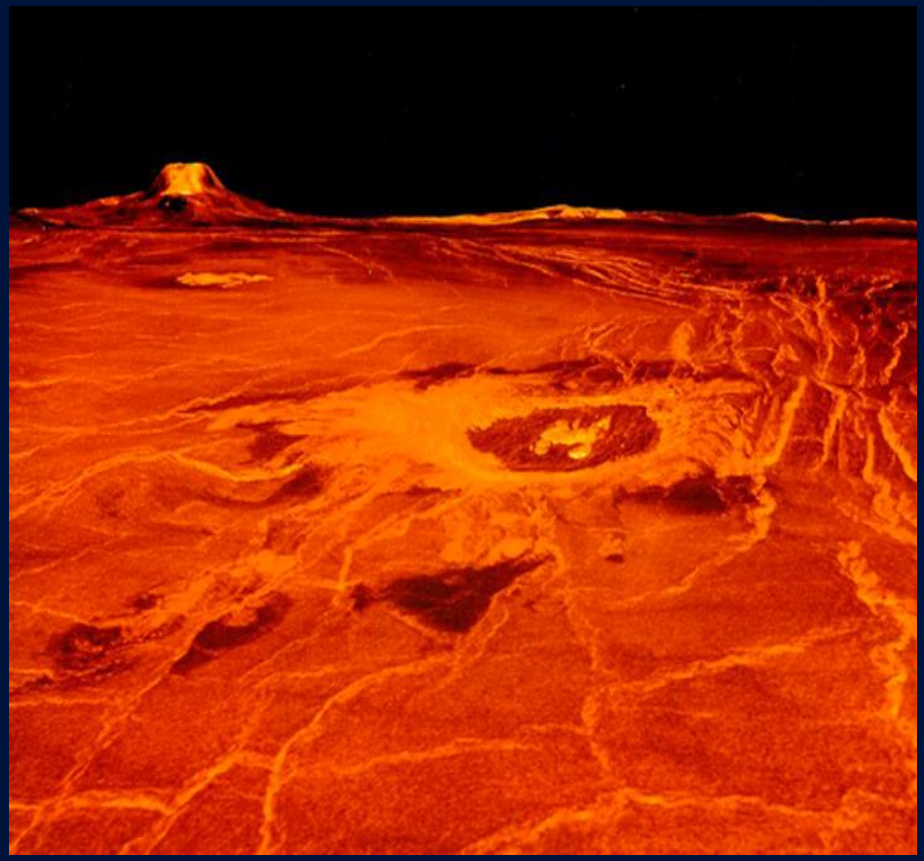

Pancake Structures

Magellan photographed enormous lava flows, pancake-like structures, and large impact craters.

Venus

Magellan found:

- No telltale signs of past major water bodies
- No evidence of plate tectonics
- Thousands to millions of volcanoes seemingly randomly distributed



Venus

The purpose of the intentional crash in October 1994 was to gather data on Venus before Magellan ceased to function in the entry fire.

Venus

Although named for the Roman goddess of beauty, Venus is, in fact, a grim and lifeless inferno hidden behind its clouds.

Aphrodite
(Roman Venus)

Review Question

List the three criteria necessary for a celestial body to be classified as a planet.

1.

2.

3.

(Use CPS "Pick a Student" for this question.)

Closing Questions

CPS Lesson
Questions 7 - 8

Questions?