

# AST 301

## Introduction to Astronomy

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Go to Department of Astronomy courses,

AST 301 (Lacy), course website

## Rearranged schedule for next few weeks

This week: Introduction to planets and a bit of geology

Next week: Planet formation and a bit on small bodies

Third week: Atmospheres

9/27 Ch 7

10/4 Ch 8 (Prof. Dinerstein)

10/11 Ch 10

10/18 Ch 13 (back on schedule)

## Topics for this week

Describe and compare briefly the compositions and orbits of the terrestrial planets, Jovian planets, asteroids, and comets.

What is inside of the terrestrial planets?

What determines the appearances of the surfaces of the terrestrial planets?

How do we determine the age of the planets?

## Photon energies

When an atom emits a photon, the atom loses the amount of energy the photon carries off.

Since atoms can only have certain energies, they can only emit photons of certain energies.

The photon energy must equal the difference between two allowed amounts of atom energy.

$hf$  = photon energy = change in atom energy = difference between two allowed amounts of atom energy

## Doppler shift

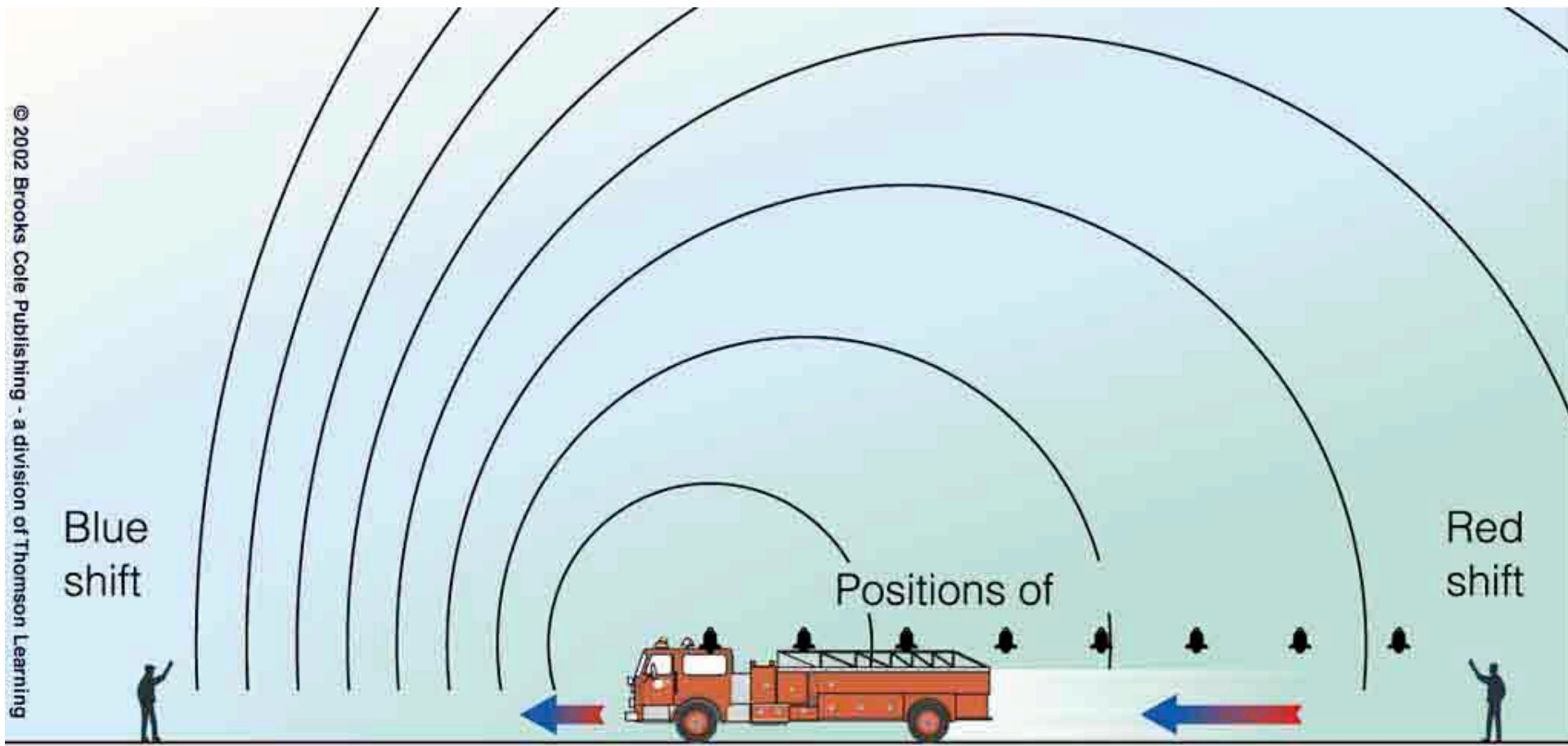
If an object emitting light (or sound) waves is moving relative to an observer, the observed wavelength is different from that emitted.

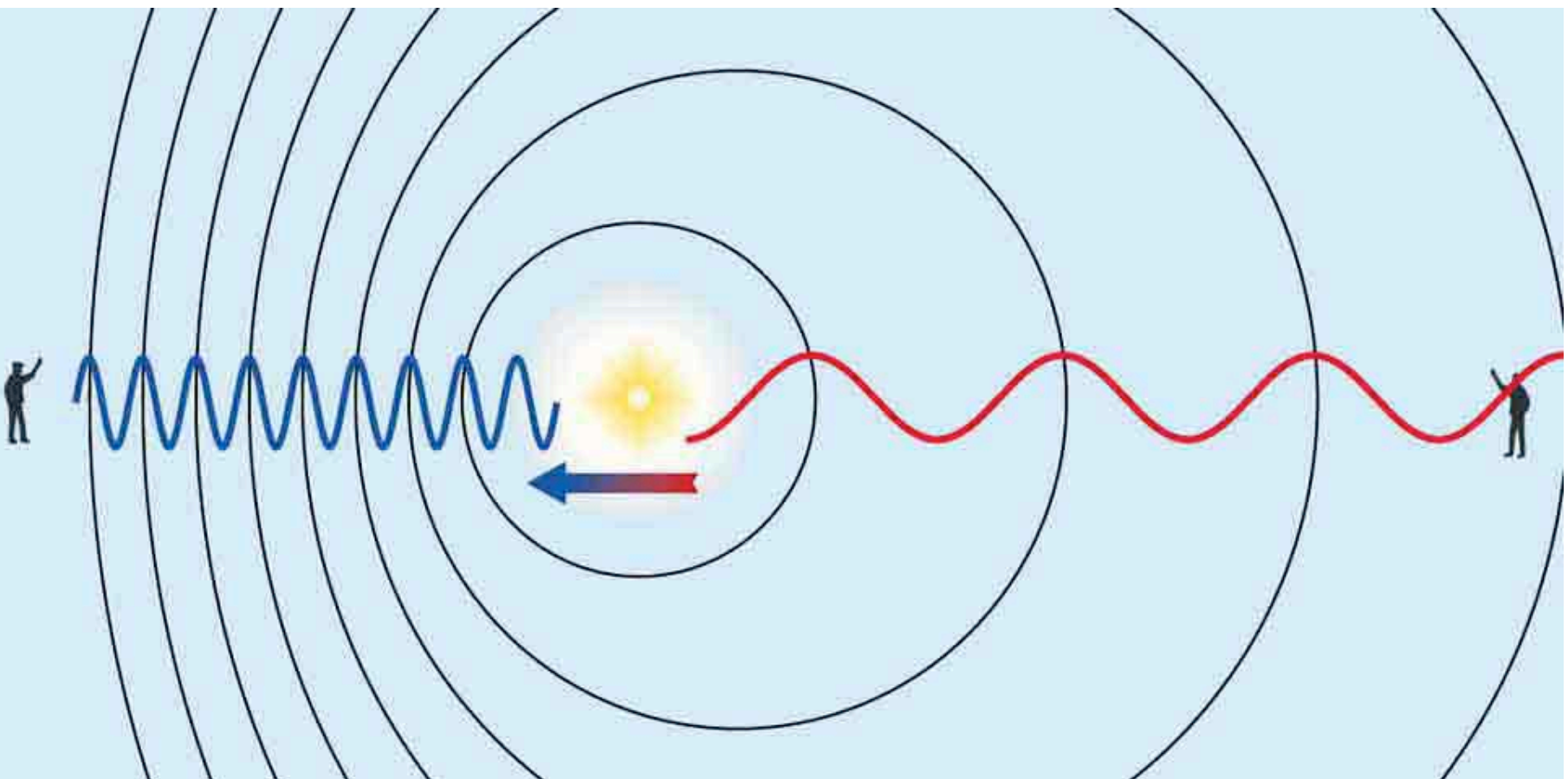
If the emitter moves toward the observer (or the observer moves toward the emitter) the observed wavelength is shorter than the emitted wavelength.

If the emitter moves away from the observer, the observed wavelength is longer than the emitted wavelength.

If the motion is small compared to the speed of the wave (the speed of light for light waves) the formula for the shift in wavelength is:

$$(\lambda_{\text{observed}} - \lambda_{\text{emitted}}) / \lambda_{\text{emitted}} = v / c$$





## Quiz

The Earth orbits around the Sun with a speed of 30 km/s.

The speed of light is 300,000 km/s.

I observe infrared radiation from sulfur atoms which is emitted at a wavelength of  $10\text{ }\mu\text{m}$ .

What is the difference between the emitted wavelength and the wavelength I observe from the moving Earth?

- A.  $.001\text{ }\mu\text{m}$
- B.  $.030\text{ }\mu\text{m}$
- C.  $30\text{ }\mu\text{m}$
- D.  $100,000\text{ }\mu\text{m}$



# Terrestrial Planets

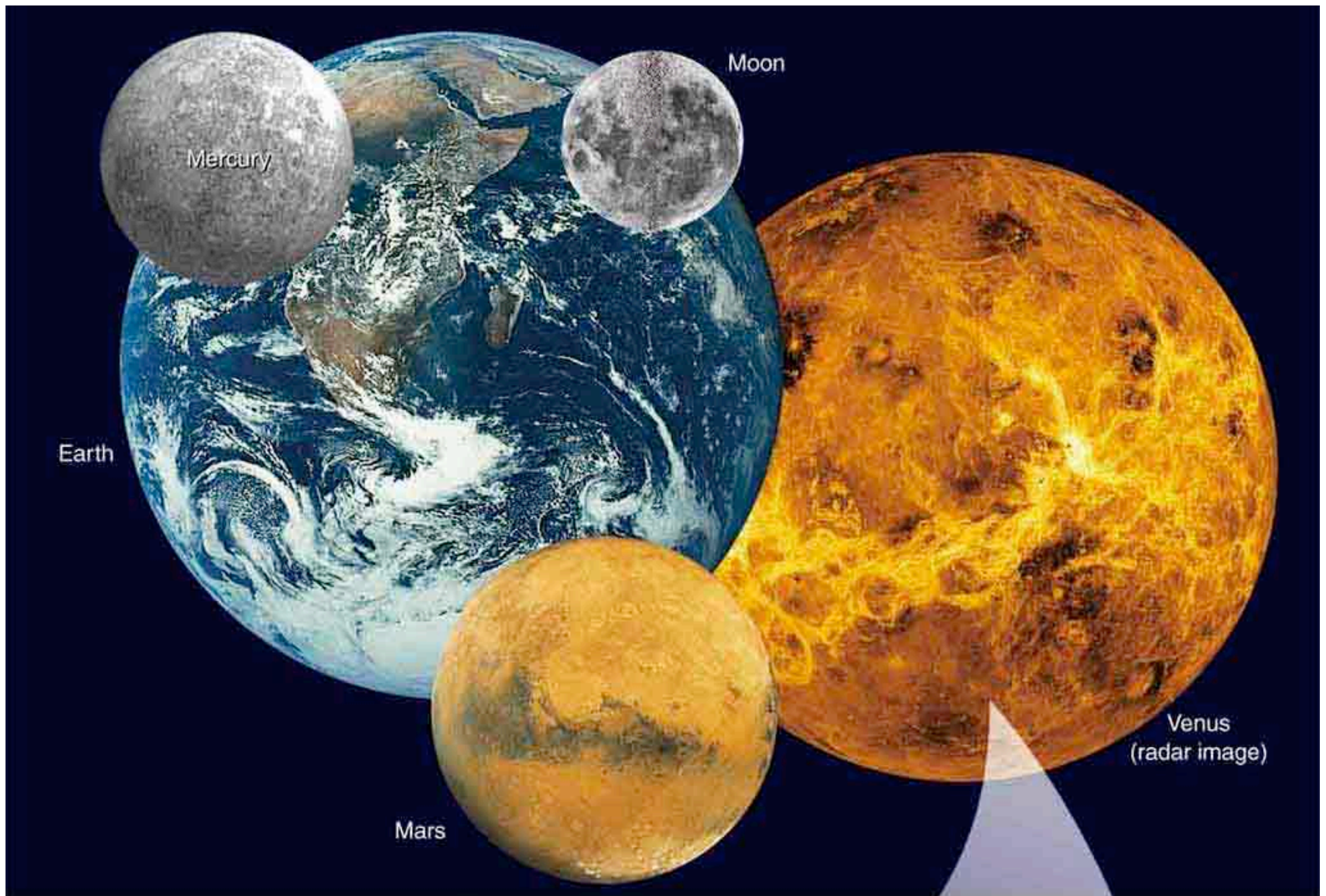
The inner four planets

Sizes similar to the Earth's

Interiors made of metals and rocks

Very thin atmospheres (compared to the diameters of the planets)

Earth also has oceans (and Mars may once have). These also make up a small fraction of the volume.



## Jovian planets

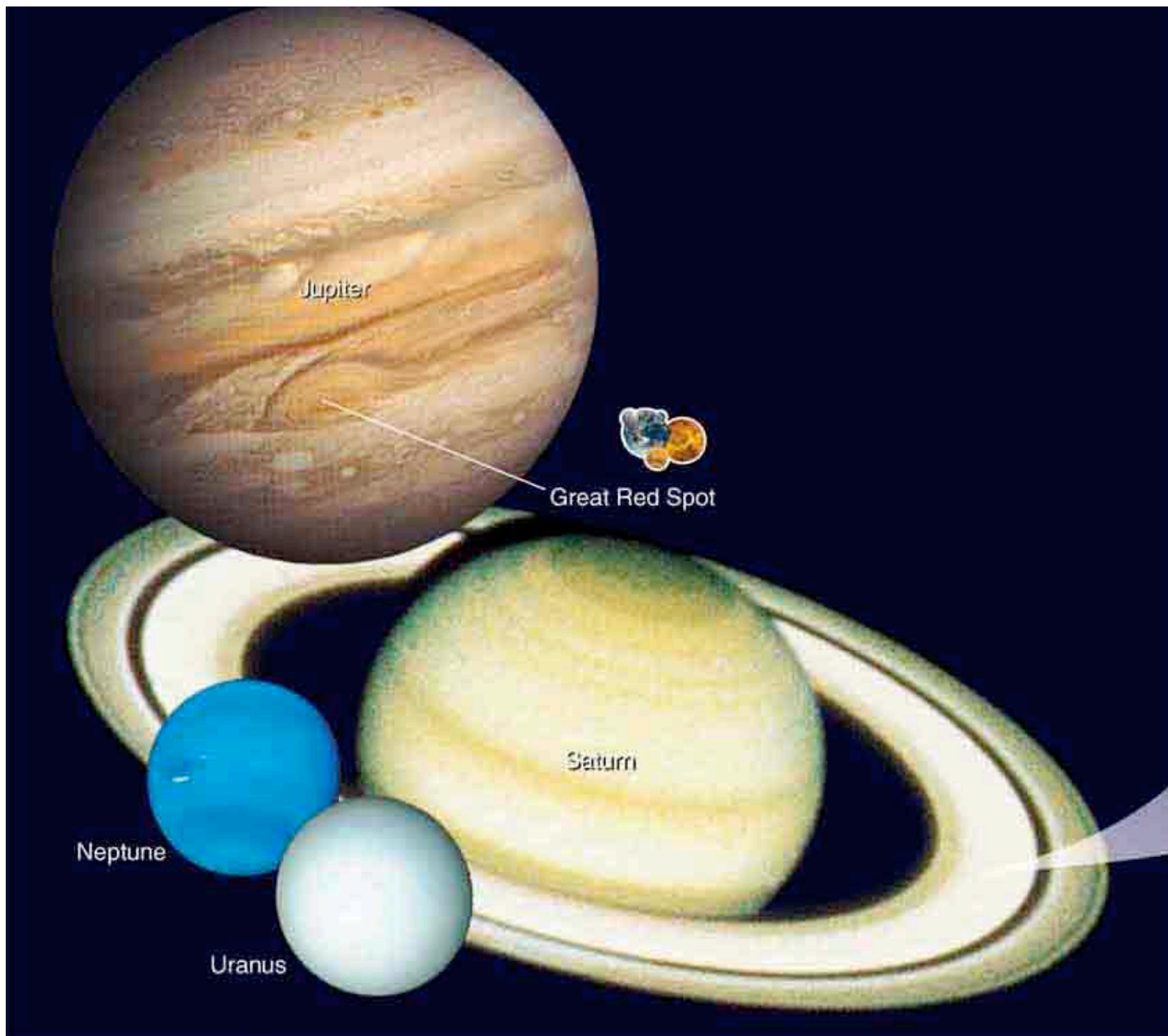
The next four planets

Diameters about 10 times the terrestrial planets'

Interiors made of ices and gasses (probably with small rocky cores)

Jupiter and Saturn are mostly gas.

Uranus and Neptune are mostly (partially melted) ices.





## “Flying” over Venus

The video was made from radar data from Venera and Magellan orbiters.

Brightnesses correspond to radar reflectivities (generally roughnesses).

The vertical scale is exaggerated by a factor of 10.

Most of the features are volcanic: domes, lava flows, and calderas.

Others are impact craters.

Without liquid water, there is less erosion on Venus, so craters are more common and prominent than on Earth.

## Mars movie

The data are from the Viking orbiters.

Vertical scale is exaggerated by a factor of 5.

The “flight” goes over Valles Marineris, the Tharsis volcanoes, and Olympus Mons.

Valles Marineris may have been cut by water, and is 1800 miles long.

Olympus Mons is 15 miles (75,000 ft) high and as wide as Missouri.