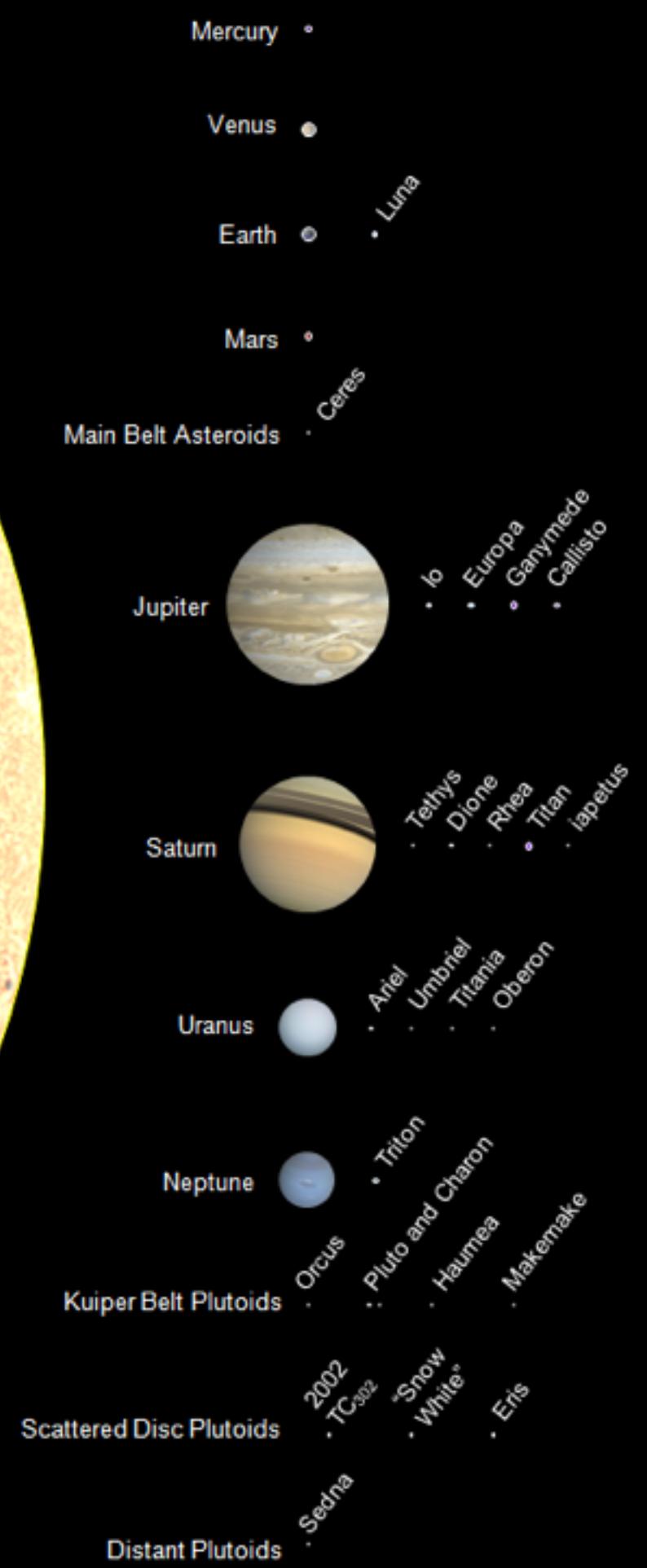
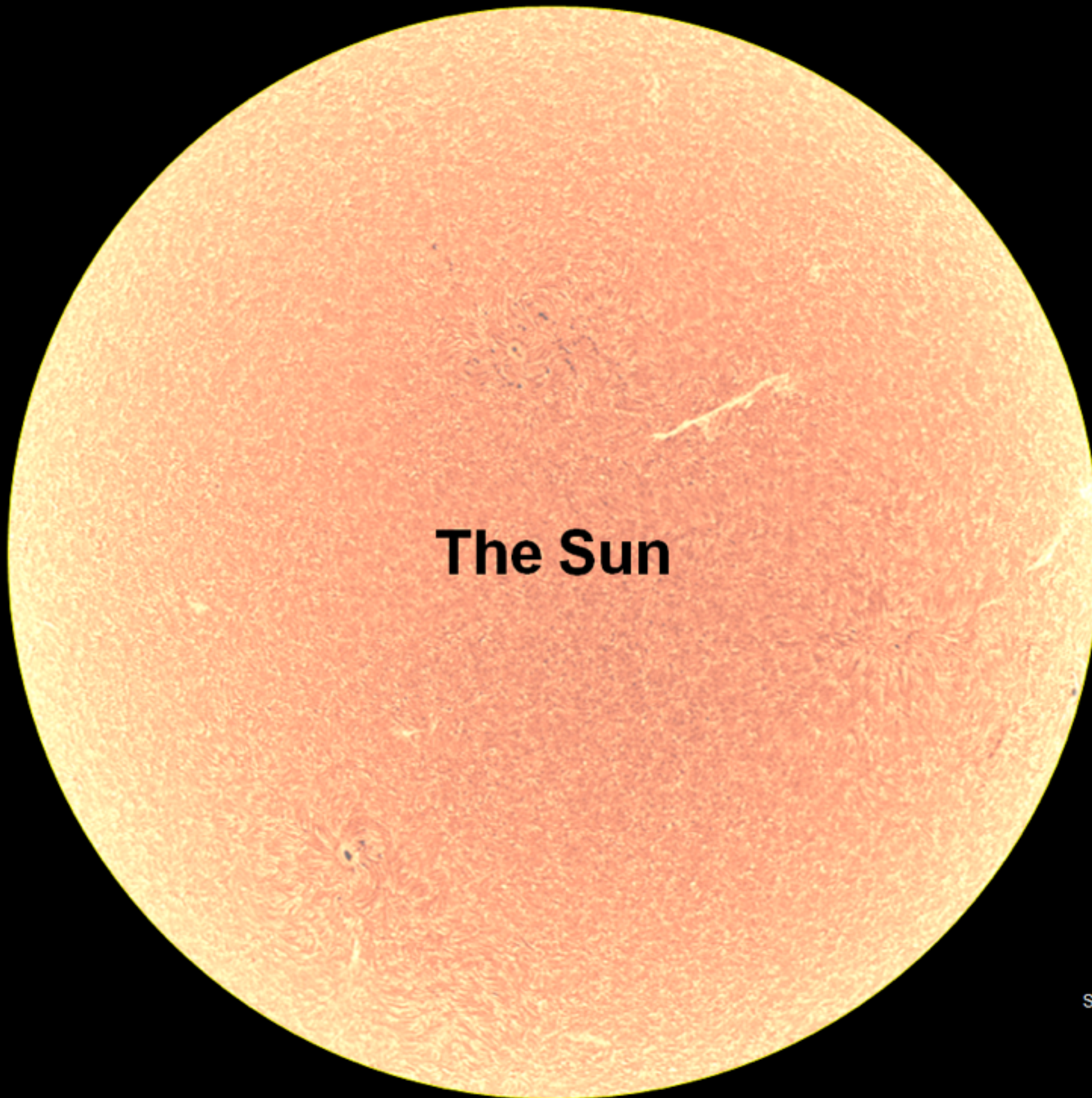


Important topics that may or may not be on the exam.



	Distance from Sun	Radius	Mass
Mercury	.38	.38	5%
Venus	.7	1	1
Earth	1	1	1
Mars	1.5	0.5	10%
Jupiter	5	10	300
Saturn	10	10	100
Uranus	20	4	15
Neptune	30	4	17

GRAVITY WELLS

SCALED TO EARTH SURFACE GRAVITY

THIS CHART SHOWS THE 'DEPTH' OF VARIOUS SOLAR SYSTEM GRAVITY WELLS.

EACH WELL IS SCALED SUCH THAT RISING OUT OF A PHYSICAL WELL OF THAT DEPTH — IN CONSTANT EARTH SURFACE GRAVITY — WOULD TAKE THE SAME ENERGY AS ESCAPING FROM THAT PLANET'S GRAVITY IN REALITY. EACH PLANET IS SHOWN CUT IN HALF AT THE BOTTOM OF ITS WELL, WITH THE DEPTH OF THE WELL MEASURED DOWN TO THE PLANET'S FLAT SURFACE.

THE PLANET SIZES ARE TO THE SAME SCALE AS THE WELLS. INTERPLANETARY DISTANCES ARE NOT TO SCALE.

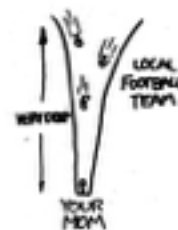
$$\text{DEPTH} = \frac{G \cdot \text{PLANET MASS}}{g \cdot \text{PLANET RADIUS}}$$

G = NEWTON'S CONSTANT
g = 9.81 m/s²

JUPITER

JUPITER IS NOT MUCH LARGER THAN SATURN, BUT MUCH MORE MASSIVE. AT ITS SIZE, ADDING MORE MASS JUST MAKES IT DENSER DUE TO THE EXTRA SQUEEZING OF GRAVITY.

IF YOU DROPPED A FEW DOZEN MORE JUPITERS INTO IT, THE PRESSURE WOULD IGNITE FUSION AND MAKE IT A STAR.



WE DROPPED A FEW DOZEN MORE JUPITERS INTO IT

TITAN

EUROPA

RINGS

SATURN

URANUS

AN EVEN MORE GLORIOUS GALAXY PLANET!

NEPTUNE

GANYMEDE

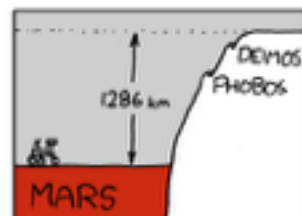
IO

MARS
1,286 km

MOON
288 km

EARTH
5,478 km

VENUS



1286 km

MARS



YOU COULD ESCAPE DEIMOS WITH A BIKE AND A RAMP

A THROWN BASEBALL COULD ESCAPE PHOBOS

TO SCALE

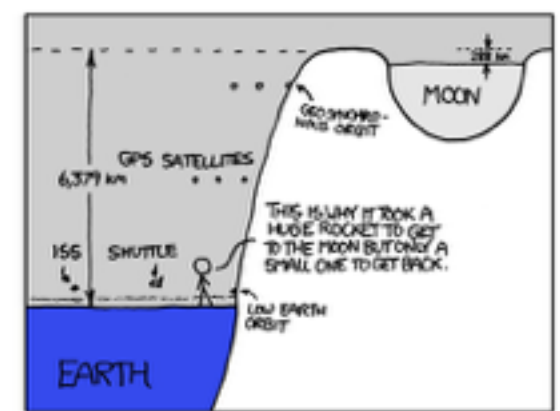
TO SCALE

DEIMOS

PHOBOS

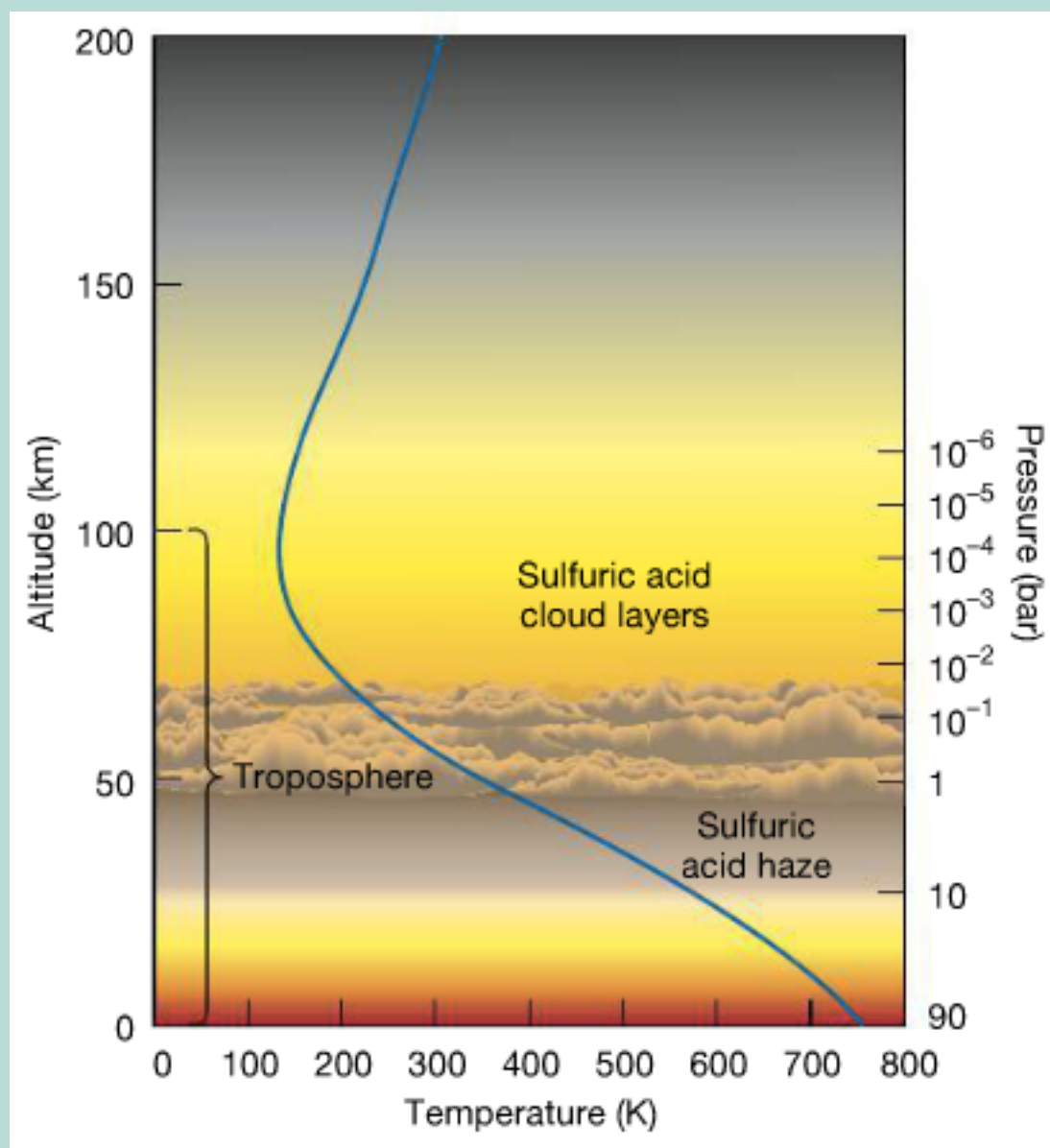
MERCURY

TO SUN, VERY VERY FAR DOWN

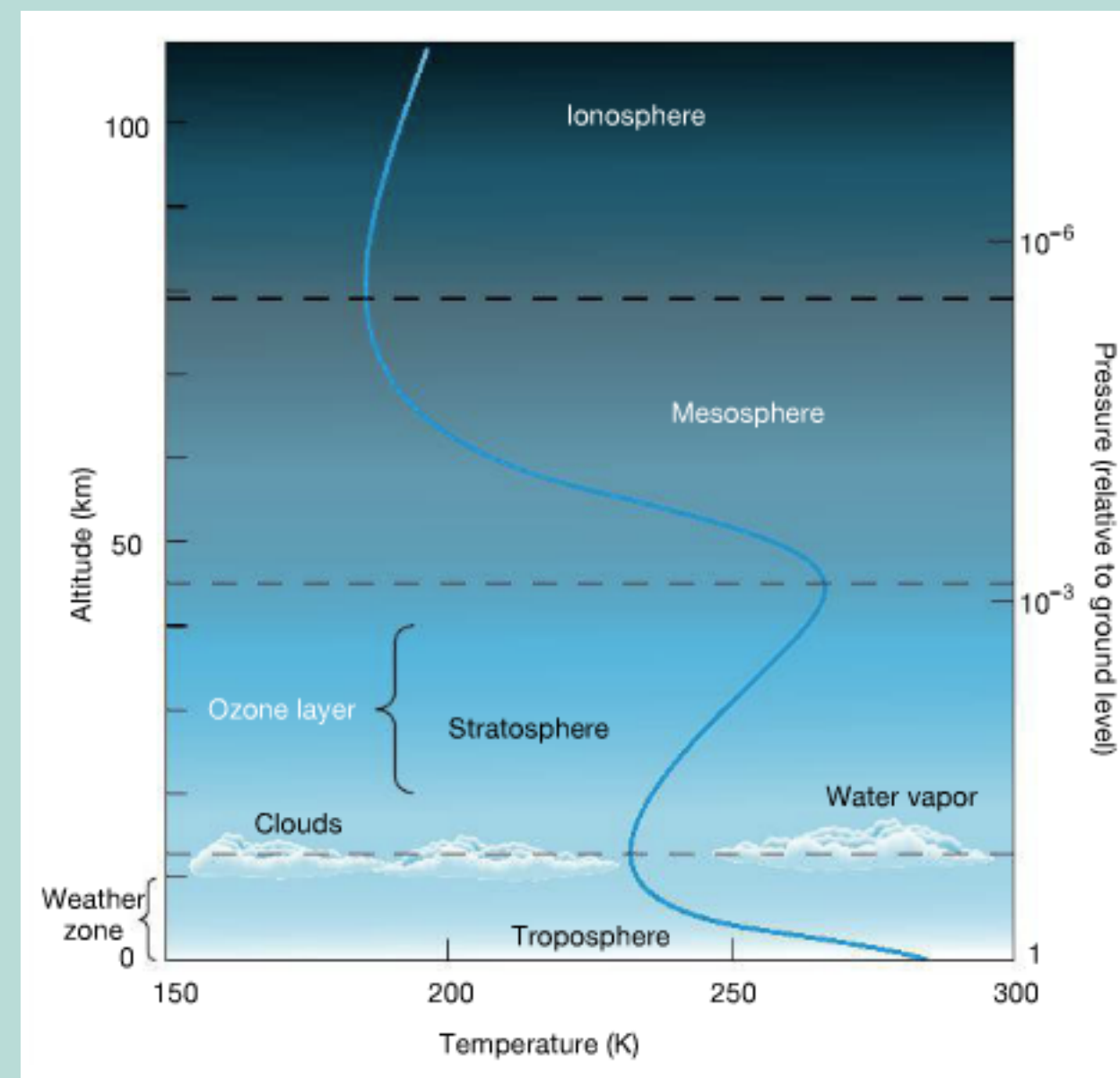


IT TAKES THE SAME AMOUNT OF ENERGY TO LAUNCH SOMETHING ON AN ESCAPE TRAJECTORY AWAY FROM EARTH AS IT WOULD TO LAUNCH IT 6,000 km UPWARD UNDER CONSTANT 9.81 m/s² EARTH GRAVITY.

HENCE, EARTH'S WELL IS 6,000 km DEEP.

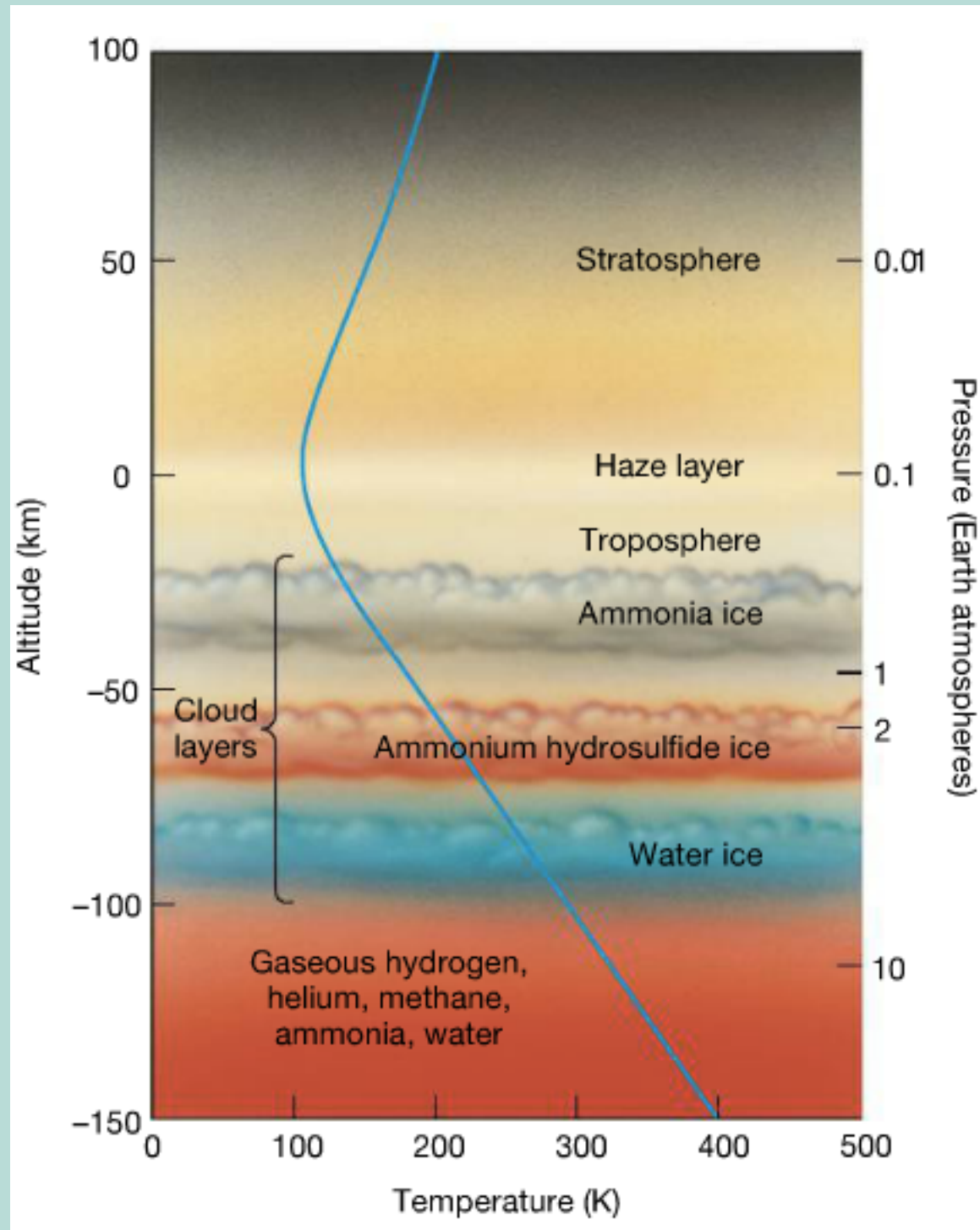


Venus

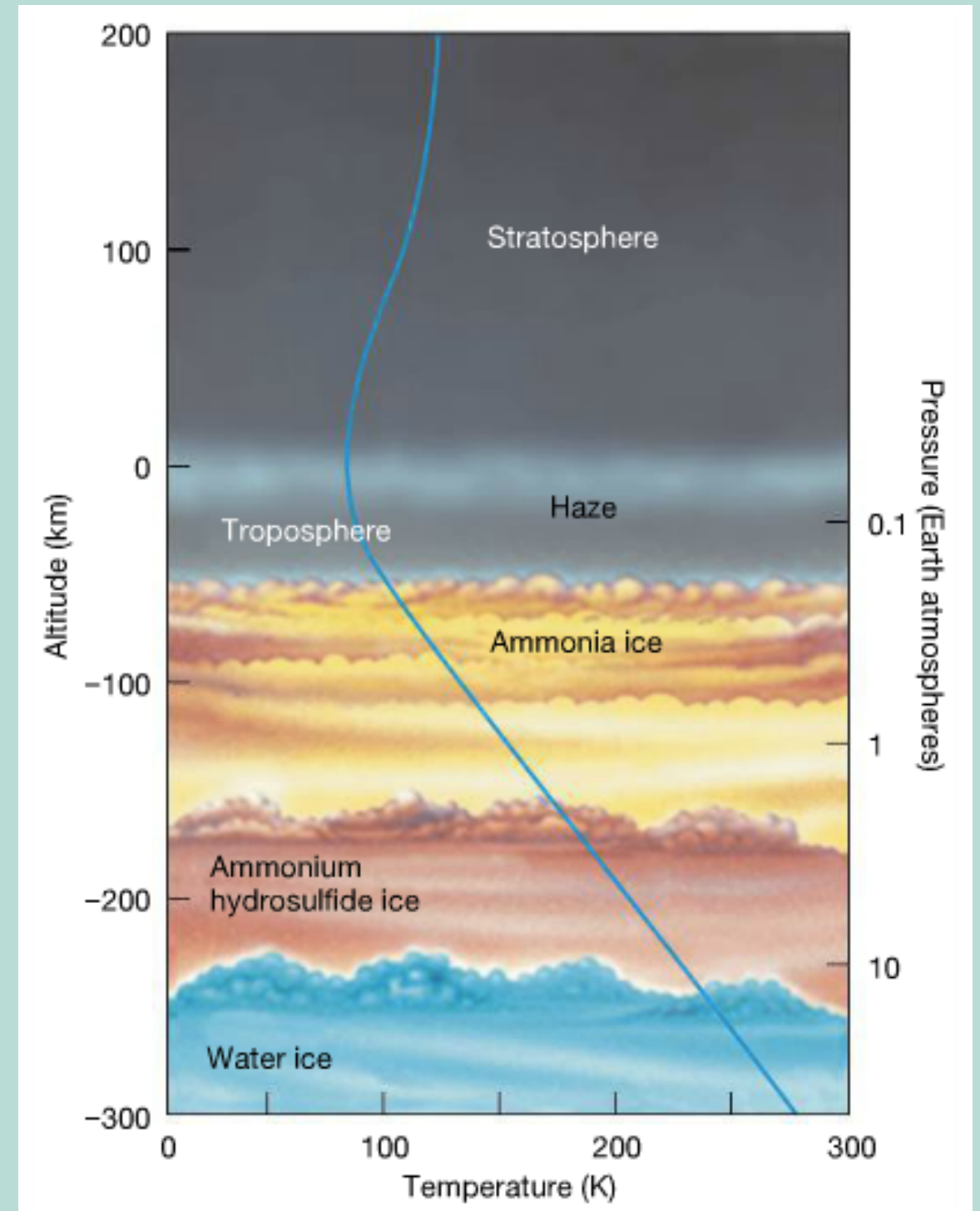


Earth

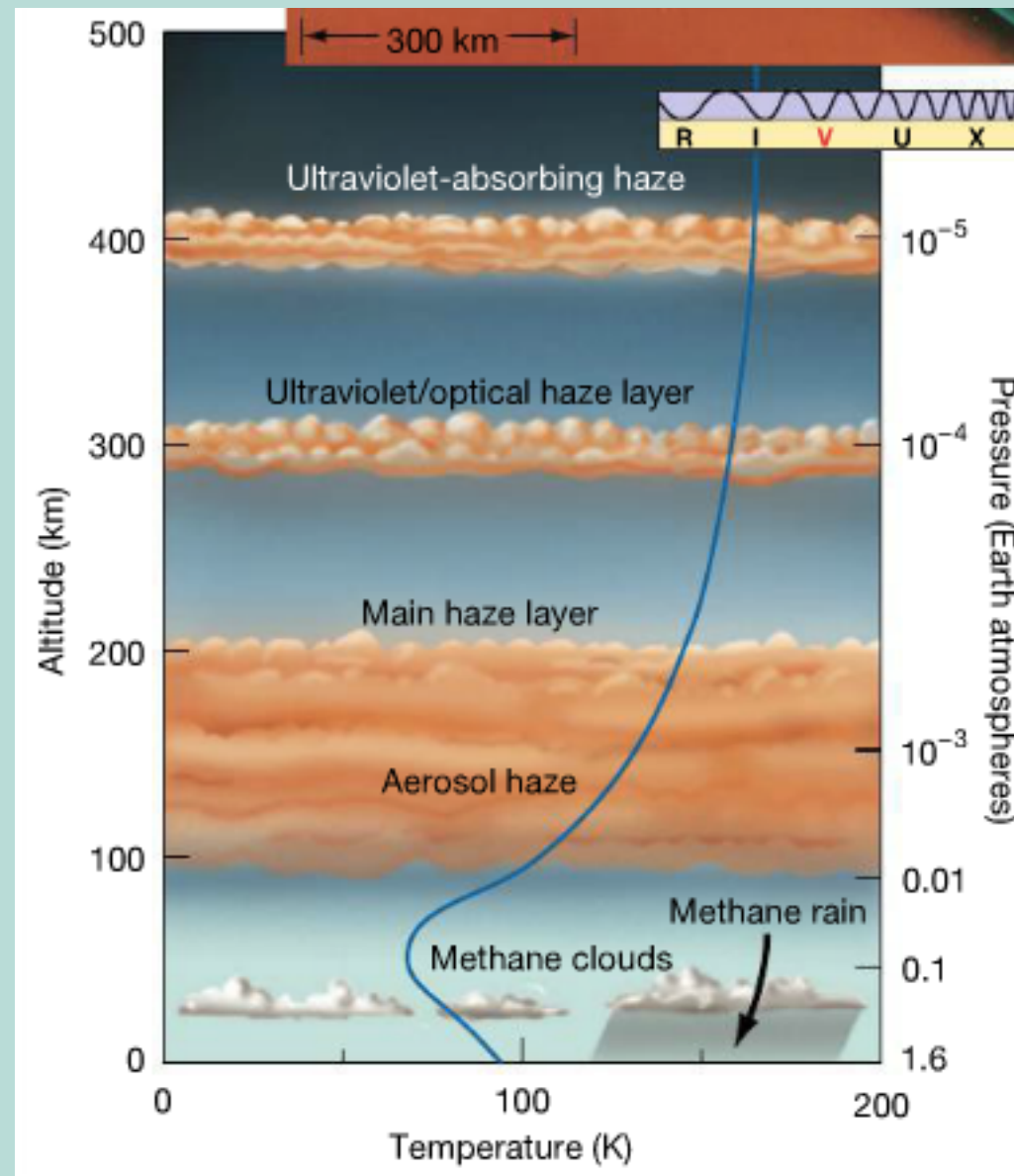
Zone & Belt Structure



Jupiter

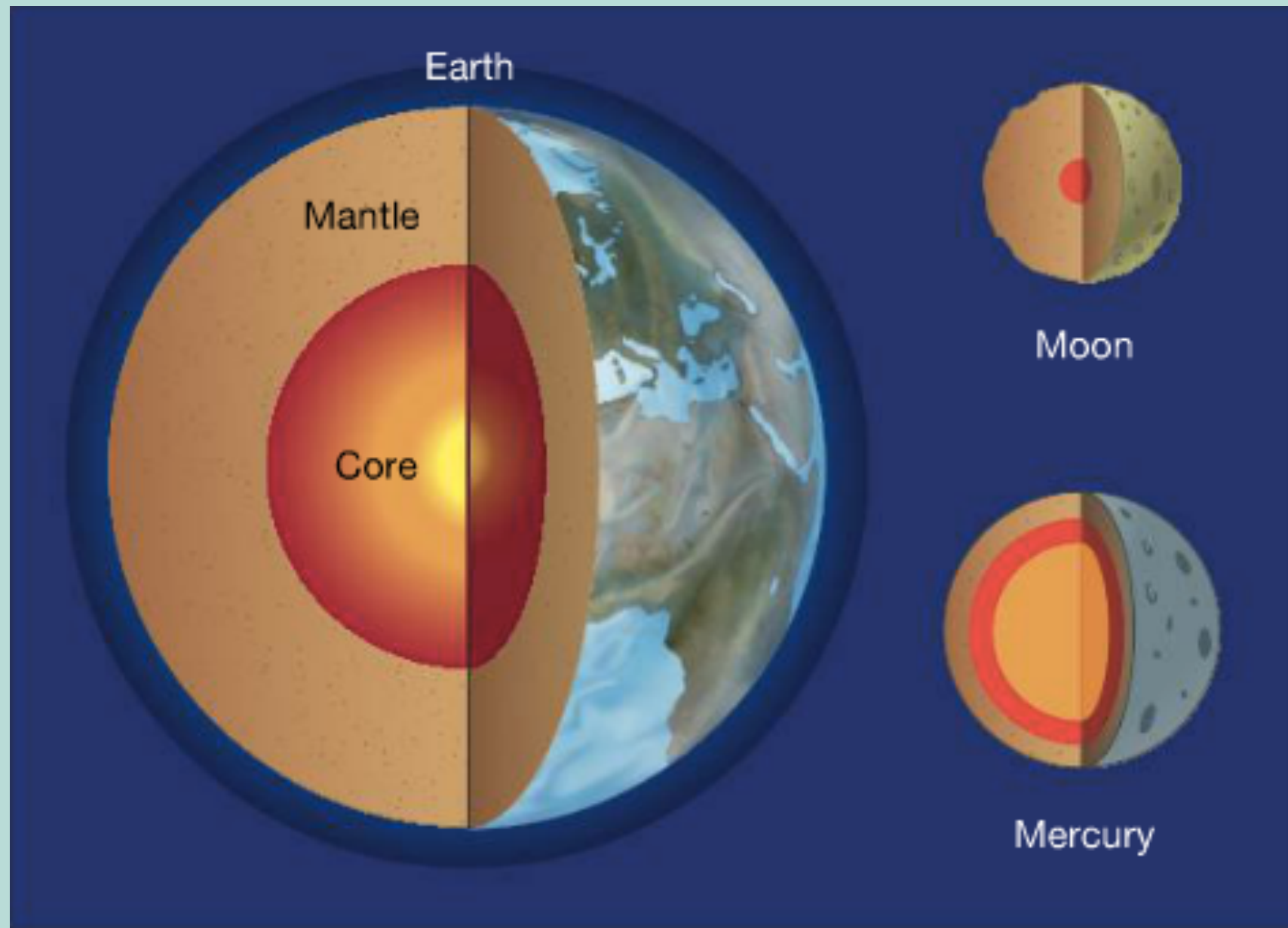


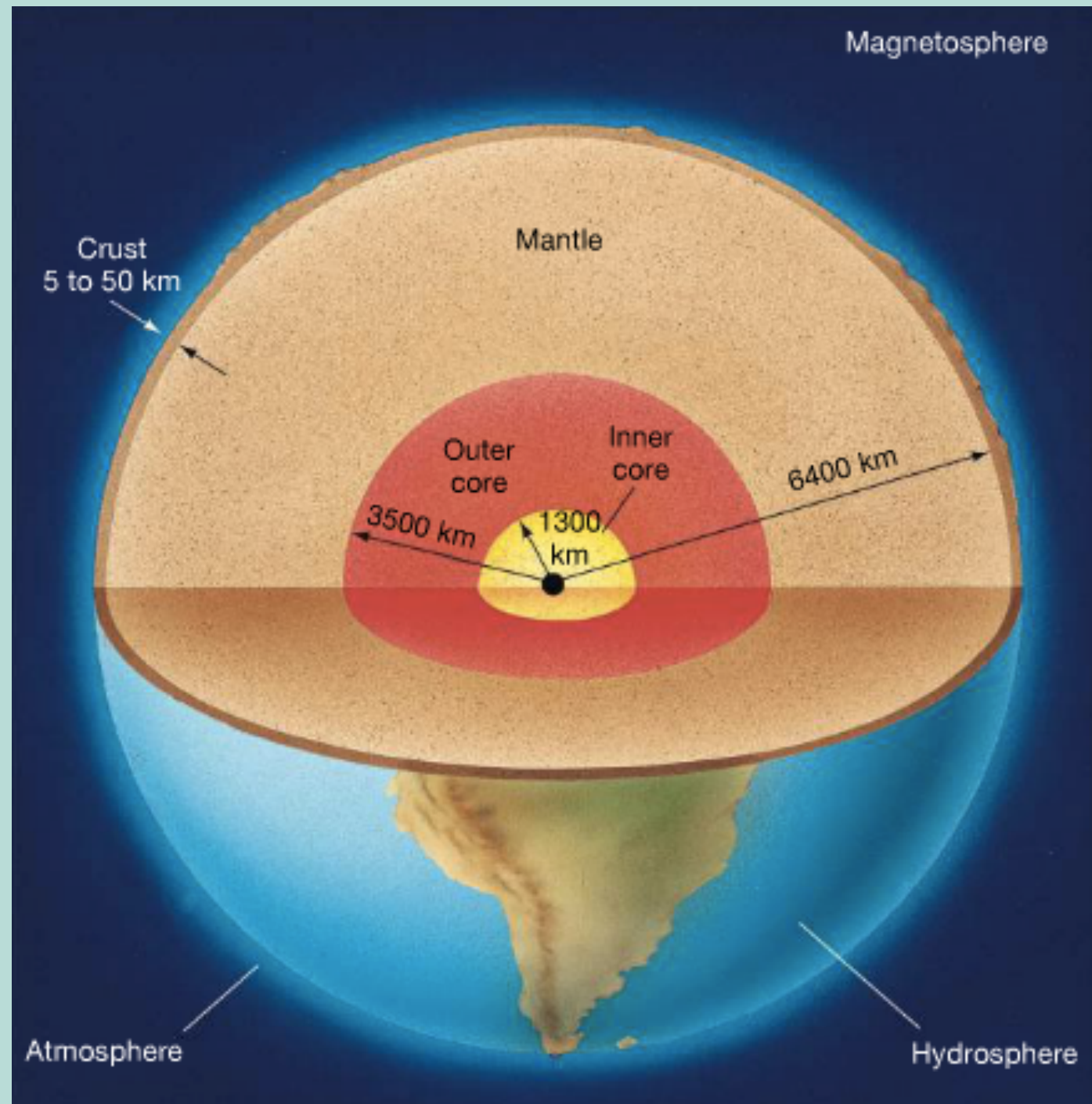
Saturn



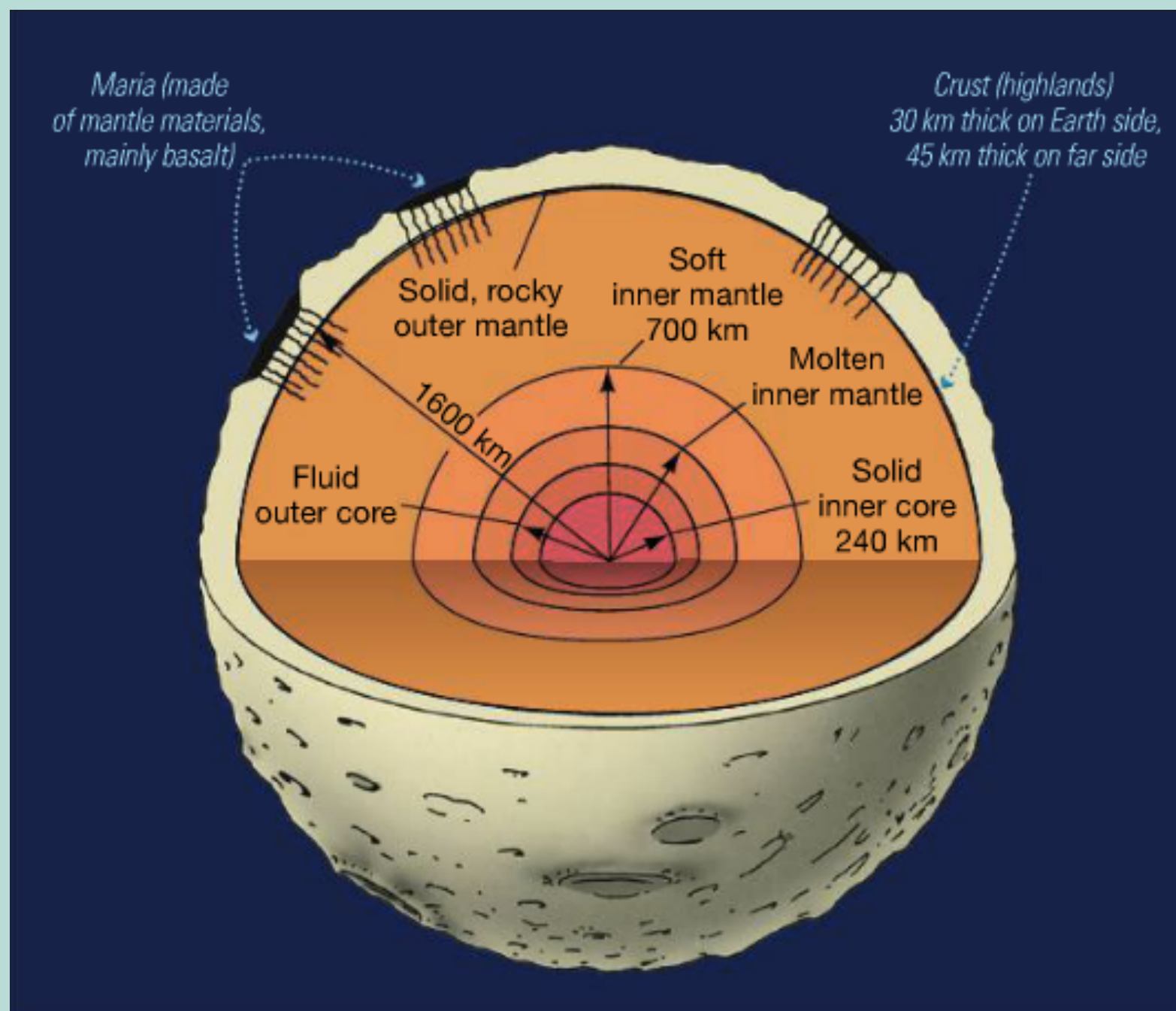
Titan

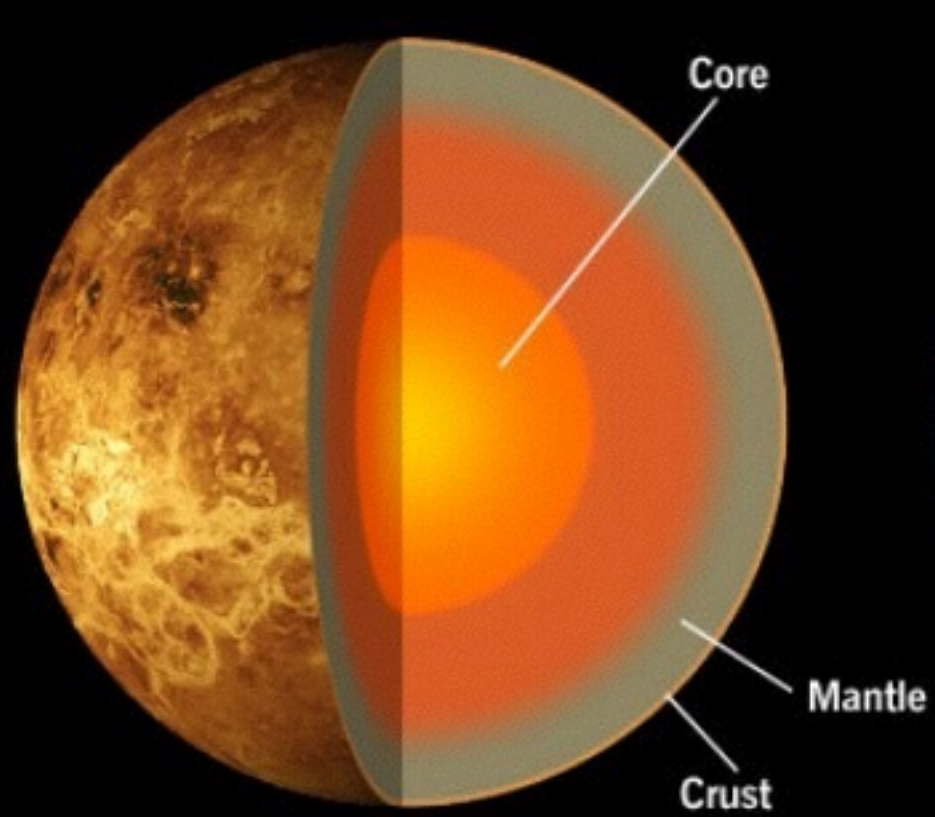
...And that's it!



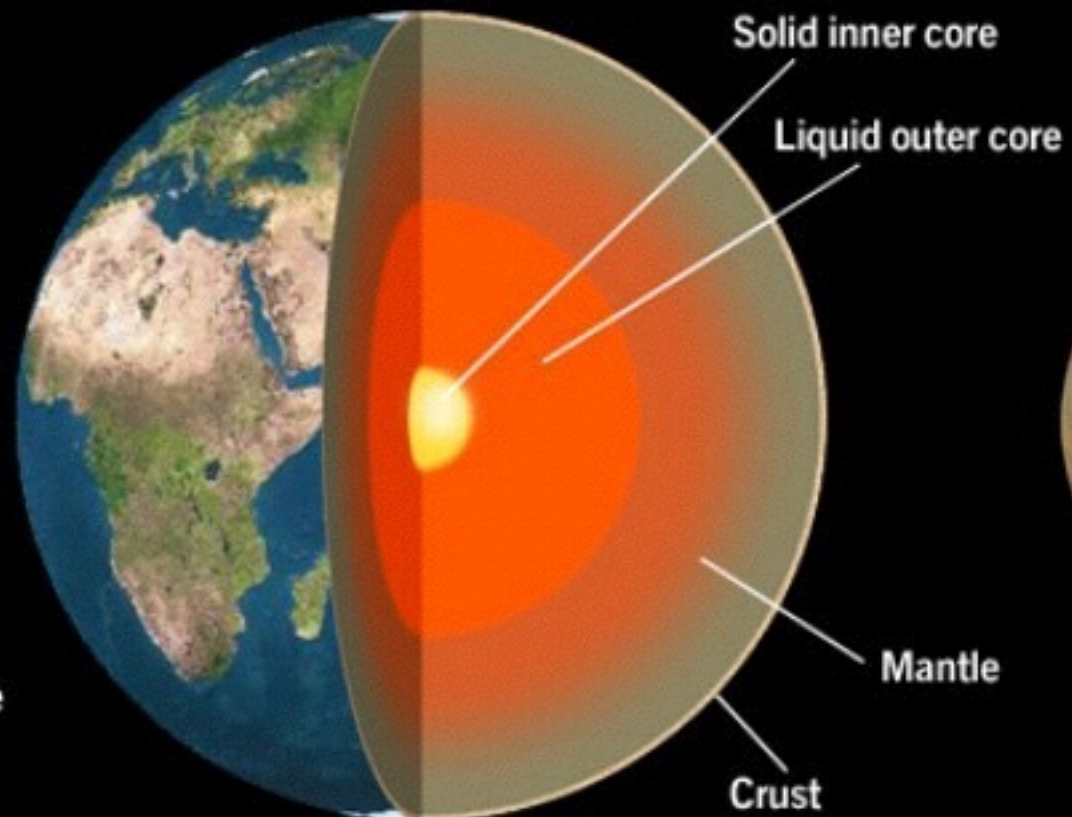


Contains Oceans (hydrosphere)
Huge Solid Iron Core

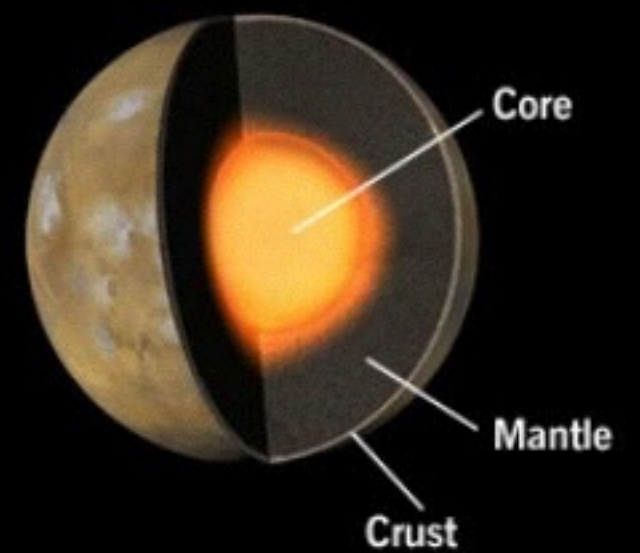




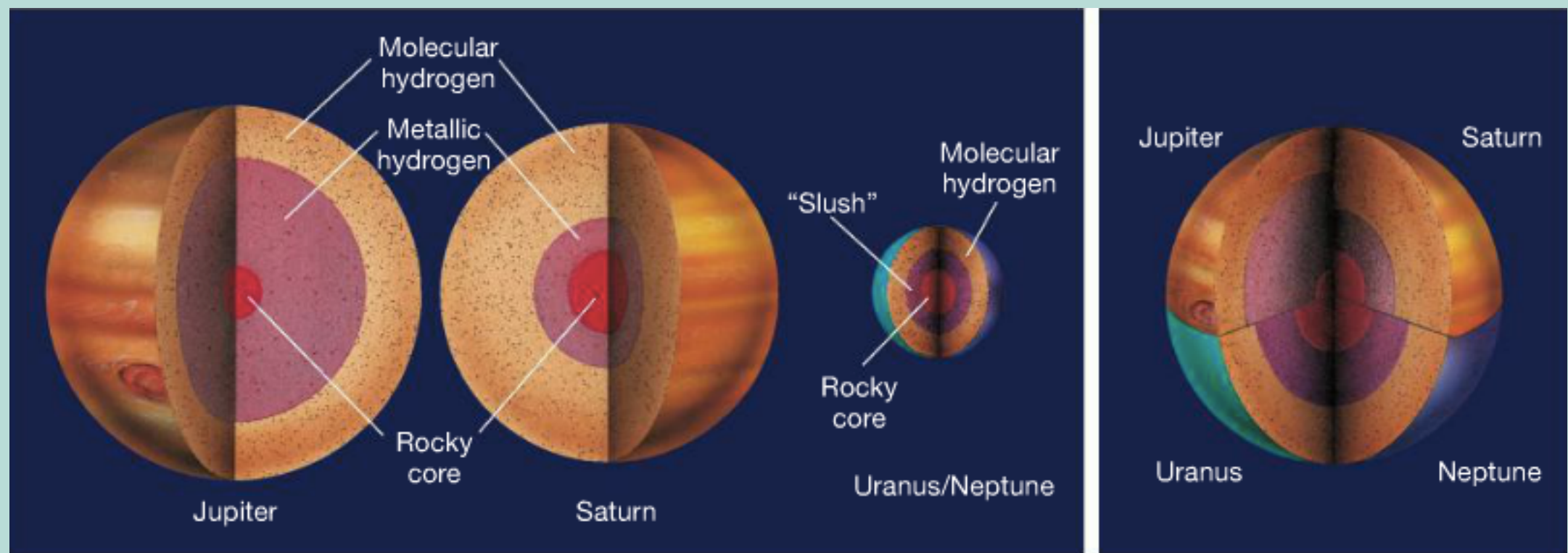
VENUS



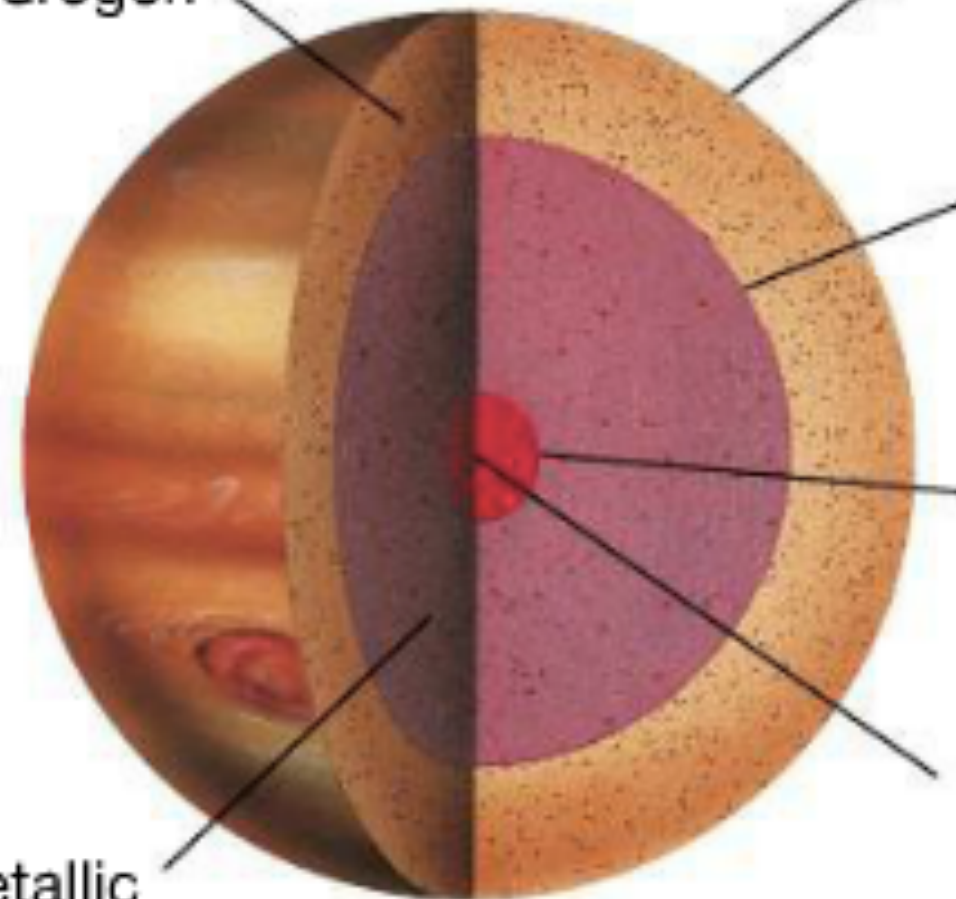
EARTH



MARS



Molecular
hydrogen



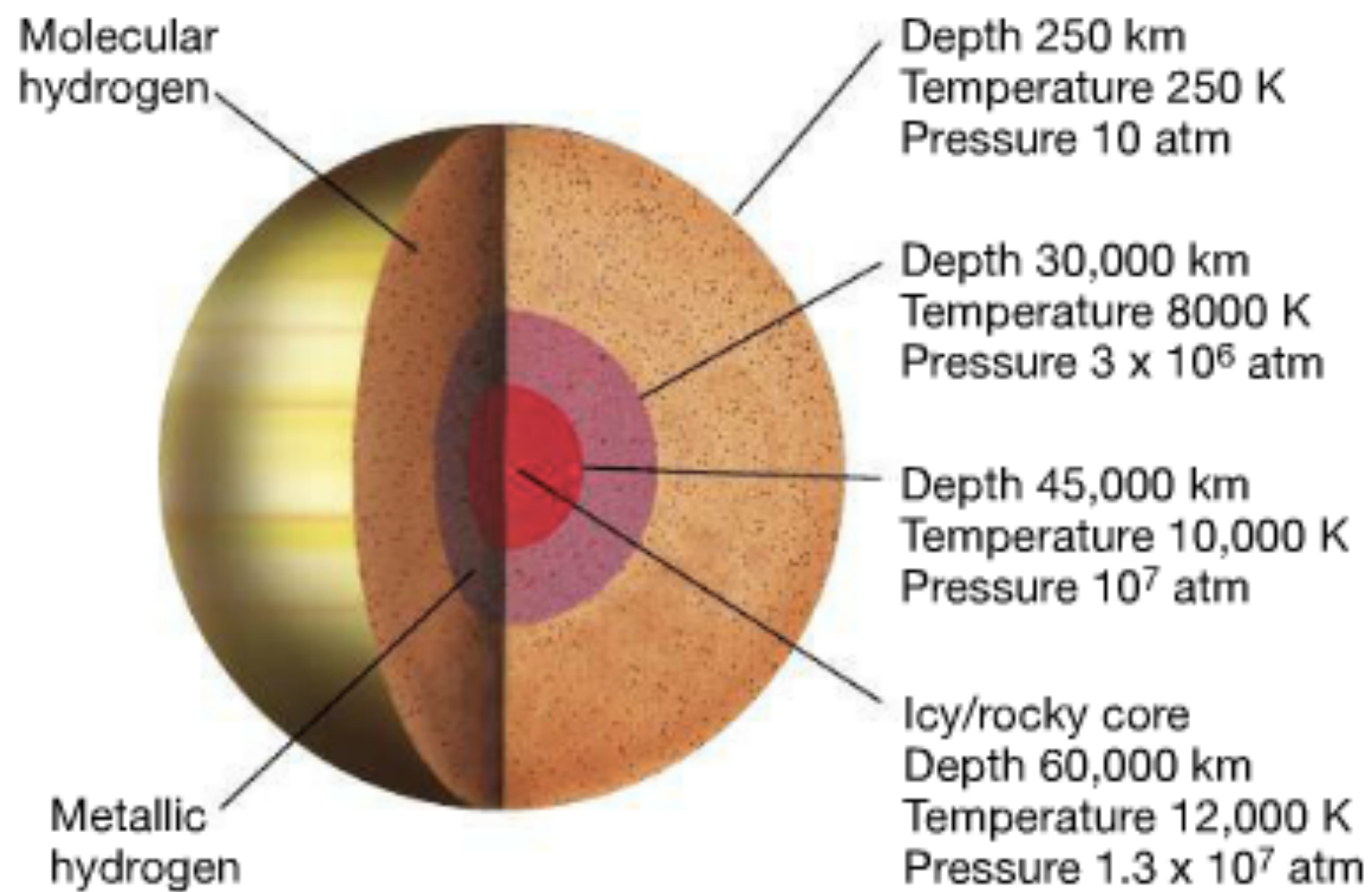
Metallic
hydrogen

Depth 100 km
Temperature 300 K
Pressure 10 atm

Depth 20,000 km
Temperature 11,000 K
Pressure 3×10^6 atm

Depth 60,000 km
Temperature 18,000 K
Pressure 4×10^7 atm

Icy, rocky core
Depth 70,000 km
Temperature 25,000 K
Pressure 6×10^7 atm



Mercury

- Most “eccentric” planet
- Inferior Orbit (28 degrees)
- Large Day/Night temperature swing
- Caloris Basin
- Magnetic Field

Venus

- Earth's Twin
- Aphrodite Terra
- Maxwell Mons
- Retrograde Spin
- Inferior Orbit (47 degrees)
 - Hot and Acidic

Earth

- Life
- Large quantities of Oxygen in Atmosphere (including ozone)
- Very Dense (5500 kg/m^3 , more than twice as much as dense as granite)
- Carbon Cycle
- Plate Tectonics
- Significant Nuclear Heating

THE Moon

- Maria: Younger, lava plains, Earth side, Higher Density
- Highlands: Older, Heavily Cratered, Both sides, Lower Density
 - Craters determine age
 - Tidally Locked and Drifting away

Mars

- Ancient Canals
- Valles Marineris
- Olympus Mons
 - Rusty
- Seasons On Mars
- Curiosity and the search for Life

Jupiter

- Differential Rotation (Zones and Belts)
 - Rapidly Spinning Interior
- Massive Magnetosphere
 - The Great Red Spot
- Like all the Jovians, its size and temperature retain hydrogen
- 4 Galilean Moons and tiny ring

Galilean Moons

- What are they/Relative Sizes
- Io Plasma Torus
- Ganymede is the big one
- Europa's got tons of water
- Callisto's not differentiated. Valhalla

Saturn

- Standard Jovian: Magnetosphere, Mostly H, He.,
Differential Rotation, High Wind Speeds
- Rings: Roche Limit, Resonances
- Helium Rain

Titan

- The Moon with an Atmosphere
- Methane Rain, Lakes

Uranus

- First non-ancient planet (1781, Herschel)
- Rotation Axis tilted 90 degrees
- Skinny Rings

Neptune

- Dark Matter
- Bluish tint like Uranus due to Methane in upper atmosphere
- The Great Dark Spot

Triton

- Nitrogen Frost
- Retrograde Orbit
- Dizzy Dance of Death