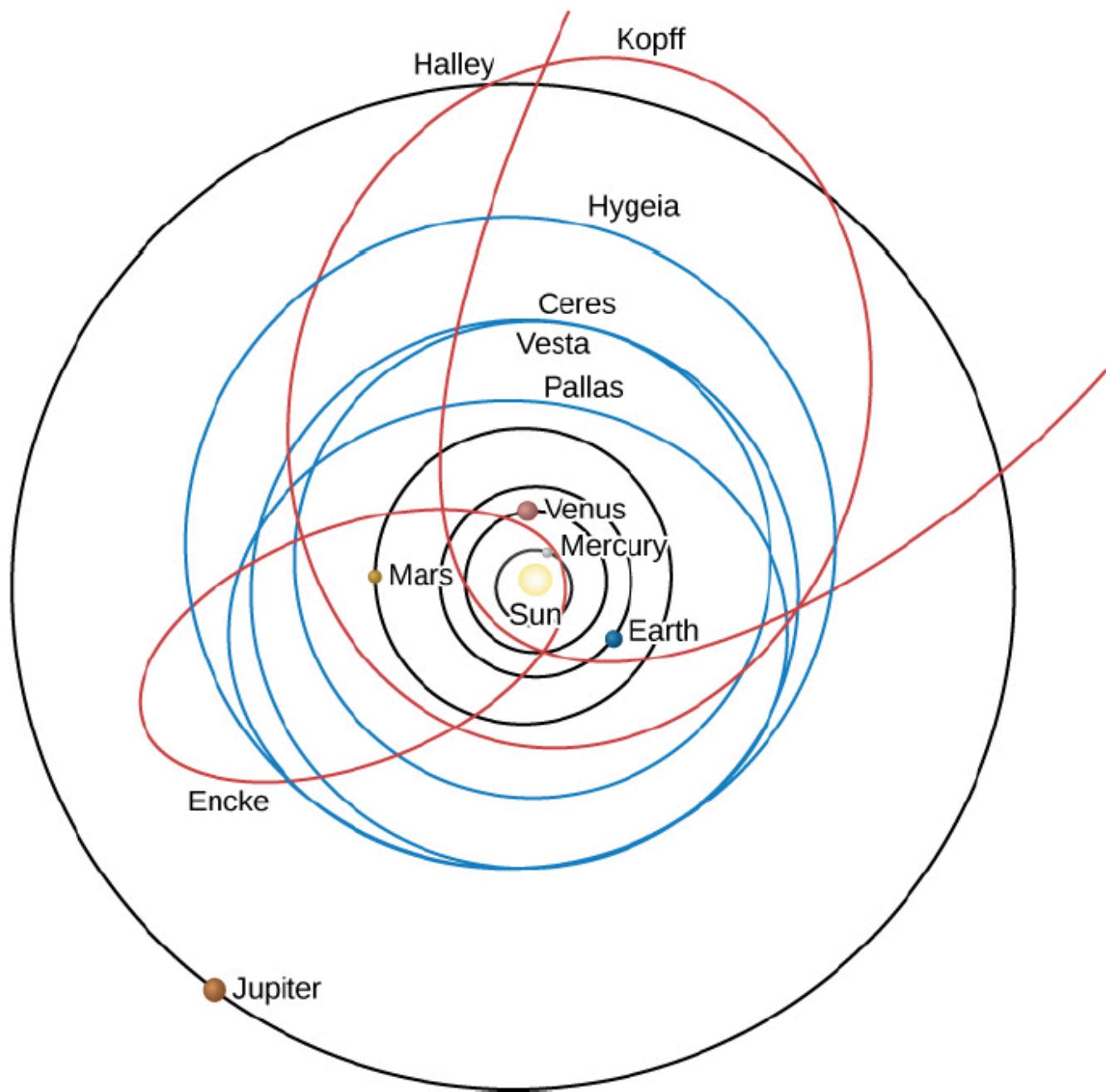


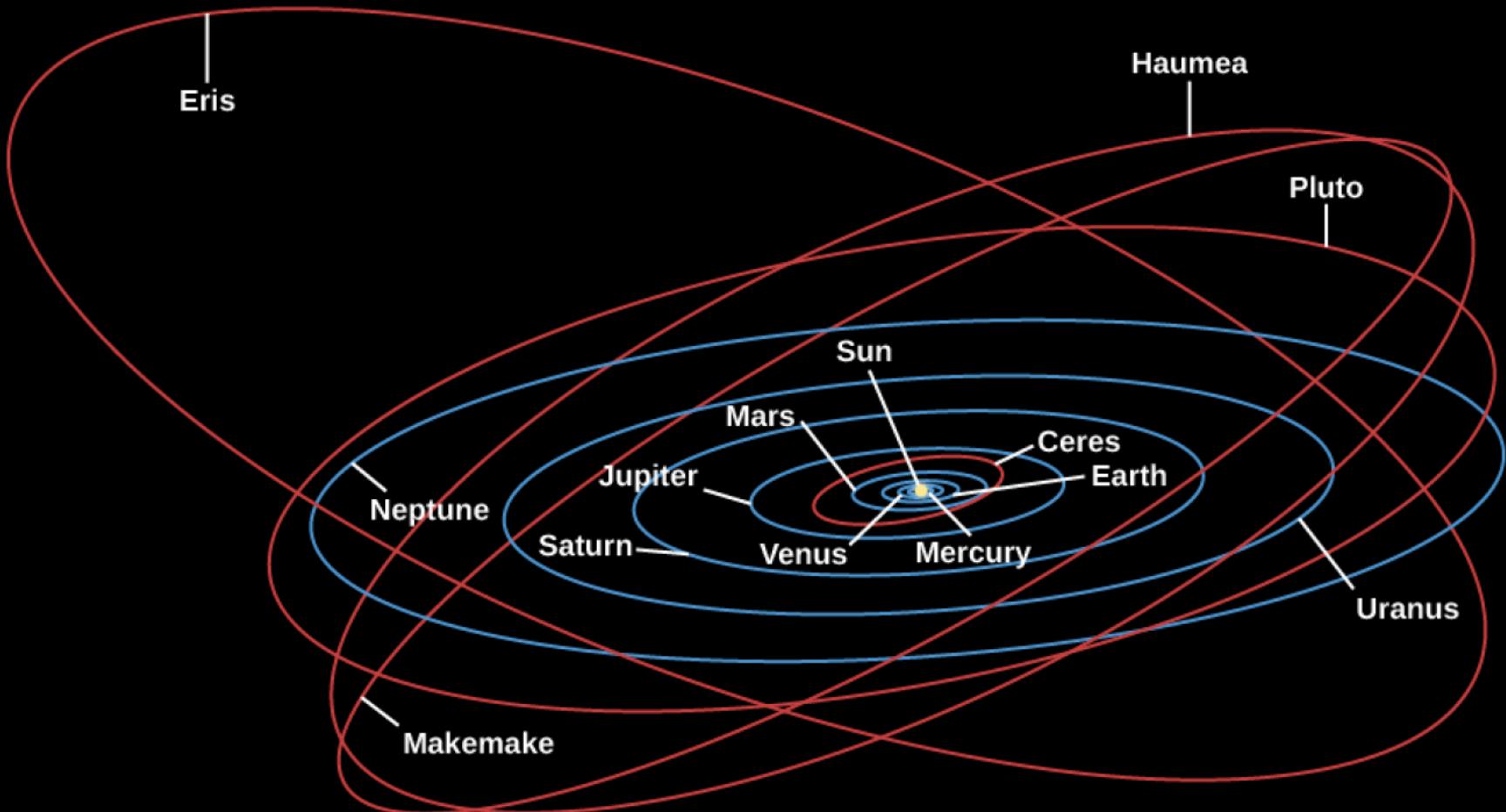
Newton's Laws of Gravity

- **Newton's first law:** Every object will continue to be in a state of rest or move at a constant speed in a straight line unless it is compelled to change by an outside force.
- **Newton's second law:** The change of motion of a body is proportional to and in the direction of the force acting on it.
- **Newton's third law:** For every action there is an equal and opposite reaction (or: the mutual actions of two bodies upon each other are always equal and act in opposite directions).

$$F_{\text{gravity}} = G \frac{M_1 M_2}{R^2}$$



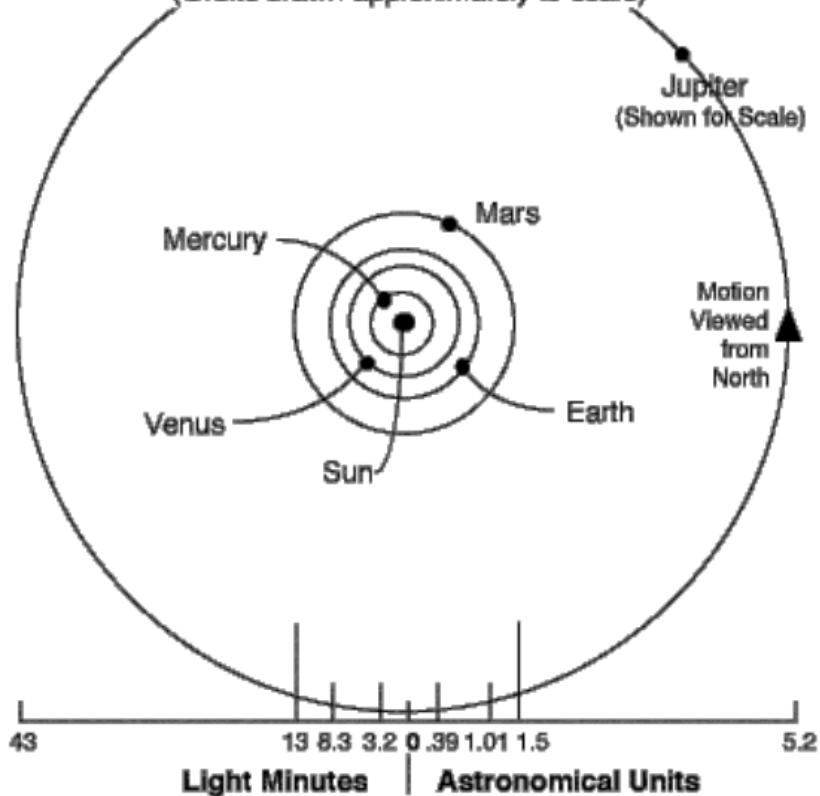
Solar System



The orbits of the planets are very nearly circular and concentric.

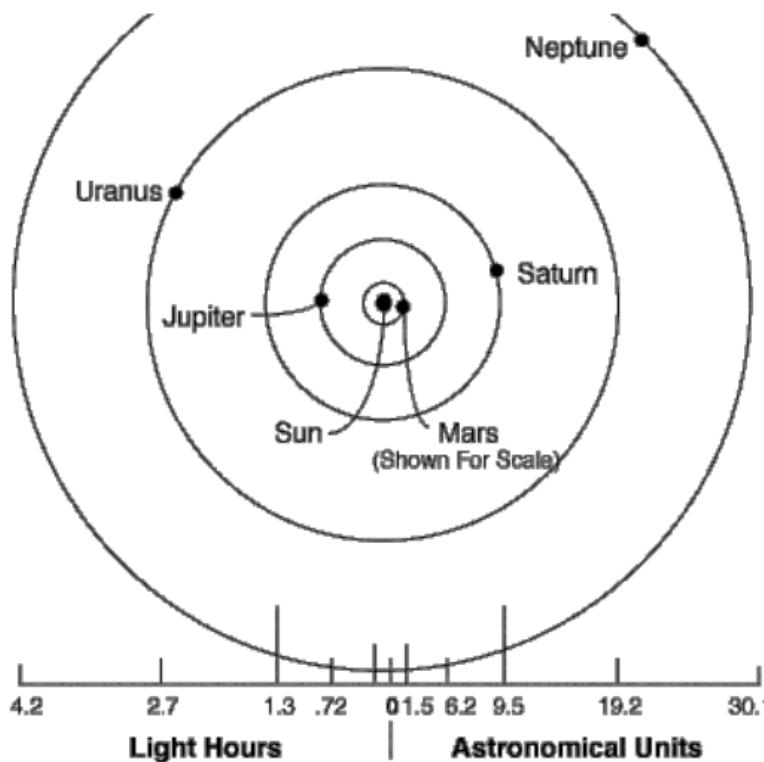
Mean Distances Of The Terrestrial Planets From The Sun

(Orbits drawn approximately to scale)

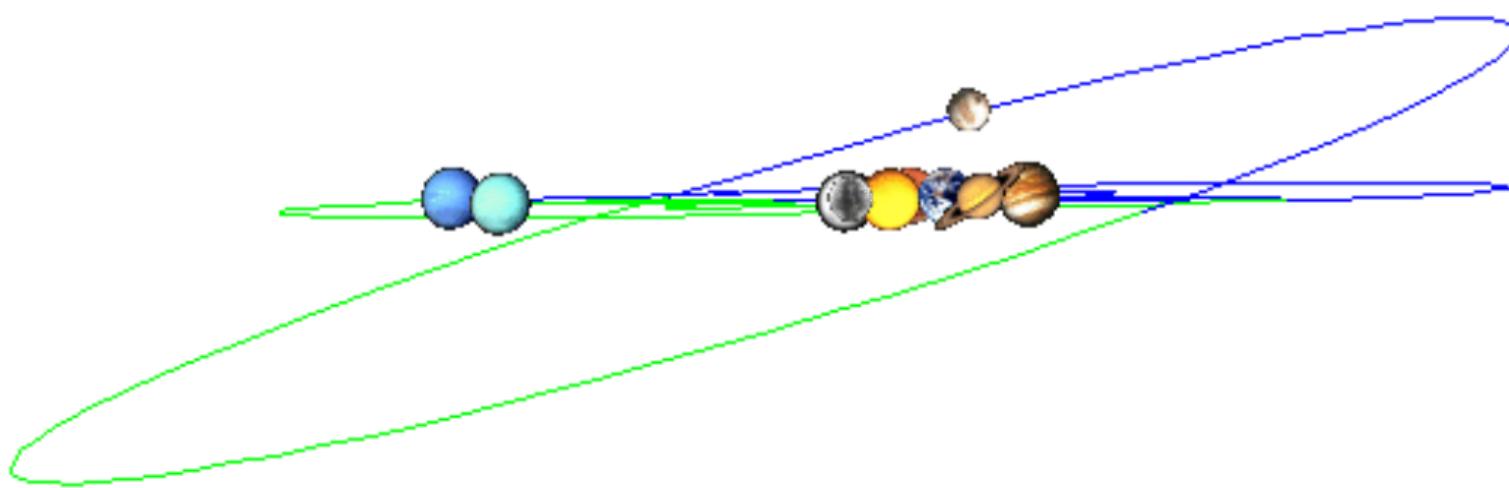


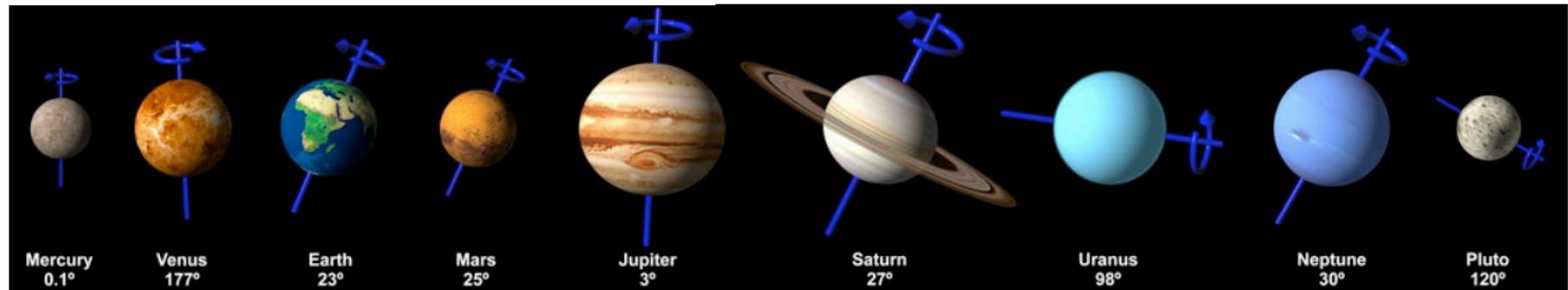
Mean Distances Of The Jovian Planets From The Sun

(Orbits drawn approximately to scale.)



All the planets (but not Pluto) orbit in the same direction and in the same plane: the **ecliptic** (to within 60°).





Orbital Data for the Planets

Planet	Semimajor Axis (AU)	Period (y)	Eccentricity
Mercury	0.39	0.24	0.21
Venus	0.72	0.6	0.01
Earth	1	1.00	0.02
Mars	1.52	1.88	0.09
(Ceres)	2.77	4.6	0.08
Jupiter	5.20	11.86	0.05
Saturn	9.54	29.46	0.06
Uranus	19.19	84.01	0.05

$$P^2 \propto a^3$$

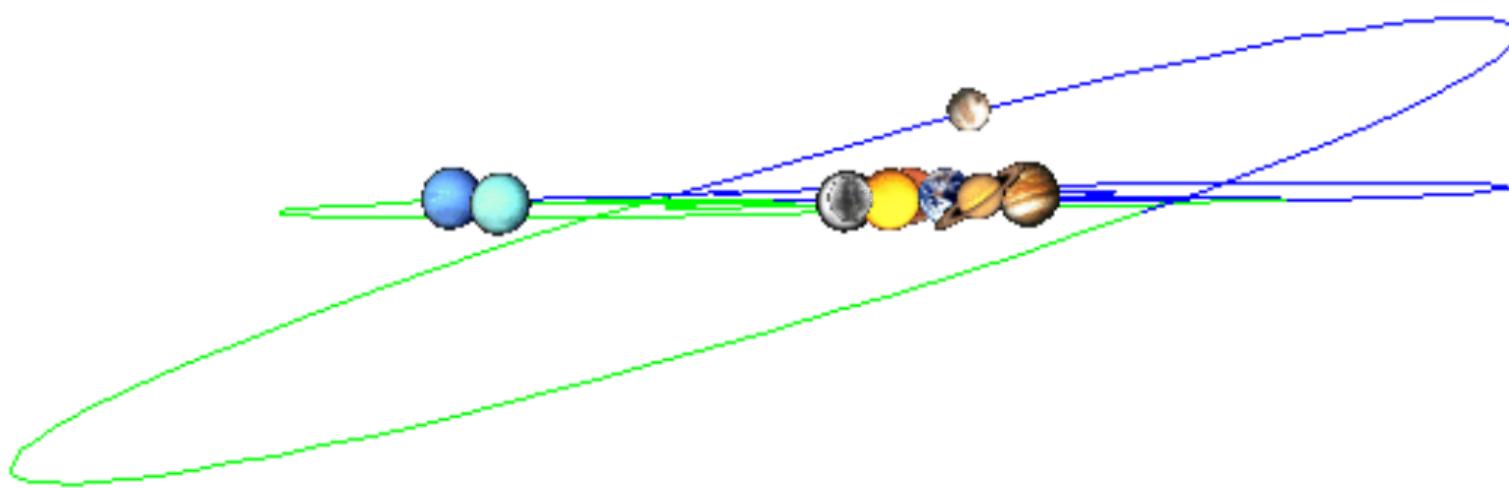


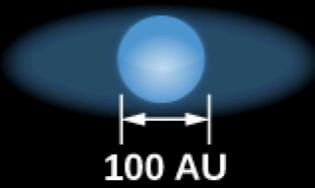
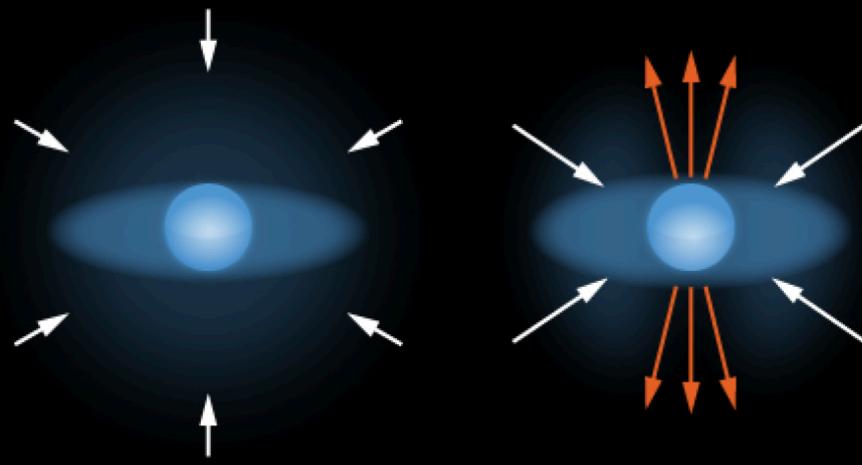
Object	Percentage of Total Mass of Solar System
Sun	99.80
Jupiter	0.10
Comets	0.0005–0.03 (estimate)
All other planets and dwarf planets	0.04
Moons and rings	0.00005

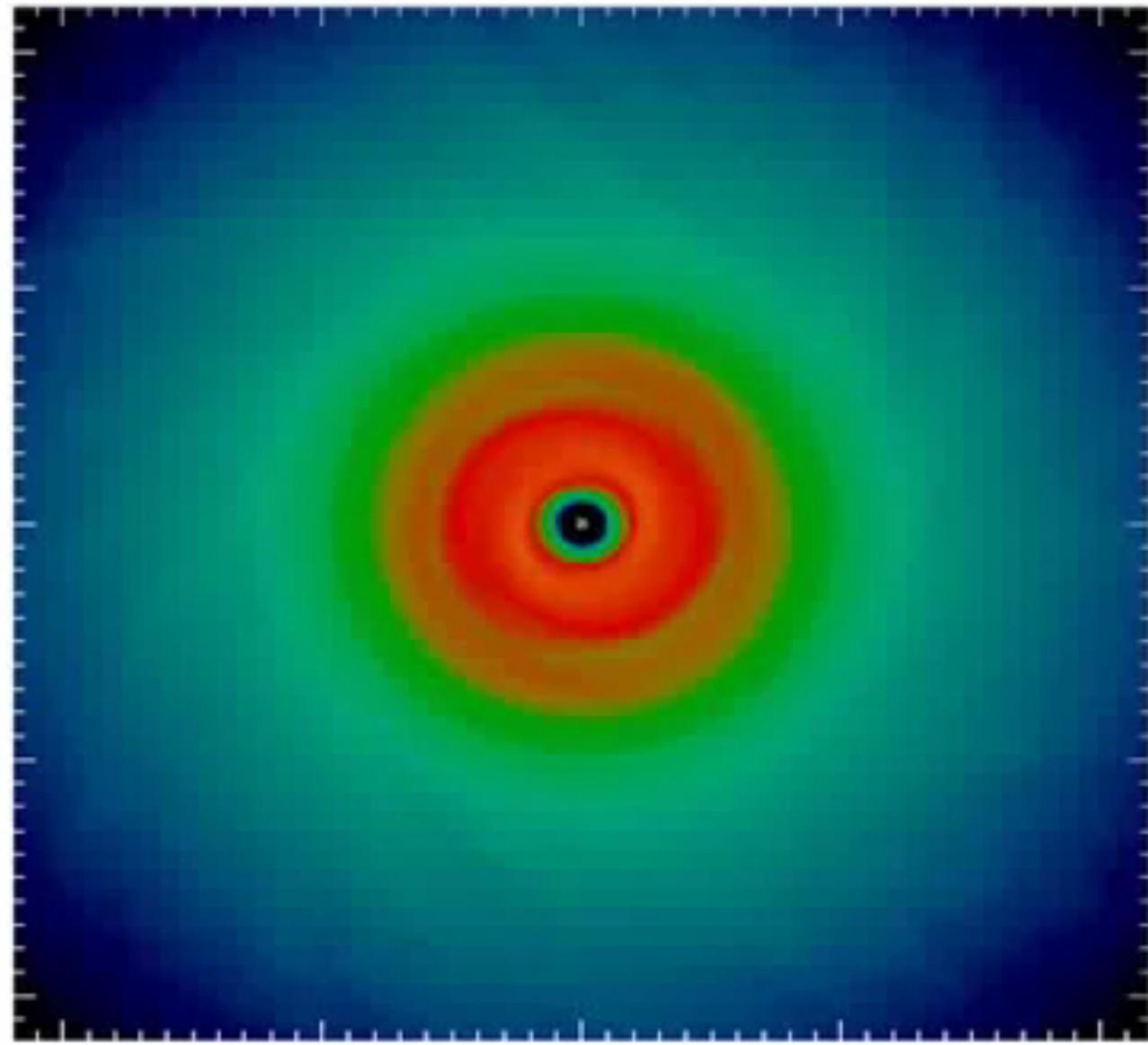
The Planets

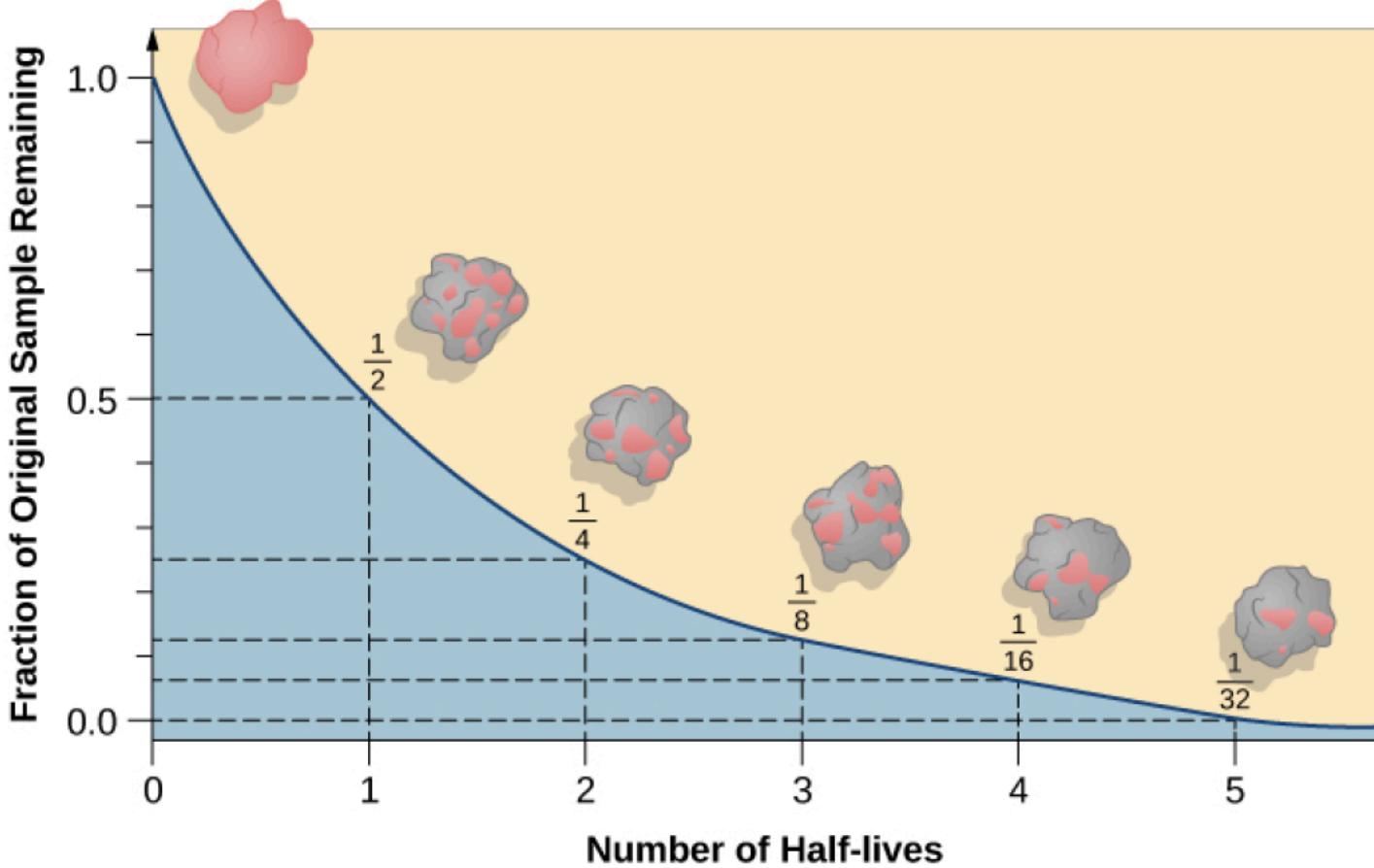
Name	Distance from Sun (AU) ^[2]	Revolution Period (y)	Diameter (km)	Mass (10 ²³ kg)	Density (g/cm ³) ^[3]
Mercury	0.39	0.24	4,878	3.3	5.4
Venus	0.72	0.62	12,120	48.7	5.2
Earth	1.00	1.00	12,756	59.8	5.5
Mars	1.52	1.88	6,787	6.4	3.9
Jupiter	5.20	11.86	142,984	18,991	1.3
Saturn	9.54	29.46	120,536	5686	0.7
Uranus	19.18	84.07	51,118	866	1.3
Neptune	30.06	164.82	49,660	1030	1.6

All the planets (but not Pluto) orbit in the same direction and in the same plane: the **ecliptic** (to within 60°).









Parent	Daughter	Half-Life (billions of years)
Samarium-147	Neodymium-143	106
Rubidium-87	Strontium-87	48.8
Thorium-232	Lead-208	14.0
Uranium-238	Lead-206	4.47
Potassium-40	Argon-40	1.31

The terrestrial planets – *rocky worlds*



The terrestrial planets – rocky worlds

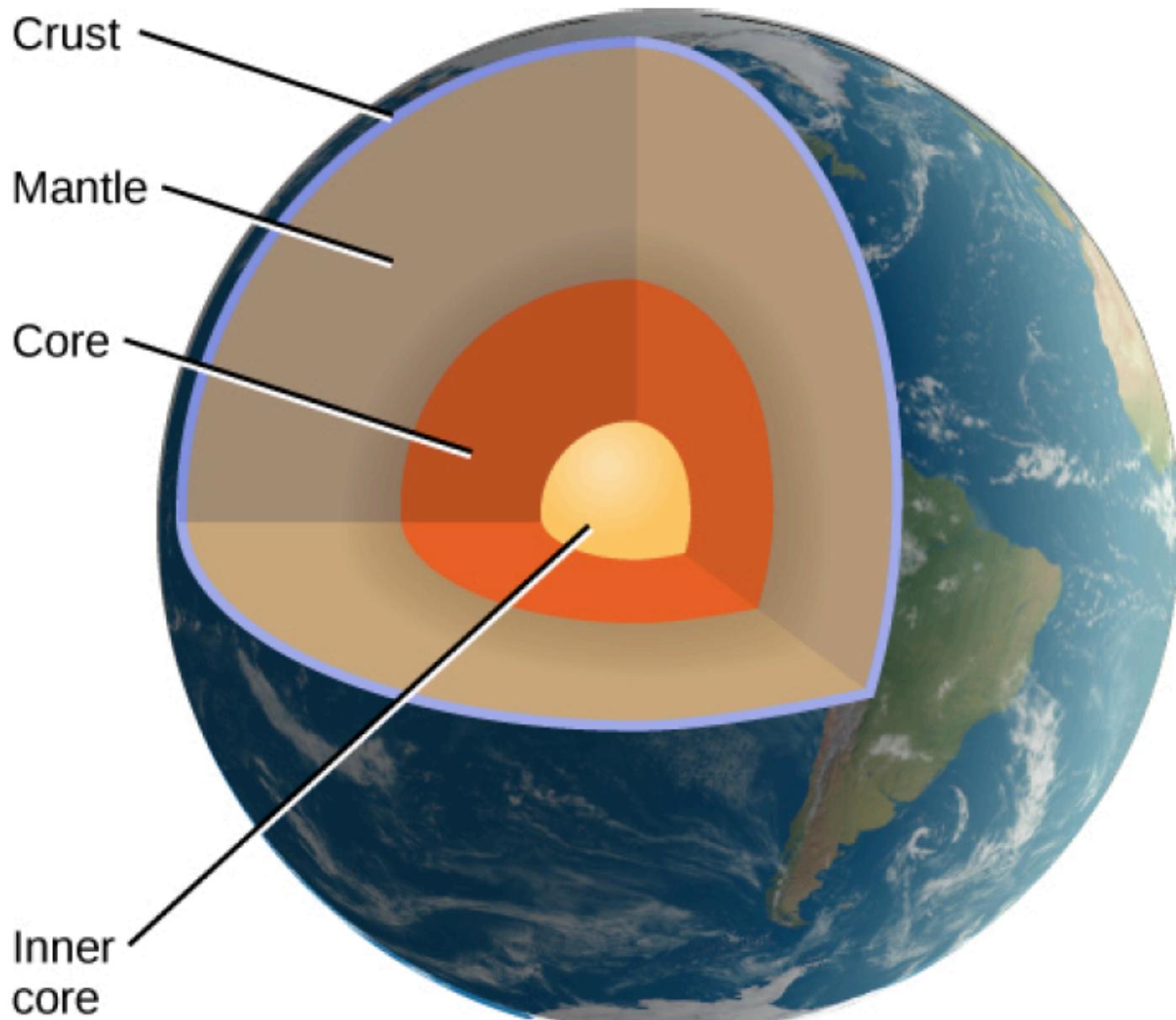


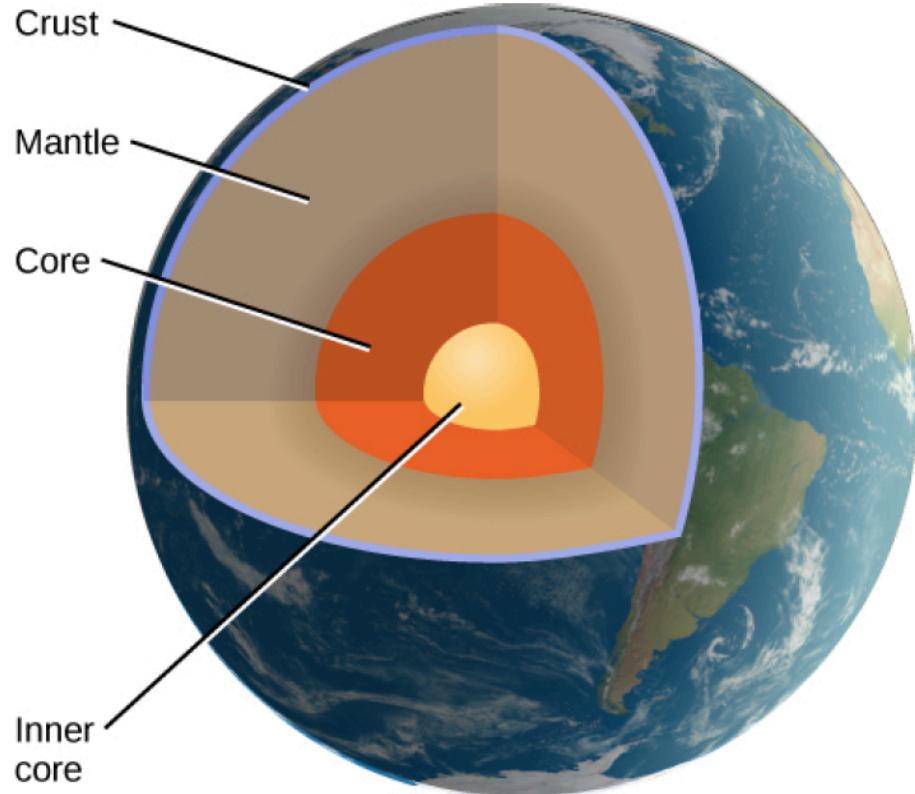
Surfaces of terrestrial planets

Bombardment (collisions with asteroids/comets)

Volcanism (includes earthquakes)
requires molten core

Erosion (if atmosphere)





Volcanism:
need molten core

Radioactivity

Larger planets have
cores that stay
molten for longer