Physical Principles of Mechanics (Motion)

Some of these will be used and explained during the lecture. Don't worry if you don't know what the terms mean. I will explain what is needed.

Newton's Laws

1st Law: An object in motion will continue in motion in a straight line at constant speed unless acted upon by an external force.
2nd Law: If a net external force acts on an object, it will undergo an acceleration given by $F = ma$.
3rd Law: For every action there is an equal and opposite reaction.

Newton's Universal Law of Gravitation:

Every object that has mass attracts every other object that has mass with a force given by $F = GmM/R^2$

Conservation Laws:

If no net external force acts on a system, the linear momentum is conserved.

If no net external torque acts on a system, the angular momentum is conserved.

Surprisingly, the first semester of a college physics course consists only of just how to apply these principles (along with other less important stuff) by using the mathematics that a student is already supposed to know. Physics is really easy – the difficulty is that students don't know the mathematics they should have learned.

The Motions of the Earth

A useful reference frame – the ecliptic.
Revolution around the Sun
The planets and other stuff
- Ptolemy, Copernicus, Brahe, Kepler, Newton
- Why are all the planets all almost in the ecliptic? Origin of the Solar System.
- Rotation of the Earth. The rotation axis. The seasons.
- The Moon. Origin of the Moon. Why the Earth's axis is tilted.Tidal forces and what they do.
- Tidal forces on Mercury and the moons of other planets. The Asteroid Belt. Tidal frictional heating and possible life on moons of Jupiter or Saturn. Tidal lock and resonance.

Precession of the Earth's rotation axis.
Other motions of the Earth within the Solar System. Milankovitch cycles.
A useful distance unit – the light year.
Closest stars to the Sun.
Motion of the Solar System in the Milky Way Galaxy. Periodic extinction events.
Motion of the Galaxy. The Local Group. Andromeda galaxy. Galactic collision.
Motion of the Local Group. The Great Attractor. Superclusters.

Solar System Fact Sheet

	MERCURY	VENUS	EARTH	MARS	JUPITER	SATURN	URANUS	NEPTUNE	CERES	PLUTO	ERIS	COMET HALLEY
Average Distance from Sun (km)	57.9×10^6	108.2×10^6	149.6×10^6	227.9×10^6	778.6×10^6	$1,434 \times 10^6$	$2,873 \times 10^6$	$4,495 \times 10^6$	414×10^6	$5,906 \times 10^6$	$10,166 \times 10^6$	$2,678 \times 10^6$
perihelion (km)	46.0×10^6	107.5×10^6	147.1×10^6	206.6×10^6	740.5×10^6	$1,352 \times 10^6$	$2,741 \times 10^6$	$4,445 \times 10^6$	383×10^6	$4,436 \times 10^6$	$5,723 \times 10^6$	87.7×10^6
aphelion (km)	69.8×10^6	108.9×10^6	152.1×10^6	249.2×10^6	816.6×10^6	$1,514 \times 10^6$	$3,003 \times 10^6$	$4,546 \times 10^6$	445×10^6	$7,376 \times 10^6$	$14,602 \times 10^6$	$5,251 \times 10^6$
Mean equatorial radius (km)	2,440	6,052	6,371	3,390	69,911	58,232	25,362	24,624	467	1,150	~1,200	15x8
Mass (kg)	3.3×10^{23}	48.7×10^{23}	59.7×10^{23}	6.4×10^{23}	$18,990 \times 10^{23}$	$5,684 \times 10^{23}$	868×10^{23}	$1,024 \times 10^{23}$	$.008 \times 10^{23}$	0.13×10^{23}	0.166×10^{23}	2.2×10^{14}
Rotation period (Earth days)	58.6	-243.02	1	1.03	0.41	0.44	-0.72	0.67	0.38	-6.39	1.08	2.2
Orbital period (Earth years)	0.24	0.62	1	1.88	11.9	29.5	84.02	164.8	4.6	247.9	560	76.1
Axial tilt (degrees)	0	177.3	23.4	25.2	3.1	26.7	97.8	28.3	4	119.6	?	45
Min/Max surface temperature	-173°C/427°C	462°C	-88°C /58°C	-153°C /20°C	N/A	N/A	N/A	N/A	-105°C /-38.2°C	-240.2°C /-218.2°C	-243.2°C /-217.2°C	30°C /130°C
Atmosphere	He, Na, O_2	CO_2, N_2	N_2, O_2	CO_2, N_2, Ar	H_2, He	H_2, He	H_2, He, CH_4	H_2, He, CH_4	?	N_2, CH_4, CO	?	Dust and gas around nucleus
Number of known moons	0	0	1	2	67	62	27	14	0	5	1	0

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Top Five Extinctions

- Ordovician-silurian Extinction: 440 million years ago.
- Devonian Extinction: 365 million years ago.
- Permian-triassic Extinction: 250 million years ago.
- Triassic-jurassic Extinction: 210 million years ago.
- Cretaceous-tertiary Extinction: 65 Million Years Ago.

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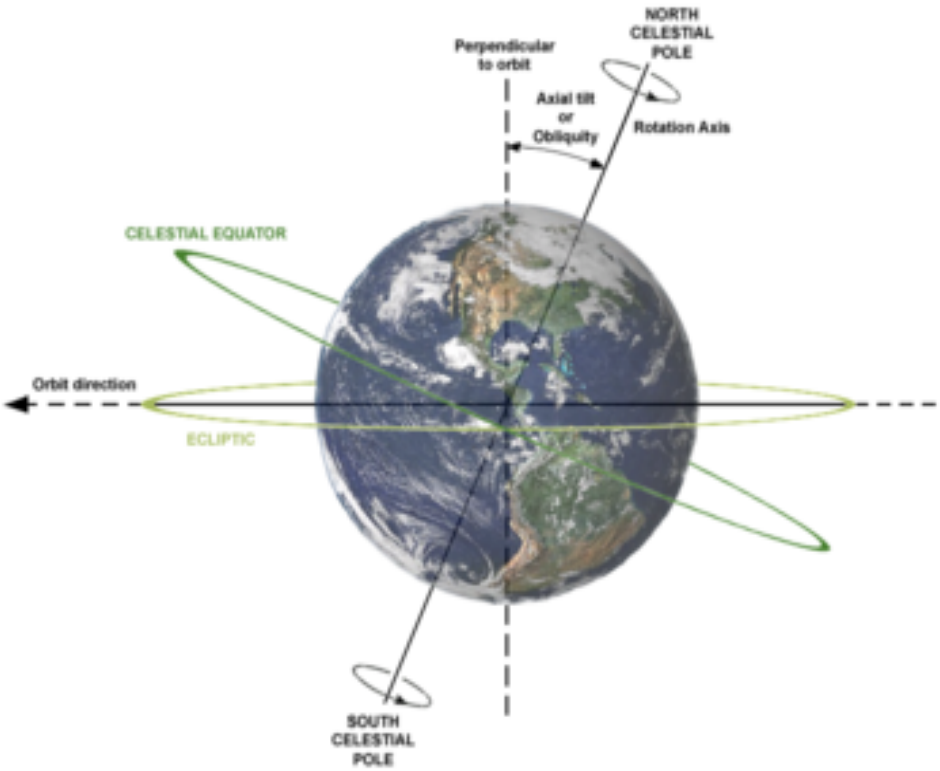
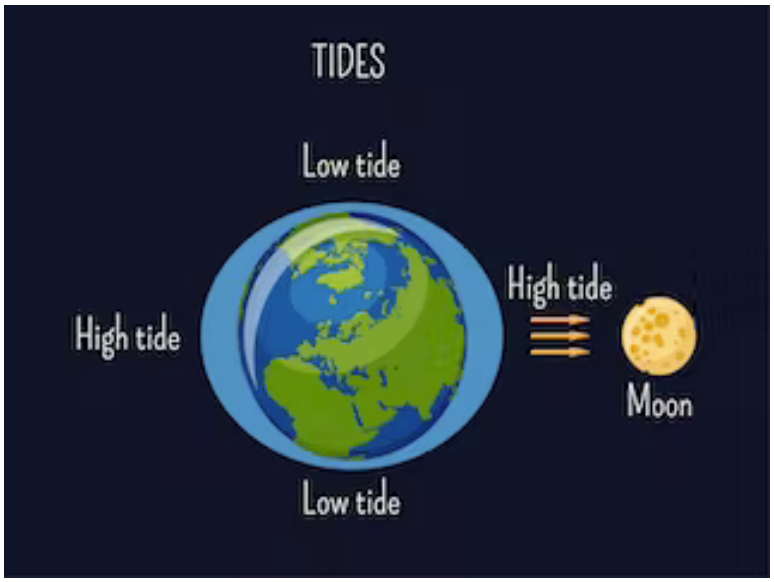
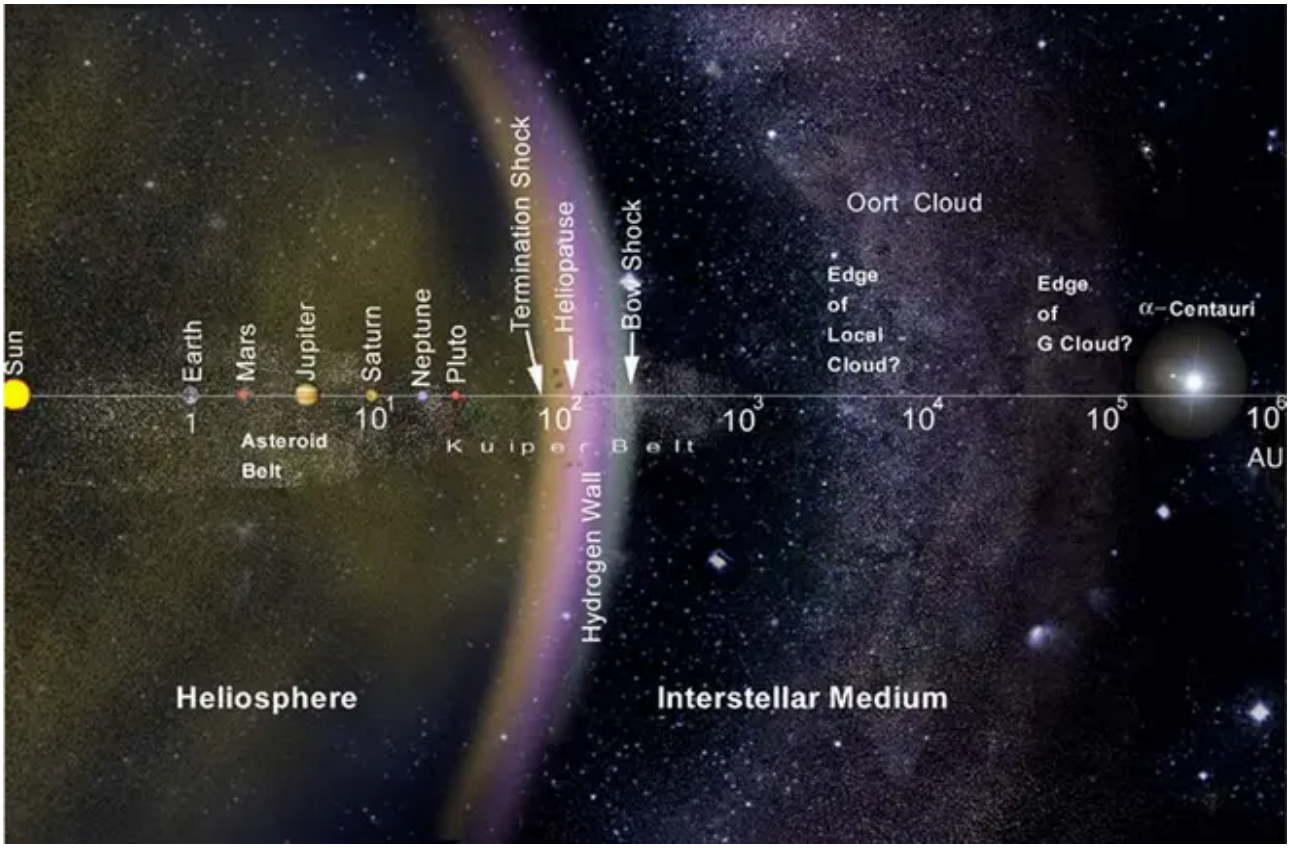


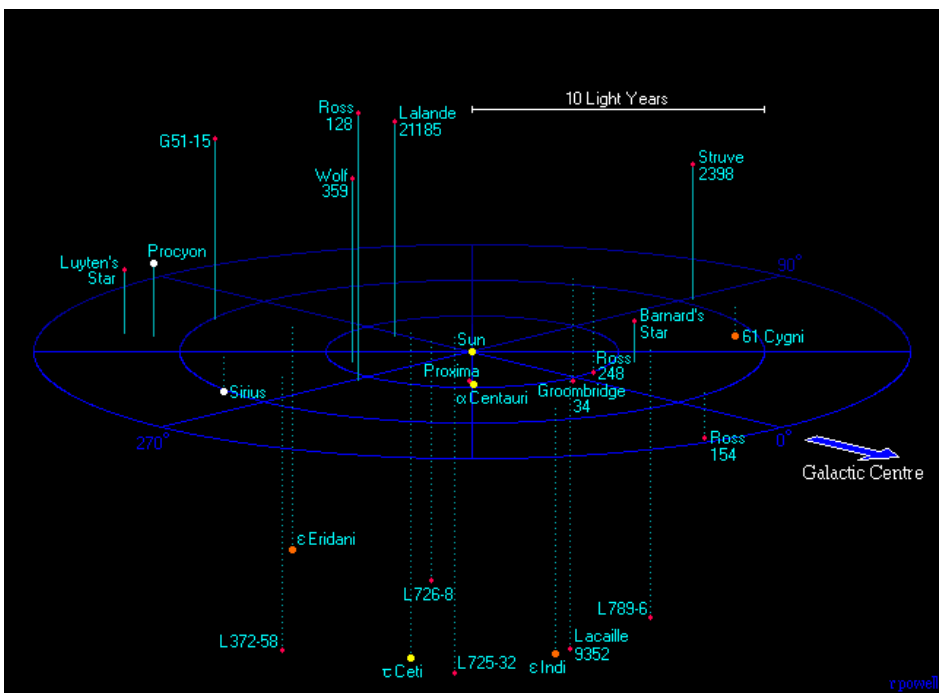
The ecliptic and the rotational axis.



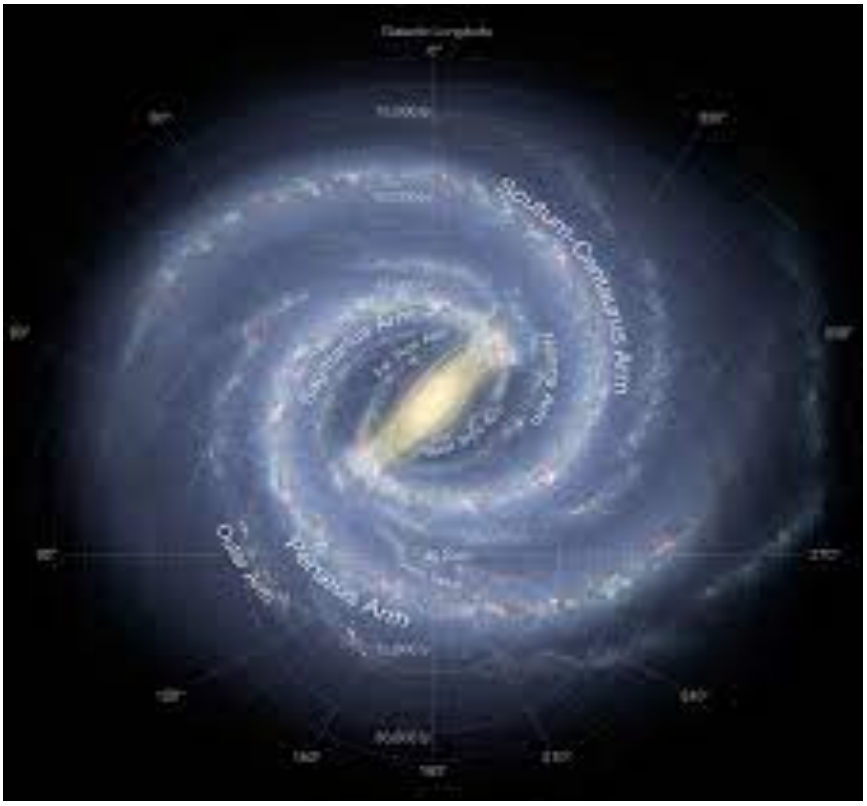
How the tides are caused.



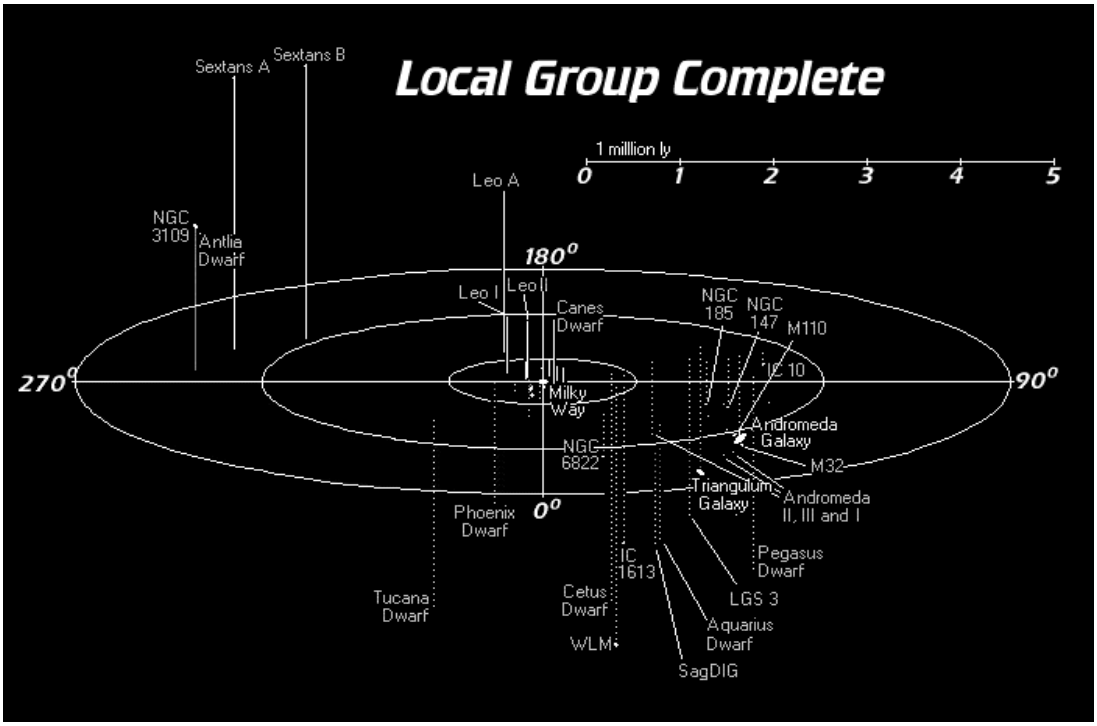
The Solar System planets in order, but the distance scale is logarithmic to confuse most of you!



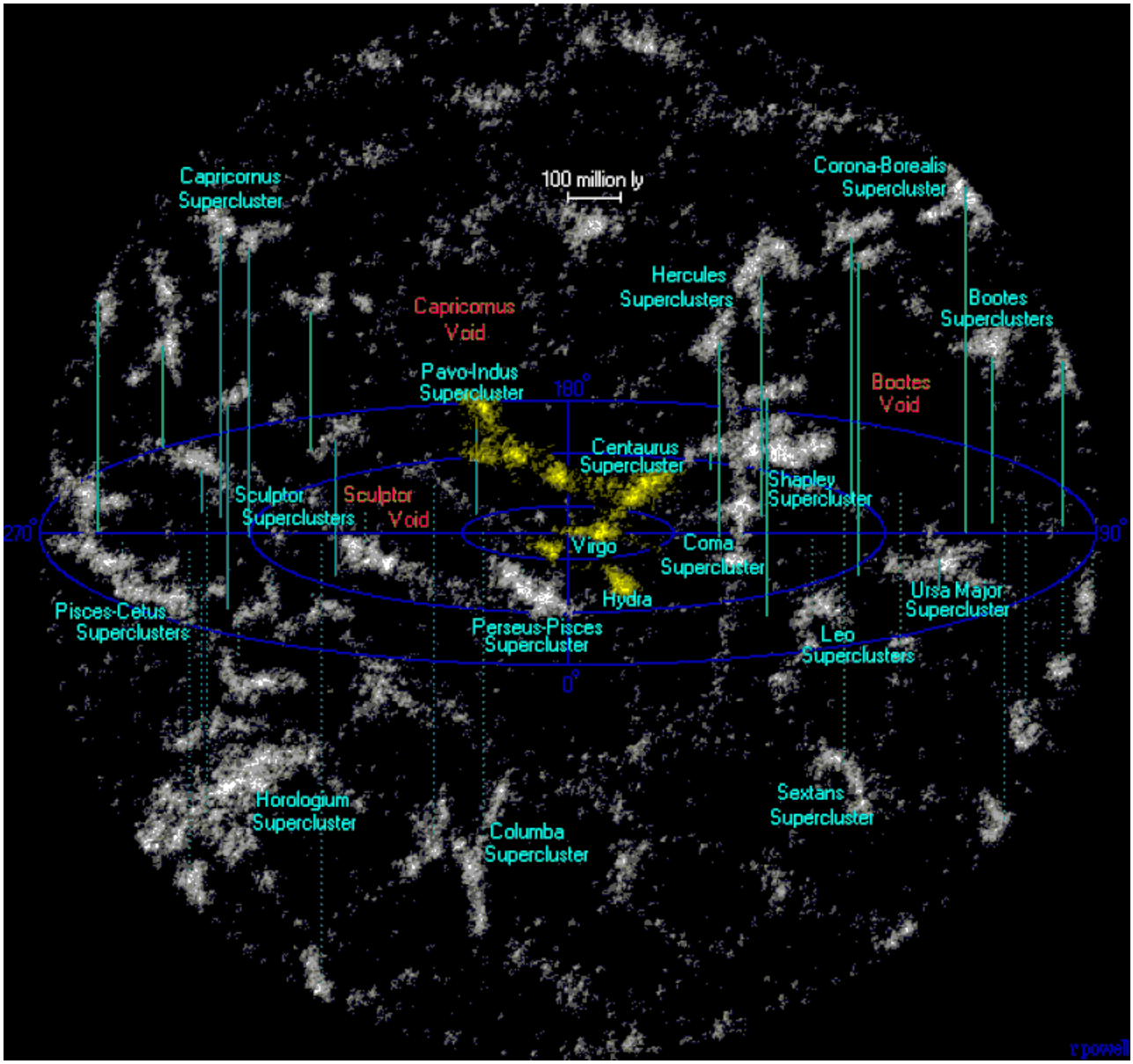
Closest stars to the Sun



The Milky Way



The Local Group



Galactic Superclusters “nearest” to us