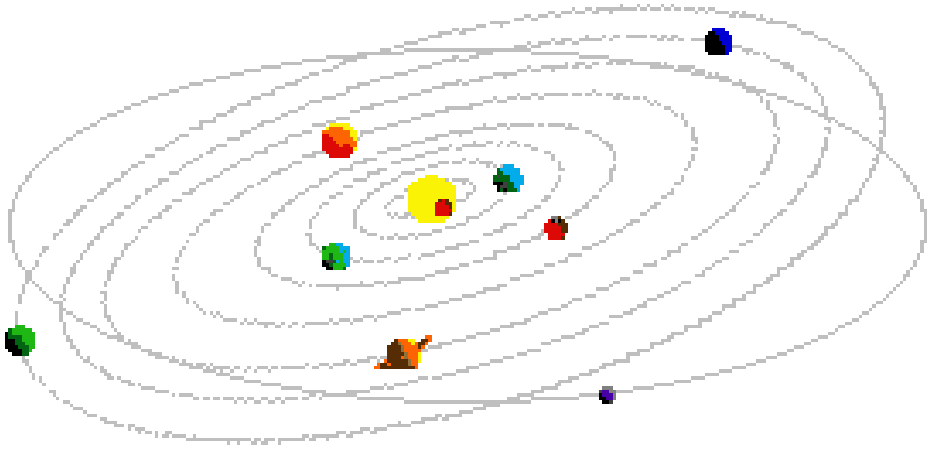

Planetary Motion

All about the laws that teach the celestial bodies to move!

Content Delivery:

Khushi Arora

Thejas K V

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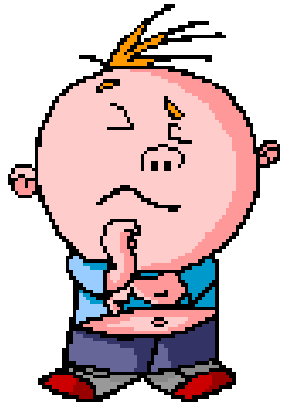
Ever wondered why planets move around the sun?

Why are planets spherical and not cubic ?

What are asteroids and comets?

What is gravity?



Sun and its family

Solar System is a group of celestial bodies that collectively orbit Sun directly or indirectly due to gravity.

These bodies that orbit our Sun are classified into different categories.

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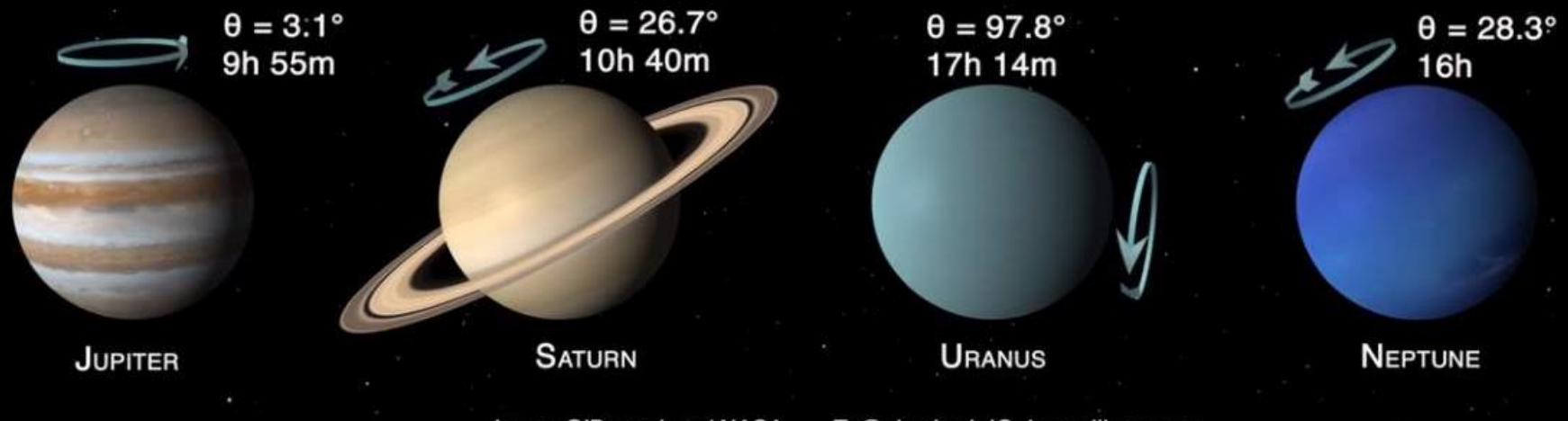
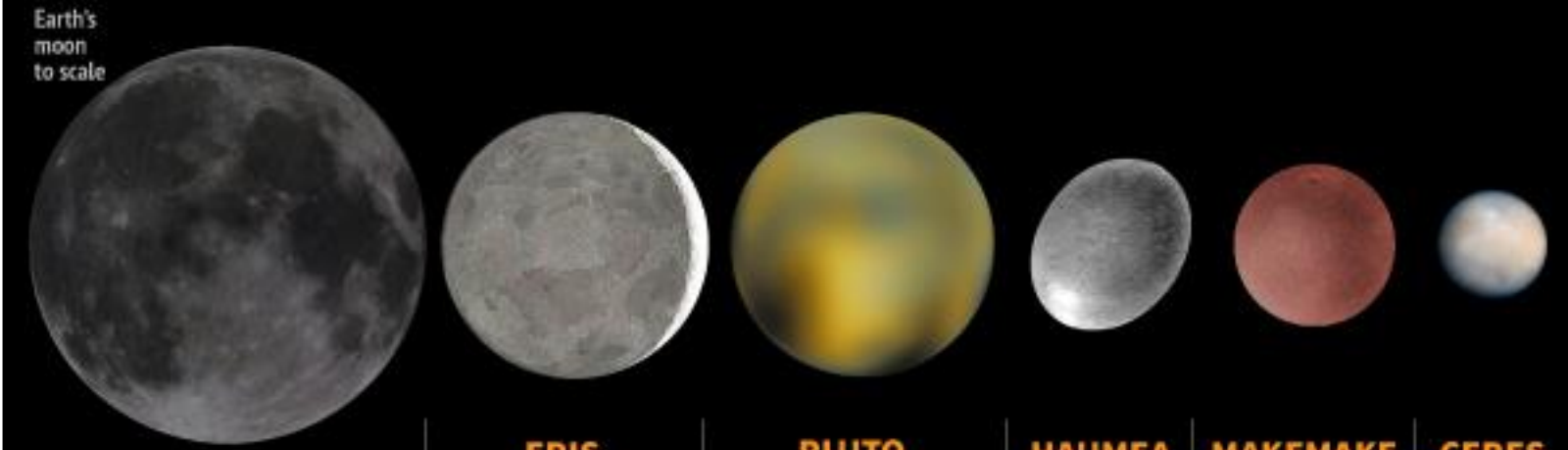
Planets: The word planet comes from the Greek word for "wanderer"

Our Solar System consists of 8 planets.





	ERIS	PLUTO	HAUMEA	MAKEMAKE	CERES
Year of discovery	2003	1930	2003	2005	1801
Diameter (mean)	1,445 miles 2,326 km	1,430 miles 2,302 km	892.3 miles 1,436 km	882 miles 1,420 km	591.8 miles 952.4 km
Orbital period (Earth years)	561.4	247.9	281.9	305.34	4.6
Distance from sun (times Earth's distance)	68	39.5	43.1	45.3	2.8
Orbital inclination (degrees)	46.9	17.14	28.2	29	10.59
Rotation period	25.9 hours	6.39 Earth days	3.9 hours	22.5 hours	9.1 hours
Moons	1	5	2	0	0

SOURCE: NASA

KARL TATE / © SPACE.com

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Dwarf Planets

Our Solar System consists of 5 dwarf planets.

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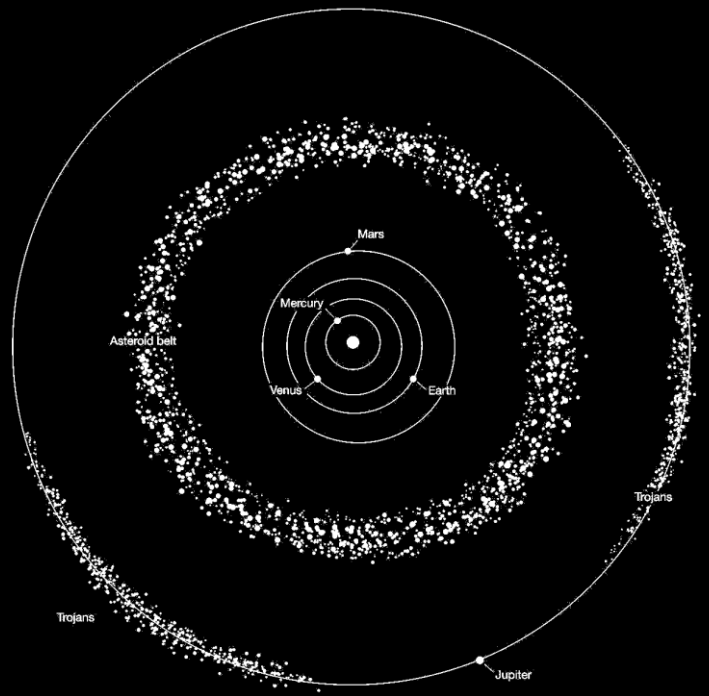
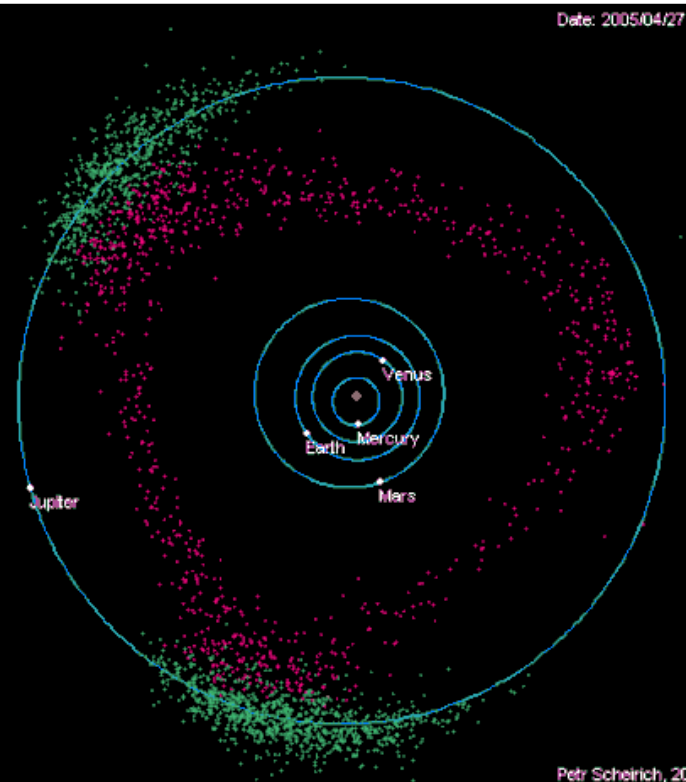
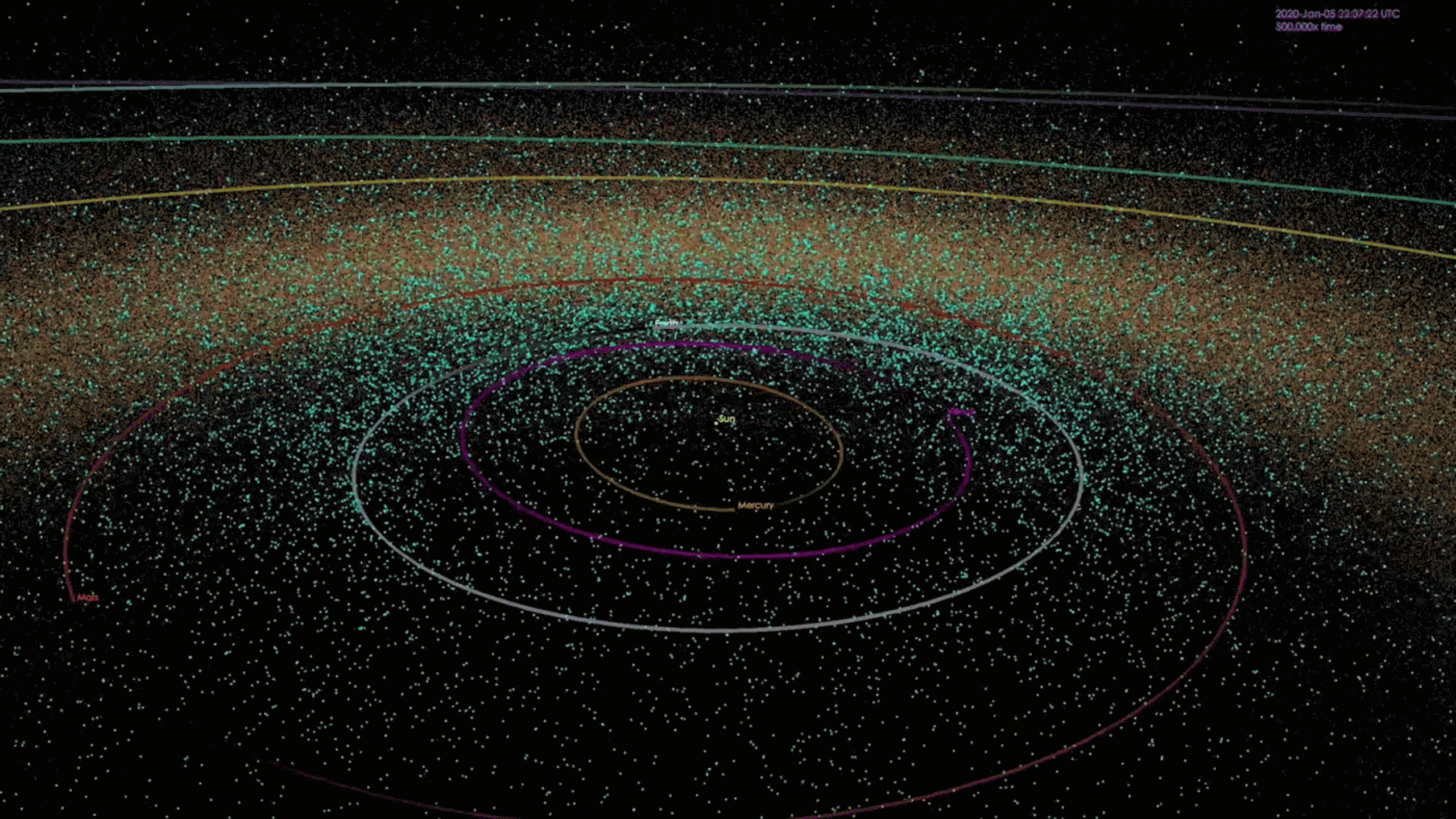
Asteroids: Asteroids, or minor planets, are small and often irregularly shaped celestial bodies.

Asteroid Belt: Region between the orbits of the planets Mars and Jupiter



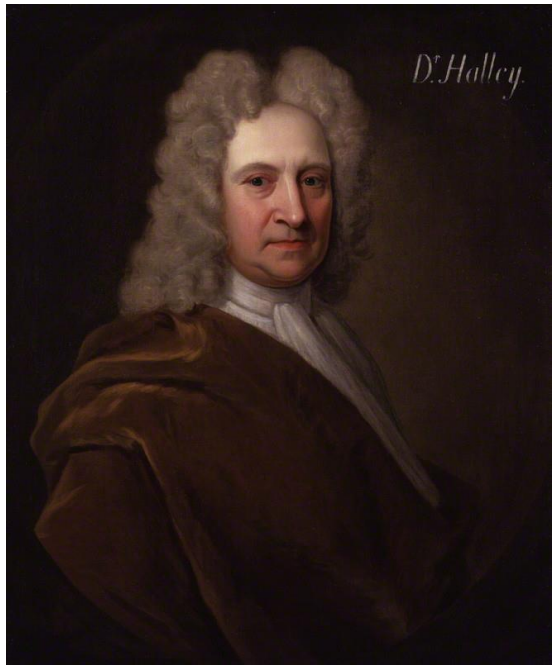
However, due to gravitational perturbations caused by planets as well as non-gravitational perturbations, a continuous migration brings main-belt asteroids closer to Sun, thus crossing the orbits of Mars, Earth, Venus and Mercury.




2020-Jan-05 22:07:22 UTC
500,000x time
Earth
Sun
Mercury
Mars

Comets: They are small irregular bodies that orbit Sun with a major fraction of their composition made up of volatile ices.

- Long Period Comet – Orbit period greater than 200 years - designated with letter “C”
- Periodic Comet - orbit intervals lesser than 200 years - designated with letter “P”
- The first periodic comet was discovered by English Astronomer Edmond Halley in 1682
- It is named after him as “1P/Halley” and has an orbit period of 75 years



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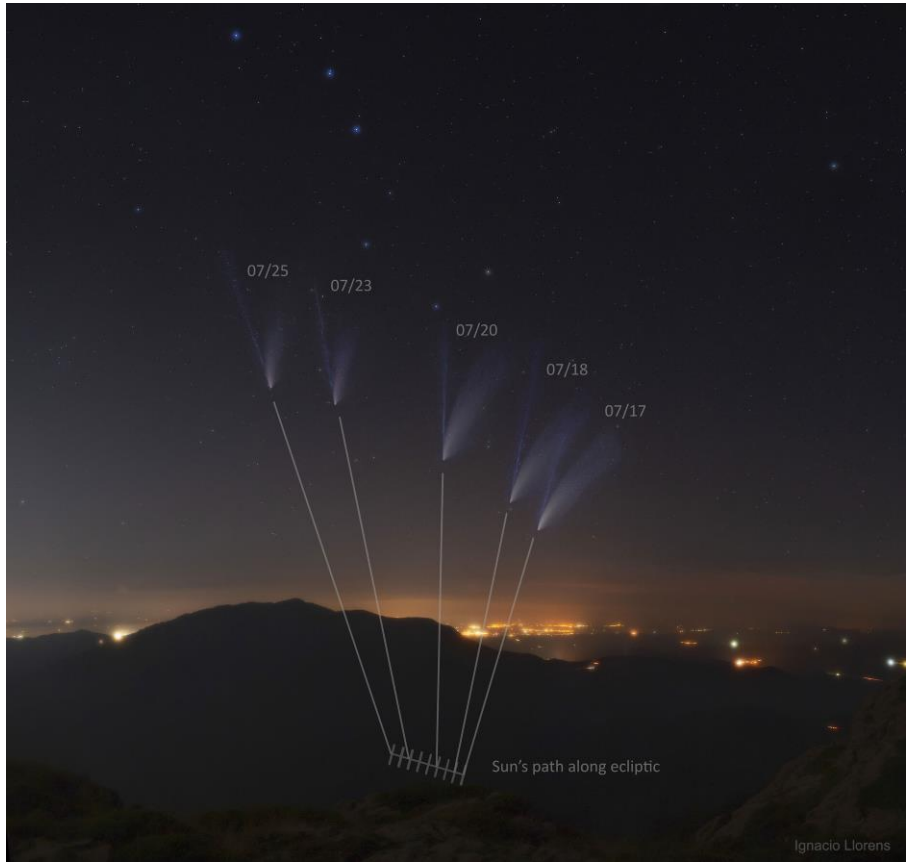
- C/2020 F3, commonly known as Comet Neowise is a long period comet that was visible through the most part of July and August night skies, this year



Kuiper Belt

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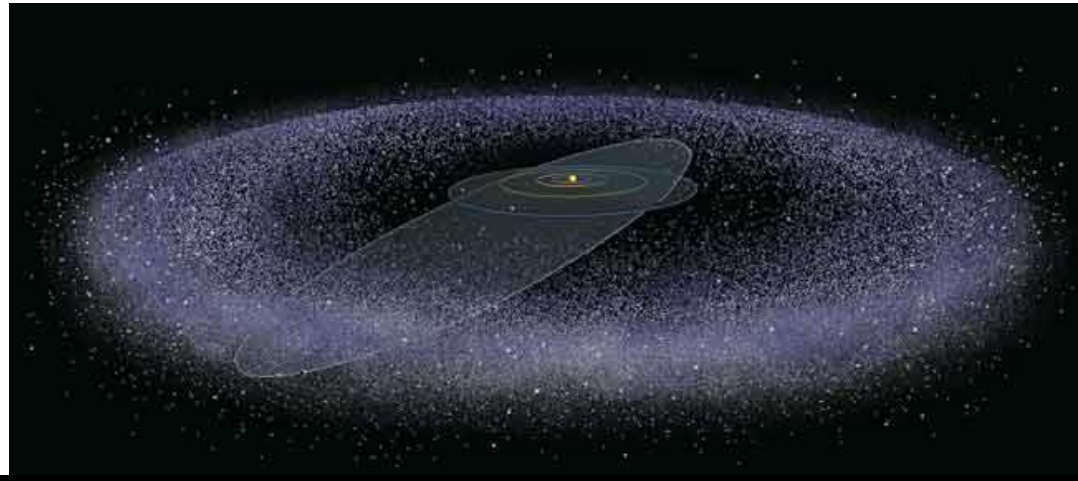
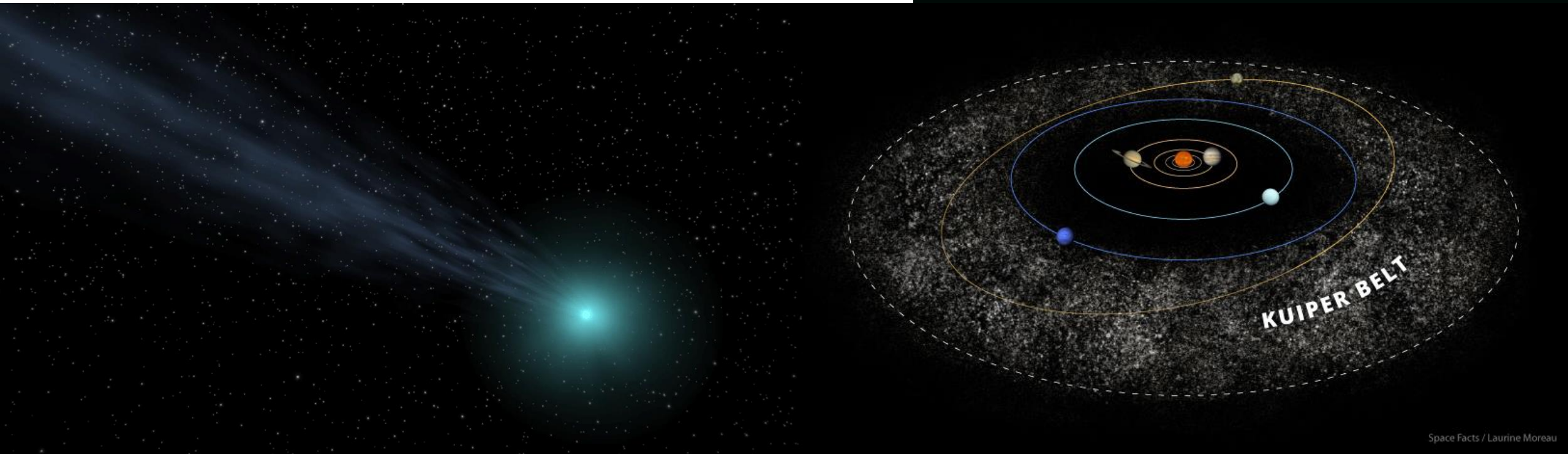
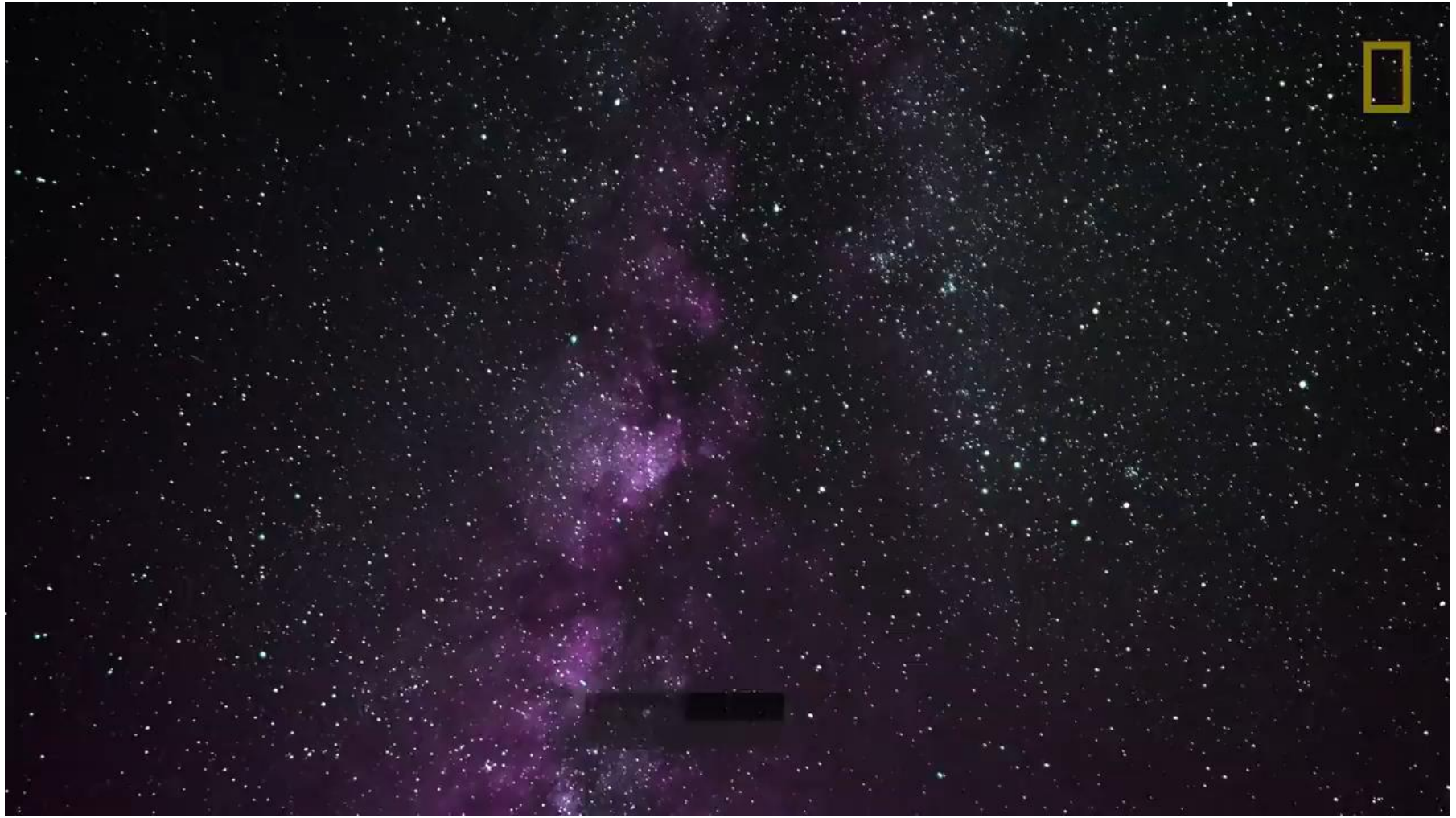
- Also called Edgeworth Kuiper Belt
- 30 AU to 55 AU from Sun
- Believed to be the remnants from the formation of the outer planets
- Most of the short-period comets observed are believed to have origin from this region







Solar System 101 by National Geographic

Source: https://www.youtube.com/watch?v=libKVRa01L8&t=80s

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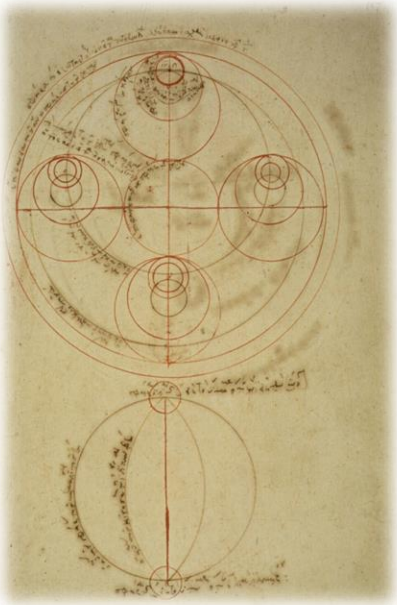
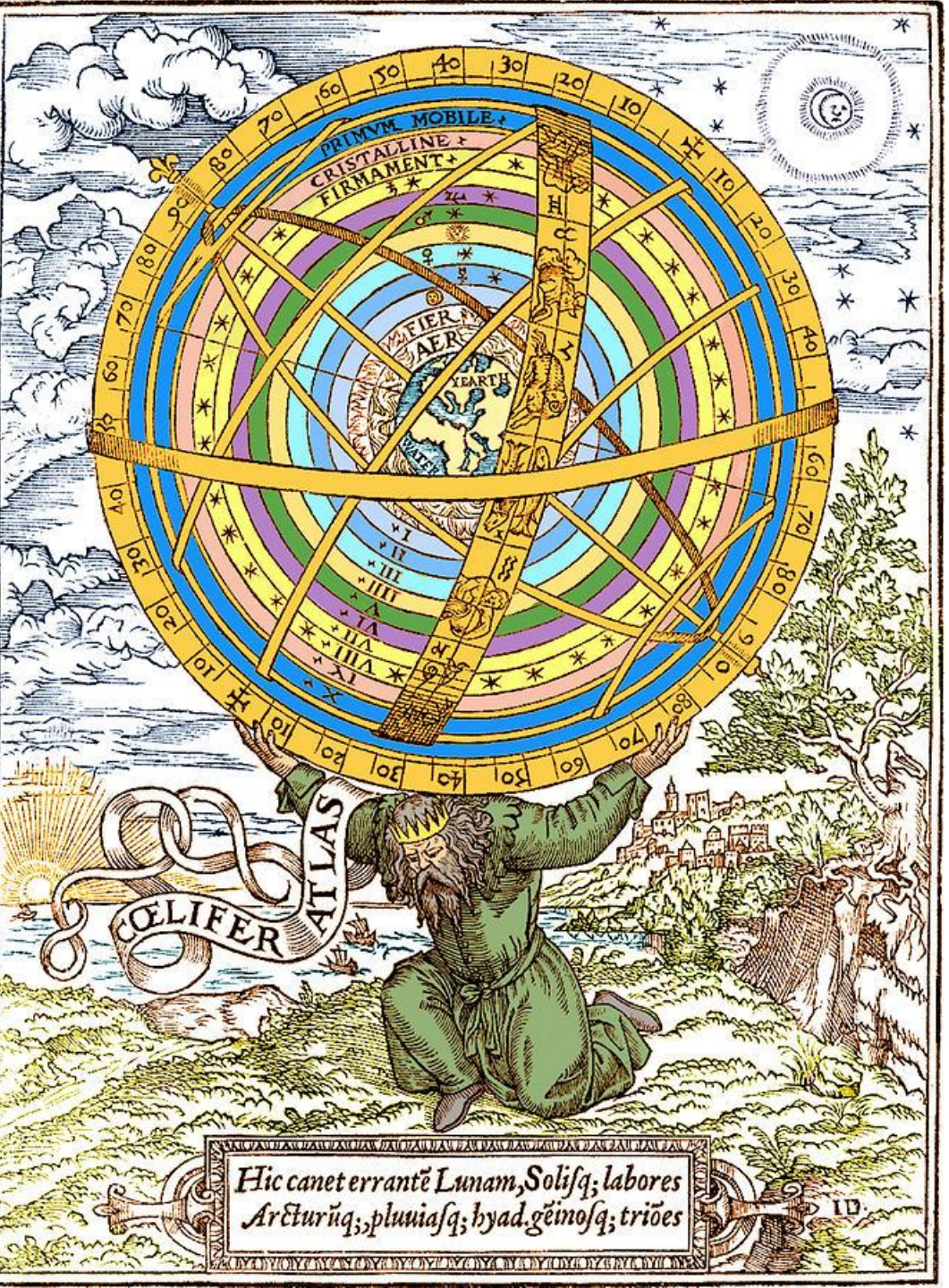
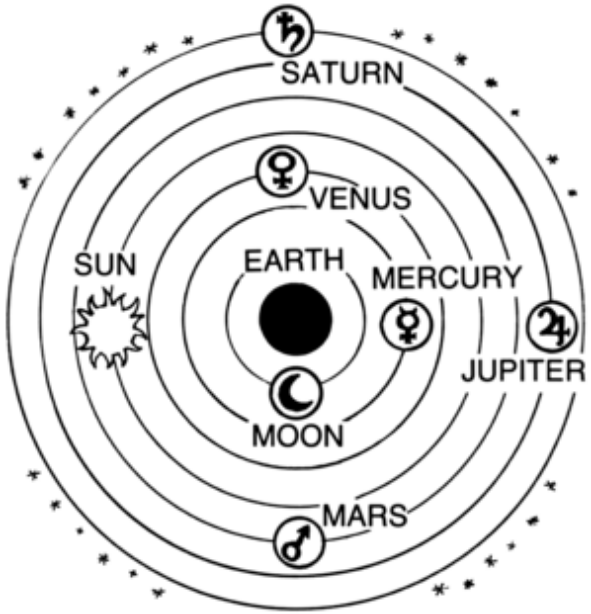
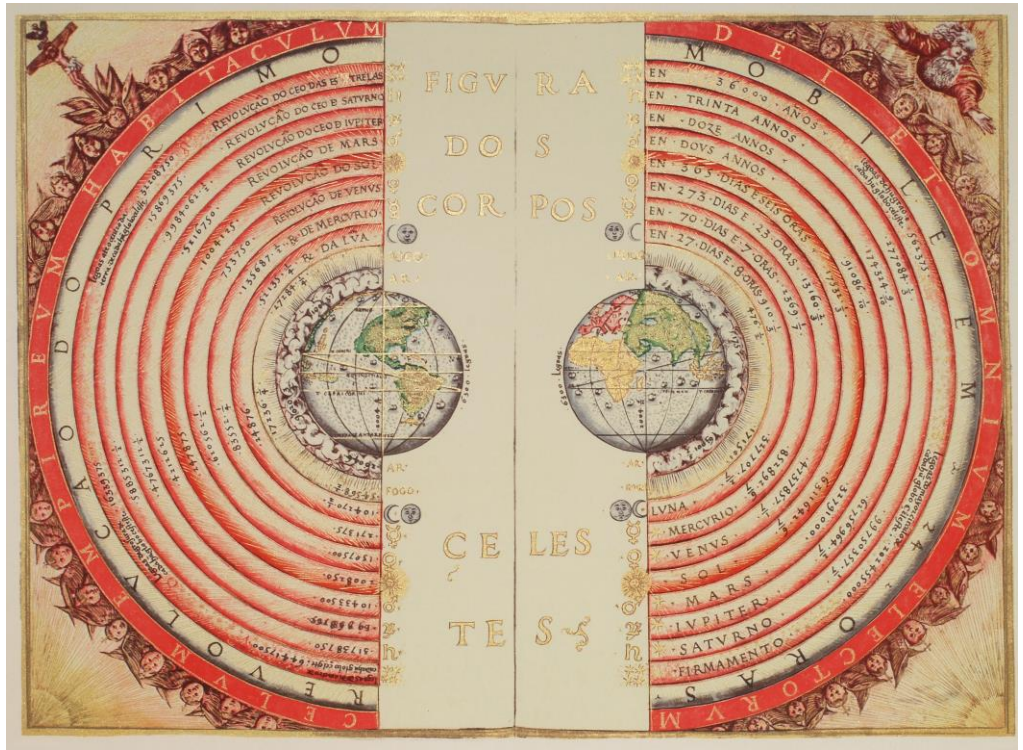
The Early Models of Stars and Planets









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Geocentric Model

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Cláudio Ptolomeo

Heliocentric Model

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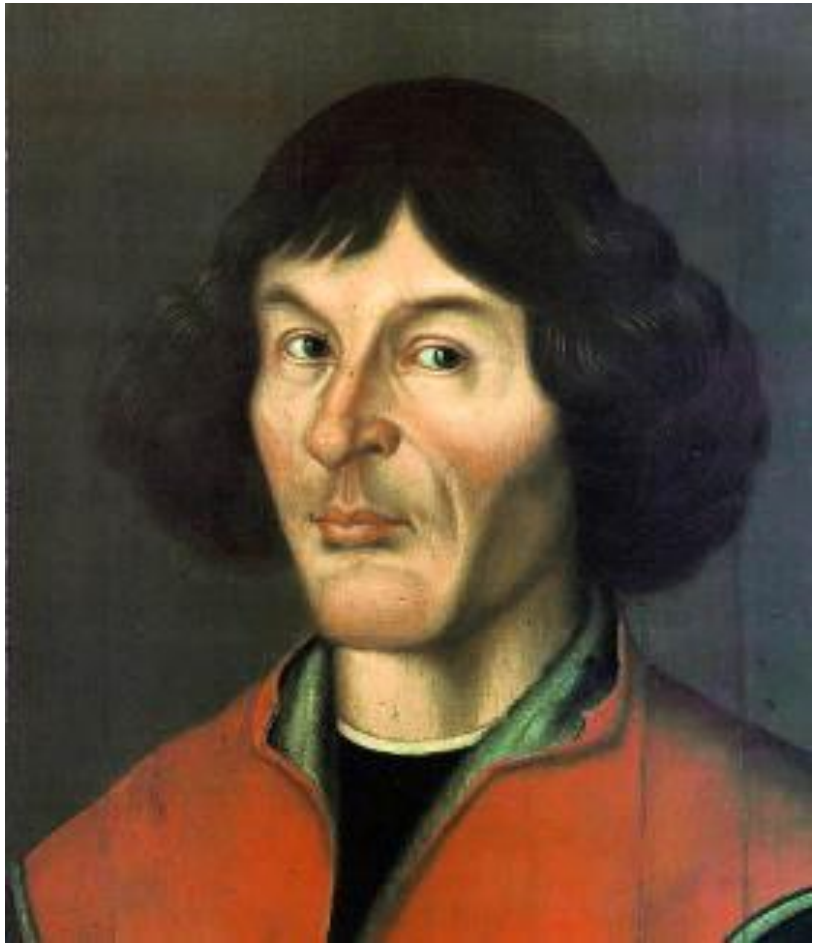

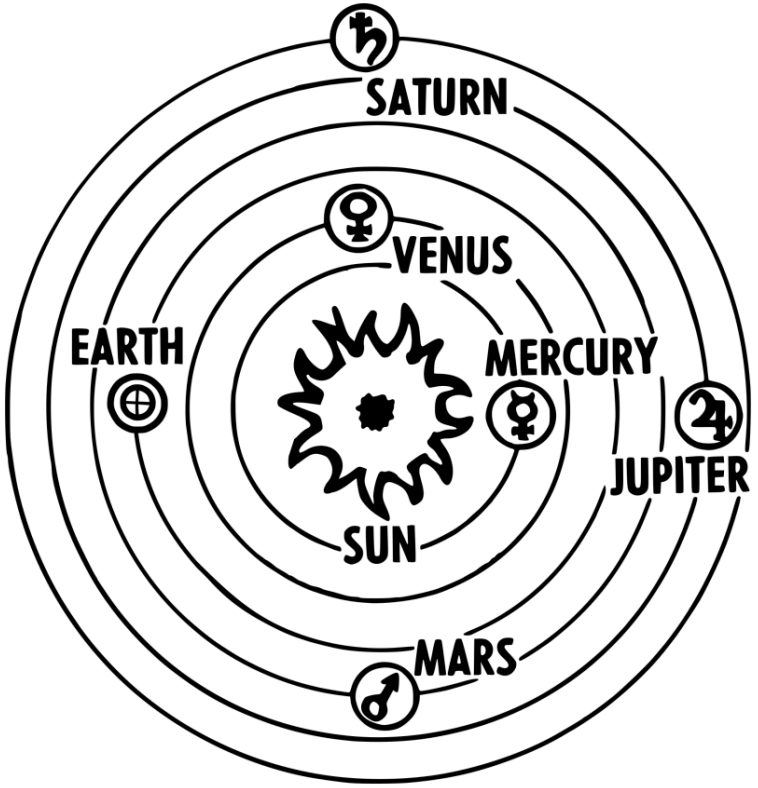

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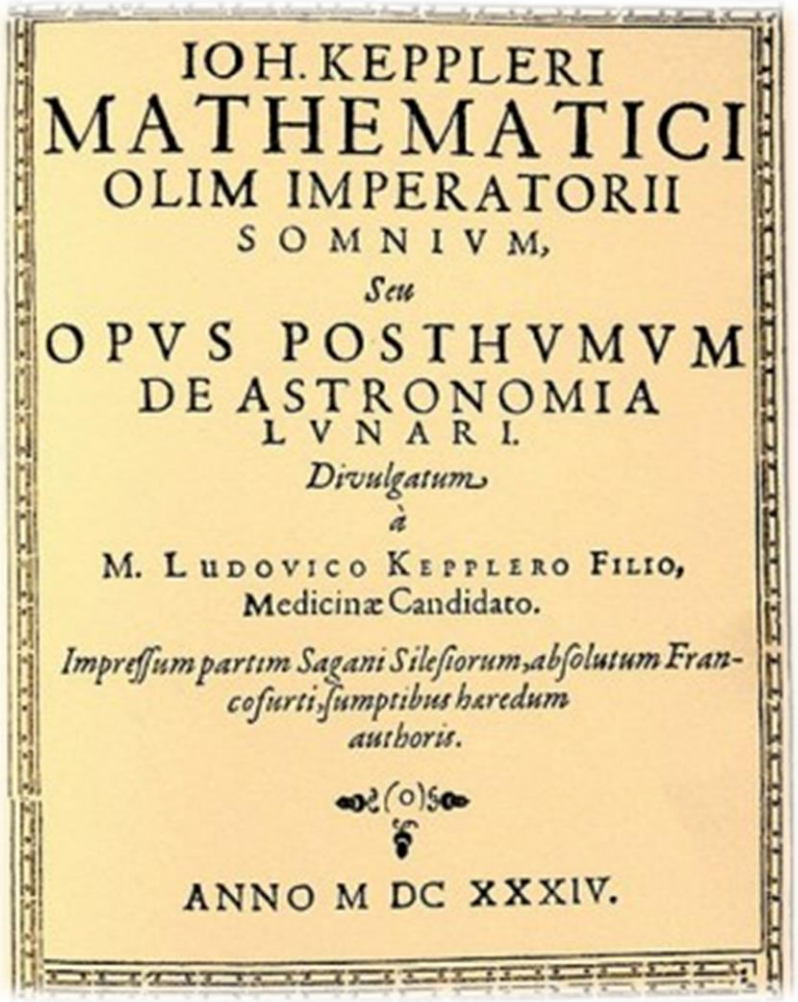


IOH. KEPPLERI
MATHEMATICI
OLIM IMPERATORII
SOMNIVM,
Seu
OPVS POSTHVMVM
DE ASTRONOMIA
LVNARI.
Divulgatum
à
M. LUDOVICO KEPPLERO FILIO,
Medicinæ Candidato.

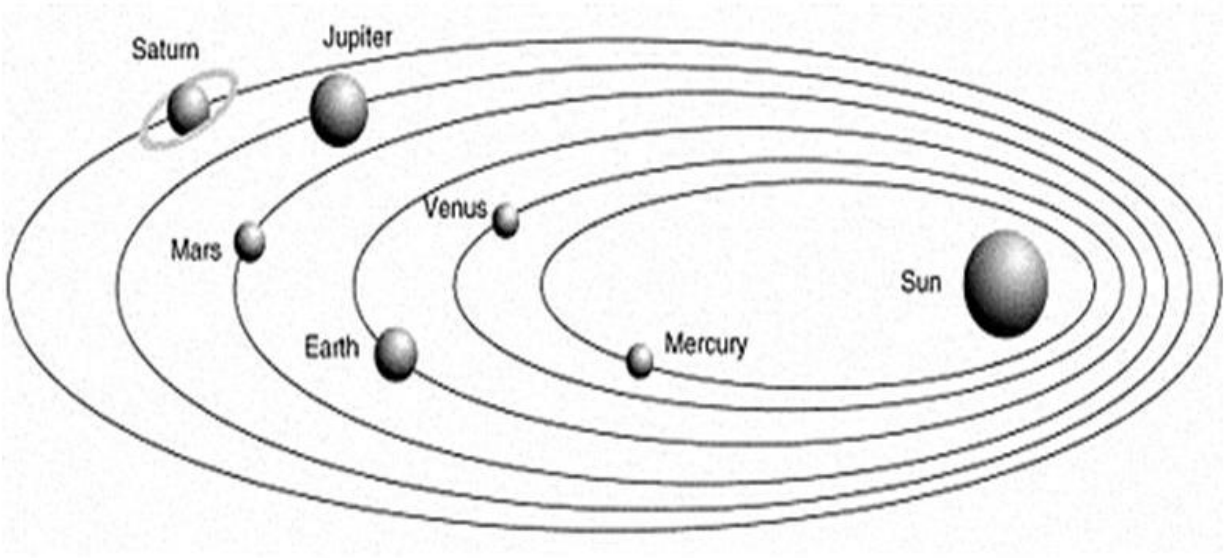
Impressum partim Sagani Silesiorum, absolutum Francofurti, sumptibus haeredum authoris.

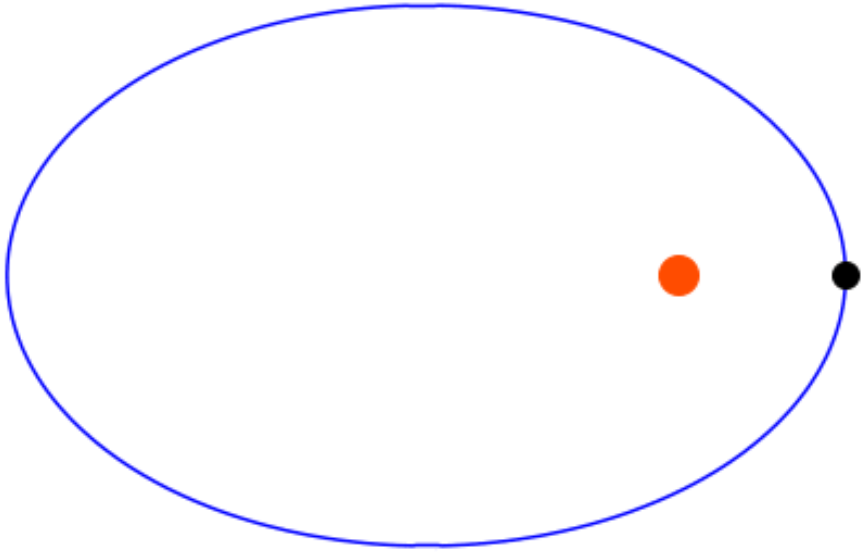
ANNO M DC XXXIV.

Johannes Kepler and the laws that govern the celestial motion

Kepler's First Law:

All planets travel around the Sun in elliptical orbits, with the Sun seated at one of the foci.





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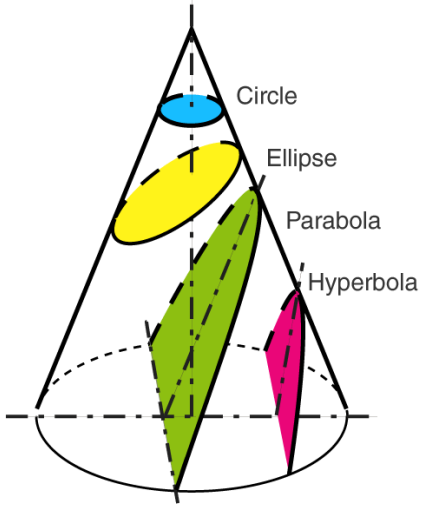
What is an Ellipse?

How to construct an Ellipse?

How is it different from a circle?

ITS TIME TO EXPLORE!



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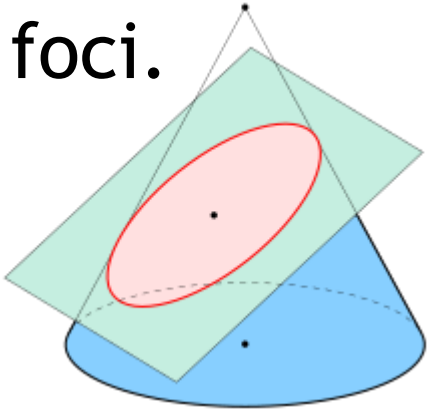
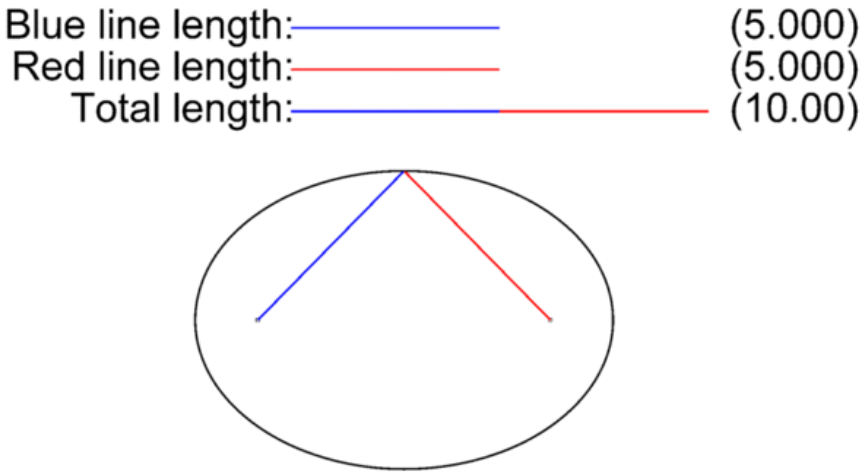
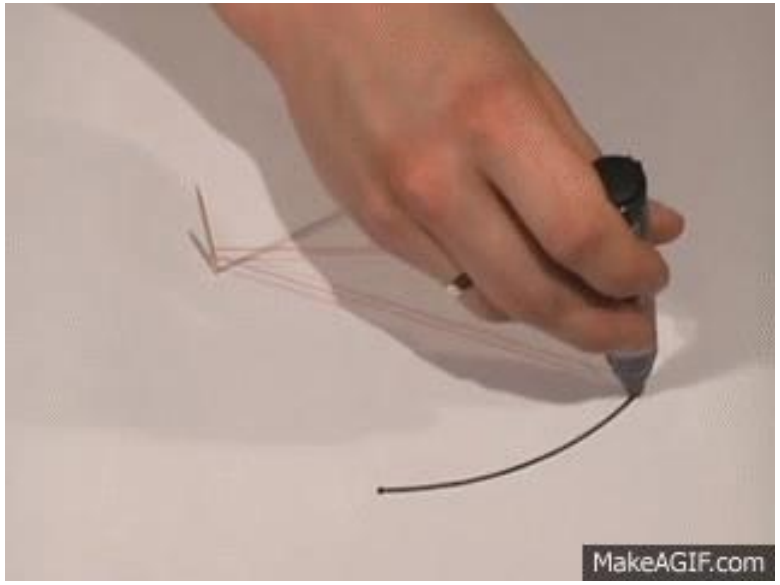
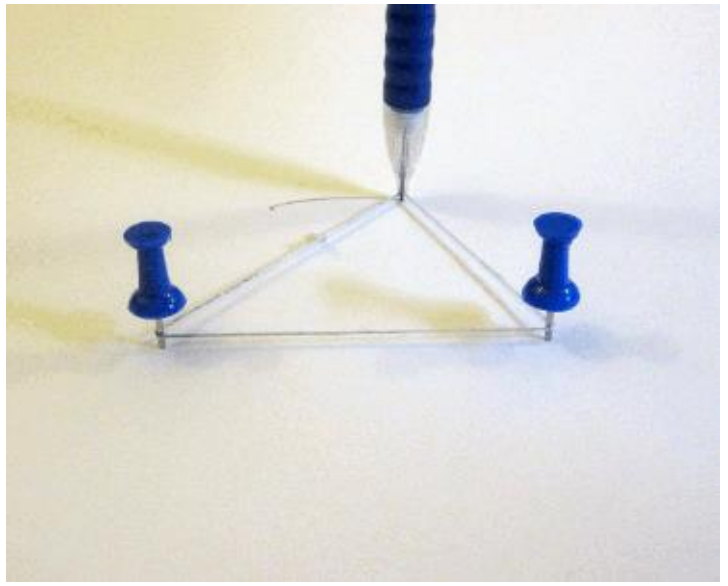
An ellipse is a conical section. It has two foci.



It is defined as a curve traced by a point, the sum of whose distances from the two foci is always constant.







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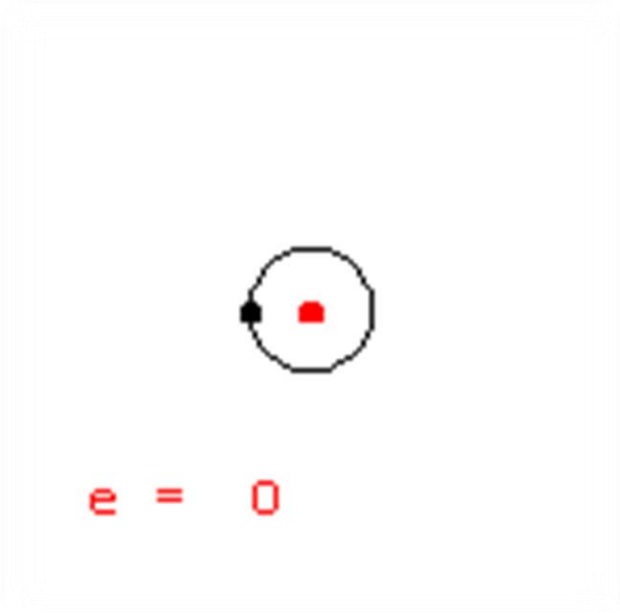
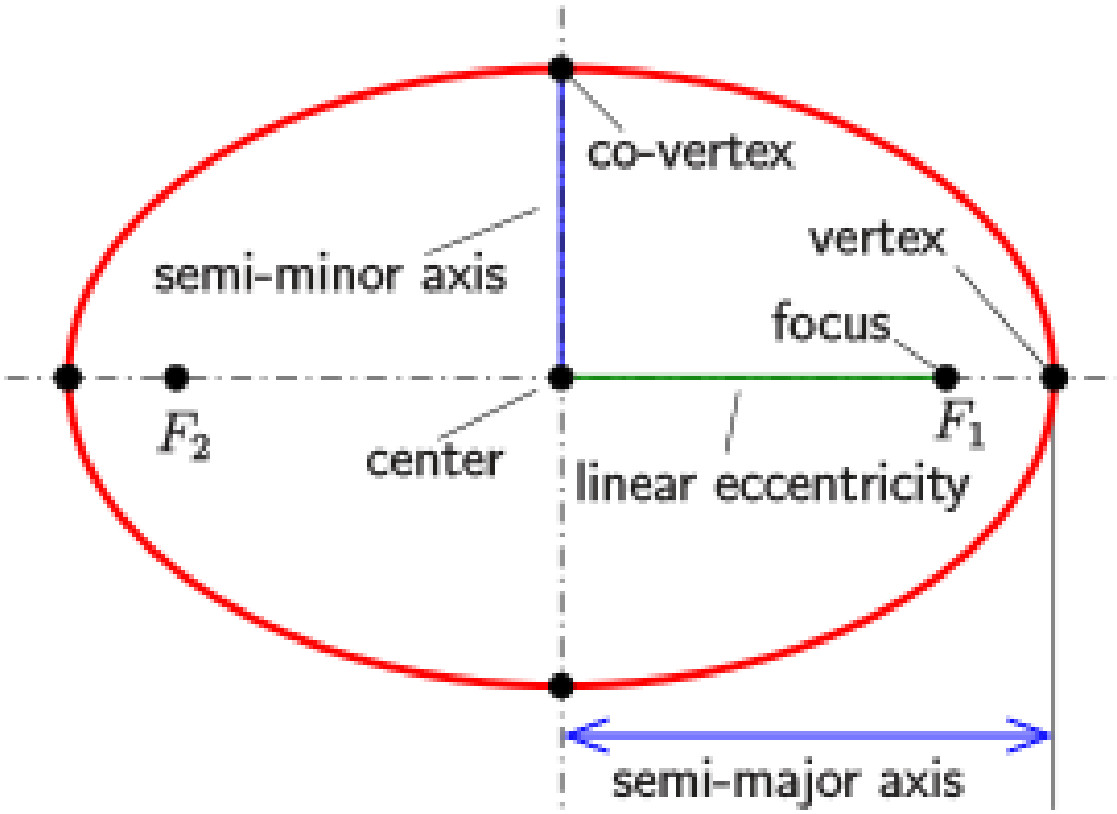
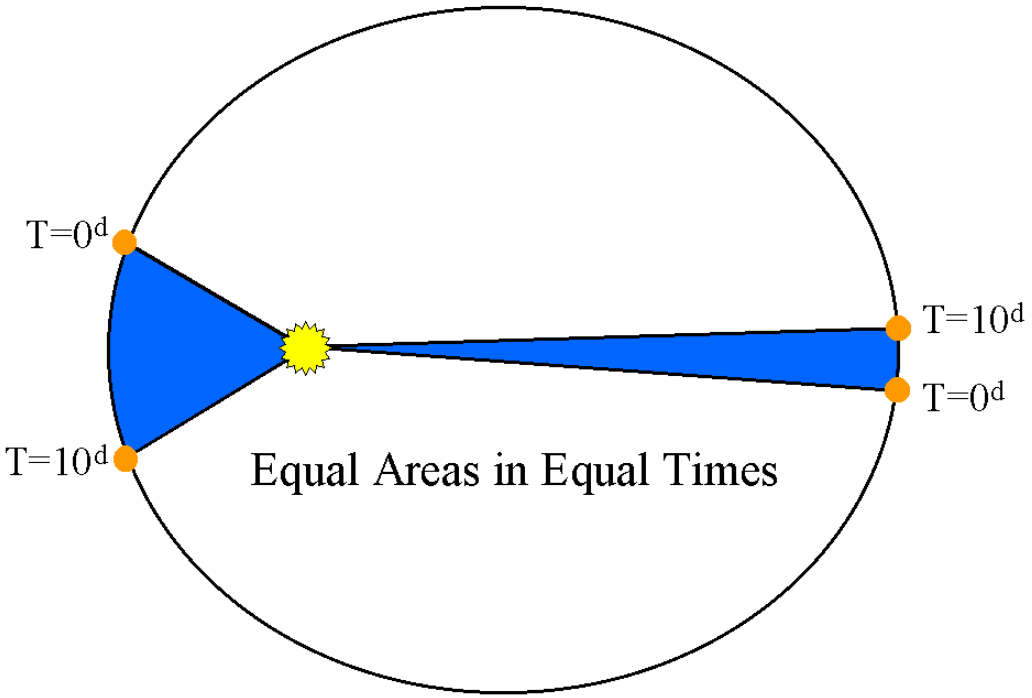


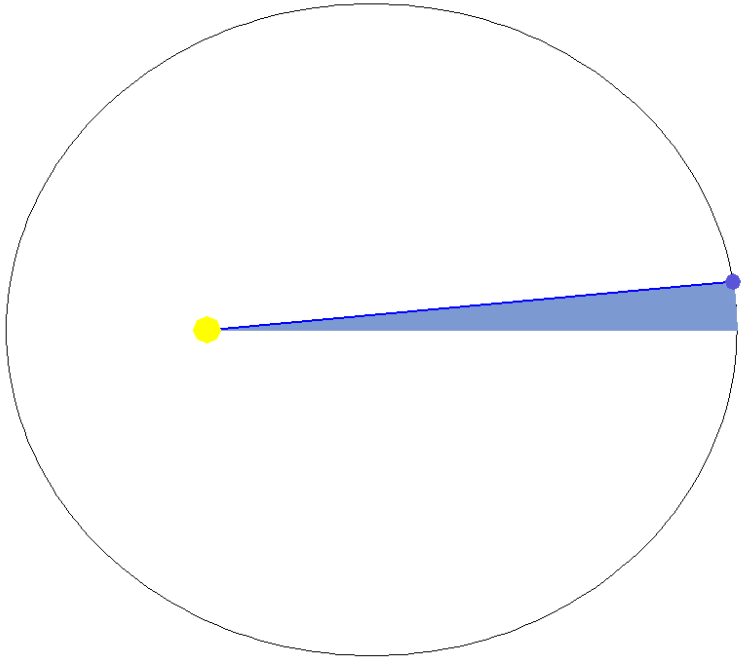


When the distance between the two foci becomes zero, the ellipse becomes a circle!

Kepler's Second Law:

An imaginary line joining a planet and the sun sweeps out equal areas in equal interval of time.





©L.Perera

Conservation of Angular Momentum

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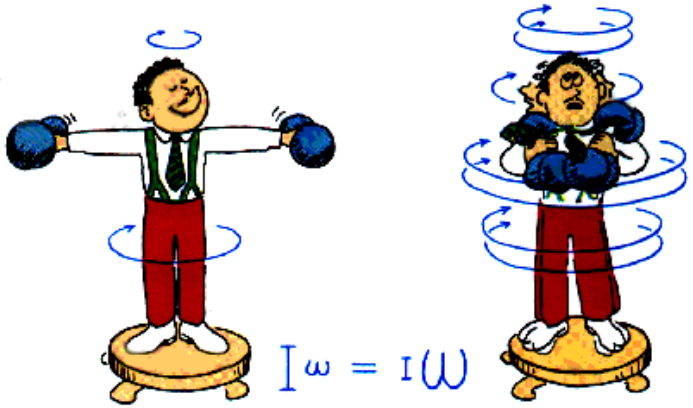
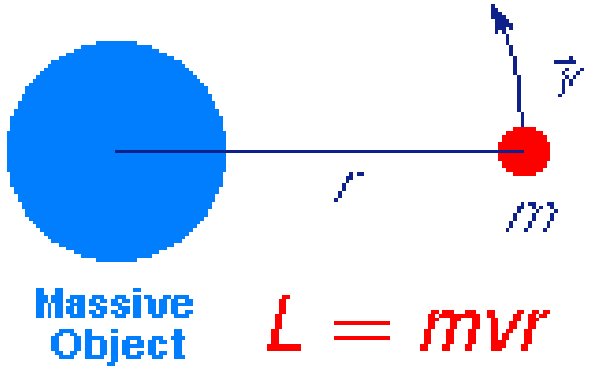
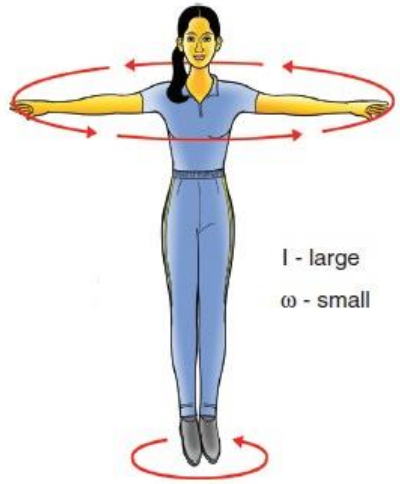
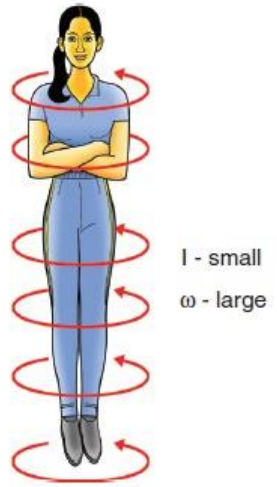


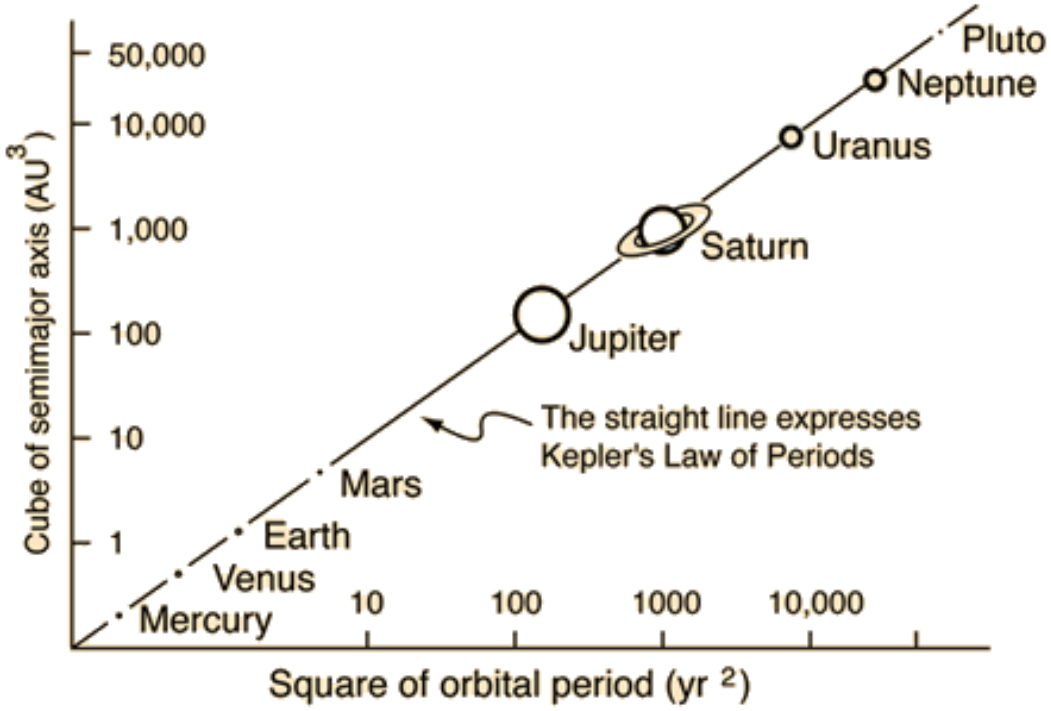






Kepler's Third Law:

The square of revolution time (sidereal period) of a planet is directly proportional to the cube of its mean distance from the Sun.



$$\frac{r_{Me}^3}{T_{Me}^2} = \frac{r_V^3}{T_V^2} = \frac{r_E^3}{T_E^2} = \frac{r_{Ma}^3}{T_{Ma}^2} = \frac{r_J^3}{T_J^2} = \frac{r_S^3}{T_S^2} = \frac{r_N^3}{T_N^2} = (\frac{r_P^3}{T_P^2})$$

Keplers Laws of Planetary Motion by 3RDFlix

Source: https://www.youtube.com/watch?v=duyCqavu7xw

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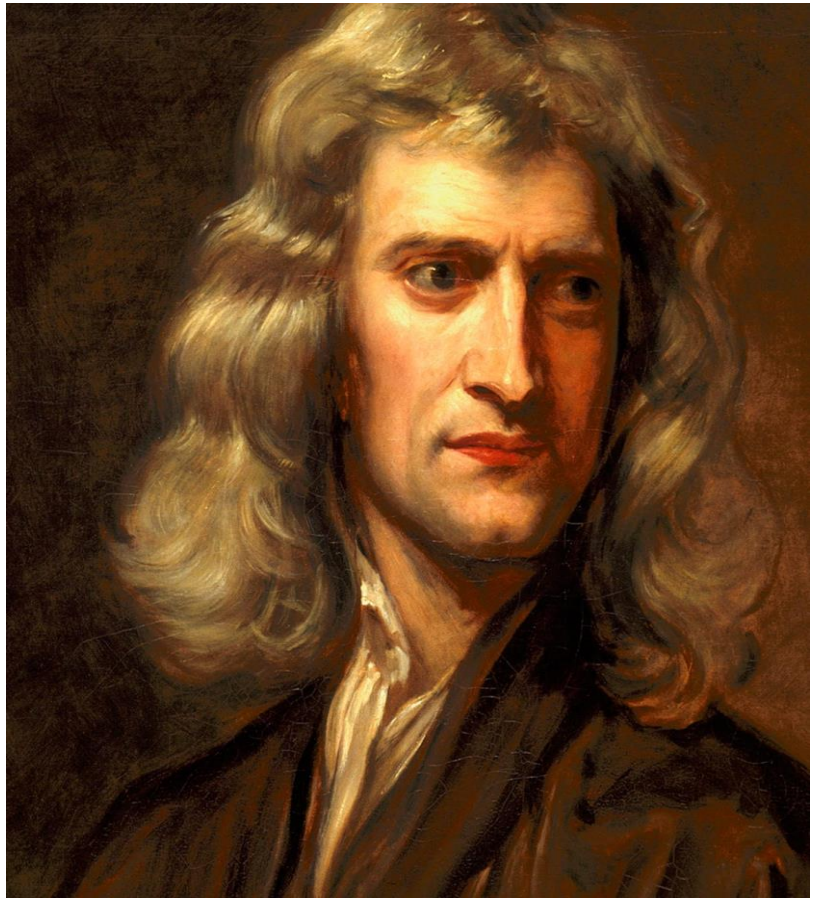

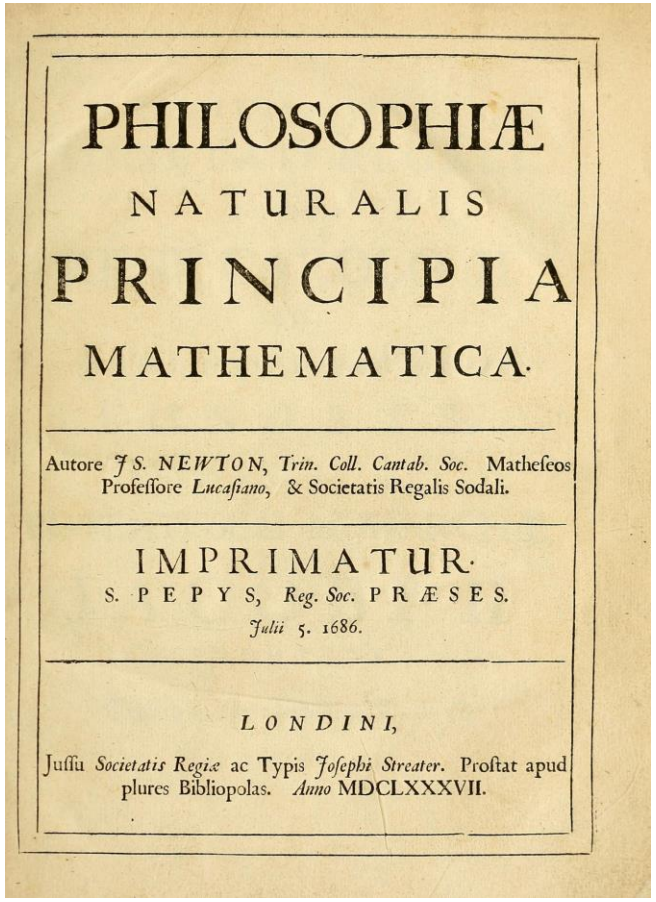

PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.

Autore *J S. NEWTON, Trin. Coll. Cantab. Soc.* Matheſeos Profeſſore *Lucaſiano*, & Societatis Regalis Sodali.

IMPRIMATUR.
S. PEPYS, *Reg. Soc.* PRÆSES.
Julii 5. 1686.

LONDINI,
Juſſu *Societatis Regiæ* ac Typis *Joſephi Streater.* Proſtat apud plures Bibliopolas. *Anno* MDCLXXXVII.

Newton's Theory of Gravitation

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Why do things fall back down on Earth?

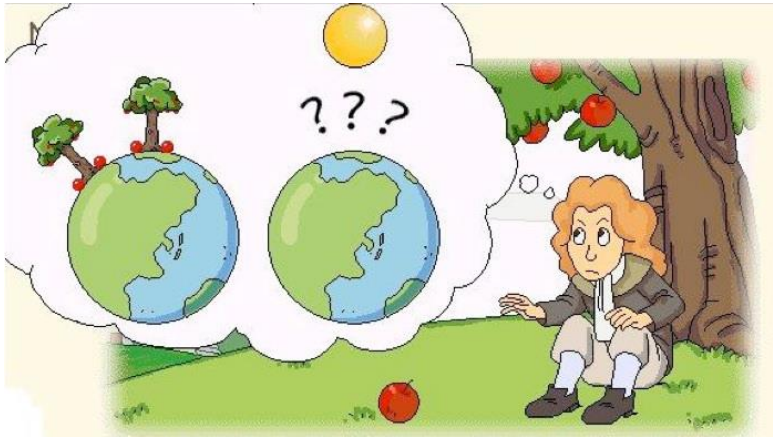
Because of Gravity!

So what is Gravity?

It is an attractive force between two distinct masses. The greater the mass of a body, the greater is its pull.

Is it like attraction between magnets?

Yes and No!



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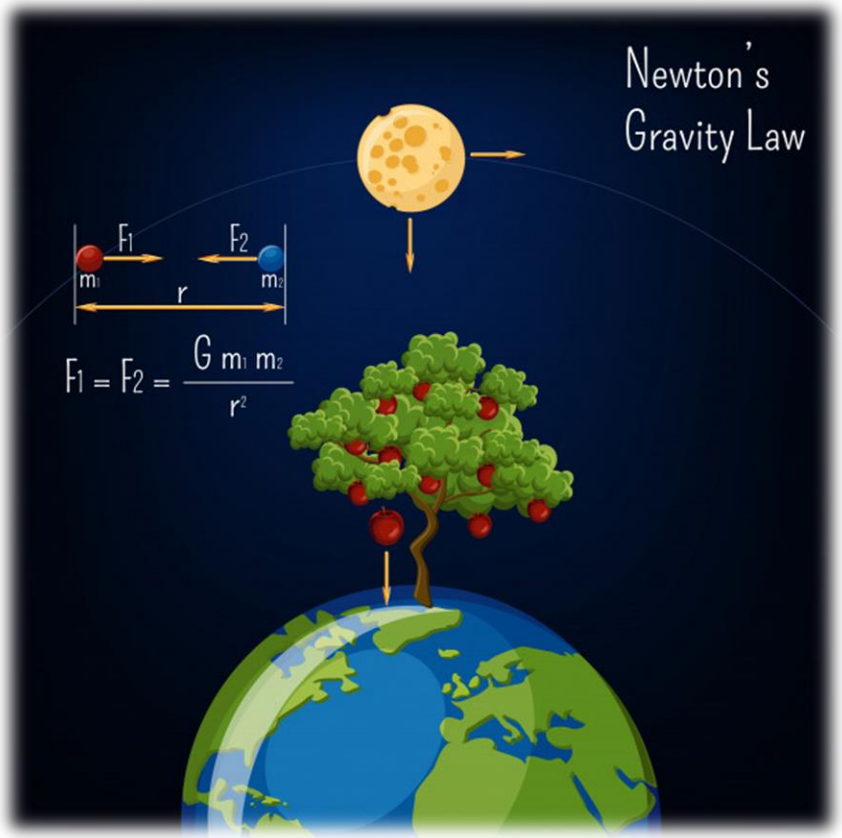
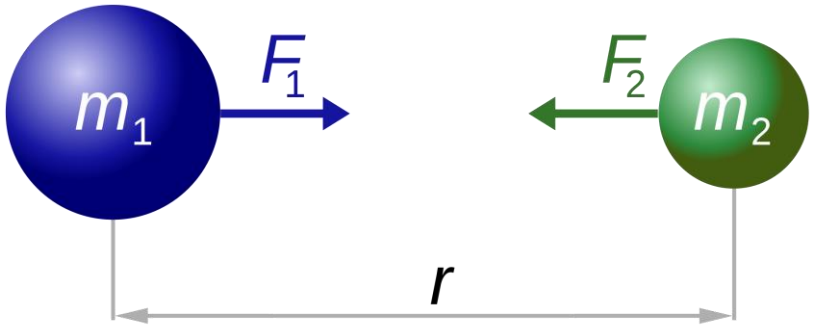


Sir Isaac Newton proposed his Theory of Gravity in the year 1687 in a book called 'Principia Mathematica'.

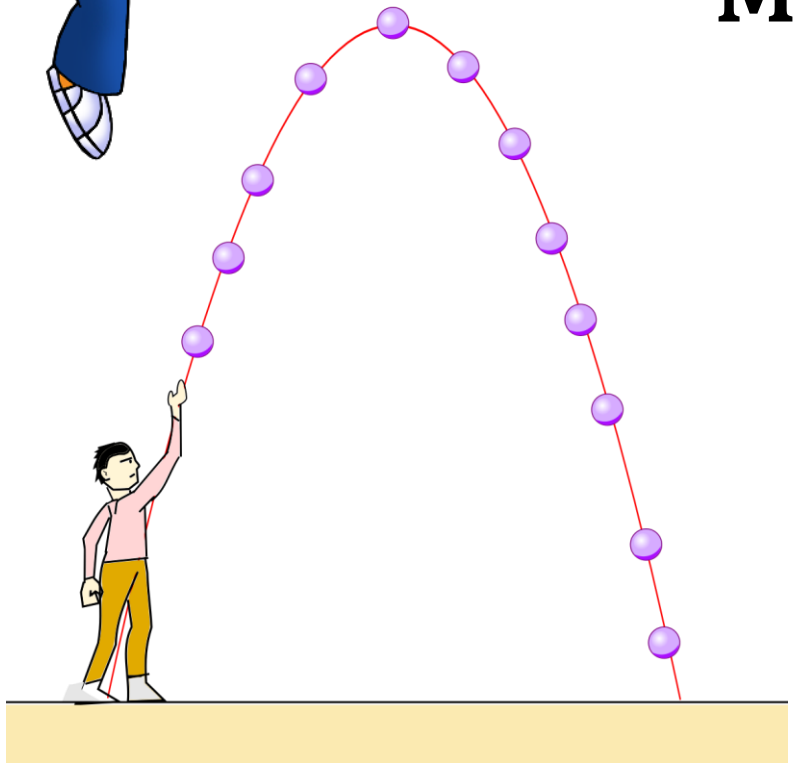


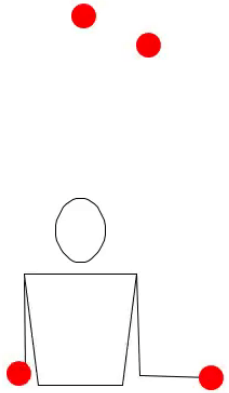
$$F_1 = F_2 = G\frac{m_1 \times m_2}{r^2}$$

GRAVITY

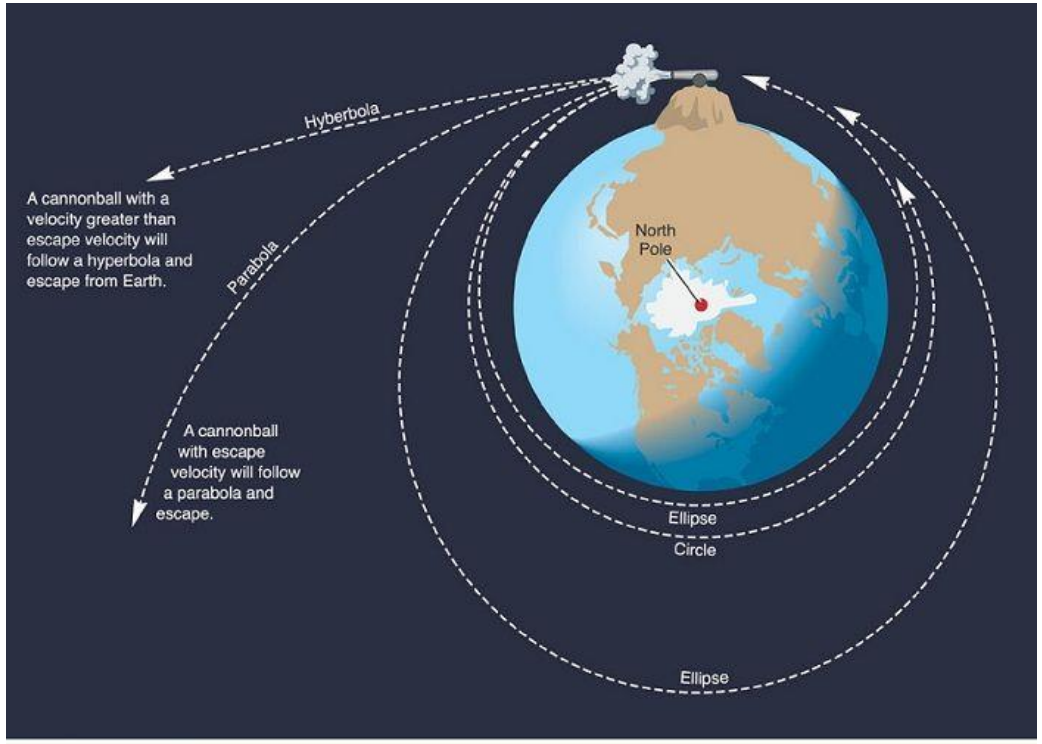
what goes UP

Must come DOWN!





or should IT ???



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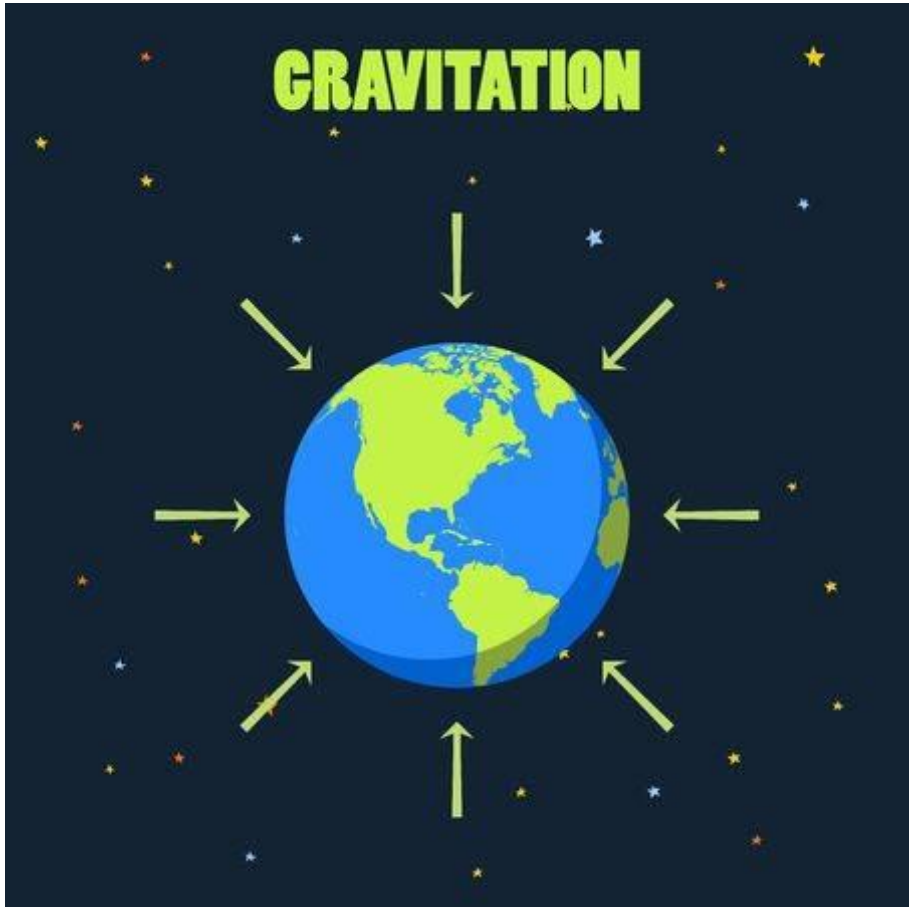
Newton's Cannonballs



Gravity is also the reason why all planets are spherical in shape!

Society for Space Education Research & Development

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Don’t forget your assignments!

Thank You!

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