EC 1424 Satellite Communication

Newton's Laws of Motion

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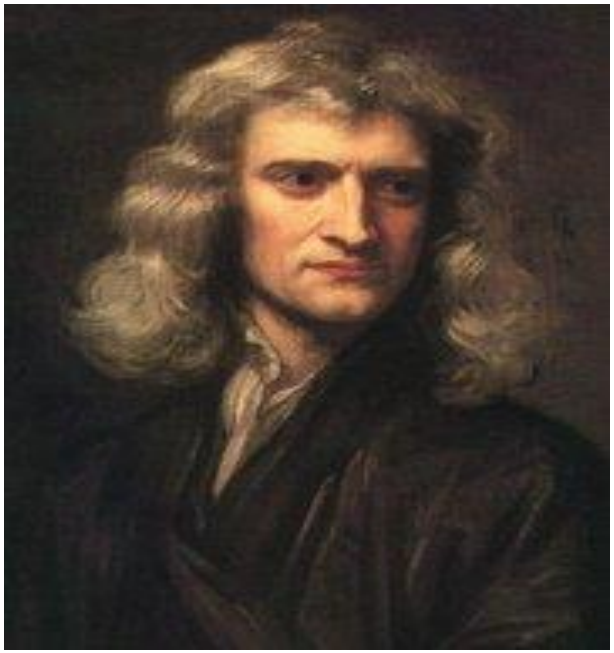
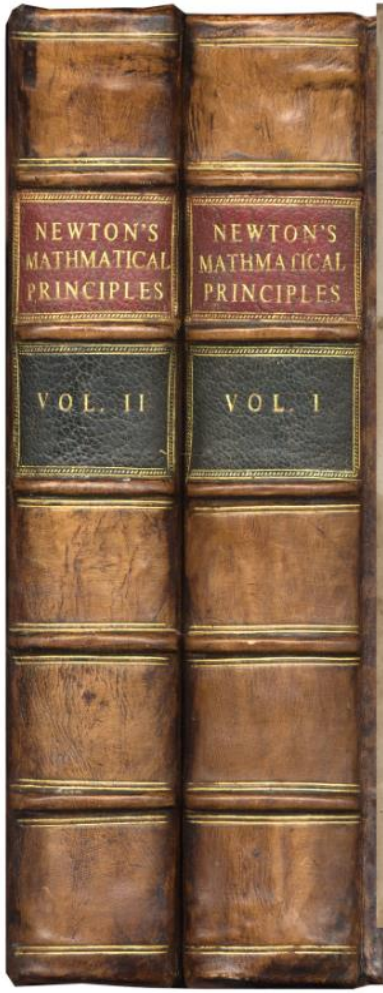
Newton's Laws

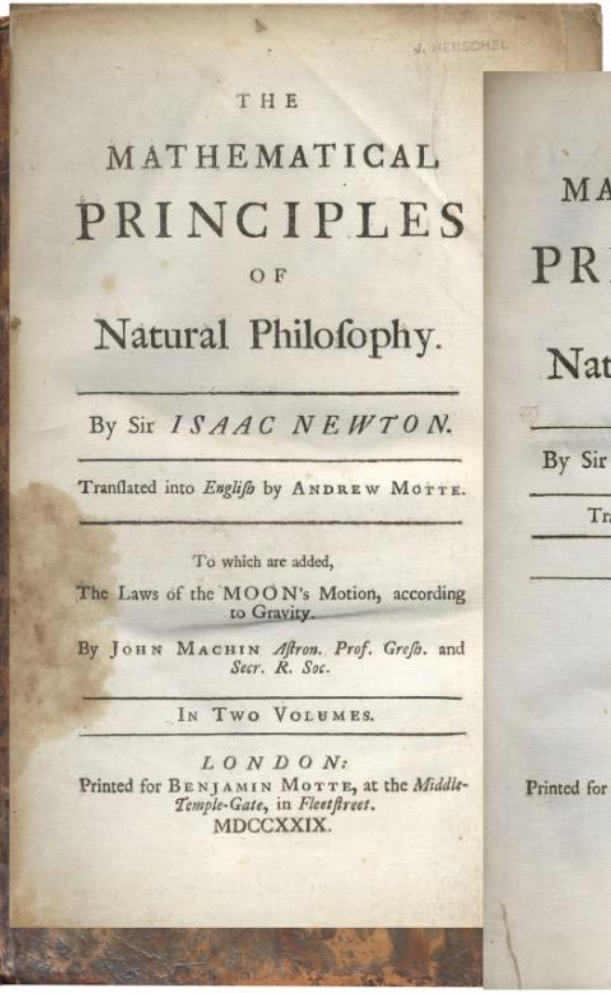


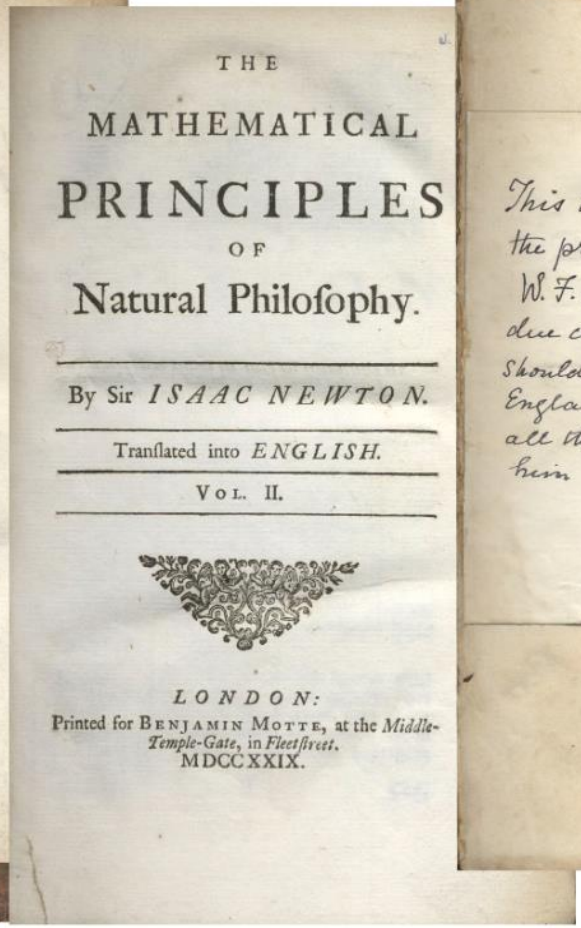
- Sir Isaac Newton (1643-1727) an English scientist and mathematician famous for his discovery of the law of gravity also discovered the three *laws of motion*.

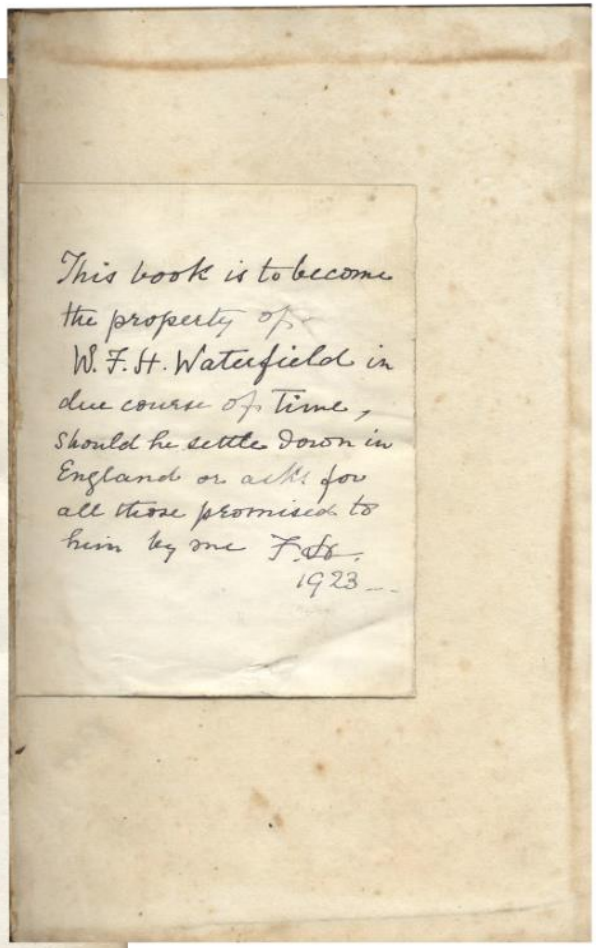
- He published them in his book ***Mathematic Principles of Natural Philosophy*** in 1687.

- Today these laws are known as *Newton's Laws of Motion* and are very much useful for defining the orbital aspects of Satellites.









https://natedsanders.com/Rare_First_Edition_of_Sir_Isaac_Newton_s___The_Mat-LOT45127.aspx

Newton's laws of motion

LAW #1

A body at rest will remain at rest, and a body in motion will remain in motion unless it is acted upon by an external force.

LAW #2

The force acting on an object is equal to the mass of that object times its acceleration, F = ma.

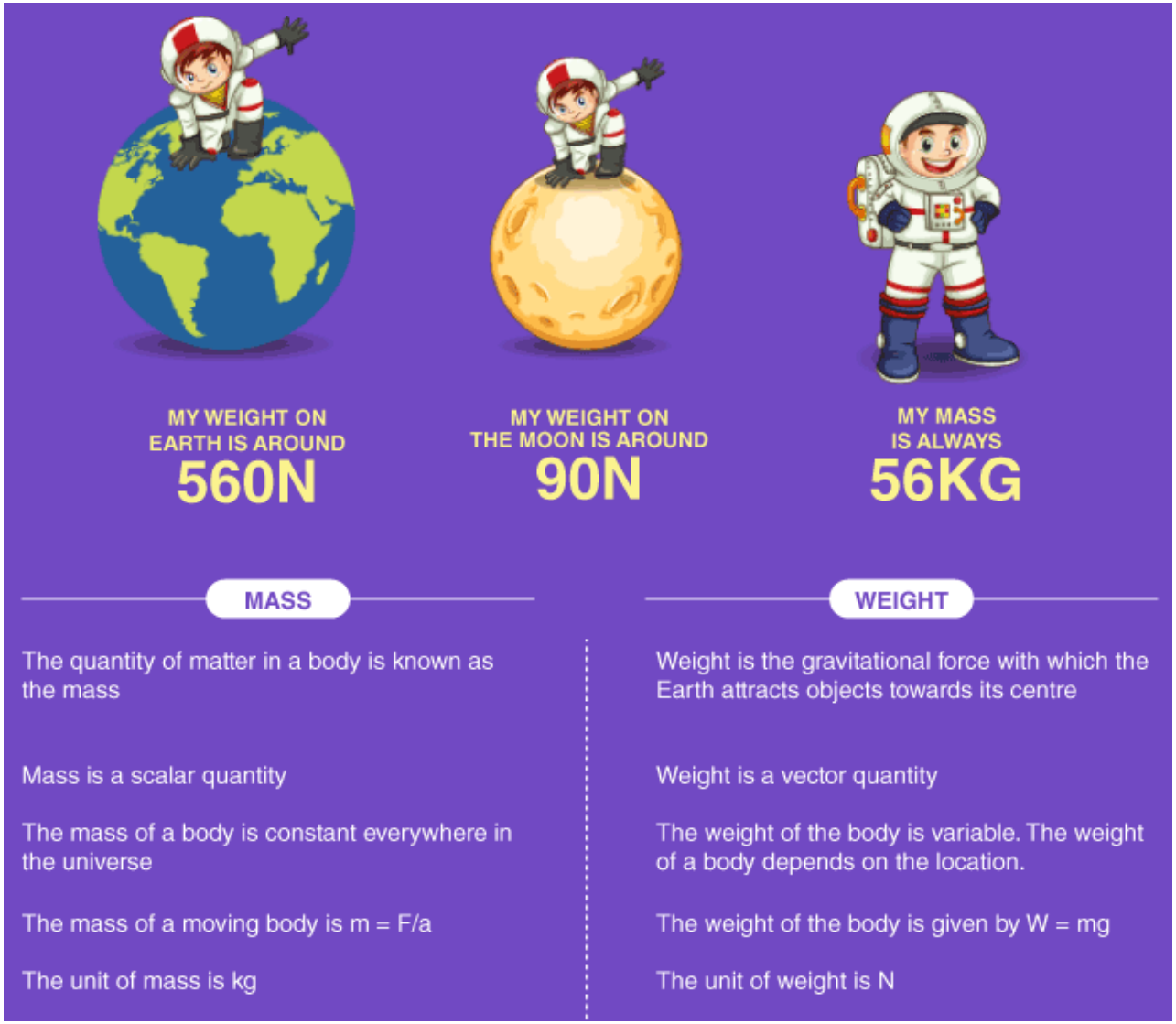
LAW #3

For every action, there is an equal and opposite reaction.

https://www.behavioraleconomics.com/the-three-laws-of-human-behavior/

Mass vs. Weight:

Mass refers to the amount of matter in an object, while weight represents the force exerted on an object due to gravity



https://byjus.com/physics/difference-between-mass-and-weight/

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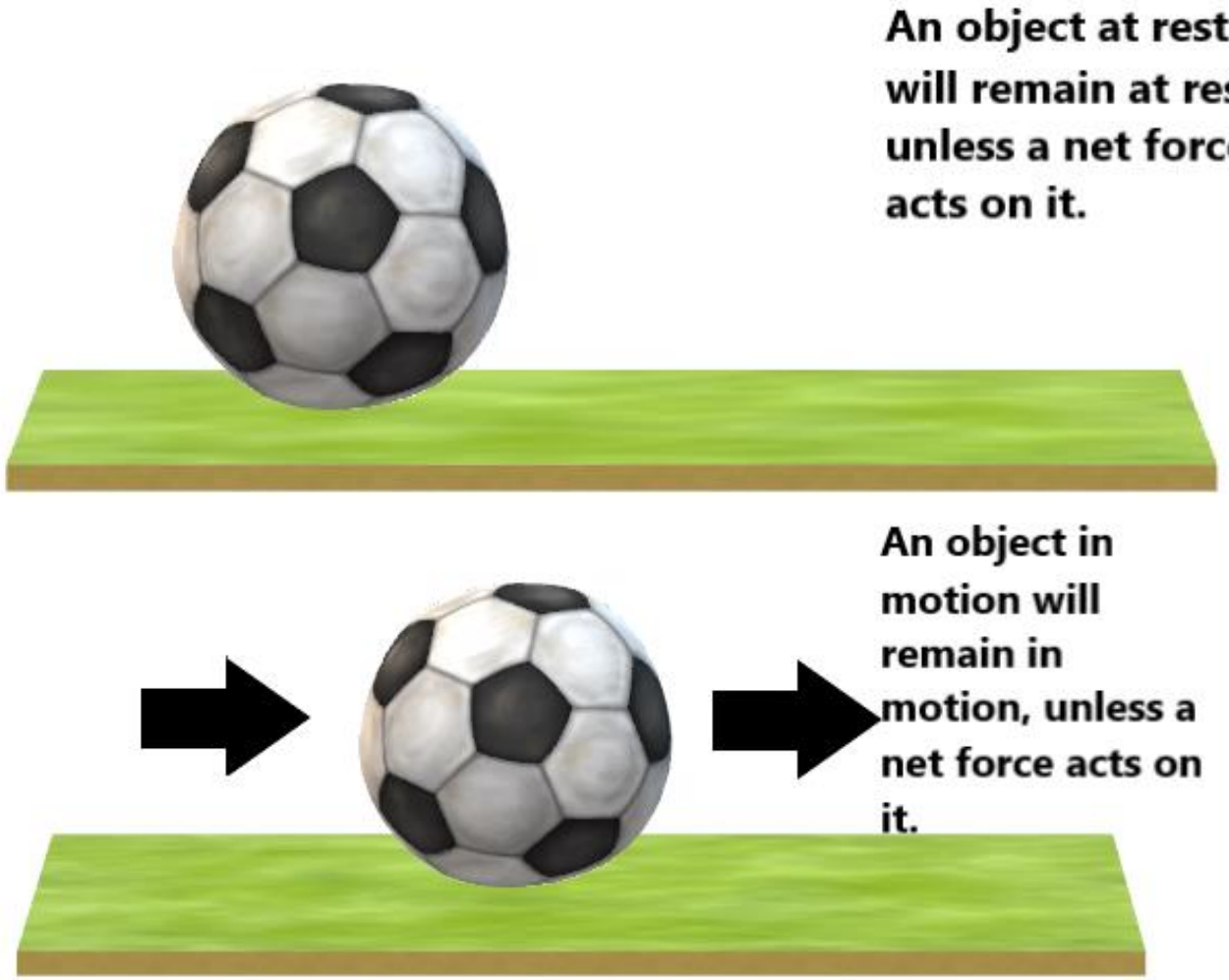


https://keneducation.in/newtons-laws-of-motion-and-their-applications/

LAW #1

A body at rest will remain at rest, and a body in motion will remain in motion unless it is acted upon by an external force.

"Every object persists in its state of rest or uniform motion in a straight line unless it is compelled to change that state by forces impressed on it."

Before firing:

Object in state of rest, airspeed zero.

Engine fired:

Thrust increases from zero.

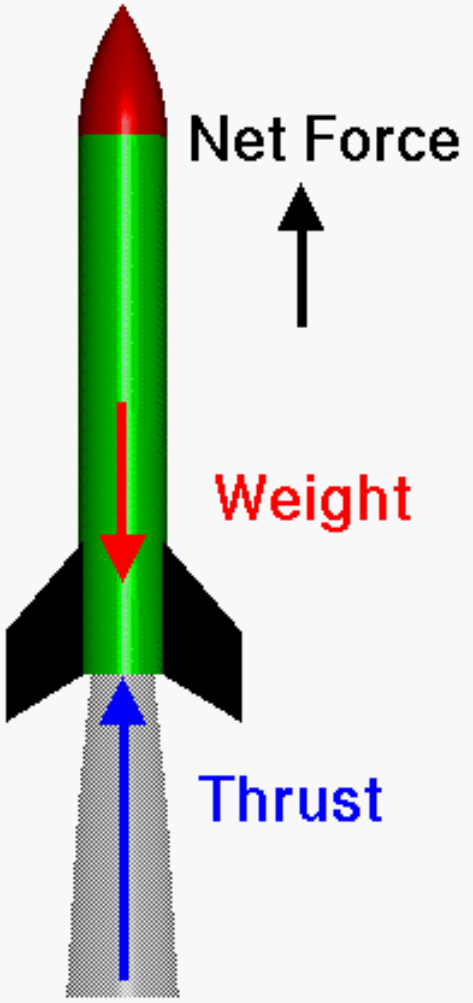
Weight decreases slightly as fuel burns.

When Thrust is greater than Weight:

Net force (Thrust – Weight) is positive upward.

Rocket accelerates upward

Velocity increases



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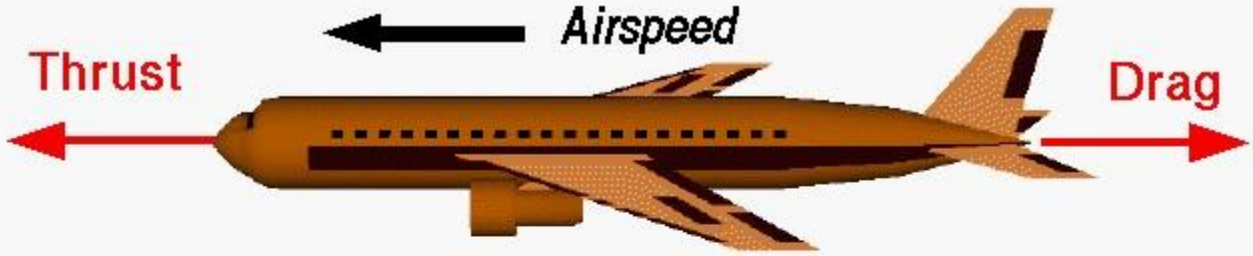


"Every object persists in its state of rest or uniform motion in a straight line unless it is compelled to change that state by forces impressed on it."

When flying at a constant altitude:

If Thrust and Drag are equal, aircraft holds constant airspeed.

If Thrust is increased:

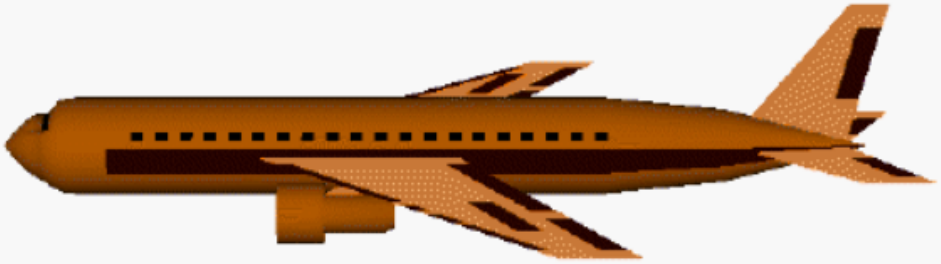
Aircraft accelerates – airspeed increases.
Drag depends on airspeed – Drag increases.

When Drag is again equal to Thrust:

Aircraft no longer accelerates but holds a new, higher, constant airspeed.

LAW #2

The force acting on an object is equal to the mass of that object times its acceleration, F = ma.



Differential Form: Force = change of momentum with change of time

$$F = \frac{d(mv)}{dt}$$

With mass constant: Force = mass X acceleration

$$F = m\,a$$

Force = mass X change in velocity with time

$$F = \frac{m(V_1 - V_0)}{(t_1 - t_0)}$$

Force, acceleration, momentum and velocity are all vector quantities.

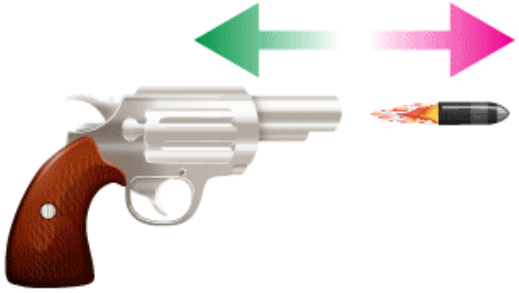
Each has both a magnitude and a direction.

https://www.grc.nasa.gov/www/k-12/BGP/newton2.html

LAW #3

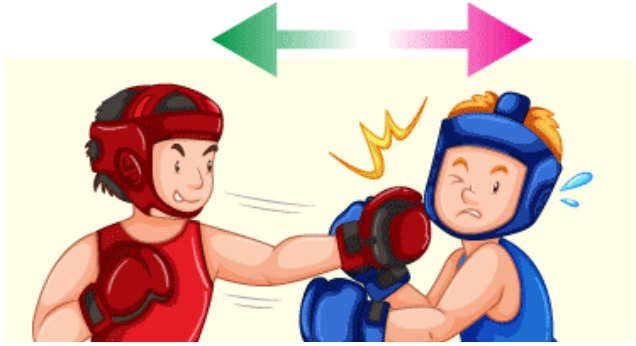
For every action, there is an equal and opposite reaction.

Action
Accelarating force of the bullet



Reaction
Recoil force on the gun

Action
Fist Exert Force on Jaw



Reaction
Jaw Exert Force on Fist

Action
Boy's feet exert force on boat

Reaction
Boat exerts force on feet

NEWTON'S THIRD LAW OF MOTION EXAMPLES IN DAILY LIFE

Vacuuming

Mopping the Floor

Getting Out of a Chair

Jumping on a Trampoline

Pushing a Shopping Cart

Bouncing a Basketball

Kicking a Soccer Ball

Rowing a Boat

https://www.examples.com/physics/newtons-third-law-of-motion.html

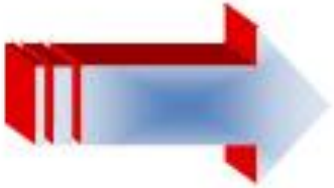
Newton’s Law of Gravity

Universal Law of Gravity

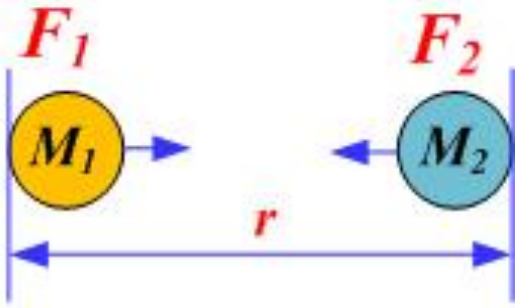
All objects in the universe attract each other by the force of gravity.

$$F = G\frac{M_1 M_2}{R^2}$$

Gravitational Force



Earth



$$F = G\frac{M_1 M_2}{R^2}$$

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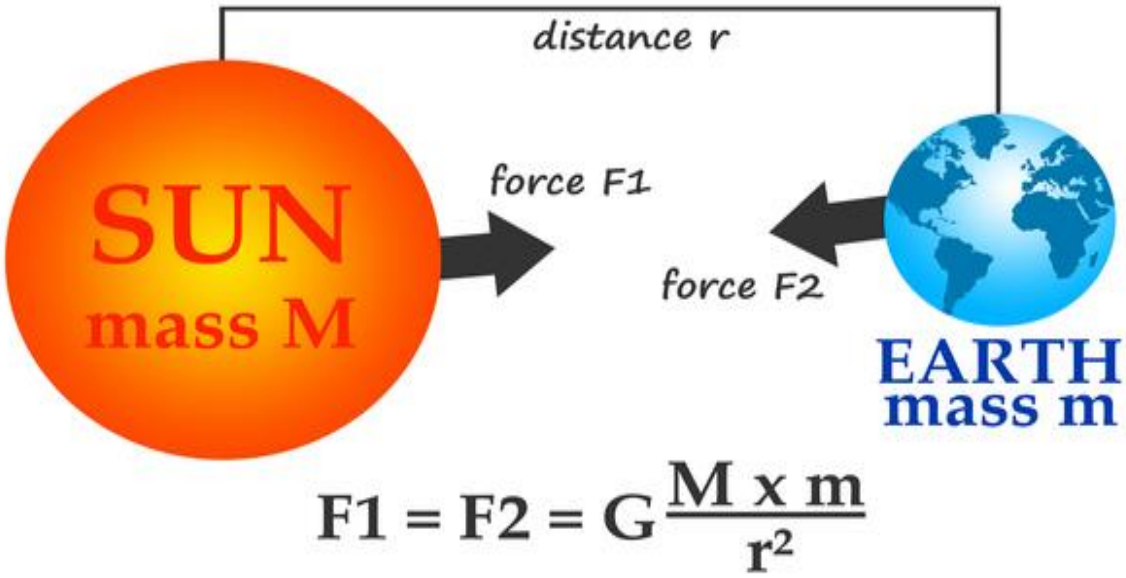
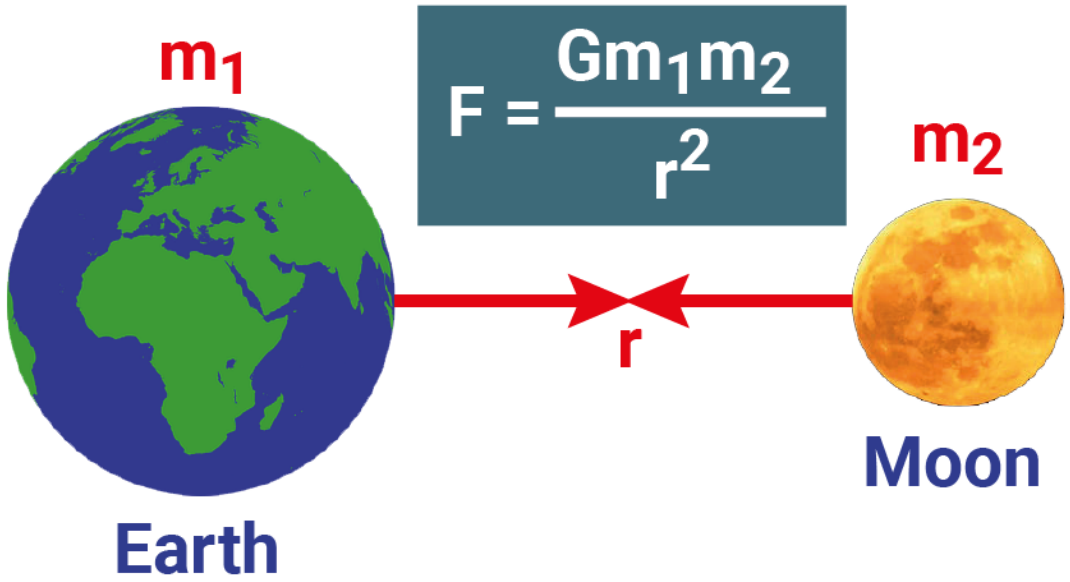


https://fairgaze.com/educationnews/newtons-law-of-universal-gravitational.html



https://executivemakers.com/science-physics-gs-gravitation-newtons-law-gravity-keplers-law/