How do we describe motion?

speed	the rate at which an object is moving
velocity	speed in a certain direction
accele-ration	a change in velocity, meaning a change in either speed or direction.
momentum	mass times velocity
force	can change an object's momentum, causing it to accelerate

Mass vs. Weight

How is mass different from weight?

> An object's mass is the same no matter where it is located, but its weight varies with the strength of gravity or other forces acting on the object.

When is an object **weightless**?

> An object is weightless when it is in **free-fall** even those the mass is *unchanged*

How did Newton change our view of the universe?

Newton showed that the same physical laws that operate on Earth also operate in the heavens, making it possible to learn about the universe by studying physical laws on Earth.
This went against Aristotle.

Newton's Laws of Motion

Newton's First Law of Motion	An object moves at a constant velocity if there is no net force acting upon it.
Newton's Second Law of Motion	Force = mass * velocity
Newton's Third Law of Motion	For any force, there is always an equal and opposite reaction force.

Why do objects move at constant velocity?

Conser-vation of momentum	an object's momentum cannot change unless the object transfers momentum to or from other objects

When no force is present, no momentum can be transferred so an object must maintain its speed and direction.

What keeps a planet rotating and orbiting the Sun?

Conser-vation of angular momentum	a planet's rotation and orbit cannot change unless the planet transfers angular moment to another object

The planets in our solar system do not exchange substantial angular momentum with each other or anything else, so their orbits and rotation rates remain steady.

Basic Energy

kinetic energy	energy of motion
radiative energy	energy carried by light
potential energy	stored energy

Energy is always conserved—it can be neither created nor destroyed. Objects received whatever energy they now have from exchanges of energy with other objects.

What determines the strength of gravity?

Universal law of gravit-ation	states that every object attracts every other object with a gravit-ational force that is proportional to the product of the objects' masses and declines with the square of the distance between their centers

Newton's and Kepler's laws

1) Newton showed that any object going around another object will obey Kepler's first two laws.

2) He showed that ellipses (or circles), which define **bound orbits**, are not the only possible orbital shape—orbits can also be **unbound** and in the form of parabolas or hyperbolas.

3) He showed that two objects actually orbit their common **center of mass.**

4) **Newton's version of Kepler's third law** allows us to calculate the masses of orbiting objects from their orbital periods and distances.

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Page 1 of 1.