Newtonian Physics

If you released a stone in mid-air, with no gravity it would not fall. It would just stay there, motionless.

Combining this idea with the results of Galileo's "ball on a ramp" investigations, we now have:

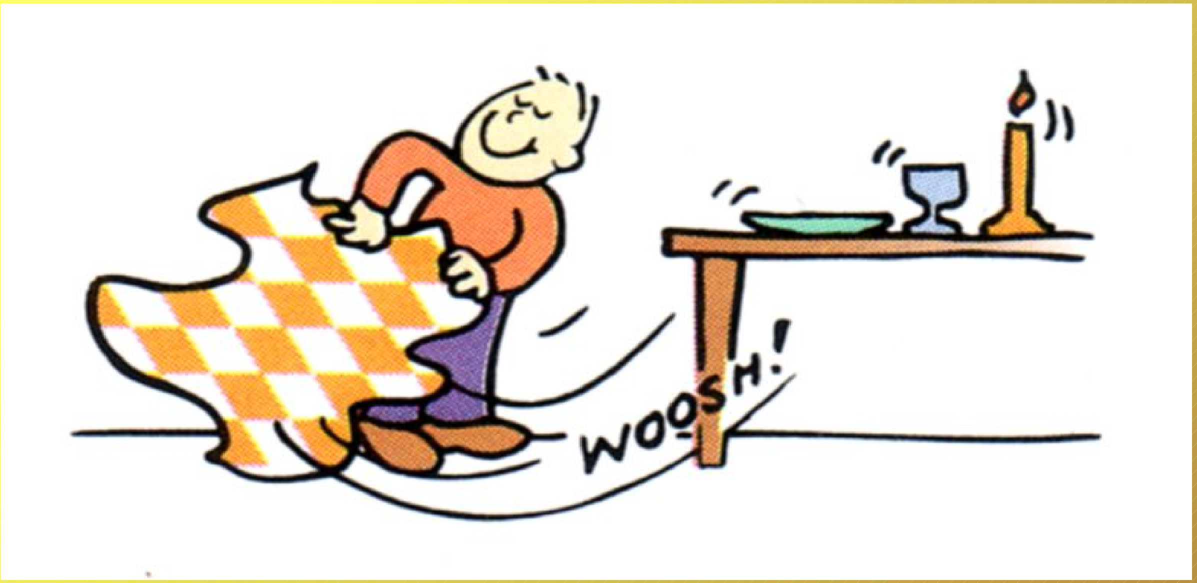
The Law of Inertia:

A body that is subject to no external influences will stay at rest, if already at rest, and will keep moving if it was already in motion. Its tendency to move will be in a straight line with unchanging speed.

Newtonian Physics

The greater the object's inertia, the greater are these tendencies to either remain at rest or to remain moving.

“Inertia” is related to mass.
The more the object's mass, the greater its inertia.



Newtonian Physics

When you are driving your car and stop suddenly, it seems as if a force pushes you forward against the steering wheel.

It is not really a force. It is just your inertia, or, in other words, your body's tendency to keep on going forward at a constant speed.

When you make a hard left turn, it feels as if you're being thrown to the right.

Again, it's your inertia. It's your tendency to keep on going straight ahead.

Newtonian Physics

Speed is how fast you are going. Mathematically, it is defined with the following equation:

$$\bar{s} = \frac{d}{t}$$

$$\text{average speed} = \frac{\text{distance traveled}}{\text{traveling time}}$$

Newtonian Physics

Instantaneous speed is how fast you are going at that particular instant in time.

Velocity means speed and direction.

A change in velocity could mean a change in speed or direction (or both).

A racing car, going around a circular track at constant speed, actually has a changing velocity.
(It is because its direction is changing!)

Newtonian Physics

In mathematical symbols, a change in velocity is written this way:

$$\Delta v$$

It is read “delta vee”

Newtonian Physics

Acceleration means how quickly your velocity changes.

$$\bar{a} = \frac{\Delta v}{t}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time to make the change}}$$

Newtonian Physics

In physics, “acceleration” can mean “speeding up”, “slowing down”, or “changing direction”.

A constant acceleration does not mean a constant speed.

Constant acceleration means that the object speeds up or slows down by the same amount, each second.

If your car speeds up by 5 miles per hour each second, then you have a constant acceleration.

Newtonian Physics

Another example of a constant acceleration is the acceleration of gravity.

$$g = 9.8\,\frac{m}{s^2}$$

A falling object gains an additional 9.8 meters per second of speed for *each* additional second it falls.

The speed of a falling object is directly proportional to the amount of time it has fallen.

$$s \propto t$$

Newtonian Physics

The distance an object has fallen will increase with the square of the time.

$$d \propto t^2$$

Examples: In twice the amount of time, an object will have fallen "two squared" or four times as much distance.

In triple the amount of time, an object will have fallen "three squared" or nine times as much distance.

Newtonian Physics

The following equations are used to calculate the speed of an accelerating object and the distance it has traveled.

$$s = a \cdot t$$

$$d = \frac{1}{2} a \cdot t^2$$

For falling objects, use $a = 9.8$ m/s^2.

Objects in Free Fall

For a rising object, gravity takes away 10 m/s each second from the object's speed.

For a falling object, gravity adds on 10 m/s each second to the object's speed.

Note that the distance that is added on in *not* a constant.