Newton's Laws

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define Force:

A push or pull on an object
Causes a change in velocity

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The unit of Force is the Newton

Mass: kg

acceleration: m/s^2

Force: mass * acceleration: $\frac{kg.m}{s^2} = N$

Newton: derived -

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two general categories of forces

vocabulary vocabulary vocabulary

Contact Force

Field Force: Gravity
Magnetism

Note reveal

Newton's first law of motion

A body in motion tends to stay in motion, and a body at rest will stay at rest, unless acted on by an unbalanced force.

(outside) (net)

Consider a passenger in a moving car:

The passenger is moving at the same velocity as the car in which he travels.

If the car stops abruptly, the passenger will not, unless attached to the vehicle (seat belted).

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A somewhat less violent, but familiar example:

You jump in your car and race to a fast food restauraunt.
The line is long, the lunch break short!
You finally get your food , with only 8 minutes to spare before the bell rings!
The driver of the car pulls away from the drive through window, out of the parking lot, hits the gas as he/she pulls onto the high way and....

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Your food, previously at rest and not attached to the car, remains at rest! (In a newtonian manner of speaking.)

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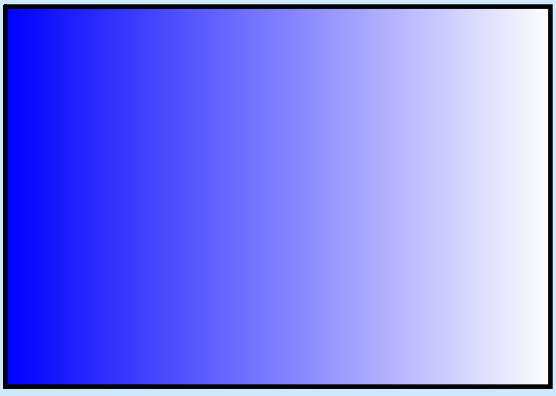
Lesson:



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vocabulary vocabulary vocabulary

The first law is also called the *Law of Inertia*

Inertia is that tendency to resist any changes in the state of motion.

consider a repair van with an unsecured ladder on the roof . If the van stops quickly, what will the ladder do?

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http://www.physicsclassroom.com/mmedia/newtlaws/cci.gif

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Newton's First Law also means that a body in motion will not change its velocity without the addition of an unbalanced force.

Before Newton proposed this, the assumption was that the natural tendency was for everything to come to rest!

Why do you think people thought this?????

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Think about a car travelling at a constant velocity.
It's acceleration is _____.

Why does the car come to rest once the gas pedal is released?

Hint: a body will remain in motion unless an unbalanced force acts on it.

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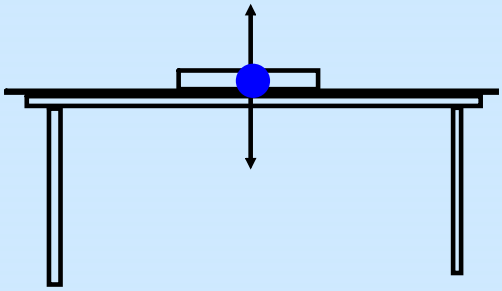

this physics book, sitting on a table, is stationery because the force of the books weight pushing down on the table is equal to the force of the table pushing up on the book.

Gravity is pulling on the book: this is the book's weight and is equal to the mass of the book times the acceleration due to gravity. We write this as:

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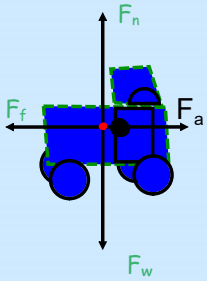
F_n = Normal Force

Force acting perpendicular to the plane of motion



A truck, travelling on level ground h
the following forces acting on it:
1: its weight (F_w)(-mg)
2: the force of the road pushing up on the truck (F_n)
3: the force of friction slowing the truck down. (F_n)
4: the force of the engine causing forward motion. (F_a)

If the truck continues along with no change in velocity,we say it is in ***equilibrium***.
In other words- everything is balanced.

"resumof

$= \emptyset$

Σ_y vertical $= \emptyset$

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another definition:

a force that acts perpendicularly to the plane of motion is known as the ***normal force***.

In our two examples- book on table and truck on road, the normal force is the surface the object is on pushing up on the object.

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For an object at a = on a horizontal surface, the normal force is equal and opposite to the object's weight. They balance one another and there is no change in velocity.

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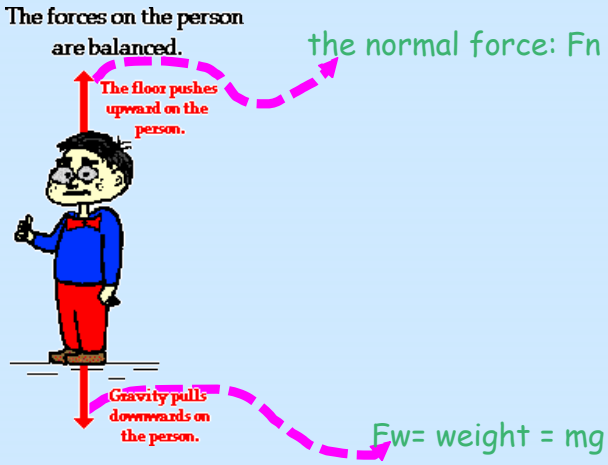

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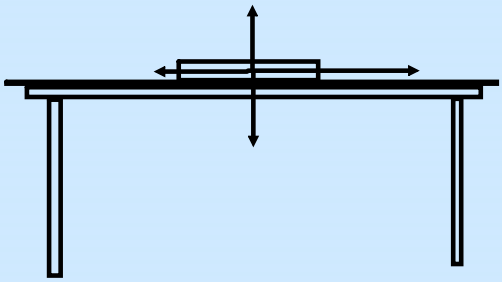
now- some unbalanced forces:

The forces at work are:
1: gravity pulling down
2: the table pushing up
3: friction causing a change in the book's velocity
4: applied force to the right



- F_w is equal and opposite to F_N
The force acting against the force of friction is larger than friction .
In what direction will the book move?

http://www.physicsclassroom.com/Class/newtlaws/U2l1d.cfm

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Acceleration, a.k.a. a change in velocity, is caused by a net external force.

In other words, the force in one direction is not balanced by the force in the opposite direction!

so, the ladder on the truck would also stop, if an unbalanced force held it on the truck
Your food would stay in the tray if you held it down.

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Review

To analyze the action of forces on an object we draw Free Body Diagrams.

Force is a vector quantity, therefore is has both _____ and _____ .

The symbol we use to denote a vector quantity:

_____

How to draw a free body diagram:

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How to construct a free body diagram

1. Determine the object being acted upon
2. draw a representation of the object
3. Determine what forces are acting on the object
4. Using arrows to represent the forces, and add them to the drawing
5. Label with the type of force the arrow represents

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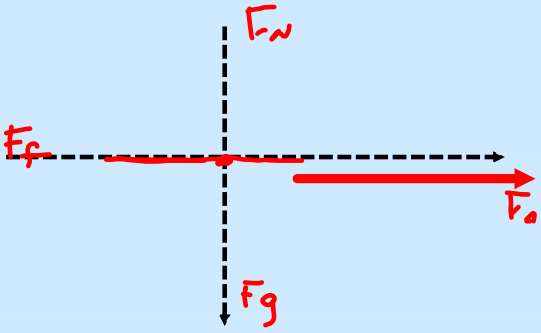

1. set up a convenient coordinate system- origin at the center of mass of the object

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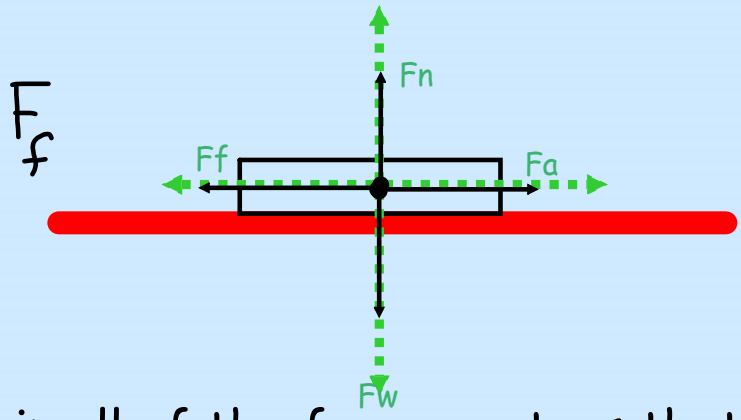

draw in all of the force vectors that apply to the moving object and label

applied forward force= F_a
force due to friction = F_f
Normal force =F_n
Weight (mg) = F_w

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Practice

a. A book is at rest on a table top.
Diagram the forces acting on the book.

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b.A girl is suspended motionless from the ceiling by two ropes. Diagram the forces acting on the combination of girl and bar.

Dec 19-7:56 AM

c.A rightward force is applied to a book in order to move it across a desk at constant velocity. Consider frictional forces Neglect air resistance. Diagram the forces acting on the bool

Feb 1-8:02 PM

d.An egg is free-falling from a nest in a tree. Neglect air resistance. Diagram the forces acting on the egg as it is falling.

Dec 19-7:57 AM

first law review

1st a.k.a. : Law of Inertia

Inertia is mass dependant

Equilibrium ≠ at rest

=no acceleration

first law review

The acceleration of a body is dependent upon force and mass

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Newton's 2nd Law

Mathematically:

$\Sigma F=ma$

The acceleration of a body in motion is indirectly proportional to its mass, and directly proportional to the forces causing the acceleration.

Oct 29-8:34 AM

$\Sigma F=ma$

ΣF is the same as Net force
The amount of force left over after all things equal cancel each other out.

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You push a cart, the mass of which is 12.3 kg, using a force of 10.1 N.

1. What is the acceleration of the cart?
2. If the cart starts from rest, how far does it move in 2.50s ?

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