# Newton's Laws

# Newton's Contributions


- Calculus
- Light is composed of rainbow colors
- Reflecting Telescope
- Laws of Motion
- Theory of Gravitation

# Newton's First Law (law of inertia)

An object at rest tends to stay at rest and an object in motion tends to stay in motion unless acted upon by an unbalanced force.

# Balanced Force


Equal forces in opposite directions produce no motion

# Unbalanced Forces

Unequal opposing forces produce an unbalanced force causing motion

If objects in motion tend to stay in motion, why don't moving objects keep moving forever?

Things don't keep moving forever because there's almost always an unbalanced force acting upon them.

If you throw a ball upwards it will eventually slow down and fall because of the force of gravity.

# Newton's First Law (law of inertia)

- MASS is the measure of the amount of matter in an object.
- It is measured in Kilograms

# Newton's First Law (law of inertia)

- INERTIA is a property of an object that describes how much it will resist change to _____ the motion of the object

mass

inertia

- more _____ means

# 1st Law

Unless acted upon by an unbalanced force, this golf ball would sit on the tee forever.

What is this unbalanced force that acts on an object in motion?

# Friction!

There are four main types of friction:

- Sliding friction: ice skating
- Rolling friction: bowling
- Fluid friction (air or liquid): air or water resistance
- Static friction: initial friction when moving an object

# 1st Law

Once airborne, unless acted on by an unbalanced force (gravity and air - fluid friction) it would never stop!

# Inerti

a

# Terminal Velocity

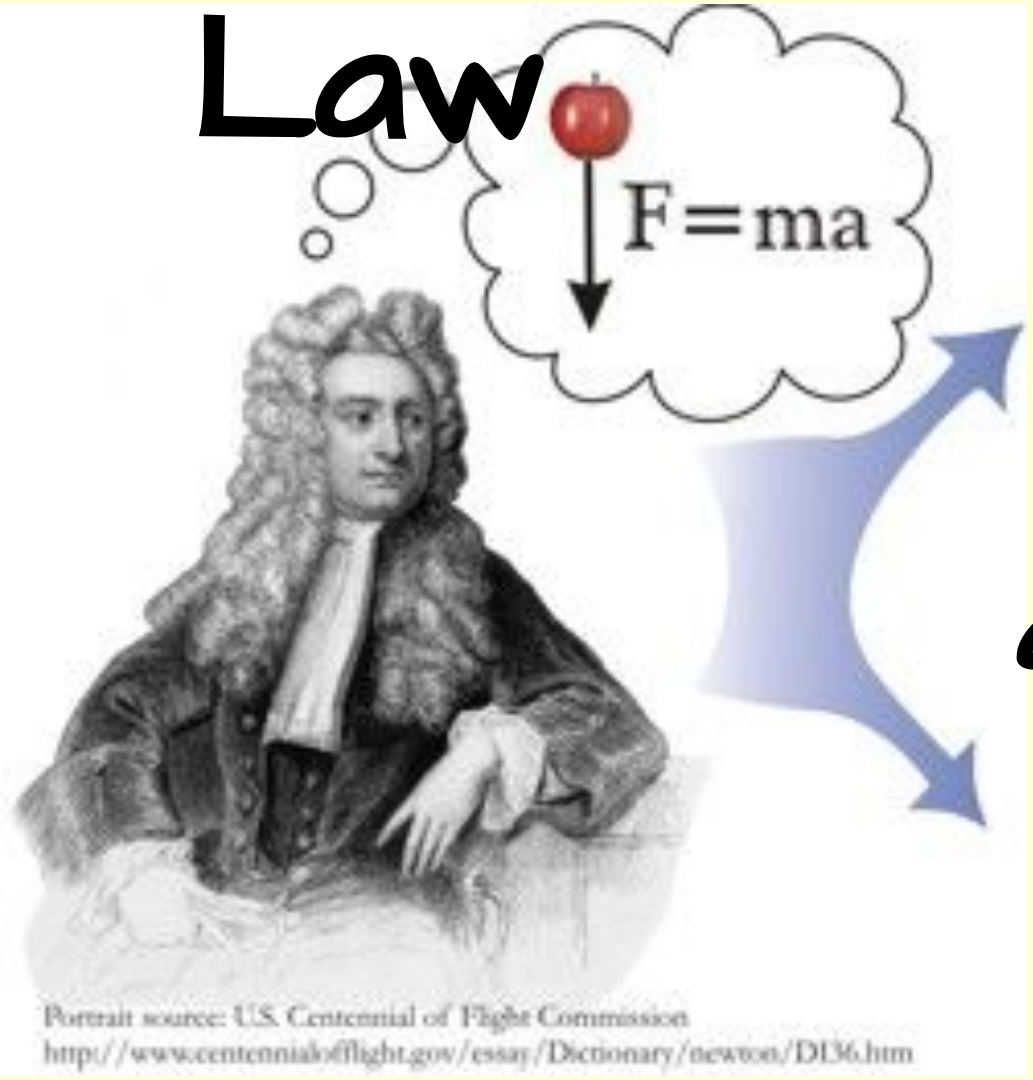

$$a = \frac{F_{net}}{m}$$

$$a = \frac{1000\ N}{100\ kg}$$

$$a = 10.0\ m/s^2$$

(down)

# Newton's Second Law



Portrait source: U.S. Centennial of Flight Commission
http://www.centennialofflight.gov/essay/Dictionary/newton/DI36.htm

Force equals mass times acceleration

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F = ma

# Newton's Second Law

- Force = Mass x Acceleration
- Force is measured in Newton
- ACCELERATION of GRAVITY(Earth) = 9.8 $m/s^2$
- Weight (force) = mass x gravity (Earth)

Moon's gravity is 1/6 of the Earth's

If you weigh 420 Newtons on earth, what will you weigh on the Moon?

70 Newtons

If your mass is 41.5Kg on Earth what is your mass on the Moon?

# Newton's Second Law

- ✔ WEIGHT is a measure of the force of gravity on the mass of an object

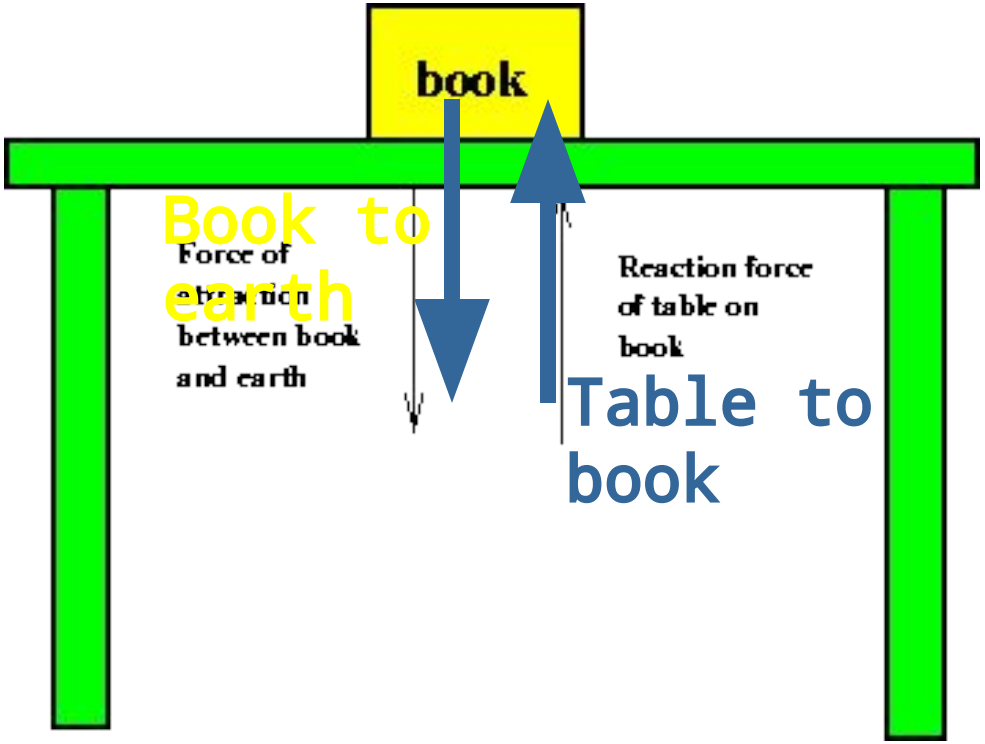
- ✔ measured in Newtons

# Newton's Third Law

For every action there is an equal and opposite reaction.

# Newton's 3rd Law

For every action there is an equal and opposite reaction.



# Newton's Third Law

A bug with a mass of 5 grams flies into the windshield of a moving 1000kg bus.

**Which will have the most force?**

- ✔ The bug on the bus
- ✔ The bus on the

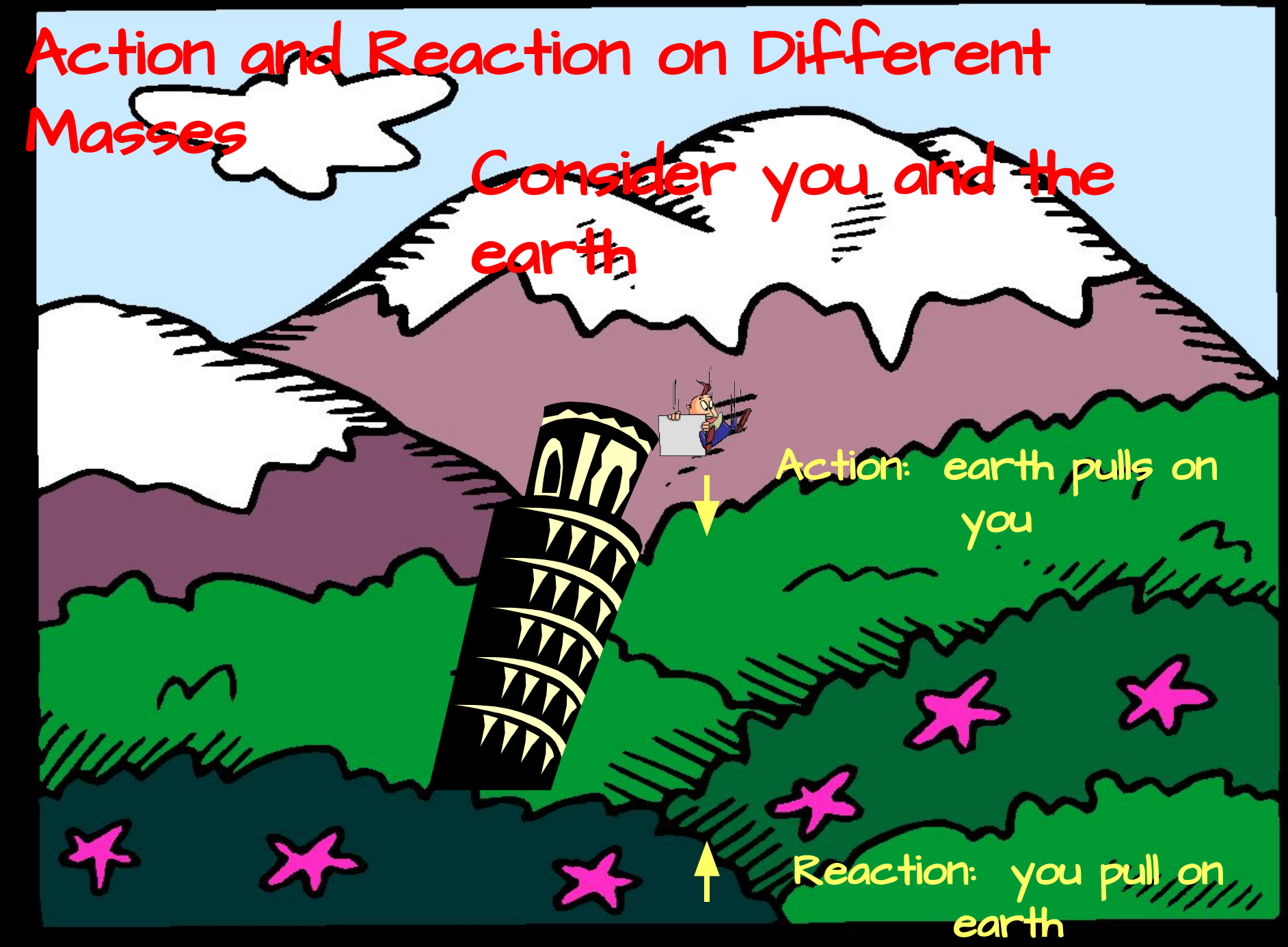
# Newton's Third Law

- The force would be the same.
- Force (bug)= m x A

- Force (bus)= M x a

# Action and Reaction on Different Masses

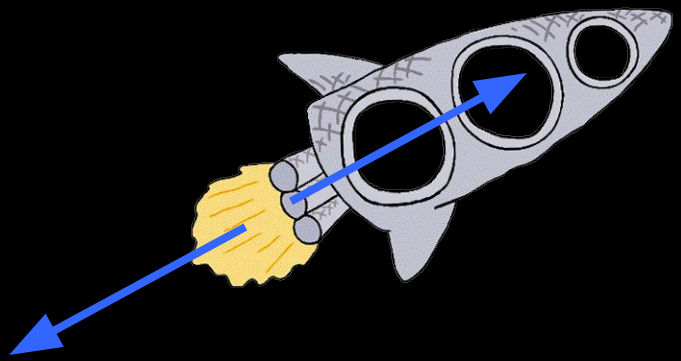
Consider you and the earth



Action: tire pushes on road

Reaction: road pushes on

Action: rocket pushes on gases



Reaction: gases push on rocket

Consider hitting a baseball with a bat. If we call the force applied to the ball by the bat the *action force*, identify the *reaction force*.

(a) the force applied to the bat by the hands

(b) the force applied to the bat by the ball

(c) the force the ball carries with it in flight

(d) the centrifugal force in the swing

# What Laws are represented?

# Review

## Newton's First Law:

Objects in motion tend to stay in motion and objects at rest tend to stay at rest unless acted upon by an unbalanced force.

## Newton's Second Law:

Force equals mass times acceleration ($F = ma$).

## Newton's Third Law:

For every action there is an equal and opposite reaction.