

Newton's 3rd Law of Motion

- Chapter 6
- Section 4
- *



Lets use the 2nd law to get to Newton's 3rd law.

- Newton's 2nd Law describes quantitatively how forces affect motion.
- A force that is applied to any object is always applied by another object.
- Force on a nail is exerted by the hammer. But Newton realized that the hammer accelerated also. It came to a quick stop.
- Only a strong force could cause such a quick change in velocity.

Newton's 3rd Law of Motion:

- Whenever one object exerts a force on a second object, the second exerts an equal & opposite force on the first.
 - For every action there is an opposite & equal reaction.
 - These Action & Reaction forces are acting on different objects.


Newton's 3rd Law of Motion:

- Ice skater pushing on a wall. The wall pushes back on her. She moves backwards.
- Boy throws a package off of a boat. The package moves forwards and the boy & boat moves backwards.

Some Real – World Examples:

- A rocket moves because it exerts a strong F on the gases, expelling them & the gases exert an equal & opposite force on the rocket. Not because it exerts gases that push against the ground and atmosphere.

Walking:

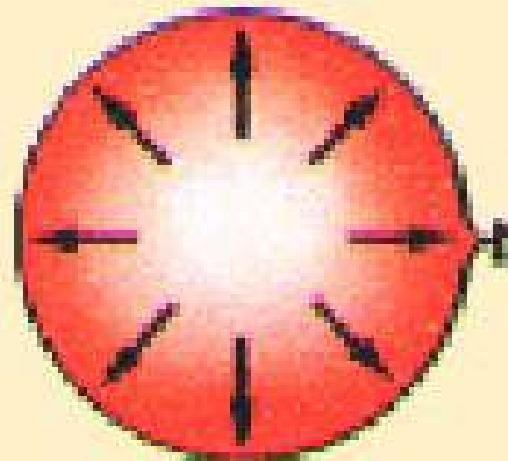
- People who like to walk are big fans of friction.
- We push on the ground with a force. The ground pushes back with a force. Try to walk on Ice.  No friction, or very little
- Use subscripts to be clear which force is to be considered.

$$F_{GP} = -F_{PG}$$

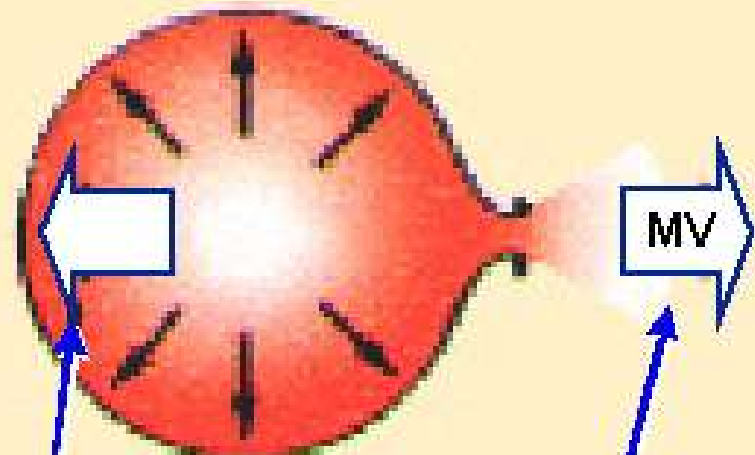
Force on ground by person 

Force on person by ground 

Newton's 3rd Law



Equilibrium



Reaction

Action

$$\text{Thrust} = \text{Mass} \times \text{Velocity (MV)}$$



Rolls-Royce

Doing Math

- A 50kg person in the middle of an ice rink pushes a 20kg box with a force of 10N. What is the acceleration of the person and the box?
- Remember $\text{Acceleration} = \text{Force} \div \text{Mass}$

Comparison

- Box

- Acceleration = $10\text{N} \div 20\text{kg}$
- So Acceleration = 0.5MS^2

- Person

- Acceleration = $10\text{N} \div 50\text{kg}$
- So Acceleration = 0.2MS^2

Why?

- If the same force is applied to two different objects, the larger mass has the smaller acceleration.

Gravity and the Third Law

- The gravity of the earth is pulling down on you.
- But you are also pulling up on the Earth.
- Every object with mass has gravity, more mass, more gravity.

Gravity and the Third Law

- So when you jump up and down how far does the earth move?
- Earths mass is several trillion times your mass the, the pull is not noticeable.

- Suppose you are an astronaut making a space walk outside your space station when your jet pack run out of fuel. How can you use your empty jet pack to get you back to the space station?

