

Newton's 3rd Law of Motion

- ** REVIEW ****

- Inertia is not a _____; it is a tendency of _____.
- A _____ is a _____ or _____.

- _____ are _____ between at least two things.

Throw a 50 pound punch at a falling tissue – does it receive the 50 pounds of force?

- Every force interaction needs an _____ and a _____.
- Some actions and reactions:
 - tire pushes road – road pushes tire
 - rocket pushes out gas backward – gas pushes rocket forward
 - person pulls spring – spring pulls back
 - earth pulls down ball – ball pulls up earth

- Newton's 3rd Law of Motion (stated 3 equivalent ways) ...**

"Whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first."

"For every _____ there is always an _____ and _____."

"Forces come in equal and opposite pairs –action and reaction."

- Defining a _____ ...**

- If an apple falls to earth, the system that surrounds the apple has a net force on it. The net force is equal to the weight of the apple.
- If an apple falls to earth, the system that surrounds the apple *and the earth* has a net force of 0.

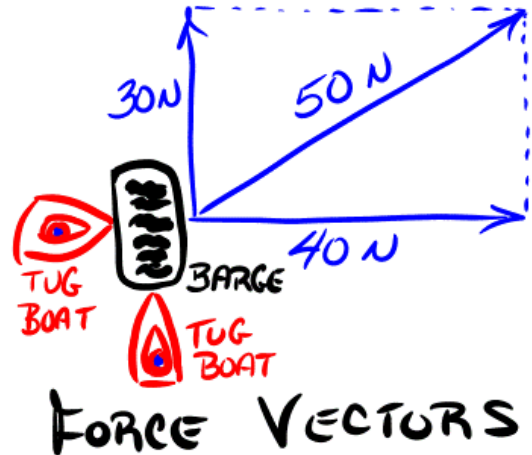
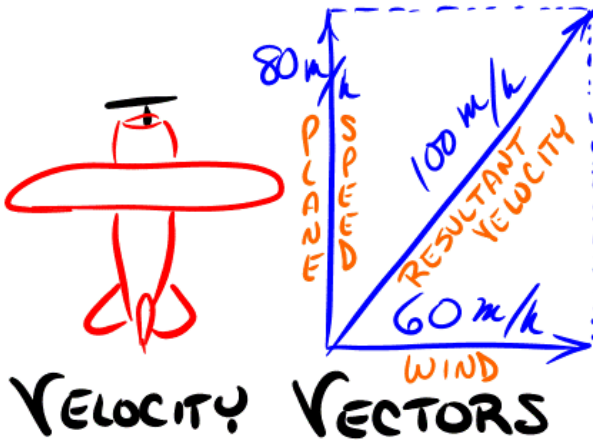
- If a rifle is fired it kicks back with an equal and opposite force. But the acceleration of the bullet is much greater than the acceleration of the rifle against the shoulder.**

- bullet's acceleration ... _____ = _____
- rifle's acceleration ... _____ = _____

- Can you see that the rifle will accelerate backwards as many times less as the ratio of the mass of the rifle to the mass of the bullet?
- Since the _____ is the same (by Newton's 3rd Law), the _____ are inversely proportional to the _____. So if the rifle is 100 times heavier than the bullet, it will accelerate 1/100th as much.

• **Vectors**

- _____ are quantities that have magnitude and direction, (eg.: f , v , a).
- _____ are quantities that have magnitude only, (eg.: speed, mass, volume).



• **Deeper Meanings ...**

- Every fight interaction needs an action and a reaction. So don't react.
- If you define your system large enough, all forces balance.
- Every effect has some cause. Every cause has some effect.
- You cannot touch another heart without being touched.

• **CALCULATIONS**

1. A rifle is fired. With what speed does the rifle hit your shoulder?
 - rifle's mass = 3.6 kg
 - bullet's mass = 250 g
 - bullet's speed = 2,000 mph, 2,000. mph, 2,000.0 mph, 2.0×10^3 mph

2. A train of mass 311 tons going 20 mph hits a stationary 1.22 ton car. How fast does the car fly away from the crash? What if the train was going 20.0 mph?

3. A 60 kg woman jumps 1 meter in the air. How far is the earth pushed away from her as she jumps? (The earth weighs about 6×10^{34} kg.)

4. A small aircraft is heading south at 120 m/h. A very strong easterly wind is blowing at 90 m/h. What is the resultant speed of the aircraft and in what direction is it heading?