**Newton’s Laws of Motion**

***Newton’s 1st Law of Motion***

* An object at rest remains at rest, and an object in motion remains in motion at constant speed and in a straight line unless acted on by an unbalanced force.
* Describes the motion of an object when the net force acting on the object is 0N.
* An object at rest will not move until an unbalanced force acts on it.
* Objects in motion will continue to move forever with the same velocity unless an unbalanced force acts on them.
* Observing the effects of Newton’s first law is difficult.
  + Friction acts on all moving objects, thus applying an unbalanced force.
* Newton’s 1st Law is also referred to as the Law of Inertia
  + Inertia is the tendency of all objects to resist any change in motion.
  + An object that has a small mass has less inertia then an object that has a large mass.
  + Baseball vs Bowling Ball

***Newton’s 2nd Law of Motion***

* + - The acceleration of an object depends on the mass of the object and the amount of force applied.
* Acceleration depends on mass: the acceleration of an object decreases as its mass increases.
* Acceleration depends on force: on object’s acceleration increases as the force on the object increases.
* The relationship in the 2nd law can be expressed mathematically:

F = m x a.

* What force is necessary to accelerate a 1,250kg car at a rate of 40 m/s2?

**Newton’s Laws of Motion**

***Newton’s 3rd Law of Motion***

* Whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first.
* Force pairs: If a force is exerted, another force occurs that is equal in size and opposite in direction.
* Action and Reaction forces: forces in a pair that do not act on the same object.
  + Examples of action and reaction force pairs: bat hitting a ball, pushing a chair, etc.
* Gravity is an action and reaction force pair. Gravity pulls the ball toward Earth, but also pulls Earth toward the ball.
  + Why don’t we see the Earth moving?

***Momentum***

* A quantity defined as the product of the mass and velocity of an object.
* The more momentum an object has, the harder it is to stop the object or change its direction.
* p = m x v
  + Momentum can be found by multiplying the velocity of an object and the mass of the object.
    - p is momentum (kg m/s)
    - m is mass (kg)
    - v is velocity (m/s)
* What is the momentum of a 6kg bowling ball that is moving at 10 m/s down the alley toward the pins?

***The law of conservation of Conservation of Momentum\_***

* The Law of Conservation of Momentum states that any time objects collide, the total amount of momentum stays the same.
* Applies to both objects that **stick together** or **bounce off each other** after they collide.
* If objects **stick together** then momentum depends on the two object’s combined mass and combined velocity.
* If objects **bounce off each other** then momentum is transferred between the objects.
* Action and reaction forces allow for the transfer of momentum.