Centripetal Force Requirement
## Lesson Notes

Learning Outcomes
- What is meant by "centripetal" force?
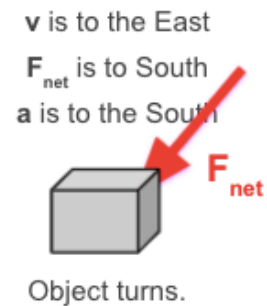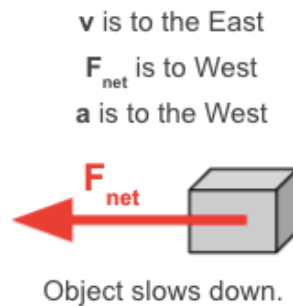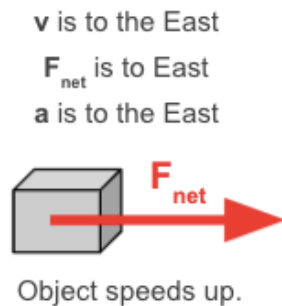- Why does the net force on an object moving in a circle have an inward direction?

Review: Direction of Velocity and Acceleration
- Accelerating objects are changing their velocity.
- At any instant, velocity is speed with a direction.
- Objects moving in circles are changing their direction, they are accelerating.
- The **velocity vector** is directed tangent to the circle.
- The **acceleration vector** is directed towards the center of the circle.
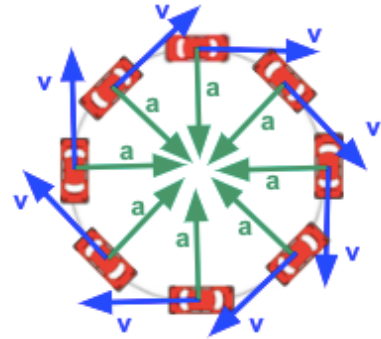
Circular Motion and Newton's Second Law
- An unbalanced force or net force causes an object to accelerate.
- The direction of the **acceleration** (**a**) is **ALWAYS** in the same directions as the **net force** (**F**net).
- The direction of the net force can be (but isn't always) in the same direction as the **velocity** (**v**).

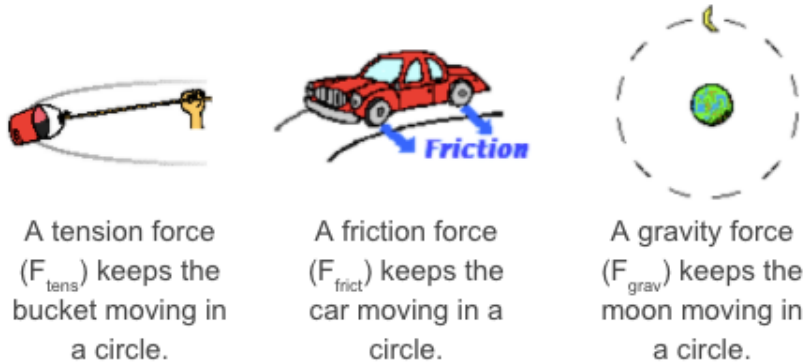|		
v is to the East	**v** is to the East	**v** is to the East
Fnet is to East	**F**net is to West	**F**net is to South
a is to the East	**a** is to the West	**a** is to the South
Fnet	**F**net	**F**net
Object speeds up.	Object slows down.	Object turns.

Circular Motion and Newton's First Law
- In the absence of an unbalanced or net force, an object will keep on doing what its doing.
- A moving object continues in a straight-line motion at a constant speed.
- Without a force, an object naturally travels tangent to the circle and away from its center. An inward force is required to maintain a circular path.

Fnet

Fnet

Fnet
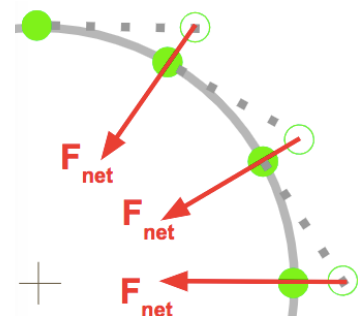
Centripetal Force Requirement

A net inward force is required in order for an object to move along a circular path. Without this inward force, the object would travel along a straight-line path.

A tension force (F_{tens}) keeps the bucket moving in a circle.

A friction force (F_{frict}) keeps the car moving in a circle.

A gravity force (F_{grav}) keeps the moon moving in a circle.

Bucket Whirled in a Vertical Circle

Consider a bucket filled with water, secured to a rope on one of its ends which is held by a person on the other end. As the bucket is whirled in a vertical circle, the tension force pulls the bucket inward.
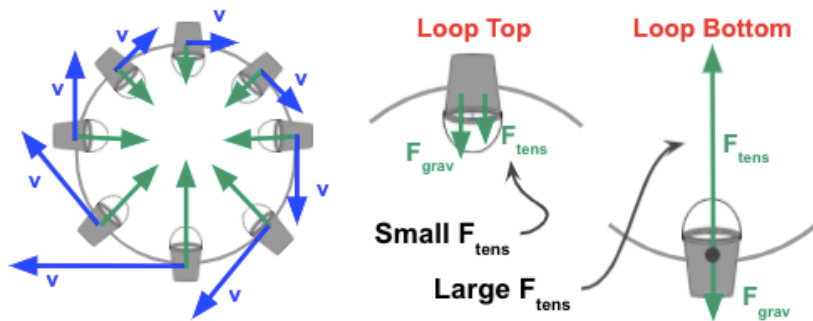
A Perpendicular Force Doesn't Change the Speed

- Object speeds are changed when there is a component of force directed in the same or the opposite direction of an object's motion.
- So as long as the force is ⊥ to the direction of motion, it will change the direction of the object without changing the speed of the object.