

# Uniform Circular Motion (UCM) Skill Objectives

What you should know and be able to do by the end of the unit.

1. For an object exhibiting uniform circular motion:
  - identify the centripetal force as the necessary cause of such motion.
  - describe the velocity as tangent to the circular path, or perpendicular to the radius.
  - predict the path the object would take if the centripetal force was suddenly reduced to zero.
2. Utilize the time for one complete circle (the period,  $T$ ) and the circle's radius,  $r$ , in order to calculate the magnitude of an object's linear velocity,  $v$  (also known as the object's speed).
3. Know and understand the equation for calculating centripetal acceleration.
  - describe how a change in the linear velocity,  $v$ , or the radius,  $r$ , would affect the centripetal acceleration,  $a_c$
  - perform calculations to determine centripetal acceleration, linear velocity, or radius
4. Know and understand Newton's 2<sup>nd</sup> law of motion in a form applicable to circular motion
  - describe how a change in the mass, linear velocity, or radius would affect the centripetal force
  - use the centripetal force relationship in order to calculate an unknown quantity, such as centripetal force, mass, linear velocity, or radius.
5. Distinguish between the physically real centripetal force and the perceived or "felt" centrifugal force.
6. Construct force diagrams that display the individual forces acting on an object undergoing uniform circular motion.
7. Recognize that an object in orbit is a special case of uniform circular motion
  - identify that the force due to gravity is the only force acting upon an object in perfect orbit
  - recognize that an object in orbit is in a perpetual state of free fall
  - an object in orbit has a centripetal acceleration of approximately  $9.8 \text{ m/s}^2$
8. Understand and be able to apply Newton's law of universal gravitation
  - distinguish "Big G",  $G$ , the universal gravitational constant, from "little g",  $g$ , the local gravitational field strength
  - recognize that gravity is a mutual attraction between objects, dependent upon the product of each object's mass
  - describe the relationship between gravitational force and distance,  $r$ , as an **inverse square relationship**
  - perform calculations with Newton's law of universal gravitation to determine unknown quantities, such as  $F_g$ ,  $m$ , or  $r$ .