Honors Physics - Unit 3 - Circular Motion

Unit Focus

Students will explore and analyze objects that move in a circular path. This analysis is based on prior units, however, allows students to apply their reasoning and problem solving to specific real world situations with which they are familiar, such as; why they feel like they are pushed to the outside of a car when the go around a curve, why they lift off their seat at the top of a roller coaster hill and why they feel heavy at the boom of the Ferris wheel. This unit will lead them into the next unit which is the study of the motion of satellites and celestial bodies.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science
High School Physical Sciences: 9 - 12

- Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. *HS-PS2-1*
- Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. *HS-PS4-1*

Next Generation Science Standards (DCI)
Science: 11

- Newton's second law accurately predicts changes in the motion of macroscopic objects. *PS2.9.A1*

Madison Public Schools Profile of a Graduate
Critical Thinking

- Analyzing: Examining information/data/evidence from multiple sources to identify possible

Transfer

T1 Apply familiar mathematical concepts to a new problem or apply a new concept to rework a familiar problem.
T2 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.

Meaning

Understanding(s)	Essential Question(s)
U1 The acceleration of an object depends upon its mass and the net force acting on it. (Newton's 2nd Law) **U2** In order for an object to move in a circular path, the Net Force on that object must be directed towards the center of that circle; if the net force is not sufficient, the object will not maintain a circular path	**Q1** Why do some objects move in a circle?

Acquisition of Knowledge and Skill

Knowledge	Skill(s)
K1 Students will understand that an object cannot move in a circular path if there is no net force acting on it. In such a case, it will move in a straight line with constant velocity. **K2** Students will understand that an unbalanced force is required to make an object travel in a circular path and that that unbalanced force is directed inward, toward the center of the circle and is called a centripetal force. **K3** Students will understand that an object traveling at a constant speed in a circular path is accelerating and that that acceleration is directed inward, toward the center of the circle	**S1** Students will be able to relate the speed of the object to the period of rotation and be able to calculate one from the other. **S2** Students will be able to identify the force that is acting centripetally (inward) in several situations: a stopper on a string, a car on a curved road, a rider on an amusement park rotor ride, a rider on a roller coaster, a mass orbiting another mass… and will be able to draw a force diagram for each of these situations.

Stage 1: Desired Results - Key Understandings		
underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)	and is called a centripetal acceleration. This acceleration only changes the direction of the velocity and NOT the magnitude. At any point in time, the direction of the object's velocity is tangent to the circular path. **K4** Students will understand that centripetal force is not a new type of force in and of itself. Instead, any of the other forces (friction, tension, normal, push/pull, gravitational) they have learned about in the past may act centripetally. **K5** Students will understand how motion in a vertical circle differs from motion in a horizontal circle and will be able to draw force diagrams for vertical circle situations at both the top and the bottom.	**S3** Students will be able to apply the formula for centripetal acceleration to determine the "direction-changing acceleration" that occurs when an object travels in a circle. **S4** Students will be able to calculate the necessary centripetal force, or the force needed by an object to stay in a circular path. **S5** Students will be able to explain or demonstrate what occurs when there is not enough force to supply the necessary centripetal force (ex. the car skids, the stopper flies off the broken string tangent to the circle etc.) **S6** Students will understand how motion in a vertical circle differs from motion in a horizontal circle and will be able to draw force diagrams for vertical circle situations at both the top and the bottom. **S7** Students will be able to apply all of the above concepts and the formula for centripetal acceleration and Newton's Second Law to solve problems, such as those involving cars on curved roads, masses swung on strings or a rider on an amusement park rotor ride