03_Circular Motion and Gravitation

Content Area: **Science**
Course(s):
Time Period: **Full Year**
Length: **3-4 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

This course is about the nature of basic things such as motion, force, energy, matter, sound, light, electricity and the composition of atoms. Laboratory experiments, demonstrations, applications to daily life and current topics in physics provide students with an appreciation of this most basic science.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Essential questions:

- How can Newton's laws be used to describe circular motion?
- How can the gravitational force be used to explain various phenomena?

Students will understand:

- Laws govern motion on Earth and throughout the universe
- Mathematical representations can be used to understand how objects move and make predictions about an object's motion
- You can use vectors and Newton's laws to describe circular motion
- Gravity is an attractive field force that acts between objects with mass

CONTENT AREA STANDARDS

SCI.HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
SCI.HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

HSA-CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
HSA-CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.

MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
MA.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
PFL.9.1.K12.P.4	Demonstrate creativity and innovation.
PFL.9.1.K12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.4	Demonstrate creativity and innovation.
TECH.K-12.P.4	Demonstrate creativity and innovation.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will know:

- The motion of an object changes only when a net force is applied
- The magnitude of acceleration of an object depends directly on the strength of the net force, and inversely on the mass of the object. This relationship (a=Fnet/m) is independent of the nature of the force.
- Friction is a force that acts to slow or stop the motion of objects
- Distinguish between Newton□s Laws and solve problems involving one and two dimensional, centripetal, and rotational motion

The following preconceptions and/or misconceptions will be addressed during the unit:

- An object in circular motion can only be accelerating if its speed is changing
- An object continues to move in a a circular path if the net force supplying a centripetal acceleration is removed
- Gravity stops at some point in space

Procedural Knowledge

Students will be able to:

- Clearly define the system of the interacting objects that is mathematically represented.
- Using the given mathematical representations, students identify and describe the gravitational attraction between two objects as the product of their masses divided by the separation distance squared ($F_g = (G m_1 m_2)/r^2$), where a negative force is understood to be attractive.
- Correctly use the given mathematical formulas to predict the gravitational force between objects or predict the electrostatic force between charged objects.
- Based on the given mathematical models, students describe that the ratio between gravitational forces between

objects with a given charge and mass is a pattern that is independent of distance.

- Describe that the mathematical representation of the gravitational field ($F_g = (G\ m_1 m_2)/r^2$) only predicts an attractive force because mass is always positive.
- Use the given formulas for the forces as evidence to describe that the change in the energy of objects interacting through gravitational forces depends on the distance between the objects.

EVIDENCE OF LEARNING

Formative Assessments

Strategic questioning

Class/small group discussions

Homework and classwork assignments

Conducting and analyzing labs

Summative Assessments

- Benchmarks – departmental benchmark given at the end of MP1, MP2, and MP3
- Alternative Assessments
    - Lab inquiries and investigations
    - Lab Practicals
    - Exploratory activities based on phenomenon
    - Gallery walks of student work
    - Creative Extension Projects
    - Build a model of a proposed solution
    - Let students design their own flashcards to test each other
    - Keynote presentations made by students on a topic
    - Portfolio

RESOURCES (Instructional, Supplemental, Intervention Materials)

The Physics Classroom - http://www.physicsclassroom.com/

PhET simulations - https://phet.colorado.edu/

Pivot - https://www.pivotinteractives.com/

Edpuzzle - https://edpuzzle.com/

Vernier labs - teacher lab manual available in classroom

INTERDISCIPLINARY CONNECTIONS

Calculations drive connections with mathematics courses

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.