Unit 3: Gravity and Motion

Content Area: **Science**
Course(s):
Time Period: **Marking Period 1**
Length: **2 weeks**
Status: **Published**

Summary

The discoveries of Galileo paved the way for Newton to develop his Laws of Motion and Law of Universal Gravitation. Newton also formalized a way of doing science that was logical and systematic, and those methods are the foundation of modern science. After the development of Newton's laws, humans were able to make important measurements relevant to astronomy, such as the masses of planets and escape velocity.

Revision Date: July 2024

MATH.K-12.1	Make sense of problems and persevere in solving them
MATH.K-12.2	Reason abstractly and quantitatively
MATH.K-12.3	Construct viable arguments and critique the reasoning of others
MATH.K-12.4	Model with mathematics
MATH.K-12.5	Use appropriate tools strategically
MATH.K-12.6	Attend to precision
MATH.K-12.7	Look for and make use of structure
MATH.K-12.8	Look for and express regularity in repeated reasoning
ELA.RI.MF.9–10.6	Analyze, integrate, and evaluate multiple interpretations (e.g., charts, graphs, diagrams, videos) of a single text or text/s presented in different formats (visually, quantitatively) as well as in words in order to address a question or solve a problem.
ELA.W.IW.9–10.2	Write informative/explanatory texts (including the narration of historical events, scientific procedures/experiments, or technical processes) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
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.
SCI.HS-PS2-1	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.
SCI.HS-PS2-3	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
SCI.HS-PS2-2	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.3	Consider the environmental, social and economic impacts of decisions.
WRK.K-12.P.4	Demonstrate creativity and innovation.

WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.6	Model integrity, ethical leadership and effective management.
WRK.K-12.P.7	Plan education and career paths aligned to personal goals.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CT	Critical Thinking and Problem-solving

Essential Questions/Enduring Understandings

Essential Questions:

How did Isaac Newton's study of motion & physics contribute to the modern scientific processes and develop the Law of Universal Gravitation?

What are the limitations to Newton's Law of Universal Gravitation, and how do scientists understand gravity in modern astrophysics?

How does Newton's Law of gravity extend Kepler's laws of orbital motion?

Enduring Understandings:

Examination of Newton's 3 Laws of Motion & applying it to our understanding of gravitational forces, rocketry, and space travel

A fundamental understanding of Newton's Laws is used to explain orbital motion and how NASA utilized this information for its space programs.

Objectives

Students will know key terms: inertia, space-time, escape velocity, conic sections, gravity, acceleration, special relativity, and general relativity.
Students will know that a planet's gravitational force & escape velocity of said planet is dependent upon its mass and size.
Students will know the difference between mass and weight.
Students will know Einstein's theories of special and general relativity.

Students will be skilled at applying Newton's 3 Laws of Motion to astrophysical problems.
Students will be skilled at using Newton's Law of Universal Gravitation to calculate the possible orbital paths of celestial objects.

Learning Plan

ISLE cycle on Newton’s 3 Laws (abbreviated).

Use data to follow Newton’s reasoning for Universal Gravitation.

PhET Simulation: Gravity and Orbits.

Determine expressions for escape velocity

Calculating the escape velocity of planets in our solar system.

Mass vs. Weight discussion.

Visual aid: Bowling ball on a sheet to model curved gravity space-time.

Video on relativity

Assessment

Formative Assessment:

Do Now &/or Start-Up Questions, Discussions

Progression through the use of ISLE cycle to describe the astronomical applications of Sir Isaac Newton.

Mathematical calculations using Newton's 3 laws of motion.

Exit Ticket Submission

Alternative Assessment:

Computer website interactive illustrating gravitational motion of the planets.

Website interactive comparisons on the gravitational force of each planet in our solar system.

Mathematical calculations to Kepler's ellipse geometry to determine the orbital period of a planet.

Summative Assessment:

Topic & Vocabulary Quizzes

Unit Tests

Benchmark Assessment:

Final Exam

Materials

quantitative/qualitative lab equipment for activities, experiments

related astronomy maps, charts
supplementary interactive multimedia, internet websites, videos

Textbook: The Cosmic Perspective - 10th Edition

Integrated Accommodation and Modifications

https://docs.google.com/spreadsheets/d/1VPJNV9-GTZxi5VPcYkvEMPdHR8D8wTBI7zIj1BWYpek/edit?usp=drive_link