Unit 3: Gravity and Motion

Content Area: **Science**
Course(s):
Time Period: **Marking Period 1**
Length: **10 days**
Status: **Published**

Summary

In this unit, students will apply Newton's Laws of Motion and Newton's Law of Universal Gravitation to the motion of stars, planets, and other objects.

Introduction: The discoveries of Galileo and the work of Kepler 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 2019

LA.RST.9-10	Reading Science and Technical Subjects
LA.WHST.9-10	Writing History, Science and Technical Subjects
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.
CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
SCI.HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
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.
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-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
WRK.9.1.2.CAP.1	Make a list of different types of jobs and describe the skills associated with each job.
TECH.9.4.2.CI.1	Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2).
TECH.9.4.2.CI.2	Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).
TECH.9.4.2.CT.1	Gather information about an issue, such as climate change, and collaboratively brainstorm ways to solve the problem (e.g., K-2-ETS1-1, 6.3.2.GeoGI.2).
TECH.9.4.2.GCA.1	Articulate the role of culture in everyday life by describing one's own culture and comparing it to the cultures of other individuals (e.g., 1.5.2.C2a, 7.1.NL.IPERS.5, 7.1.NL.IPERS.6).

Essential Questions/Enduring Understandings

How did Isaac Newton use modern scientific processes to 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?

Objectives

Students will know key terms: inertia, space-time, escape velocity, conic sections, gravity, acceleration, special relativity, 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.

Students will know that escape velocity depends on the mass and size of a celestial body.

Students will know the difference between mass and weight.

Students will know Einstein's theories of special and general relativity.

Learning Plan

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

Use data to follow Newton's reasoning to Universal Gravitation.

PhET Simulation: Gravity and Orbits.

Determine expression for and calculate escape velocity.

Mass vs. Weight discussion.

Bowling ball on a sheet model of curved space-time.

Video on relativity

Assessment

Formative Assessment: Progression through ISLE cycle

Quizzes throughout chapter

Summative Assessment:

End of Chapter test

Materials

quantitative/qualitative lab equipment for activities, experiments
related astronomy maps, charts
supplementary interactive multimedia, internet websites, videos

Foundations of Astronomy Textbook

Integrated Accommodation and Modifications

https://docs.google.com/spreadsheets/d/1243s4Clz7zHx_VnPe-hYDP06QSohB0jKJY2NuNYySSc/edit?usp=sharing