02: Forces

Content Area: **Science**
Course(s): **Physics**
Time Period: **October**
Length: **30 days**
Status: **Published**

Unit Overview:

The purpose of this unit is to give students a firm understanding of the forces that govern the mechanical universe and how these forces come together to determine the motion of an object.

In this unit of study, students are expected to *plan and conduct investigations*, *analyze data and using math to support claims*, and *apply scientific ideas to solve design problems* students in order to develop an understanding of ideas related to why some objects keep moving and some objects fall to the ground. Students will also build an understanding of forces and Newton's second law. Finally, they will develop an understanding that the total momentum of a system of objects is conserved when there is no net force on the system. Students are also able to apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. The crosscutting concepts of *patterns*, *cause and effect*, and *systems and systems models* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate proficiency in *planning and conducting investigations*, *analyzing data and using math to support claims*, and *applying scientific ideas to solve design problems* and to use these practices to demonstrate understanding of the core ideas.

Enduring Understandings:

- Force Elastic is a restoring force on a deformed object
- Force Friction depends on surface conditions and the Force Normal
- Force gravity is an attractive force that gets stronger with mass and weaker with distance
- With a net force an object will accelerate
- Without net force, an object will not change it's state of motion
- Force Buoyancy is an upward force on an object in a fluid
- Forces are pushes or pulls on an object
- Forces require 2 objects and each object will feel the same force but in opposite directions
- Pressure is the concentration of force on an object

Essential Questions:

- How can we predict the future behavior of an object?
- How do we know what forces are acting on an object and how strong are those forces?

Standards/Indicators/Student Learning Objectives (SLOs):

- SWBAT apply the ideas of force gravity to a falling object and develop the equations that best describe it's motion.
- SWBAT define and calculate pressure acting on an object.
- SWBAT define elastic force and identify the factors that determine its magnitude for a variety of unique situations.
- SWBAT define force buoyancy and identify the factors that determine its magnitude for a variety of unique situations.
- SWBAT define force friction and identify the factors that determine its magnitude and direction for a variety of unique situations
- SWBAT define forces, net force and identify the forces acting on an object.
- SWBAT describe the thought process that lead to the development of the idea of gravity.
- SWBAT identify the factors that determine the force gravity between two objects and calculate that force.
- SWBAT state each of Newton's Laws and describe the effect of balanced and unbalanced forces on an object.

9-12.HS-ETS1-4.4.1	Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows— within and between systems at different scales.
9-12.HS-ETS1-2.6	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.
9-12.HS-ETS1-3.6.1	Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12.HS-ETS1-4.ETS1.B.1	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
9-12.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.
9-12.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.
9-12.HS-PS1-3.1.1	students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
9-12.HS-PS1-1.2	Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
9-12.HS-PS1-4.2.1	Develop a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-PS1-1.2.1	Use a model to predict the relationships between systems or between components of a system.
9-12.HS-PS2-1.2.1	students understand that empirical evidence is required to differentiate between cause

	and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
9-12.HS-PS3-2.2.1	Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-PS2-3.2.1	Systems can be designed to cause a desired effect.
9-12.HS-PS2-5.3	Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.
9-12.HS-PS2-5.3.1	Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
9-12.HS-PS3-1.4.1	Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.
9-12.HS-PS2-2.4.1	When investigating or describing a system, the boundaries and initial conditions of the system need to be defined.
9-12.HS-PS1-2.6	Constructing Explanations and Designing Solutions
9-12.HS-PS2-3.6.1	Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.
9-12.HS-PS1-6.7.1	students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.
9-12.HS-PS2-6.8.1	Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
9-12.HS-PS2-1.PS2.A.1	Newton’s second law accurately predicts changes in the motion of macroscopic objects.
9-12.HS-PS2-5.PS2.B.1	Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
9-12.HS-PS2-4.PS2.B.1	Newton’s law of universal gravitation and Coulomb’s law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.
9-12.HS-PS2-3.ETS1.A.1	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
9-12.HS-PS2-3.ETS1.C.1	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Lesson Titles

- Force Buoyancy

- Force Gravity
- Pressure
- Force Elastic
- Force Friction
- Introduction to Forces
- Newton's Laws of Motion
- Stopping Distance
- Vertical Motion

Career Readiness, Life Literacies & Key Skills

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
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.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections:

LA.RH.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, qualitatively, as well as in words) in order to address a question or solve a problem.
LA.RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
LA.RST.11-12.10	By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.
LA.WHST.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
LA.WHST.11-12.1.B	Develop claim(s) and counterclaims using sound reasoning and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form that anticipates the audience’s knowledge level, concerns, values, and possible biases.
LA.WHST.11-12.1.C	Use transitions (e.g., words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
LA.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.11-12.2.E	Provide a concluding paragraph or section that supports the argument presented.

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK

- Classwork: 8 Vertical Motion Proble
- Classwork: Newton's Laws including Freefall. A series of problems that center around Newton's laws but also include problems with vertical motion
- Homework: A series of short answer questions dealing with Newton's Laws of Motion.
- Homework: Gravity on a Satellite. You will be finding the force of gravity on a satellite that is a certain radius above the surface of a planet.
- Homework: Practice vertical motion problem from a height on various planets.
- Homework: Practice vertical motion problems
- Homework: Identifying Forces
- Lab Activity: Crash Test Dummy Lab. Students will be using our motion tracking software to find the acceleration of a car during a crash into a static object.
- Lab Activity: Gravity-Distance Lab. In this activity you will be using a simulation program to find the relationship between the force of gravity and the distance between two objects.
- Lab Activity: Measuring the Gravitational Force. You will be learning how to use the force probe to determine the relationship between the force of gravity and the mass of an object.
- Lab Activity: Relationships for Newton's Second Law. In this activity you will be developing equations to relate mass, force and
- Lab Activity: Tracking Vertical Motion. In this activity you will be learning a few things about freefall using prerecorded videos of objects moving vertically.
- Lab Activity: Students will determine the pressure they exert on the ground by measuring their weight and area of their footprints
- Notes on Forces and Pressure
- Notes on Gravitation
- Notes on Newton's Laws of Motion
- Notes on Pressure
- Notes on Vertical Motion
- Ownwork: Pressure Problems. Problems to help you practice the equation that relates force and area to pressure.
- Ownwork: Problems Involving Newton's Laws. A sampling of problems dealing with Newton's Laws of Motion.
- Ownwork: Problems with Gravity and Freefall. Practice problems involving Newton's formula for universal gravitation and problems involving free fall.
- Ownwork: Using Google as a Calculator
- Review Material for Quiz: Here is some information about your upcoming quiz.

Modifications

- Tutoring During Delsea 1

ELL Modifications:

- Focus on domain specific vocabulary and key words

- Digital Translators
- Offer sources for specific topics in primary language (Youtube web resources)
- Repeat, reword and clarify
- Use real objects when possible

IEP & 504 Modifications:

- Formula sheets and example problems to use on assessments
- Modeling and showing various examples
- Scaffolding Notes
- Students will be able to use calculators and/or other math tools

G&T Modifications:

- Extra labs to do outside the classroom
- Provide links to extension videos or other media
- Increase the level of problems and challenge problems

At Risk Modifications

- Reach out to parents
- Utilize Delsea One to complete assignments, try supplemental material or to modify classroom behaviors

Formative Assessment:

- Quiz 2.1 Forces, Pressure and Newton's Laws
- Quiz 2.2 Gravity and Vertical Motion
- Quiz 2.3 Forces Friction, Elastic and Buoyancy

Summative Assessment:

- Lab Assessment: Newton's Laws and Forces
- MPA 1 Assessment
- Unit 2 Assessment: Newton's Laws and Forces

Alternative Assessments:

Performance tasks
Project-based assignments

Problem-based assignments
Presentations
Reflective pieces
Concept maps
Case-based scenarios
Portfolios

Benchmark Assessments:

Skills-based assessment
Reading response
Writing prompt
Lab practical

Resources & Materials:

https://sites.google.com/site/delseaphysics1/Home

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- Cell Phone Apps for video editing
- Chromebooks
- Lab Pro Modules and appropriate sensors
- Meter Sticks/metric rules
- Timing Devices

Technology:

- Chromebook
- Class Website
- Ed Puzzle
- Google Classroom
- Google Suite
- Graphical Analysis Program
- Lab Pro Modules and Sensors
- Other
- Promethean Board

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.D.CS1	Advocate and practice safe, legal, and responsible use of information and technology.
TECH.8.1.12.D.CS2	Demonstrate personal responsibility for lifelong learning.
TECH.8.1.12.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
TECH.8.1.12.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.C.4	Explain and identify interdependent systems and their functions.
TECH.8.2.12.C.CS3	The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.
TECH.8.2.12.E	Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.
TECH.8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
TECH.8.2.12.E.CS1	Computational thinking and computer programming as tools used in design and engineering.