Unit 3: Newton's Laws of Motion

Content Area: **Science**
Course(s):
Time Period: **Marking Period 2**
Length: **5 Weeks**
Status: **Published**

Summary

Students will build on the representations in the previous unit to describe what causes motion. They will learn how Newton's Three Laws of Motion are constructed and applied to everyday scenarios. The force Earth exerts on objects is defined, with the question left open of how Earth "knows" what force to exert.

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CS.9-12.8.1.12.DA.5	Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
LA.RST.9-10	Reading Science and Technical Subjects
LA.RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.RST.9-10.6	Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.RST.9-10.8	Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
LA.RST.9-10.9	Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
LA.WHST.9-10	Writing History, Science and Technical Subjects
LA.WHST.9-10.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.
LA.WHST.9-10.1.A	Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
LA.WHST.9-10.1.B	Develop claim(s) and counterclaims using sound reasoning, supplying data and evidence

	for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
LA.WHST.9-10.1.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.9-10.1.D	Establish and maintain a style and tone appropriate to the audience and purpose (e.g., formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
LA.WHST.9-10.1.E	Provide a concluding paragraph or section that supports the argument presented.
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
LA.WHST.9-10.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
LA.WHST.9-10.9	Draw evidence from informational texts to support analysis, reflection, and research.
LA.WHST.9-10.10	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
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.CRP10	Plan education and career paths aligned to personal goals.
SCI.HS.PS2.A	Forces and Motion
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	Motion and Stability: Forces and Interactions
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.TL.2	Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
	Newton's second law accurately predicts changes in the motion of macroscopic objects.
	Analyze data using tools, technologies, and/or models (e.g., computational, mathematical)

in order to make valid and reliable scientific claims or determine an optimal design solution.

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Text Types and Purposes

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object sliding down a ramp, or a moving object being pulled by a constant force.

Research to Build and Present Knowledge

Analyzing and Interpreting Data

Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.

Integration of Knowledge and Ideas

Range of Writing

Craft and Structure

Key Ideas and Details

Essential Questions/Enduring Understandings

Essential Questions

What causes objects to move the way they do?

How do assumptions affect the predictions we make about the outcomes of testing experiments?

How does physics affect decisions related to car safety, laws, and manufacturing?

Enduring Understandings

Forces cause changes in motion.

Learning Plan

Students will start with a motivating question, such as the physics behind car safety features like seat belts and air bags.

Then, students will perform observational experiments such as holding objects of different mass, pushing rolling objects with different starting velocities with a meter stick, and hanging things from spring scales in different ways. This will allow students to develop force diagrams as representations and relate the direction of

the sum of the forces to the direction of the change in velocity vector.

This will lead to a mathematical statement of Newton's 2nd Law which can be tested using the PhET simulation Forces and Motion: Basics or a hands-on laboratory activity.

Students will explore the role of air and whether or not air exerts forces , this will be tested using a video experiment of an air-filled soda bottle in a bell jar.

Students will construct the idea of Newton's 1st law by investigating reference frames using videos.

Students will use experimental evidence to determine the force Earth exerts on objects, which can be used going forward for problem solving.

Newton's 3rd Law will be constructed using experimental evidence, and if time and equipment allows, Newton's 3rd Law will be tested by students using equipment.

Using a Lenz's Law apparatus and predicting the reading on a digital scale. Frictional forces will be investigated in the Friction Formal Lab.

Throughout the unit, students will be working in small heterogeneous groups and putting their ideas and work on white boards to be shared with the class. The teacher will summarize ideas on the front board or in a slide show so that students can take accurate notes.

Assessment

Formative:

Students will present their work during class throughout the unit. Homework will be reviewed in class so that students can self-assess and teacher can decide if reteaching is necessary. Exit tickets

Summative:

Quizzes and Test on Newtons Lows of Motion, assessments include a formal lab testing Newton's 2nd Law, the Friction Formal Lab, and/or a car safety research paper explaining the relationship between a particular safety device and Newton's Laws.

Benchmark: This unit is included in the midterm exam.

Alternative: Student presentation on Newton's 2nd Law, the Friction Formal Lab, and/or a car safety

Materials

Computer with PowerPoint/Google Slides and internet access

Textbook Physics: Principles and Problems, Glencoe

Calculators, rulers, meter sticks, colored pencils, graph paper, Chromebooks for students, bowling ball,

styrofoam ball, human dynamics carts or rollerblades, Lenz's Law apparatus, spring scales, foam, platform scales, digital scales, friction blocks or friction surfaces, small mass objects, medicine ball if available, library access, whiteboards for collaborative work, dry erase markers and erasers for student groups.

Integrated Accommodation and Modifications

Integrated Accommodation and Modifications, Special Education students, English Language Learners, At-Risk students, Gifted and Talented students, Career Education, and those with 504s

https://docs.google.com/spreadsheets/d/18XhAi7Rm-E8LJwO4uMQS7ZEh0dh3NxYbTFH2IoHLH7Y/edit?usp=sharing