Unit 3: Dynamics

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. In depth treatments of frictional forces and projectiles are at the end of this unit after students have had time to work with Newton's Laws.

Revised: July 2026

1	Make sense of problems and persevere in solving them
L.SS.11–12.1.A	Apply the understanding that usage is a matter of convention, can change over time, and place, and is sometimes contested.
2	Reason abstractly and quantitatively
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
3	Construct viable arguments and critique the reasoning of others
4	Model with mathematics
L.KL.11–12.2.A	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level.
5	Use appropriate tools strategically
L.VL.11–12.3	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, including technical meanings, choosing flexibly from a range of strategies.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
6	Attend to precision
8.1.12.DA.5	Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
W.AW.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 claim(s), counterclaims, reasons, and evidence.
W.AW.11–12.1.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.
W.AW.11–12.1.E	Provide a concluding paragraph or section that supports the argument presented (e.g., articulating implications or the significance of the topic).
W.IW.11–12.2	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.
9.4.12.TL.2	Generate data using formula-based calculations in a spreadsheet and draw conclusions

	about the data.
W.WR.11–12.5	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.
W.RW.11–12.7	Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes.
SL.PE.11–12.1.B	Collaborate with peers to promote civil, democratic discussions and decision-making, set clear goals and assessments (e.g., student developed rubrics), and establish individual roles as needed.
SL.II.11–12.2	Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
HS-PS2	Motion and Stability: Forces and Interactions
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. 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. Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds. Analyzing and Interpreting Data 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. 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.
PS2.A	Forces and Motion Newton's second law accurately predicts changes in the motion of macroscopic objects. Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

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.

Frictional forces will be investigated in the Friction Formal Lab.

Projectile motion will be investigated primarily on a conceptual level with options to add in mathematical problem solving for horizontally launched projectiles depending on the needs and skills of the students. Conceptual understanding of projectiles will be built using a simulation, such as PhET Projectile Motion.

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 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, 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