Unit 2: Kinematics

Content Area: **Science**
Course(s):
Time Period: **Marking Period 1**
Length: **3 Weeks**
Status: **Published**

Summary

Students will learn how to describe one dimensional motion using motion diagrams, graphs, words, and equations. This unit progresses to uniformly accelerated motion using the tools developed in the previous unit. The motion of freely falling objects is closely analyzed and related to uniformly accelerated motion.

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
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
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.
4	Model with mathematics
5	Use appropriate tools strategically
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
L.VL.11–12.3.D	Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, its etymology, or its standard usage.
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).

SL.PE.11–12.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
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.
	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.
	Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.
	Patterns
	Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
	Engaging in Argument from Evidence
	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
	Stability and Change
	Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.
	Using Mathematics and Computational Thinking
	Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Essential Questions/Enduring Understandings

Essential Questions

What do effective problem solvers do when they get stuck?

How do multiple descriptions of motion allow us to communicate with others effectively?

What are the limitations of our mathematical models of motion?

Enduring Understandings

Motion can be represented and described in multiple ways.

Objectives

Students will be able to use the particle model to represent an object and determine in which situations the particle model is useful.
Students will be able to draw and interpret motion diagrams.
Students will be able to create and interpret graphs of motion.
Students will be able to calculate displacement, time, velocity, and acceleration using kinematic equations.
Students will be able to describe the motion of objects in free fall using motion diagrams, graphs, and words.
Students will be able to solve problems involving objects in free fall and distinguish between a vector and a scalar, and give examples of each.
Students will be able to add vectors using graphical methods.
Students will be able to predict the motion of a projectile by analyzing its vertical and horizontal motion.

Learning Plan

Students will build on the multiple representations of motion they developed in the first part of the unit to represent and define uniform acceleration.

Students will use laboratory techniques to analyze free-fall motion and decide whether or not it constitutes uniformly accelerated motion.

Computer based activities include use of the Moving Man simulation at PhET (online).

Kinematics equations will be derived in an algebra-based or graphical way, and students will use them as tools to answer complex, multi-step problems that require the skills of all group members.

Students will utilize math skills throughout this unit.

Assessment

Formative Assessment: Students will present work on white boards throughout the unit and will critique the problem solutions of others. Students will complete independent homework assignments that will be reviewed in class and allow for self-assessment of progress.

Summative Assessment: Students will complete an end of chapter test.

Benchmark Assessment: midterm exam

Alternate Assessment: Project or Presentation on Motion

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, ramps, marbles or toy cars (i.e. Hot Wheels), whiteboards for collaborative work, dry erase markers and erasers for student groups, cardboard vectors.

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