Unit 2: Motion and Kinematics

Content Area:	**Science**
Course(s):	
Time Period:	**Marking Period 1**
Length:	**5 Weeks**
Status:	**Published**

Summary

Students will learn how to describe one dimensional motion using motion diagrams, graphs, words, and equations. This unit starts with constant velocity motion and then progresses to uniformly accelerated motion. The motion of freely falling objects is closely analyzed and related to uniformly accelerated motion. Students will then explore and learn about the motion of projectiles. The vector will be introduced as a mathematical tool that can be used in the analysis of two-dimensional motion.

Revised: July 2021

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.
WRK.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.
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.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
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).
	Patterns
	Engaging in Argument from Evidence
	Using Mathematics and Computational Thinking
	Stability and Change
	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.
	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.

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.

Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

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.

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.

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 distinguish between displacement and distance.
Students will be able to distinguish between velocity and speed.
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

Constant Velocity Motion:

Students will work in small groups throughout the unit to construct multiple representations of motion, including written descriptions, graphs, motion diagrams, and mathematical models (equations).

Hands-on activities include working with battery-powered cars and bean bags to measure how far a car travels each second, acting out descriptions of motion with a group, using manipulatives to add and subtract vectors, and predicting where two cars will meet based on a mathematical model of their motion (Where Will the Cars Meet? Formal Lab).

Computer based activities include use of Universe and More Motion Mapper (online) and the Moving Man simulation at PhET (online).

Uniformly Accelerated Motion:

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 Universe and More Motion Mapper (online) and 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 a formal lab report (ex Toy Car Lab or Where Will the Cars Meet?). Students will complete Motion quiz Kinematics Quiz and 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, battery powered constant velocity cars, batteries, bean bags or sugar packets, 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