Unit 1: Matter, Motion, Forces

Content Area: **Science**
Course(s):
Time Period: **Trimester 1**
Length: **9-10 weeks**
Status: **Published**

Matter, Motion, And Forces Summary

In this unit, students will work to explore the world around them, focusing on matter and force, and motion, while utilizing the scientific method, problem-solving, and engineering practices. Students will explore Newton's Laws of Motion as well as the properties of matter. Students will also be able to construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. Students will explore laboratory fundamentals, with a specific focus on lab safety, while highlighting physics concepts through a paper airplane lab, sticky shoes lab, and others. Students will gain experience in communicating results, scientific writing, and data representation and analysis through a unit project. The crosscutting concepts of scale, proportion, and quantity, and structure and function provide a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in planning and carrying out investigations, analyzing and interpreting data, and developing and using models. Students are also expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas. Also, students will demonstrate that cause and effect relationships may be used to predict phenomena in natural or designed systems. Students will demonstrate understanding by using science and engineering practices to construct explanations, engage in argument from evidence, and design models that reflect the interplay between forces and matter. This unit prepares students to think critically and scientifically about the world around them and apply their learning to solve problems in novel contexts. Through hands-on explorations and collaborative problem-solving, students will deepen their understanding of key physical science concepts. Students will also build foundational laboratory techniques and safety awareness.

Revision Date: July 2025

Essential Questions/Enduring Understandings

Essential Questions

How do scientists use data and evidence to communicate their findings and influence our understanding of the world?

What fundamental principles and tools do we use to describe and measure motion?

How do forces shape the motion of objects, and how can we predict those changes?

How does gravity shape the structure and movement of the universe?

How do the fundamental properties of matter dictate the function and purpose of materials in different systems?

Enduring Understanding

How to carry out proper lab safety techniques, create a testable hypothesis, and utilize the scientific method.

Anything that is not energy is matter.

All Newton's Laws of Motion and the basic qualities of each.

Forces can cause changes in the motion of objects, and these changes can be predicted using Newton’s Laws of Motion.

The structure and properties of matter influence how materials behave, which affects their usefulness in physical systems or design challenges.

Objectives

Students will know SI measurements, including units and symbols for length, volume, mass, density, time, and temperature.

Students will know how to use Newton’s Second Law of Motion to mathematically relate force, mass, and acceleration.
Students will know how the motion of certain objects is due to action-reaction forces according to Newton’s Third Law of Motion.
Students will know the Law of Conservation of Momentum when calculating the momentum of an object.

Students will know the properties of matter and how these properties affect material behavior.

Students will be skilled at converting between metric units.
Students will be skilled at communicating their data using graphs.
Students will be skilled at classifying matter based on its characteristics.
Students will be skilled at considering the effects of forces on objects, including motion, speed, velocity, and acceleration.
Students will be skilled at explaining the change in motion of an object using Newton’s First Law of Motion.
Students will be skilled at comparing and contrasting weight and mass.
Students will be skilled at understanding that gravity, friction, and air resistance are net forces that can overcome the effects of inertia and cause a change in the motion of an object.

Students will be skilled at analyzing and interpreting data from experiments to identify patterns and relationships.

Students will be skilled at constructing scientific explanations and engaging in argument from evidence to support claims about gravitational interactions and force effects.

Students will be skilled at communicating findings through scientific writing, oral presentations, and visual displays.

Students will be skilled at making predictions based on patterns and identifying cause-and-effect relationships in experimental results.

Learning Plan

1. **Discuss and practice science lab safety procedures**
   Students will learn and demonstrate proper lab safety practices, including how to use goggles, handle chemicals responsibly, respond to accidents, and follow classroom safety rules to ensure a safe learning environment.

2. **Review the Scientific Method**
   Students will revisit the steps of the scientific method, using past experiments or real-world scenarios to model how scientists ask questions, form hypotheses, test ideas, analyze data, and draw conclusions.

3. **Introduce Unit Conversions in the Metric System and Practice Metric-to-Metric Conversions**
   Students will learn the metric system units (meter, liter, gram) and practice converting between units using conversion charts and dimensional analysis strategies to support accurate measurements in future labs.

4. **Metric Measurement Labs**
   Students will apply metric system knowledge in hands-on stations to measure length, mass, volume, and temperature using tools like rulers, triple beam balances, and graduated cylinders. This reinforces accuracy and consistency in scientific data collection.

5. **Students Design and Develop a Class Lab with a "Testable Hypothesis"**
   Working collaboratively, students will brainstorm and propose a lab investigation, identifying a testable question, independent and dependent variables, and methods to ensure fair testing. Emphasis is on student ownership and critical thinking.

6. **Develop Well-Written Lab Report**
   Students will follow a structured format to communicate their experimental design, data, analysis, and conclusions. Focus is on clear organization, use of scientific vocabulary, and supporting claims with evidence.

7. **Define and Discuss the Three Phases of Matter and the Physical and Chemical Properties Associated with Each**
   Through demonstrations and discussion, students will identify and describe solids, liquids, and gases, and distinguish between physical and chemical properties such as density, solubility, and reactivity.

8. **Define and Discuss Speed and Velocity**
   Students will explore the differences between speed and velocity conceptually and mathematically, using real-world examples (e.g., running, driving) to apply directional motion and rate calculations.

9. **Complete Measuring Motion Gizmo**
   1. Students will complete gizmo calculating and comparing animals and their motion.

10. **Calculate Basic Speed = Distance ÷ Time Word Problems and Graph Various Speed/Time Relationships**
    Students will solve motion problems using the speed formula and create distance-time and speed-time graphs to interpret and compare different types of motion.

11. **Paper Airplane Lab**
    Students will design and test paper airplanes, collect data on flight distance and time, and analyze how variables such as mass and force influence speed and flight. This hands-on lab reinforces experimental design, measurement, and motion concepts.

12. **Define and Discuss Balanced and Unbalanced Forces and the Motion of an Object When Acted Upon by External Forces**
    Through examples, models, and short demos, students will learn how net force affects the motion of objects and how to identify when forces are balanced or unbalanced in everyday scenarios.

13. **Calculate the Relationship Between Forces, Mass, and Acceleration**
    Students will apply Newton's Second Law (F = ma) to solve problems involving changes in force, mass, or acceleration, reinforcing mathematical reasoning and modeling.

14. **Complete Interactivity: Weight on the Moon from the online textbook**
    1. Students will complete this online simulation, which will provide a visual explanation of the difference between weight and mass.

15. **Newton's Laws of Motion**
    Students will explore all three of Newton's Laws through interactive demonstrations and real-life examples. Focus will be placed on identifying which law applies in various physical systems.

16. **"Egg-stra" Safe Car Design Lab**
    In this engineering design challenge, students will create model vehicles that protect a raw egg in a simulated crash. Students apply Newton's laws, material science, and force absorption principles to design, test, and revise their vehicles.

17. **Inertia Stations Lab**
    Students rotate through multiple stations that demonstrate the effects of inertia (Newton's First Law). Each station helps visualize how objects resist changes in motion.

18. **Friction Lab**
    Students will investigate how different surfaces affect the motion of objects, measuring how frictional force resists motion and discussing how friction relates to engineering and daily life (e.g., shoes, tires).

19. **Discuss the Law of Conservation of Momentum and Lab**
    Students will learn how momentum is conserved in closed systems (e.g., collisions) and observe momentum transfer through lab demonstrations involving carts, balls, or collision simulations.

Advanced

1. **Define and Discuss Free Fall, Air Resistance, Terminal Velocity, and Gravity**
   Students will conceptually and mathematically explore how gravity affects falling objects, and how air resistance can alter acceleration. Real-world examples like parachutes and skydiving will be used for context.
2. **Calculate the Acceleration of Different Objects During Free Fall**
   Using the acceleration due to gravity (9.8 m/s^2), students will calculate how long objects fall, how fast they travel, and compare theoretical data with lab or simulation results.
3. **Calculate the Effects of Air Resistance on Free Fall by Completing Word Problems**
   Students will solve contextual word problems that explore how air resistance affects falling speed, comparing objects of different shapes and masses to understand the influence of drag and surface area.

Lab Safety will be reviewed before beginning all Lab Activities

Assessment

Science courses are designed to promote skill attainment. Student progression and pace through which they proceed through the performance tasks are based on their affinity for and ability to reach skill attainment. The teacher will determine formative and summative skill attainment; alternative assessments will be incorporated for each student based on their strengths and challenges.

Formative Assessments:

Worksheets

Exit Tickets

Class Discussion

Quizzes

Labs

Check for Understandings

Gizmos

Practice Problems:

Calculating Density

Calculating Velocity

Calculating Acceleration

Calculating Momentum

Calculating Efficiency

Calculating Force

Newton's 3rd Law

States of Matter

Gizmos and Phet simulations

Summative Assessments:

Quizzes

Calculating Density

Calculating Velocity

Calculating Acceleration

Calculating Momentum

Calculating Efficiency

Calculating Force

Newton's 3rd Law

States of Matter

Unit Test

Matter, Motion, Forces

Bench Marks:

Formal Lab Reports/Lab Write-ups

Some Suggested Options

Density Cubed

Inclined to Roll

Can You Power

The Water Games

Laboratory Techniques

Alternative:

Long-Term Projects

Some Suggested Options:

Amusement Park Physics

Saving Eggbert

Crash Test Cars

Laboratory Practical

Materials

General lab equipment

General lab kits

General classroom supplies

Safety Equipment

- goggles, gloves, lab aprons, sinks, fire extinguisher, fire blanket, eye wash station, safety shower, fume hood, first aid kit, safety contract for students, tongs, hot plate

Textbook: Elevate Science Physical Savvas Realize

Computer(s)

Smartboard

Internet Access

Powerpoints / Google Slides

Relevant worksheets/notes

Relevant videos

Relevant virtual activities

Relevant interactive programs

Various size and weighted balls

Feathers

Eggs

Stop watch

Coins

Cups
String
Rubber bands

Shoes

Standards

SCI.MS-PS1	Matter and its Interactions
SCI.MS-PS1-1	Develop models to describe the atomic composition of simple molecules and extended structures.
	Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
MATH.8.EE.A	Work with radicals and integer exponents
ELA.L.KL.8.2.A	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases.
SCI.MS-PS1-2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
MATH.8.EE.B	Understand the connections between proportional relationships, lines, and linear equations
SCI.MS.PS1.A	Structure and Properties of Matter
	Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
SCI.MS.PS1.B	Chemical Reactions
SCI.MS-PS1-3	Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
	Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
ELA.RI.CR.8.1	Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.
SCI.MS.PS1.A	Structure and Properties of Matter
	Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.
MATH.8.F.A	Define, evaluate and compare functions
SCI.MS-PS1-4	Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

MATH.8.F.B	Use functions to model relationships between quantities
ELA.W.AW.8.1	Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence.
SCI.MS.PS1.A	Structure and Properties of Matter
ELA.W.AW.8.1.A	Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
ELA.W.AW.8.1.B	Support claim(s) with logical reasoning and relevant evidence, using relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
ELA.W.IW.8.2	Write informative/explanatory texts (including the narration of historical events, scientific procedures/experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
ELA.W.IW.8.2.B	Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
SCI.MS-PS1-5	Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
ELA.W.IW.8.2.D	Use precise language and domain/grade-level-specific vocabulary to inform about or explain the topic.
ELA.W.IW.8.2.F	Provide a concluding statement or section (e.g., sentence, part of a paragraph, paragraph, or multiple paragraphs) that synthesizes the information or explanation presented.
MATH.8.G.B	Understand and apply the Pythagorean Theorem
ELA.SL.PE.8.1.A	Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
ELA.SL.PE.8.1.B	Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed.
ELA.SL.PI.8.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
SCI.MS-PS2	Motion and Stability: Forces and Interactions
SCI.MS-PS2-1	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
SCI.MS.PS2.A	Forces and Motion
SCI.MS-PS2-2	Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
SCI.MS-PS2-3	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
SCI.MS-PS2-4	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
SCI.MS-PS3	Energy
SCI.MS-PS3-2	Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
SCI.MS-PS3-4	Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

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.
	Sources of information are evaluated for accuracy and relevance when considering the use of information.
	Resources need to be utilized wisely to have positive effects on the environment and society. Some technological decisions involve trade-offs between environmental and economic needs, while others have positive effects for both the economy and environment.
	Technological disparities have consequences for public health and prosperity.
	Data is represented in many formats. Software tools translate the low-level representation of bits into a form understandable by individuals. Data is organized and accessible based on the application used to store it.
	An essential aspect of problem solving is being able to self-reflect on why possible solutions for solving problems were or were not successful.
	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
	Awareness of and appreciation for cultural differences is critical to avoid barriers to productive and positive interaction.
	Increases in the quantity of information available through electronic means have heightened the need to check sources for possible distortion, exaggeration, or misrepresentation.
	Multiple solutions often exist to solve a problem.
	Computer models can be used to simulate events, examine theories and inferences, or make predictions.