Unit 4: Pressure, Energy, and Magnetism

Content Area: **Science**
Course(s):
Time Period: **Trimester 3**
Length: **9-10 Weeks**
Status: **Published**

Pressure, Energy, and Magnetism Summary

In this unit, students will investigate the relationships between pressure, energy, and magnetism through hands-on exploration and application of the scientific method. Students will explore topics such as hydraulics, energy transformations, and Earth's magnetosphere. Key concepts include the Gas Laws, the interplay between kinetic and potential energy, and the behavior of particles that give rise to magnetic forces and poles. Students will also build foundational laboratory techniques and safety awareness. Throughout the unit, students will engage in lab-based investigations to build foundational scientific skills, including data collection, analysis, and interpretation. They will also develop proficiency in scientific communication through written reports and a culminating project that demonstrates their understanding of the core physical science principles. Critical thinking and problem-solving will be emphasized as students apply their learning to real-world phenomena and engineering challenges.

Revision Date: July 2025

Essential Questions/Enduring Understandings

Essential Questions

What are the fundamental principles of energy transfer, and how does this process drive changes in the world around us?

How do the principles of magnetism enable the generation of electricity and the development of new energy technologies?

In what ways is pressure a fundamental force that governs the behavior of diverse systems, from weather patterns to biological functions?

How can the study of particle behavior at the microscopic level unlock our understanding of macroscopic phenomena, such as changes in pressure, temperature, and the states of matter?

Enduring Understanding

An object's density is a fundamental property that dictates its buoyancy and explains its behavior in different fluids, allowing us to predict whether it will sink or float.

The principle of conservation states that in a closed system, quantities like mass and energy are neither created nor destroyed, but simply transferred or transformed.

The invisible force of magnetism is a fundamental principle that is harnessed in countless technologies and devices that shape our modern world, from simple compasses to electrical generators.

Energy is constantly transferred through various mechanisms—conduction, convection, radiation, and mechanical work—and this continuous process is the driving force behind all natural and engineered systems.

Pressure is a measurable, macroscopic phenomenon that arises directly from the motion and collisions of microscopic particles, influencing the state, volume, and movement of matter.

Living organisms have evolved sophisticated biological systems that utilize fundamental principles of physics, such as pressure, buoyancy, and fluid dynamics, to navigate, communicate, and interact with their environments.

Objectives

Students will be skilled at explaining how fluids exert pressure.

Students will be skilled at demonstrating how hydraulic systems multiply force.

Students will be skilled at determining the density of a regular and irregularly shaped solid. Students will be skilled at incorporating mass, air resistance, and terminal velocity as factors that determine the rate of falling objects.

Students will be skilled at using the Law of Conservation of Energy to explain how kinetic and potential energy combine to make mechanical energy
Students will be skilled at demonstrating the transfer of energy through motion by calculating work energy.

Students will be skilled at modeling how changes in particle motion affect pressure and temperature in gases.

Students will be skilled at identifying and describing real-world examples of energy conversion (e.g., electrical to thermal, kinetic to potential).

Students will be skilled at evaluating how energy is stored and released in different systems (e.g., springs, batteries, magnetic fields).

Students will be skilled at using diagrams and graphs to represent energy transformations and forces in physical systems.

Students will know how magnetic poles interact.

Students will know why density is a derived unit.

Students will know how energy is transferred through conduction, convection, and radiation.

Students will know how to distinguish between renewable and nonrenewable energy sources, including the role of magnetic energy in sustainable technologies.

Students will know that pressure is caused by the motion and collisions of particles in a fluid.

Students will know that conservation laws apply to both energy and matter in closed systems.

Students will know that magnetism and electricity are interrelated forces that can be manipulated to generate power.

Students will know that density is a ratio comparing mass to volume, which helps explain sinking, floating, and material properties.

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. **Discuss pressure, heat, and temperature. Predict their relationship to each other.**
   Students will be able to build a foundational understanding of how these physical concepts are defined and interrelated in physical systems.

3. **Students calculate their pressure (psi) on the ground as they walk by tracing their foot. Investigate changes in pressure as their shoe changes (i.e., high heel).**
   Students will be able to apply the concept of pressure to real-life scenarios to understand how surface area affects pressure.

4. **Deduce the relationship between heat and pressure and the relationship between volume and pressure through a series of labs.**
   Students will be able to explore gas laws (Boyle's and Charles') through hands-on investigation to reinforce understanding of heat, pressure, and volume relationships.

5. **Pressure Labs**
   Students will be able to provide experimental opportunities for students to observe and measure pressure changes in various conditions.

6. **Define Charles' and Boyle's Laws and the kinetic molecular theory.**
   Students will be able to introduce key scientific laws that describe gas behavior and the particle model that explains them.

7. **Discuss the changes in pressure as altitude or depth changes.**
   Students will be able to connect pressure concepts to real-world phenomena such as mountain climbing or scuba diving.

8. **Boyle's Law Demo**
   Students will be able to visually demonstrate the inverse relationship between pressure and volume in a gas to reinforce learning.

9. **Compare and contrast heat and temperature.**
   Students will be able to clarify a common misconception and emphasize the difference between energy transfer (heat) and average kinetic energy (temperature).

10. **Define and discuss convection, conduction, and radiation heat.**

Students will be able to explain the three mechanisms of heat transfer to deepen their understanding of thermal energy flow.

11. **Discuss how heat and radiation affect the environment.** Define and discuss global warming, the ozone layer, CFCs, carbon dioxide, and the greenhouse effect.
    Students will be able to connect physical science concepts to environmental issues and human impact on the climate.

12. **Discuss the causes and effects of global warming and suggestions to combat it.**
    Students will be able to encourage critical thinking and responsible citizenship through the analysis of climate change.

13. **Participate in a debate comparing various alternative emergency sources.** Students will be able to compare a country's energy usage and create a plan to use more environmentally friendly options.

14. **Create an informational tool to educate others about global warming.**
    Students will be able to promote communication skills and reinforce understanding by teaching others.

15. **Complete Interactivity: Hot Air Balloon Ride using online textbook**
    1. Students will explore the Gas Laws through manipulating variables on a hot air balloon ride.

16. **Define and discuss Bernoulli's principle.**
    Students will be able to introduce a key fluid dynamics concept used in real-world applications like flight and ventilation systems.

17. **Paper Helicopter Lab**
    Students will be able to demonstrate Bernoulli's principle and air resistance in an engaging, hands-on activity.

Advanced

1. **Discuss specific heat and how a calorimeter works**
   Students will be able to teach how substances absorb heat at different rates and how calorimetry measures heat transfer.
2. **Conductor and Insulator Lab**
   Students will be able to investigate how different materials transfer heat, reinforcing the concept of thermal conductivity.
3. **Free Fall Gizmo**
   1. Students will use the simulation to drop objects off the Leaning Tower of Pisa to calculate free fall.

Lab Safety will be reviewed before all Lab Activities

Assessment

Science courses are designed to promote skill attainment. Student progression and pace through which they proceed through the performance tasks is 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, labs, class discussion, q*uizzes, check for understanding, gizmos*

***Some Suggested Options**:*

Gas Laws, Pascal, Bernoulli's Principle, Archimedes' Principle of Buoyancy

Types of Energy

Energy Transformations

Kinetic vs. Potential Energy

Summative:

Quizzes

***Some Suggested Options**:*

Gas Laws, Pascal, Bernoulli's Principle, Archimedes' Principle of Buoyancy

Types of Energy

Energy Transformations

Kinetic vs. Potential Energy

Unit Tests

***Some Suggested Options**:*

Pressure

Energy

Magnetism

Bench Marks:

Formal Lab Reports/Lab Write-ups

Lab Work

***Some Suggested Options**:*

Sink or Spill

Bounce Lab

Helicopter Lab

Versorium Lab

Laboratory Techniques

Alternative:

Long-Term Projects

Roller coasters

Skate park design

U.N. Energy Convention - Energy Sources

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

Elevate Science Physical Savvas Realize

Computer(s)

Smartboard

Access to Internet

Powerpoints

Relevant worksheets/notes

Relevant videos

Relevant virtual activities

Relevant interactive programs

Paper helicopter template

Empty soda cans/bottles

Marshmallows

Plastic eggs

Balloons

Magnets

Standards

P.1	Act as a responsible and contributing community members and employee.
P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
	Multiple solutions often exist to solve a problem.
P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
	An essential aspect of problem solving is being able to self-reflect on why possible solutions for solving problems were or were not successful.
	Advancements in computing technology can change individuals' behaviors. Society is faced with trade-offs due to the increasing globalization and automation that computing brings.
8.EE.B	Understand the connections between proportional relationships, lines, and linear equations
	People use digital devices and tools to automate the collection, use, and transformation of data. The manner in which data is collected and transformed is influenced by the type of digital device(s) available and the intended use of the data.
8.EE.C	Analyze and solve linear equations and pairs of simultaneous linear equations
	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.
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.
	Awareness of and appreciation for cultural differences is critical to avoid barriers to productive and positive interaction.
	Computer models can be used to simulate events, examine theories and inferences, or make predictions.

	Increases in the quantity of information available through electronic means have heightened the need to check sources for possible distortion, exaggeration, or misrepresentation.
8.F.A	Define, evaluate and compare functions
	Digital tools make it possible to analyze and interpret data, including text, images, and sound. These tools allow for broad concepts and data to be more effectively communicated.
8.F.B	Use functions to model relationships between quantities
	Sources of information are evaluated for accuracy and relevance when considering the use of information.
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.
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.
W.AW.8.1.E	Provide a concluding statement or section that follows from and supports the argument presented.
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.
	There is a need to produce and publish media that has information supported with quality evidence and is intended for authentic audiences.
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.
	Economic, political, social and cultural aspects of society drive development of new technological products, processes, and systems.
	Technology interacts with society, sometimes bringing about changes in a society's economy, politics, and culture, and often leading to the creation of new needs and wants. New needs and wants may create strains on local economies and workforces. Improvements in technology are intended to make the completion of tasks easier, safer, and/or more efficient.
	Technology advances through the processes of innovation and invention which relies upon the imaginative and inventive nature of people. Sometimes a technology developed for one purpose is adapted to serve other purposes. Engineers use a systematic process of creating or modifying technologies that is fueled and constrained by physical laws, cultural norms, and economic resources. Scientists use systematic investigation to understand the natural world.
	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.
MS-PS3-1	Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
	Analyzing and Interpreting Data
PS3.A	Definitions of Energy
	Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
	Proportional relationships (e.g., speed as the ratio of distance traveled to time taken)

	among different types of quantities provide information about the magnitude of properties and processes.
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.
	Developing and Using Models
	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.
	Develop a model to describe unobservable mechanisms.
PS3.A	Definitions of Energy
	A system of objects may also contain stored (potential) energy, depending on their relative positions.
PS3.C	Relationship Between Energy and Forces
	When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.
	Models can be used to represent systems and their interactions–such as inputs, processes, and outputs–and energy and matter flows within systems.
MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
	Constructing Explanations and Designing Solutions
	Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
	Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.
	Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
	Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
	The transfer of energy can be tracked as energy flows through a designed or natural system.
	Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.
	Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
	Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
	The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.
	Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to

constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds.

Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon.

When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

Energy may take different forms (e.g., energy in fields, thermal energy, energy of motion).

Suggested Strategies for Modifications

This link includes content specific accommodations and modifications for the populations listed below the link.

https://docs.google.com/spreadsheets/d/1-5KhjcdFRswaPUN1joj7W_KCoowH0TRTHF6kBkW_P_o/copy