



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY GLOBAL SKILLS

**Springfield Public Schools
Springfield, New Jersey 07081**

**Conceptual Physics
Grade 11**

Curriculum Guide

2026

This curriculum may be modified through varying materials, techniques, and strategies as per an individual student's IEP.

*Springfield Board of Education
Approved on July 27, 2026*

Springfield Public Schools

Cultivating compassionate and extraordinary learners!

EXTRACT OF THE MINUTES OF A MEETING OF
THE BOARD OF EDUCATION OF
THE TOWNSHIP OF SPRINGFIELD
COUNTY OF UNION, NEW JERSEY
AS RECORDED IN THE OFFICIAL MINUTE BOOK

Resolution: 21

Introduced By: Mrs. Gamarekian

Seconded By: Vice President Rinaldi

Adopted: July 27, 2026

Curriculum Adoption

To approve the following new and revised curriculum and courses for the 2026-2027 school year:

1. High School Courses

- a. AP Cybersecurity (new course)
- b. AP Business with Personal Finance (new course)
- c. AP Biology
- d. AP Chemistry
- e. AP Physics 1
- f. PLTW Robotics and Automation
- g. PLTW Introduction to Engineering Design
- h. PLTW Principles of Engineering
- i. Biology
- j. Biology Honors
- k. Chemistry
- l. Chemistry Honors
- m. Conceptual Physics
- n. Physics
- o. Environmental Science
- p. Forensics
- q. Human Anatomy and Physiology
- r. Oceanography
- s. Science 8
- t. Molecular Biology Research Lab (new course)

2. Middle School Courses

- a. Science 6
- b. Science 7

3. Elementary School Courses

- a. Kindergarten Science
- b. Grade 1 Science
- c. Grade 2 Science

Michelle Calas, School Business Administrator/Board Secretary

(continued)

I, Michelle Calas, School Business Administrator/ Board Secretary of the Springfield Board of Education, hereby certify that the extract from the minutes of a meeting of the Board of Education duly called and held on July 27, 2026 has been compared by me with the original minute book of said Board of Education, and is a true, complete and exact copy thereof, as far as the same relates to the subject matter to on said extract.

In WITNESS THEREOF, I have hereunto set my hand and seal of the Springfield Board of Education, this 28th day of July 2026.

SEAL



Michelle Calas

School Business Administrator/ Board Secretary



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**Springfield Public Schools
Springfield, New Jersey**

**Rachel Goldberg
Superintendent of Schools**

Curriculum Developed By:

Erica Scudero ~ Assistant Superintendent of Curriculum and Instruction

Dr. Norman Francis ~ Principal of Jonathan Dayton High School

Greg Salmon ~ Supervisor of Mathematics and Science

**Unit Overview Template****Content Area:** Science **Grade Level:** 11 **Unit Title:** Forces and Interactions

Unit Summary: In this unit of study, students are expected to plan and conduct investigations, analyze data and use math to support claims, and apply scientific ideas to solve design problems in order to develop an understanding of ideas related to why some objects keep moving and some objects fall to the ground. Students will also build an understanding of forces and Newton's second law. Finally, they will develop an understanding that the total momentum of a system of objects is conserved when there is no net force on the system. Students are also able to apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

Primary Interdisciplinary Connections: Mathematics

21st Century Themes ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ ICT Literacy

☐ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy

Unit Rationale: Students are expected to demonstrate proficiency in planning and conducting investigations, analyzing data and using math to support claims, and applying scientific ideas to solve design problems and to use these practices to demonstrate understanding of the core ideas.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities.
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.



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Learning Targets

Standards: HS-PS2

Content Statements: Motion and Stability: Forces and Interactions

CPI#:	Cumulative Progress Indicator (CPI):
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.
HS-PS2-2	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
HS-PS2-3	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
HS-PS2-4	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
HS-PS2-5	Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
Math.A-CED.A	Create equations that describe numbers or relationships.
Math.A-SSE.B	Write expressions in equivalent forms to solve problems.
8.2.12.ETW.1	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.
8.2.12.ETW.3	Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.
8.2.12.EC.3	Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.

Science and Engineering Practices:

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS2-5)

Analyzing and Interpreting Data



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Analyzing data in 9–12 builds on K–8 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. (HS-PS2-1)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 builds on K–8 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.

- Use mathematical representations of phenomena to describe explanations. (HS-PS2-2), (HS-PS2-4)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3)

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.

- Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)

Disciplinary Core Ideas (DCIs):

PS1.A: Structure and Properties of Matter

- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (secondary to HS-PS2-6)

PS2.A: Forces and Motion

- Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)
- Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2)
- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2), (HS-PS2-3)



PS2.B: Types of Interactions

- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4), (HS-PS2-5)
- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6), (secondary to HS-PS1-1), (secondary to HS-PS1-3)

ETS1.A: Defining and Delimiting Engineering Problems

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS2-3)

ETS1.C: Optimizing the Design Solution

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (secondary to HS-PS2-3)

Crosscutting Concepts:

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1), (HS-PS2-5)
- Systems can be designed to cause a desired effect. (HS-PS2-3)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2)

Structure and Function

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-PS2-6)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Theories and laws provide explanations in science. (HS-PS2-1), (HS-PS2-4)
- Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1), (HS-PS2-4)



Unit Essential Questions:

- What are the major forces acting on our planet and the fundamental forces of physics?
- Who developed the laws of physics, what are they, and how do they affect motion?
- What are the major attraction and repulsion forces, and how are they modeled and calculated?
- How are forces and interactions involved in the real world?
- How does the weight (force of gravity) of an astronaut of a specific mass change at specific distances from Earth as the shuttle flies toward the moon?
- How can one explain and predict interactions between objects and within systems of objects?
- Why are people on Earth stuck here while astronauts appear to be weightless?

Unit Enduring Understandings:

- Newton's Law of Universal Gravitation provides the mathematical models to describe and predict the effects of gravitational forces between distant objects.
- Forces at a distance are explained by fields (gravitational) permeating space that can transfer energy through space.
- 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 the gravitational force between objects.
- Make predictions about the sign and relative quantity of net charge of objects or systems after various charging processes
- Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.
- Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object or a ball, respectively).
- The Big Bang theory is supported by observations of distant galaxies receding from our own, by the measured composition of stars and non-stellar gases, and by the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.
- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from or collisions with other objects in the solar system.

Unit Learning Targets:

Students will...

- Identify, calculate, and model the major forces.
- Identify and model Newton's Laws of Motion as well as Kepler's Laws of Orbit.
- Differentiate between mass and weight.
- Describe universal gravitation and its effects in our solar system and on Earth.
- Analyze motion in all directions and demonstrate the forces involved using free body diagrams.
- Produce their own motion and analyze the forces involved.



Evidence of Learning

Summative Assessment: Information covered in this unit will be tested on the midterm and final examination and as individual chapter tests in addition to the formative assessments listed below.

Equipment Needed: Calculators, notebooks/folders/binders, computers with Internet access.

Teacher Resources:

- Teacher: Textbook, test banks, formative assessment, and analysis software (Socrative.com, Kahoot.com and Excel)
- Class: Lab equipment - Vernier GoDirect wireless photogates, motion detectors, force sensors and accompanying Graphical Analysis Software. Mass balances, Newton Scales, meter sticks, stopwatches, motion tracks, and collision carts.

Formative Assessments:

- Hallway Investigation Persuasive Lab Report
- Newton's Laws of Motion and Everyday life project
- Hot Wheel speed, distance, acceleration lab
- Kinematics Assessments
- Dynamics Lab
- Dynamics Assessments
- Marble Projectile Lab
- Force scale investigation lab – What is weight vs. mass?
- Solar System Weight Activity
- Frictional force Lab
- Photobooth Physics
- Free-Body-Diagrams Assessment
- Newton's Laws Assessment
- Egg Drop Design Lab
- Forces Assessment



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Lesson Plans

Lesson	Time Frame
Lesson 1 Hallway Physics	2 days
Lesson 2 Free Fall (Weight vs. Mass)	2 days
Lesson 3 Newton's laws of motion	2 days

Teacher Notes: The three lessons above represent three investigations that are at the core of the forces and interactions unit.

1. Students will investigate speed/distance/time and how they relate to their own movement throughout the school building, and the school hallway time policy.
2. Students will analyze how objects fall in a gravitational field as well as the difference between mass and weight.
3. Students will have Newton's laws of motion demonstrated to them in class, and then will model the laws themselves. Students will create presentations and projects that model and apply the laws of motion to activities or hobbies in the students' daily life.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

- Informational aids, interactive digital labs, and additional resources for students: Physicsclassroom.com Hyperphysics.phy-astr.gsu.edu, <http://Phet.colorado.edu>
- Physics/Science YouTube Channels: Mark Rober, Veritasium, Vsauce, Walter Lewin, NASA, NASA JPL

Applications:

- Stellarium (Virtual Sky Map)
- Vernier Graphical Analysis Software
- Photobooth/Motion camera (for capturing motion students themselves produce)
- Google Sheets, Google Docs, Google Slides



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Lesson Plan 1 Template

Content Area: Science

Lesson Title: Hallway Physics

Time Frame: 2 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

iPads for timing trials, collecting motion data, recording observations, and collaborating on shared documents

Google Sheets for organizing data, calculating average speeds, and creating graphs

Step-counting and fitness applications to compare different methods of measuring distance and movement

Video analysis tools to review motion and improve measurement accuracy

Equipment Needed:

Meter sticks or measuring tapes

Stopwatches

Masking tape or floor markers

Clipboards

Calculators

Hallway maps or school floor plans

Student iPads

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Measure and compare walking speeds under different conditions • Collect and analyze motion data from real-world situations • Investigate factors that influence travel time in a school environment	Lesson Sequence Anchoring phenomenon 1. Students are presented with a common student complaint: "There isn't enough time to get from one class to another." 2. Students discuss whether this claim is based on evidence or opinion and	• Distance and speed data collection sheets • Travel time predictions • Data tables and graphs • Analysis of factors affecting motion • Evidence-based hallway policy recommendation • Group presentation and peer feedback



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| <ul style="list-style-type: none"> • Develop and use models to predict travel times using distance and speed • Evaluate the effectiveness of the school's hallway time policy using evidence • Communicate evidence-based recommendations supported by data analysis • Collaborate to solve a practical problem affecting students and staff | <p>identify what information would be needed to answer the question scientifically.</p> <ol style="list-style-type: none"> 3. Student teams identify several common routes throughout the school. 4. Groups measure distances using measuring tools, floor plans, pacing techniques, and digital tools. 5. Students predict how long it should take to travel each route. 6. Students conduct multiple walking trials under different conditions: <ul style="list-style-type: none"> ○ Normal walking pace ○ Fast walking pace ○ Carrying materials ○ Simulated crowded hallway conditions 7. Students collect time and distance data and calculate average speeds. 8. Students organize data using Google Sheets and create graphs comparing predicted and actual travel times. 9. Groups identify patterns and sources of variation in their data. 10. Students discuss factors such as hallway congestion, traffic flow, locker stops, stairways, and accessibility needs. 11. Student teams are given different school schedules and classroom assignments. | <ul style="list-style-type: none"> • Exit ticket explaining how distance, speed, and environmental factors influence travel time |
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| | <ol style="list-style-type: none">12. Using their collected data, groups determine whether students could realistically travel between classes within the allotted passing time.13. Teams develop recommendations for improving hallway efficiency.14. Recommendations may include schedule adjustments, traffic-flow changes, staggered passing times, or physical changes to school spaces.15. Students evaluate the costs, benefits, and potential impacts of each proposal.16. Groups present findings to classmates in the form of a brief policy recommendation supported by evidence. | |
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Differentiation:

- Students may access information through visual demonstrations, written instructions, digital resources, and peer collaboration.
- Students may demonstrate understanding through written reports, presentations, graphs, models, or verbal explanations.
- Structured data tables, guided calculations, and sample analyses may be provided for students requiring additional support.
- Extension opportunities include statistical analysis of class data, redesigning school traffic patterns, or comparing results to transportation systems in communities.

Resources Provided:

- School floor plans
- Distance-speed-time reference sheet
- Data collection templates
- Google Sheets graphing template
- Sample policy recommendation framework
- Relevant class notes and instructional resources



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Lesson Plan 2 Template

Content Area: Science

Lesson Title: Weight vs. Mass

Time Frame: 2 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
- ☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
- ☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

iPads for slow-motion video capture and motion analysis
Google Sheets for organizing data, calculating averages, and graphing results
Video analysis applications to examine free-fall motion frame-by-frame
Digital simulations to compare gravitational effects on different planets and moons

Equipment Needed:

Masses of varying sizes
Washers, balls, or other safe falling objects
Stopwatches
Meter sticks or measuring tapes
Balances or digital scales
Spring scales
Calculators
Student iPads
Chart paper and markers

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Investigate the motion of objects during free fall - Collect and analyze data from falling objects of different masses - Distinguish between mass and weight using	Lesson Sequence Anchoring phenomenon 1. Students watch a demonstration in which two objects of noticeably different masses are dropped simultaneously	- Free-fall investigation data tables - Video analysis observations - Mass and weight comparison charts - Graphs of collected data



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evidence from investigations

- Develop models to explain why objects of different masses fall at the same rate under identical conditions
- Analyze how gravity affects weight while mass remains constant
- Evaluate common misconceptions about falling objects
- Communicate scientific explanations using evidence and data

and reach the ground at nearly the same time.

2. Students predict what should happen before the demonstration and discuss why many people expect the heavier object to fall faster.
3. Student teams brainstorm factors that may influence how quickly an object falls.
4. Groups develop testable claims and identify variables that should be controlled.
5. Students conduct multiple free-fall investigations using objects with different masses.
6. Groups collect time data from repeated trials and calculate average fall times.
7. Students compare results across groups and identify patterns in the data.
8. Students use slow-motion video analysis to examine the motion of falling objects more closely.
9. Students compare stopwatch data with video observations and discuss sources of measurement error.
10. Students measure the mass of several objects using balances and determine weight using spring scales.
11. Groups organize data into tables and compare the two measurements.

- Visual model explaining mass versus weight
- Engineering scenario response
- Peer review of scientific explanations
- Exit ticket explaining the difference between mass and weight using evidence from the investigation



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12. Students identify how mass and weight are related but represent different physical quantities.
13. Students use simulations to compare how weight changes on Earth, the Moon, Mars, and other planetary bodies.
14. Groups discuss why astronauts have the same mass in different locations but different weights.
15. Students create visual models explaining the difference between mass and weight and use evidence from their investigations to support their explanations.
16. Student teams are presented with a scenario involving transporting scientific equipment to the Moon or Mars.
17. Groups determine how changes in gravity would affect the equipment and propose solutions for handling transportation and operational challenges.
18. Students present conclusions and revisit the anchoring phenomenon, explaining why mass does not determine how quickly an object falls under normal free-fall conditions.

Differentiation:

- Students may access information through demonstrations, simulations, videos, written resources, and collaborative investigations.



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- Students may demonstrate understanding through written explanations, diagrams, presentations, models, or multimedia products.
- Structured data tables, guided calculations, and graphic organizers may be provided for students requiring additional support.
- Extension opportunities include investigating gravity on additional celestial bodies, analyzing historical misconceptions about motion, or exploring applications in aerospace engineering.

Resources Provided:

- Free-fall investigation guide
- Mass and weight data tables
- Google Sheets graphing template
- Video analysis instructions
- Planetary gravity reference charts
- Equation reference sheet
- Relevant class notes and instructional resources



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Lesson Plan 3 Template

Content Area: Science

Lesson Title: Newton's Laws of Motion

Time Frame: 2 days

Lesson Components

21st Century Themes

- ☒ Global Awareness
- ☒ Financial, Economic, Business and Entrepreneurial Literacy
- ☒ Civic Literacy
- ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation
- ☒ Critical Thinking and Problem Solving
- ☒ Information Literacy
- ☒ Life and Career Skills
- ☒ Communication and Collaboration
- ☒ Media Literacy
- ☒ ICT Literacy

Interdisciplinary Connections:

Mathematics

Integration of Technology:

iPads for video recording, slow-motion analysis, and collaborative work
Video analysis tools to examine motion frame-by-frame
Google Sheets for organizing data and creating graphs
Digital presentation tools for communicating scientific explanations
PhET Forces and Motion simulations for extending investigations and testing predictions

Equipment Needed:

Dynamics carts or toy cars
Ramp materials
Masses and weights
Spring scales
Meter sticks or measuring tapes
Stopwatches
Balls of various sizes
Wiffle ball bats, tennis rackets, and other classroom objects for demonstrations
Masking tape
Student iPads
Chart paper and markers

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Investigate Newton's Three Laws of Motion through hands-on activities - Collect and analyze data related to force, mass, and motion	Lesson Sequence Anchoring phenomenon - Students watch several short demonstrations: - A tablecloth pulled from beneath objects - A cart colliding with another cart	- Investigation station data tables - Motion observations and analysis - Video analysis notes - Newton's Laws demonstration design - Digital presentation or video project



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| <ul style="list-style-type: none">• Develop models that explain how forces affect the motion of objects• Apply Newton's Laws to real-world situations and technologies• Communicate scientific explanations using evidence gathered during investigations• Collaborate to design and evaluate demonstrations of motion• Connect physics concepts to transportation, sports, engineering, and everyday experiences | <ol style="list-style-type: none">4. A balloon-powered vehicle5. Students are asked: "Why do objects move the way they do, and what determines whether they speed up, slow down, or change direction?"6. Students develop initial explanations and predictions.7. Students rotate through investigation stations focused on each of Newton's Laws.8. At the first station, students investigate inertia by observing objects at rest and in motion and testing how objects respond when forces are applied or removed.9. At the second station, students use carts with different masses and varying applied forces.10. Students collect data on how mass and force influence motion.11. Groups organize data and identify patterns.12. At the third station, students investigate action-reaction forces using balloon rockets, colliding carts, or similar demonstrations.13. Students record observations and develop evidence-based explanations.14. Students use video analysis tools to capture motion during investigations. | <ul style="list-style-type: none">• Peer evaluation of demonstrations• Exit ticket identifying and explaining examples of Newton's Laws in daily life |
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15. Groups analyze recordings and compare observations with collected data.
16. Student teams identify examples of Newton's Laws in sports, transportation systems, workplace safety equipment, amusement park rides, aerospace technology, or other real-world applications.
17. Teams evaluate how understanding forces and motion influences design decisions, safety considerations, and economic costs.
18. Groups design and perform an original demonstration that illustrates one or more of Newton's Laws.
19. Demonstrations must include scientific explanations supported by evidence collected during the lesson.
20. Students create a short digital presentation or video connecting their demonstration to real-world examples and explaining how Newton's Laws influence everyday life.

Differentiation:

- Students may access information through demonstrations, simulations, videos, written resources, and collaborative investigations.
- Students may demonstrate understanding through written explanations, diagrams, presentations, models, videos, or multimedia products.
- Structured data tables, guided notes, graphic organizers, and partially completed analyses may be provided for students requiring additional support.
- Extension opportunities include designing more complex investigations, analyzing engineering case studies, or evaluating how Newton's Laws influence emerging technologies.



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Resources Provided:

- PhET Forces and Motion simulations
- Investigation station directions
- Data collection templates
- Video analysis guides
- Newton's Laws reference sheet
- Presentation rubric
- Relevant class notes and instructional resources



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Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging Strongly and require higher order thinking and problem solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Science

Grade Level: 11

Unit Title: Forces and Interactions

Created: 2026

Board Approved on:



Unit Overview Template

Content Area: Science

Grade Level: 11

Unit Title: Energy and Vibrations

Unit Summary: In this unit of study, students develop and use models, plan and carry out investigations, use computational thinking and design solutions as they make sense of the disciplinary core idea. The disciplinary core idea of Energy is broken down into subcore ideas: definitions of energy, conservation of energy and energy transfer, and the relationship between energy and forces. Energy is understood as a quantitative property of a system that depends on the motion and interactions of matter, and the total change of energy in any system is equal to the total energy transferred into and out of the system. Students also demonstrate their understanding of engineering principles when they design, build, and refine devices associated with the conversion of energy. Also included in this unit, students will apply their understanding of how wave properties and energy can be used to transfer information across long distances, store information, and investigate nature on many scales.

Primary Interdisciplinary Connections: Mathematics, Engineering

21st Century Themes ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ ICT Literacy

☒ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy

Unit Rationale: Students are expected to demonstrate proficiency in using mathematical thinking, developing and using models, planning and carrying out investigations, using computational thinking and designing solutions, and they are expected to use these practices to demonstrate understanding of core ideas.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities.
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others.
- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately.
- 9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity.



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- 9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

Learning Targets

Standards: HS-PS3

Content Statements: Energy; Waves and their Applications in Technologies for Information Transfer

CPI#:	Cumulative Progress Indicator (CPI):
HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
HS-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-PS3-4	Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).
HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
Math.A-CED.A	Create equations that describe numbers or relationships.
Math.A-SSE.B	Write expressions in equivalent forms to solve problems.
8.2.12.ETW.1	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.
8.2.12.ETW.3	Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.
8.2.12.EC.3	Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.

Science and Engineering Practices:

Developing and Using Models



Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2), (HS-PS3-5)

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS3-4)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 builds on K–8 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.

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS3-3)

Disciplinary Core Ideas (DCIs):

PS3.A: Definitions of Energy

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1), (HS-PS3-2)
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the



particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)

PS3.B: Conservation of Energy and Energy Transfer

- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1), (HS-PS3-4)
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)
- The availability of energy limits what can occur in any system. (HS-PS3-1)
- Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4)

PS3.C: Relationship Between Energy and Forces

- When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)

PS3.D: Energy in Chemical Processes

- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3), (HS-PS3-4)

ETS1.A: Defining and Delimiting Engineering Problems

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS3-3)

Crosscutting Concepts:

Cause and Effect

- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-PS3-4)



- Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. (HS-PS3-1)

Energy and Matter

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS3-3)
- Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS3-3)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS3-1)

Unit Essential Questions:

- What is energy, and what is conservation of energy?
- Why and how does energy transfer?
- How are work and power related to energy transfer?
- What is the relationship between energy and force?
- How are oscillations and energy related?

Unit Enduring Understandings:

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system.
- In some cases, the relative position energy can be thought of as stored in fields (which mediate interactions between particles).
- Energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems.
- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.
- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.



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- Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.
- Differentiate conservative from non-conservative forces.

Unit Learning Targets:

Students will....

- Model and calculate potential and kinetic energy
- Model and calculate energy transfer (work and power)
- Differentiate energy, energy transfer, and force during real-world interactions
- Analyze energy of a system and the components in a system
- Develop wave motion and energy and analyze the relationship to force



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Evidence of Learning

Summative Assessment: Information covered in this unit will be tested on the midterm and final examination and as individual chapter tests in addition to the formative assessments listed below.

Equipment Needed: Calculators, notebooks/folders/binders, computers with Internet access.

Teacher Resources:

- Teacher: Textbook, test banks, formative assessment, and analysis software (Socrative.com, Kahoot.com and Excel)
- Class: Lab equipment - Vernier GoDirect wireless photogates, motion detectors, force sensors and accompanying Graphical Analysis Software. Mass balances, Newton Scales, meter sticks, stopwatches, motion tracks, springs, pendulums, and rotating bodies like discs/gyroscopes.

Formative Assessments:

- Online Energy Investigation (Physicsclassroom.com)
- Gas Tank Energy Transfer Activity
- Felix the Skydiver Activity
- Wave analysis softwares
- Work and Power Quiz
- Roller Coaster Design
- Potential and Kinetic Energy Quiz
- Do Work! Staircase Power Lab activity
- What can you power? Lab activity
- Energy Unit Test



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Lesson Plans

Lesson	Time Frame
Lesson 1 Roller Coaster Design	3 days
Lesson 2 Do Work! Staircase Power Lab	3 days
Lesson 3 Digital Sound Waves	3 days

Teacher Notes: The three lessons above represent three investigations that are at the core of the energy and vibrations.

1. Students will model and apply concepts in potential and kinetic energy to roller coasters. They will use online software to design and create their own roller coaster. Using the law of conservation of energy, they will calculate energies and speeds in order to create a roller coaster that would be safe and fun in the real world.
2. Students will calculate the energy they transfer running up a flight of stairs. Using their knowledge of work and power, and the calculations of energy, they will translate their energy transfer to power to determine how many light bulbs, and other appliances they could power by running up the stairs at varying speeds.
3. Students will use their knowledge of energy and wave properties to model and create sound waves using the wave analysis software (PhET and Chrome Music Lab). They will use their created waves to analyze properties and determine frequency, energy, pitch and other variables associated with vibrations and energy.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

- Informational aids, interactive digital labs, and additional resources for students:
Physicsclassroom.com Hyperphysics.phy-astr.gsu.edu, <http://Phet.colorado.edu>
- Physics/Science YouTube Channels: Mark Rober, Veritasium, Vsauce, Walter Lewin, NASA, NASA JPL

Applications:

- Stellarium (Virtual Sky Map)
- Vernier Graphical Analysis Software
- Photobooth/Motion camera
- PhET and Chrome Music Lab (or any sound wave analysis software)
- Google Sheets, Google Docs, Google Slides



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Lesson Plan 1 Template

Content Area: Science

Lesson Title: Roller Coaster Design

Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness
- ☒ Financial, Economic, Business and Entrepreneurial Literacy
- ☒ Civic Literacy
- ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation
- ☒ Critical Thinking and Problem Solving
- ☒ Information Literacy
- ☒ Life and Career Skills
- ☒ Communication and Collaboration
- ☒ Media Literacy
- ☒ ICT Literacy

Interdisciplinary Connections:

Mathematics, Engineering

Integration of Technology:

Student iPads for accessing simulations, collecting data, collaborating with teammates, and creating presentations

Physics Classroom Roller Coaster Simulator for modeling energy transformations and coaster performance

Google Sheets for organizing calculations, graphing energy changes, and analyzing coaster efficiency

Digital presentation tools for communicating design decisions and recommendations

Equipment Needed:

Marble roller coaster materials (foam pipe insulation, cardboard track pieces, tape, supports, marbles, etc.)

Meter sticks or measuring tapes

Stopwatches

Calculators

Student iPads

Graph paper

Design planning sheets

Equation reference sheets

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Design and construct a model roller coaster - Investigate the relationship between potential and kinetic energy - Calculate and compare energy at various points	Lesson Sequence Anchoring phenomenon 1. Students view footage of several roller coasters with dramatically different designs and are asked: "How can roller coasters travel through loops, hills, and turns"	- Introduction survey responses - Initial design sketches - Roller coaster model construction and testing observations - Energy calculation sheets - Simulation data tables - Revised coaster design plans



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throughout a roller coaster system

- Analyze how energy transfers affect coaster performance
- Evaluate the efficiency, safety, and cost-effectiveness of engineering designs
- Use evidence to justify design decisions and modifications
- Communicate findings through written and visual presentations

without engines continuously pushing them?"

2. Students discuss where the coaster's energy comes from and what factors engineers must consider when designing safe and exciting rides.
3. Students complete a brief survey about roller coaster design, energy, and safety.
4. Student teams examine photographs and specifications of real roller coasters and identify common design features.
5. Teams receive design criteria and constraints, including height limitations, safety requirements, construction materials, and budget considerations.
6. Students sketch an initial coaster design and predict how energy will transfer throughout the ride.
7. Student groups construct small-scale roller coaster models using provided materials.
8. Teams test their designs and record observations about coaster performance.
9. Students identify areas where the coaster loses energy or fails to complete the track successfully.
10. Using the Physics Classroom Roller Coaster

- Engineering proposal presentation
- Coaster analysis write-up explaining energy transfers, efficiency, safety considerations, and design tradeoffs



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- Simulator, students model their coaster digitally and analyze energy changes at various locations.
11. Students calculate potential and kinetic energy at selected points and compare calculations with simulation results.
 12. Groups revise their coaster designs based on collected data and testing results.
 13. Students evaluate tradeoffs between excitement, safety, efficiency, material usage, and construction costs.
 14. Teams prepare a brief engineering proposal explaining how their design meets project criteria.
 15. Students present their coaster designs, energy analyses, and recommendations to the class.

Differentiation:

- Students may access content through demonstrations, simulations, hands-on construction, videos, diagrams, and collaborative discussions.
- Students may demonstrate understanding through calculations, models, presentations, written explanations, videos, or engineering sketches.
- Structured calculation guides, graphic organizers, data tables, and sample analyses may be provided for students requiring additional support.
- Extension opportunities include calculating coaster speeds, investigating energy losses due to friction, comparing commercial roller coaster designs, or evaluating economic considerations involved in amusement park engineering projects.

Resources Provided:

- Physics Classroom Roller Coaster Simulator
- Design planning sheets
- Energy calculation reference sheet
- Data collection templates
- Engineering proposal template
- Relevant class notes and instructional resources



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Lesson Plan 2 Template

Content Area: Science

Lesson Title: Do Work! Staircase Power Lab

Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS3-3)
- Energy cannot be created or destroyed – only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2)

Integration of Technology:

Student iPads for data collection, video recording, calculations, and collaboration

Google Sheets for organizing measurements, calculating work and power, and graphing results

Online appliance energy calculators and manufacturer specifications for comparing human power output to real-world devices

Digital presentation tools for communicating findings and recommendations

Equipment Needed:

Meter sticks or measuring tapes

Stopwatches

Calculators

Stairwell access

Mass scales

Clipboards

Student iPads

Data collection sheets

Equation reference sheets

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Calculate work and power using measurements collected during a hands-on investigation	Lesson Sequence Anchoring phenomenon 1. Students are shown examples of emergency situations in which people generate	• Staircase measurements • Work calculations • Power calculations • Data tables and graphs • Energy transfer models • Appliance comparison calculations



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|---|---|---|
| <ul style="list-style-type: none">• Analyze the relationship between force, distance, work, and power• Compare human power output to household appliances and technologies• Develop models that illustrate energy transfer within physical systems• Evaluate the efficiency of energy use in everyday activities and technologies• Use evidence to support conclusions about energy consumption and resource use• Communicate findings through written and visual presentations• Demonstrate work and power | <ul style="list-style-type: none">• electricity through hand cranks, bicycle generators, or human-powered devices.2. Students are asked: "Could a person generate enough power to run a classroom, a home, or even a single appliance?"3. Students make predictions and justify their reasoning.4. Student teams measure the vertical height of a school staircase and determine the mass that will be lifted during the investigation.5. Students predict how much work they will perform and how much power they can generate.6. Students complete multiple staircase trials at different speeds while teammates record times and observations.7. Groups calculate the work completed during each trial and determine average power output.8. Students organize data using Google Sheets and create graphs comparing work, power, and climbing speed.9. Teams compare class results and identify factors that influence power output.10. Students develop energy flow models showing how chemical energy stored in food is converted into mechanical energy and eventually thermal energy. | <ul style="list-style-type: none">• Community energy recommendation activity• Modeling energy transfer video• Power and applications write-up• Exit ticket explaining the relationship between work, power, and energy use |
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11. Using online appliance specifications, groups investigate the power requirements of common devices such as LED light bulbs, laptops, refrigerators, microwaves, phone chargers, and electric vehicles.
12. Students compare their measured power output to these devices and calculate how long they would need to generate energy to operate each one.
13. Student teams analyze the economic and environmental implications of energy production.
14. Groups compare human-generated energy, fossil fuels, renewable energy sources, and emerging technologies.
15. Students evaluate tradeoffs involving efficiency, cost, sustainability, accessibility, and community needs.
16. Teams create recommendations for powering a small community facility using a combination of energy sources.
17. Students support their recommendations with evidence collected during the investigation.
18. Students present their findings and revisit the anchoring phenomenon using their calculated



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power outputs and
energy comparisons.

Differentiation:

Students may access content through demonstrations, hands-on investigations, videos, simulations, readings, and collaborative discussions.

Students may demonstrate understanding through calculations, models, presentations, written explanations, videos, or multimedia products.

Structured calculation guides, graphic organizers, data tables, and sample analyses may be provided for students requiring additional support.

Extension opportunities include analyzing energy efficiency ratings, investigating renewable energy technologies, calculating household energy consumption, or evaluating the economic costs of different energy sources.

Resources Provided:

- Work and power equation reference sheet
- Data collection templates
- Google Sheets calculation template
- Appliance power rating reference materials
- Community energy planning worksheet
- Relevant class notes and instructional resources



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Lesson Plan 3 Template

Content Area: Science

Lesson Title: Digital Sound Waves

Time Frame: .75hours/1day

Lesson Components

21st Century Themes

- ☒ Global Awareness
- ☒ Financial, Economic, Business and Entrepreneurial Literacy
- ☒ Civic Literacy
- ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation
- ☒ Critical Thinking and Problem Solving
- ☒ Information Literacy
- ☒ Life and Career Skills
- ☒ Communication and Collaboration
- ☒ Media Literacy
- ☒ ICT Literacy

Interdisciplinary Connections:

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1)
- Systems can be designed to cause a desired effect. (HS-PS4-5)

Integration of Technology:

Student iPads for wave investigations, data collection, and collaboration

PhET Waves Intro simulation for modeling wave behavior and properties

Chrome Music Lab for generating and analyzing sound waves

Google Sheets for organizing measurements and analyzing relationships between wave variables

Digital presentation tools for communicating findings and real-world applications

Equipment Needed:

Student iPads

Headphones or earbuds

Tuning forks

Rubber bands of varying thicknesses

Plastic cups and string

Meter sticks

Calculators

Equation reference sheets

Data collection sheets

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Differentiate the major properties of waves, including amplitude, wavelength, frequency, and energy	Lesson Sequence Anchoring phenomenon 1. Students listen to several sounds that differ in pitch and	• Wave property review activities • Sound-producing device investigation data tables • PhET simulation data collection sheets



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| <ul style="list-style-type: none">• Investigate the relationship between vibrations and sound production• Model wave behavior using physical and digital tools• Analyze how changes in wave properties affect sound• Collect and interpret quantitative and qualitative data related to wave phenomena• Apply wave concepts to communication technologies, music, medicine, and engineering• Communicate evidence-based explanations of wave behavior | <ol style="list-style-type: none">1. Students observe volume and observe corresponding waveform visualizations.2. Students are asked: "How can invisible vibrations carry information, music, and communication across the world?"3. Students develop initial explanations and predictions about sound and wave behavior.4. Students review basic wave properties through demonstrations using ropes, slinkies, tuning forks, and rubber band instruments.5. Student groups identify observable differences between waves with varying amplitudes and frequencies.6. Students construct simple sound-producing devices using rubber bands, cups, strings, or other classroom materials.7. Groups investigate how changing tension, length, or thickness affects sound production.8. Students record observations and identify patterns.9. Students use the PhET Waves Intro simulation to manipulate amplitude, frequency, and wavelength. | <ul style="list-style-type: none">• Chrome Music Lab waveform screenshots• Wave analysis calculations• Real-world applications research summary• Wave model and explanation• Peer feedback discussion• Exit ticket explaining how changes in amplitude and frequency affect sound |
|--|--|--|



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10. Groups collect data and analyze how changes in one variable affect other aspects of the wave.
11. Students use Chrome Music Lab to create and visualize sound waves.
12. Teams compare digitally generated sounds to their physical investigations.
13. Students measure and analyze wave characteristics using provided data tables and digital tools.
14. Student teams investigate real-world applications of wave technology, including medical imaging, earthquake monitoring, noise-canceling headphones, wireless communication, music production, sonar, and acoustical engineering.
15. Groups evaluate how understanding wave behavior influences design decisions, efficiency, accessibility, and technological innovation.
16. Students develop a model explaining how vibrations produce sound and how wave properties influence what we hear.
17. Groups present findings and support explanations using evidence collected during investigations.



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Differentiation:

- Students may access content through demonstrations, simulations, physical models, videos, readings, and collaborative investigations.
- Students may demonstrate understanding through written explanations, diagrams, presentations, models, videos, or multimedia products.
- Structured data tables, graphic organizers, guided notes, and sample analyses may be provided for students requiring additional support.
- Extension opportunities include investigating musical acoustics, digital sound engineering, medical imaging technologies, seismic waves, or communication systems.

Resources Provided:

- PhET Waves Intro simulation
- Chrome Music Lab
- Wave property reference sheet
- Data collection templates
- Investigation guides
- Relevant class notes and instructional resources



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Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging Strongly and require higher order thinking and problem solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Science
Vibrations

Grade Level: 11

Unit Title: Energy and

Created: 2026

Board Approved on:

**Unit Overview Template****Content Area:** Science
Radiation**Grade Level:** 11**Unit Title:** Electromagnetism and

Unit Summary: In this unit of study, students are able to apply their understanding of wave properties to make sense of how electromagnetic radiation can be used to transfer information across long distances, store information, and investigate nature on many scales. Models of electromagnetic radiation as both a wave of changing electrical and magnetic fields or as particles are developed and used. Students also demonstrate their understanding of engineering ideas by presenting information about how technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. Students will also apply their understanding of how forces at a distance can be explained by fields, why some materials are attracted to each other while others are not, how magnets or electric currents cause magnetic fields, and how charges or changing magnetic fields cause electric fields.

Primary Interdisciplinary Connections: Mathematics, Engineering

21st Century Themes ☑ Creativity and Innovation ☑ Critical Thinking and Problem Solving ☑ ICT Literacy
☑ Information Literacy ☑ Life and Career Skills ☑ Communication and Collaboration ☑ Media Literacy

Unit Rationale: Students are expected to demonstrate proficiency in planning and conducting investigations, developing and using models, asking questions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. They are also expected to use these practices to demonstrate understanding of the core ideas.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities.
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

Learning Targets



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Standards: HS-PS2; HS-PS3; HS-PS4

Content Statements: Motion and Stability: Forces and Interactions; Energy; Waves and their Applications in Technologies for Information Transfer

CPI#:	Cumulative Progress Indicator (CPI):
HS-PS4-1	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
HS-PS4-2	Evaluate questions about the advantages of using a digital transmission and storage of information.
HS-PS4-3	Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS4-4	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
HS-PS4-5	Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy
Math.A-CED.A	Create equations that describe numbers or relationships.
Math.A-SSE.B	Write expressions in equivalent forms to solve problems.
8.2.12.ETW.1	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.
8.2.12.ETW.3	Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.
8.2.12.EC.3	Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.

Science and Engineering Practices:

Asking Questions and Defining Problems

Asking questions and defining problems in grades 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. (HS-PS4-2)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at 9–12 builds on K–8 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.

- Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)

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 worlds. Arguments may also come from current scientific or historical episodes in science.

- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3)

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.

- Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. (HS-PS4-4)
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS4-5)

Disciplinary Core Ideas (DCIs):

PS3.D: Energy in Chemical Processes

- Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary to HS-PS4-5)

PS4.A: Wave Properties

- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)
- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2), (HS-PS4-5)
- Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3)

PS4.B: Electromagnetic Radiation

- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful



for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3)

- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4)
- Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5)

PS4.C: Information Technologies and Instrumentation

- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)

Crosscutting Concepts:

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1)
- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS4-4)
- Systems can be designed to cause a desired effect. (HS-PS4-5)

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-PS4-3)

Stability and Change

- Systems can be designed for greater or lesser stability. (HS-PS4-2)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology

- Science and engineering complement each other in the cycle known as research and development (R&D). (HS-PS4-5)

Influence of Engineering, Technology, and Science on Society and the Natural World

- Modern civilization depends on major technological systems. (HS-PS4-2), (HS-PS4-5)



- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS4-2)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-PS4-3)

Unit Essential Questions:

- How can electromagnetic radiation be both a wave and a particle at the same time?
- Should we encourage the board of education to install solar panels?
- How does the International Space Station power all of its equipment?
- How do astronauts communicate with people on the ground?
- How does my hard drive store information?
- How can I exert a force on an object when I can't touch it?
- What are the relationships between electric currents and magnetic fields?

Unit Enduring Understandings:

- Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other.
- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features.
- A wave model or a particle model (e.g., physical, mathematical, computer models) can be used to describe electromagnetic radiation—including energy, matter, and information flows—within and between systems at different scales.
- A wave model and a particle model of electromagnetic radiation are based on a body of facts that have been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.
- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells.
- Cause-and-effect relationships can be suggested and predicted for electromagnetic radiation systems when matter absorbs different frequencies of light by examining what is known about smaller scale mechanisms within the system.
- Solar cells are human-made devices that capture the sun's energy and produce electrical energy.
- Photoelectric materials emit electrons when they absorb light of a high enough frequency.



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- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.
- Radiation is a phenomenon in which energy stored in fields moves across spaces.
- Humanity faces major global challenges today, such as the need for supplies of clean water and food and for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts
- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.
- Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.
- “Electrical energy” may mean energy stored in a battery or energy transmitted by electric currents.
- When two objects interacting through a field change relative position, the energy stored in the field is changed.

Unit Learning Targets:

Students will....

- Plan and conduct an investigation individually and collaboratively to produce data that can serve as the basis for evidence that an electric current can produce a magnetic field.
- Plan and conduct an investigation individually and collaboratively to produce data that can serve as the basis for evidence that a changing magnetic field can produce an electric current.
- In experimental design, decide on the types, amounts, and accuracy of data needed to produce reliable measurements, consider limitations on the precision of the data, and refine the design accordingly.
- Collect empirical evidence to support the claim that an electric current can produce a magnetic field.
- Collect empirical evidence to support the claim that a changing magnetic field can produce an electric current.
- Suggest and predict cause-and-effect relationships for two objects interacting through electric or magnetic fields.



Evidence of Learning

Summative Assessment: Information covered in this unit will be tested on the midterm and final examination and as individual chapter tests in addition to the formative assessments listed below.

Equipment Needed: Calculators, notebooks/folders/binders, computers with Internet access.

Teacher Resources:

- Teacher: Textbook, test banks, formative assessment, and analysis software (Socrative.com, Kahoot.com and Excel)
- Class: Lab equipment - Vernier GoDirect wireless photogates, motion detectors, force sensors and accompanying Graphical Analysis Software. Vernier circuit boards, LED lights, multimeters

Formative Assessments:

- Online circuit investigation
- Attraction and repulsion matching
- "Put that Charge in the Goal!" online lab
- "Build a Circuit" online lab
- Field lines drawing activity
- Online investigation: magnetism
- Hands-on: Building a real circuit, powering a light/battery
- Attraction and repulsion quiz
- Electromagnetic spectrum quiz
- Electricity and magnetism unit test



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Lesson Plans

Lesson	Time Frame
Lesson 1 Building Circuits — Series and Parallel Investigations	3 days
Lesson 2 Put that Charge in the Goal! — Exploring Electric and Magnetic Fields	3 days
Lesson 3 Powering a Light Bulb — Engineering Reliable Electrical Systems	3 days

Teacher Notes: The three lessons above represent three investigations that are at the core of the electromagnetism and radiation unit.

- Students will use online software from PCCL interactives to practice building series and parallel circuits to determine the different properties of both configurations.
- Students will demonstrate their knowledge of magnetic field lines and apply them to shape field lines that will move a charge into a goal using software from physicsclassroom.com
- Students will demonstrate a real-world circuit by creating series and parallel circuits and actually powering light bulbs and capacitors of varying strengths.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

- Informational aids, interactive digital labs, and additional resources for students: Physicsclassroom.com Hyperphysics.phy-astr.gsu.edu, <http://Phet.colorado.edu>, www.physics-chemistry-interactive-flash-animation.com/electricity_interactive.htm (circuit analysis)
- Physics/Science YouTube Channels: Mark Rober, Veritasium, Vsauce, Walter Lewin, NASA, NASA JPL

Applications:

- Vernier Graphical Analysis Software
- Google Sheets, Google Docs, Google Slides



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Lesson Plan 1 Template

Content Area: Science Lesson Title: Building Circuits — Series and Parallel Investigations

Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Mathematics, Electrical Engineering

Integration of Technology:

Student iPads for recording observations, collecting data, photographing circuit designs, and collaborating with teammates
Google Sheets for organizing data and comparing circuit performance
Digital circuit simulation (Physics Classroom or PhET Circuit Construction Kit) used after the hands-on investigation to test additional designs and compare results
Digital presentation tools for communicating findings and design recommendations

Equipment Needed:

D-cell batteries and holders
Miniature light bulbs and bulb holders
Connecting wires with alligator clips
Switches
Multimeters
LED bulbs
Circuit building kits
Student iPads
Data collection sheets
Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Construct functional electrical circuits using common circuit components	Lesson Sequence Anchoring phenomenon 1. Students observe two lighting setups: a strand of older holiday lights wired in series and a	- Initial circuit sketches - Successful circuit construction - Series circuit investigation data table - Parallel circuit investigation data table



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| <ul style="list-style-type: none">• Compare and contrast series and parallel circuit configurations• Investigate how current pathways affect circuit performance• Collect and analyze qualitative and quantitative circuit data• Develop models that explain how electrical energy moves through a circuit• Evaluate circuit designs based on efficiency, reliability, cost, and practical applications• Communicate evidence-based conclusions about circuit behavior | <ol style="list-style-type: none">modern lighting system wired in parallel.The teacher removes a bulb from each system and asks students to explain why one system stops working while the other remains illuminated.Students develop initial hypotheses about how electricity travels through different circuit designs.Student teams examine circuit components and discuss how electrical energy might move through a system.Groups sketch an initial circuit design that they believe will successfully light a bulb.Students construct a simple closed circuit using a battery, wires, and a bulb.Teams troubleshoot designs and identify conditions required for successful operation.Groups build a series circuit containing multiple bulbs.Students observe brightness, measure voltage when appropriate, and record performance data.Students redesign the system as a parallel circuit.Teams compare brightness, reliability, and energy distribution between the two configurations. | <ul style="list-style-type: none">• Circuit diagrams• Circuit photographs• Digital simulation comparison activity• Circuit analysis questions• Written explanation comparing series and parallel circuits• Exit reflection explaining how circuit design impacts performance and reliability |
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12. Students collect observations and organize findings in data tables.
13. Groups create diagrams showing energy flow and current pathways in both circuit types.
14. Students investigate real-world applications including household wiring, emergency lighting systems, holiday lights, transportation systems, and renewable energy installations.
15. Teams evaluate why engineers select series or parallel configurations for different situations.
16. Students consider safety, cost, efficiency, maintenance requirements, and community needs when evaluating designs.
17. Students use a digital circuit simulation to test additional circuit arrangements and compare virtual results with their hands-on findings.
18. Teams present recommendations identifying which circuit configuration would be most appropriate for various real-world applications and justify their decisions using evidence from the investigation.

Differentiation:

- Students may access content through demonstrations, hands-on investigations, simulations, diagrams, videos, readings, and collaborative discussions.



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- Students may demonstrate understanding through circuit models, written explanations, presentations, diagrams, videos, or multimedia products.
- Structured data tables, guided notes, circuit templates, and troubleshooting guides may be provided for students requiring additional support.
- Extension opportunities include measuring current and voltage with multimeters, investigating household electrical systems, exploring renewable energy applications, or designing circuits for specific engineering challenges.

Resources Provided:

- Circuit construction kits
- Data collection templates
- Circuit diagram reference sheets
- Series and parallel comparison organizer
- Digital circuit simulation resources
- Relevant class notes and instructional resources



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Lesson Plan 2 Template

Content Area: Science
Magnetic Fields

Lesson Title: Put that Charge in the Goal! — Exploring Electric and
Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Mathematics, Electrical Engineering

Integration of Technology:

Student iPads for recording observations, collecting data, photographing models, and collaborating with teammates

Physics Classroom "Put that Charge in the Goal" simulation used after hands-on investigations to test predictions and visualize electric field interactions

Google Sheets for organizing observations and analyzing patterns in field behavior

Digital presentation tools for communicating findings and design solutions

Equipment Needed:

Bar magnets
Ring magnets
Compasses
Iron filings
Clear plastic trays
Small magnetic marbles or steel ball bearings
Masking tape
Meter sticks
Student iPads
Data collection sheets
Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Model electric and magnetic fields using physical and digital representations	Lesson Sequence Anchoring phenomenon 1. Students observe a magnet moving a paper clip without touching it.	- Initial field predictions - Magnetic field maps - Iron filings observations - Magnetic challenge course performance



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| <ul style="list-style-type: none">• Investigate how forces act at a distance through field interactions• Analyze the behavior of charged objects and magnetic poles• Predict the motion of objects placed within electric and magnetic fields• Develop models to explain field patterns and interactions• Evaluate how electromagnetism is applied in modern technologies• Communicate evidence-based explanations of field behavior | <ol style="list-style-type: none">2. The teacher then demonstrates two magnets attracting and repelling each other through space.3. Students are asked: "How can an object exert a force without making contact?"4. Students develop initial explanations and predictions about invisible fields.5. Students use compasses and bar magnets to map magnetic field lines around single magnets and pairs of magnets.6. Groups create field maps and identify patterns associated with attraction and repulsion.7. Students place iron filings over magnets in clear trays to visualize magnetic field structures.8. Teams compare their observations with their compass-generated field maps.9. Students construct a simple challenge course using magnets, barriers, and magnetic marbles.10. Groups attempt to move an object through the course using only magnetic forces.11. Students test multiple arrangements and evaluate which field configurations are most effective.12. Teams analyze how changes in magnet position, orientation, and | <ul style="list-style-type: none">• Data tables and observations• Physics Classroom simulation progress• Field model diagrams• Technology design proposal• Written explanation of electric and magnetic field interactions• Exit reflection explaining how fields influence object motion |
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- strength influence object motion.
13. Students record observations and identify patterns in force interactions.
 14. Students use the Physics Classroom simulation to complete progressively challenging levels.
 15. Groups compare simulation results to their hands-on investigations and revise explanations when necessary.
 16. Students investigate real-world applications of electric and magnetic fields including MRI machines, electric motors, maglev trains, speakers, renewable energy technologies, recycling systems, and wireless charging devices.
 17. Teams design a proposal for a technology that uses magnetic or electric fields to solve a real-world problem.
 18. Students justify their design decisions using evidence collected during the investigation.
 19. Students present their field models and explain how forces acting at a distance influence motion and technology.

Differentiation:

- Students may access content through demonstrations, hands-on investigations, simulations, diagrams, videos, readings, and collaborative discussions.
- Students may demonstrate understanding through models, diagrams, presentations, written explanations, videos, or multimedia products.
- Structured data tables, guided notes, graphic organizers, and field mapping templates may be provided for students requiring additional support.



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- Extension opportunities include investigating electromagnets, electric motors, magnetic levitation systems, renewable energy generators, or advanced field interactions.

Resources Provided:

- Bar magnets and compasses
- Iron filings investigation materials
- Magnetic challenge course materials
- Data collection templates
- Field mapping guides
- Physics Classroom simulation resources
- Relevant class notes and instructional resources



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Lesson Plan 3 Template

Content Area: Science
Electrical Systems

Lesson Title: Powering a Light Bulb — Engineering Reliable
Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Mathematics, Electrical Engineering

Integration of Technology:

Student iPads for recording observations, photographing circuit designs, collecting data, and collaborating with teammates

Vernier circuit analysis equipment for measuring electrical properties

Multimeters for collecting voltage, current, and resistance data

Google Sheets for organizing measurements, graphing results, and analyzing circuit performance

Digital presentation tools for communicating findings and engineering recommendations

Equipment Needed:

Vernier circuit boards

Batteries and battery holders

Connecting wires

Light bulbs and bulb holders

Switches

Capacitors

Multimeters

Student iPads

Data collection sheets

Equation reference sheets

Graph paper

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Construct functional series and parallel circuits using Vernier circuit boards - Measure and compare voltage, current, and resistance in different circuit configurations	Lesson Sequence Anchoring phenomenon Students examine several lighting systems, including household lighting, emergency	- Circuit prediction activity - Series circuit data table - Parallel circuit data table - Voltage and current measurements - Circuit photographs - Graphs and data analysis



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| <ul style="list-style-type: none">• Analyze how circuit design affects performance and reliability• Troubleshoot electrical systems using evidence-based reasoning• Evaluate circuit designs based on efficiency, cost, safety, and intended purpose• Develop engineering solutions to real-world electrical challenges• Communicate evidence-based conclusions about circuit behavior | <ol style="list-style-type: none">lighting, and holiday lights.2. The teacher demonstrates a circuit failure in one system and asks students why some electrical systems continue operating while others stop functioning.3. Students develop initial explanations and identify factors that influence reliability.4. Student teams review circuit symbols and electrical components.5. Groups predict how different circuit configurations will affect bulb brightness, reliability, and energy distribution.6. Students construct a series circuit using Vernier circuit boards and record observations about brightness and performance.7. Teams use multimeters to measure voltage and current at multiple points in the circuit.8. Students redesign the system as a parallel circuit.9. Groups collect comparable measurements and analyze differences between the two configurations.10. Students organize data using Google Sheets and create tables and graphs to compare circuit performance. | <ul style="list-style-type: none">• Troubleshooting challenge results• Engineering design proposal• Build-a-circuit lab activity sheet• Written explanation comparing circuit performance and reliability |
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11. Teams investigate the impact of adding additional bulbs, switches, or capacitors to their circuits.
12. Students identify how modifications affect overall system behavior.
13. Groups participate in a troubleshooting challenge in which a circuit contains intentional faults such as loose connections, reversed components, or damaged wires.
14. Students diagnose problems and propose solutions using collected evidence.
15. Teams are presented with an engineering challenge to design an electrical system for a community facility such as a school, hospital, emergency shelter, or recreation center.
16. Students evaluate design options based on safety, reliability, maintenance requirements, energy efficiency, and budget considerations.
17. Groups present their recommended design and justify their decisions using data collected during the investigation.

Differentiation:

- Students may access content through demonstrations, hands-on investigations, simulations, diagrams, videos, readings, and collaborative discussions.
- Students may demonstrate understanding through circuit models, written explanations, presentations, diagrams, videos, or multimedia products.
- Structured data tables, guided notes, circuit templates, troubleshooting guides, and graphic organizers may be provided for students requiring additional support.



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- Extension opportunities include investigating household electrical systems, renewable energy technologies, smart-grid systems, battery storage systems, or advanced circuit design challenges.

Resources Provided:

- Vernier circuit boards
- Batteries, wires, bulbs, switches, and capacitors
- Multimeters
- Data collection templates
- Circuit diagram reference sheets
- Equation reference sheets
- Relevant class notes and instructional resources



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Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging Strongly and require higher order thinking and problem solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Science
Radiation

Grade Level: 11

Unit Title: Electromagnetism and

Created: 2026

Board Approved on:



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Unit Overview Template

Content Area: Science

Grade Level: 11

Unit Title: Energy, Forces, and Earth

Systems: Understanding and Engineering Our Dynamic Planet

Unit Summary: Students investigate how energy and forces shape Earth systems and human societies, from electricity generation and resource use to plate tectonics, gravity, and planetary motion. Through hands-on investigations, modeling, engineering design challenges, and computational simulations, students explore how energy moves through natural and engineered systems across vastly different spatial and temporal scales. Students evaluate the scientific, economic, environmental, and societal tradeoffs associated with using Earth's resources while developing solutions to complex global challenges.

Primary Interdisciplinary Connections: Engineering, Environmental Science

21st Century Themes ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ ICT Literacy
☒ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy

Unit Rationale: This unit connects core physics principles of energy, forces, motion, and fields to real-world Earth systems and engineering challenges, helping students understand how scientific knowledge informs decisions about resources, hazards, sustainability, and our place in the universe.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities.
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.TL.1: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

Learning Targets

Standards: HS-PS2, HS-PS3, HS-ESS1, HS-ESS2, HS-ESS3, HS-ETS1

Content Statements: Motion and Stability: Forces and Interactions; Energy; Earth's Place in the Universe; Earth's Systems; Earth and Human Activity; Engineering Design



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CPI#:	Cumulative Progress Indicator (CPI):
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.
HS-PS2-5	Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
HS-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
HS-ESS2-1	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
HS-ESS3-2	Evaluate competing design solutions for developing, conserving, managing, and utilizing energy and mineral resources based on the associated economic, social, environmental, and geopolitical costs and risks, as well as benefits.
HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
Math.A-CED.A	Create equations that describe numbers or relationships.
Math.A-SSE.B	Write expressions in equivalent forms to solve problems.
8.2.12.ETW.1	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.



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8.2.12.ETW.3	Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.
8.2.12.EC.3	Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.

Science and Engineering Practices:

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS2-5)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 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. (HS-PS2-1)

Asking Questions and Defining Problems

Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-1)

Developing and Using Models

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2), (HS-PS3-5), (HS-ESS2-1), (HS-ESS2-3)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 builds on K–8 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.



- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1)
- Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4)
- Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS3-3)
- Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. (HS-ESS1-6)

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.

- Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). (HS-ESS3-2)

Disciplinary Core Ideas (DCIs):

PS1.C: Nuclear Processes

- Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to HSESS1-5), (secondary to HS-ESS1-6)

PS2.A: Forces and Motion

- Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)

PS2.B: Types of Interactions

- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-5)

PS3.A: Definitions of Energy



- “Electrical energy” may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5)
- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1), (HS-PS3-2)
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2), (HS-PS3-3)
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)

PS3.B: Conservation of Energy and Energy Transfer

- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)
- The availability of energy limits what can occur in any system. (HS-PS3-1)

PS3.C: Relationship Between Energy and Forces

- When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)

PS3.D: Energy in Chemical Processes

- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3)

PS4.A: Wave Properties

- Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. (secondary to HS-ESS2-3)

ESS1.B: Earth and the Solar System

- Kepler’s laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)

ESS1.C: The History of Planet Earth

- Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as



lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS-ESS1-6)

ESS2.A: Earth Materials and Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1)
- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3)

ESS2.B: Plate Tectonics and Large Scale System Interactions

- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. (HS-ESS2-1)
- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. (HS-ESS2-3)

ESS3.A: Natural Resources

- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

Delimiting Engineering Problems

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)
- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)

ETS1.A: Defining and Delimiting Engineering Problems

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS3-3)

ETS1.B: Developing Possible Solutions

- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and



in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)

Crosscutting Concepts:

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1), (HS-PS2-5)
- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5)

Systems and System Models

- Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. (HS-PS3-1)
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. (HS-ETS1-4)

Scale, Proportion, and Quantity

- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (HS-ESS1-4)

Energy and Matter

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS3-3)
- Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2)
- Energy drives the cycling of matter within and between systems. (HS-ESS2-3)

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS1-6)
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1)

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-ESS1-6)



- Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. (HS-ESS1-6)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-ESS3-3)
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-ESS3-2)
- Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS3-2)
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-1)

Interdependence of Science, Engineering, and Technology

- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (HS-ESS1-4), (HS-ESS2-3)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Theories and laws provide explanations in science. (HS-PS2-1)
- Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1)

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS3-1)

Science Addresses Questions About the Natural and Material World

- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (HS-ESS3-2)
- Science knowledge indicates what can happen in natural systems— not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (HS-ESS3-2)
- Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. (HS-ESS3-2)

Unit Essential Questions:

- How does energy move through natural and engineered systems?
- How do forces influence motion and interactions within Earth systems and the universe?
- How can models be used to explain, predict, and optimize the behavior of complex systems?
- How do electricity and magnetism enable the generation and transfer of energy?
- How do Earth's internal processes shape the planet over time?
- How do scientists and engineers use evidence to address challenges related to energy resources and sustainability?



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- How do tradeoffs influence decisions about energy production, resource management, and technological development?
- How can scientific knowledge and engineering design be used to reduce risks associated with natural hazards?
- How does gravity influence the motion of objects on Earth and in space?
- How do computational tools and simulations help scientists and engineers solve real-world problems?

Unit Enduring Understandings:

- Energy is conserved and can be transferred, transformed, and stored within and between systems.
- Forces cause changes in motion and govern interactions among objects and systems.
- Electric and magnetic fields are interconnected and can be used to generate and transfer energy.
- Models are valuable tools for describing, predicting, and improving the behavior of natural and engineered systems.
- Earth's internal energy drives processes that continually reshape the planet.
- Patterns in data can be used to explain phenomena and predict future events.
- Engineering solutions require balancing scientific evidence, societal needs, economic considerations, and environmental impacts.
- Human decisions regarding energy and resource use have consequences for communities and the environment.
- Computational models and simulations allow scientists and engineers to analyze complex systems and evaluate potential solutions.
- Scientific knowledge is developed through evidence, testing, revision, and collaboration.

Unit Learning Targets:

Students will....

- Analyze the relationship between force, mass, and acceleration using experimental data.
- Investigate the relationship between electricity and magnetism through hands-on laboratory investigations.
- Develop and use models to describe energy transfers and transformations within systems.
- Design, build, test, and refine devices that convert energy from one form to another.
- Create and interpret computational models of energy flow and system interactions.
- Develop models that explain the movement of matter and energy within Earth's interior.
- Analyze evidence to explain how Earth's internal processes create and modify geological features.
- Evaluate competing energy production and resource management strategies using scientific, economic, and environmental criteria.
- Use mathematical and computational representations to predict the motion of objects influenced by gravity.
- Analyze data and evidence to support scientific explanations and engineering solutions.
- Apply systems thinking to explain interactions among natural and engineered systems.
- Communicate scientific and engineering information using models, data, evidence, and reasoning.
- Evaluate the effectiveness of proposed solutions to complex global challenges involving energy, resources, and sustainability.



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- Collaborate with peers to investigate phenomena, develop models, and solve engineering design challenges.

Evidence of Learning

Summative Assessment: Information covered in this unit will be tested on the midterm and final examination and as individual chapter tests in addition to the formative assessments listed below.

Equipment Needed: Calculators, notebooks/folders/binders, computer/iPad and software, basic laboratory equipment

Teacher Resources:

- Teacher: Textbook, test banks, formative assessment, and analysis software (Socrative.com, Kahoot.com and Excel)
- Class: Lab equipment - Vernier GoDirect wireless photogates, motion detectors, force sensors and accompanying Graphical Analysis Software. Vernier circuit boards, LED lights, multimeters

Formative Assessments:

- Quizzes will be given to assess student learning after every 3-4 lessons.
- In class assignments will be completed to practice a lesson.
- Homework will be given 2-3 times per week.
- Projects will be given ample time to complete and may be individual or group assignments.
- Lab Reports
- Do Now Questions
- Exit Slips
- Group Assignments



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Lesson Plans

Lesson	Time Frame
Lesson 1 Powering a Community — Exploring Energy Transfer and Electricity Generation	3 days
Lesson 2 When Earth Moves — Forces, Energy, and Plate Tectonics	3 days
Lesson 3 Defending Earth — Gravity, Motion, and Predicting Meteor Impacts	3 days

Teacher Notes:

- This unit is designed around the theme of energy transfer within natural and engineered systems, allowing students to apply core physics principles to Earth science phenomena and real-world engineering challenges.
- Emphasize hands-on investigations, model development, and engineering design challenges throughout the unit. Students should regularly collect data, analyze evidence, build physical and computational models, and revise their thinking based on results.
- Encourage students to think about systems at multiple scales, from electrical circuits and energy devices to Earth's interior and planetary motion.
- Whenever possible, connect learning activities to current issues involving energy production, sustainability, resource management, natural hazards, and technological innovation.
- Computational thinking should be integrated throughout the unit using simulations, spreadsheets, graphing tools, and digital models to help students analyze complex systems and evaluate proposed solutions.
- Students should routinely consider tradeoffs associated with engineering decisions, including cost, efficiency, reliability, environmental impact, resource availability, and societal needs.
- The unit provides numerous opportunities for collaboration, communication, and evidence-based argumentation. Students should frequently explain phenomena using data, models, and scientific reasoning.
- Real-world phenomena should anchor instruction whenever possible. Examples may include electrical power generation, renewable energy systems, earthquakes, volcanic activity, satellite motion, asteroid tracking, and planetary defense initiatives.
- While Earth science phenomena provide the context, instruction should maintain a strong emphasis on core physics concepts including forces, energy transfer, fields, motion, conservation principles, and system interactions.
- Encourage students to compare multiple solution pathways when solving engineering problems and to evaluate how scientific knowledge informs decisions that affect communities locally and globally.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

- Informational aids, interactive digital labs, and additional resources for students: Physicsclassroom.com Hyperphysics.phy-astr.gsu.edu, <http://Phet.colorado.edu>, www.physics-chemistry-interactive-flash-animation.com/electricity_interactive.htm (circuit analysis)



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- Physics/Science YouTube Channels: Mark Rober, Veritasium, Vsauce, Walter Lewin, NASA, NASA JPL
- <https://phet.colorado.edu/>
- <https://www.nasa.gov/learning-resources/for-kids-and-students/>
- <https://www.usgs.gov/programs/earthquake-hazards>
- <https://learn.concord.org/>

Applications:

- Vernier Graphical Analysis Software
- Google Sheets, Google Docs, Google Slides



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Lesson Plan 1 Template

Content Area: Science
Electricity Generation

Lesson Title: Powering a Community – Exploring Energy Transfer and
Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Engineering, Environmental Science

Integration of Technology:

iPads for accessing energy production datasets, simulations, and collaborative documents
PhET simulations related to energy forms, circuits, and electricity generation
Google Sheets for organizing and graphing collected data
Digital mapping tools to investigate regional energy production and consumption
Vernier Go Direct sensors for measuring voltage, current, or energy transfer during investigations

Equipment Needed:

Hand-crank generators
Small DC motors
LEDs and light bulbs
Batteries
Wires with alligator clips
Magnets
Simple turbine materials (cardboard, cups, dowels, blades, tape)
Multimeters or Vernier electrical sensors
Fan for wind energy investigations
Water source or demonstration setup for hydroelectric modeling
Engineering design notebooks

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Investigate how energy is transferred and transformed within electrical generation systems	Lesson Sequence Anchoring phenomenon 1. Students examine maps showing how neighboring communities obtain electricity from different	- Energy transfer station investigation notes - Energy flow system models - Engineering design sketches and revisions



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- Develop and use models to explain energy flow through natural and engineered systems
- Collect and analyze quantitative data from energy generation devices
- Compare multiple methods of generating electricity based on efficiency, cost, environmental impact, and resource availability
- Design and refine a device that converts one form of energy into electrical energy
- Evaluate competing solutions for meeting the energy needs of a community
- Communicate evidence-based recommendations using scientific and engineering reasoning

- sources such as solar, wind, hydroelectric, nuclear, and fossil fuel power plants.
2. Students are presented with the challenge: "A growing community needs a reliable source of electricity. How should it generate its power?"
 3. Students work in teams to explore several energy conversion stations.
 4. At each station students investigate a different method of converting energy:
 - Hand-crank generator
 - Magnet and coil generator
 - Wind turbine model
 - Water turbine model
 5. Students record observations about inputs, outputs, and energy transformations occurring in each system.

Developing energy flow models

6. Students construct system diagrams showing how energy moves through each device.
7. Students identify where energy enters, is transferred, transformed, and leaves the system.
8. Groups compare models and revise them based on evidence gathered during investigations.

- Data tables and graphs from device testing
- Community energy planning worksheet
- Group presentation with evidence-based justification
- Exit ticket explaining how energy is transferred and transformed in one investigated system



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Engineering design challenge

9. Teams design and build a small device capable of generating electrical energy.
10. Design constraints include:
 - Limited materials
 - Cost limits
 - Minimum electrical output requirements
 - Reliability requirements
11. Students test designs using sensors and measurement tools.
12. Teams collect quantitative performance data and identify areas for improvement.
13. Students modify their designs based on collected evidence.
14. Teams compare tradeoffs among efficiency, cost, durability, and environmental considerations.
15. Students graph performance data and identify patterns in successful designs.

Community energy planning challenge

16. Each team is assigned a fictional community with unique characteristics:
 - Population size
 - Geographic location
 - Budget constraints
 - Available natural resources



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- Environmental priorities
- 17. Teams analyze energy options and recommend an energy portfolio for their community.
- 18. Recommendations must be supported by scientific, engineering, environmental, and economic evidence.
- 19. Teams present their proposed energy plans to the class.
- 20. Students evaluate competing proposals and discuss how communities balance societal needs, resource availability, environmental impacts, and financial constraints.
- 21. Students revisit the anchoring phenomenon and explain how physics principles guide real-world energy decisions.

Differentiation:

- Students may access information in multiple formats including visual models, written texts, diagrams, and digital simulations to support comprehension of scientific concepts.
- Students may demonstrate understanding through multiple modalities including written explanations, verbal presentations, visual models, diagrams, or digital products.
- Instruction includes scaffolded supports such as guided notes, sentence starters for scientific explanations, and partially completed models or data tables for students who need additional structure.
- Extension opportunities are provided through open-ended investigations, analysis of real-world case studies, or application of concepts to novel or complex scenarios.

Resources Provided:

- PhET Energy Forms and Changes simulation
- PhET Generator simulation
- NASA energy and Earth systems resources
- Community energy planning templates
- Engineering design notebook templates
- Data collection sheets
- Graphing and analysis templates



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Lesson Plan 2 Template

Content Area: Science
Tectonics

Lesson Title: When Earth Moves — Forces, Energy, and Plate
Time Frame: 3 day

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Engineering, Environmental Science

Integration of Technology:

iPads for accessing earthquake and plate tectonic datasets, simulations, and digital maps
Google Sheets for organizing and graphing earthquake and plate movement data
USGS earthquake mapping tools and real-time earthquake data
EarthViewer or similar Earth history and plate tectonic simulation tools
Vernier Go Direct sensors for motion and acceleration investigations

Equipment Needed:

Convection tank materials (clear containers, water, food coloring, heat source)
Foam sheets, cardboard, or wooden blocks for plate boundary models
Sand trays or stream tables
Spring scales
Dynamics carts
Masses and weights
Measuring tapes or meter sticks
Stopwatches
Marbles or balls for impact and motion investigations
Chart paper and markers
Engineering design notebooks

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Develop models to explain how thermal energy drives convection within Earth's interior	Lesson Sequence Anchoring phenomenon 1. Students examine footage, maps, and data from a major earthquake and are asked:	- Force, mass, and acceleration investigation data tables and graphs - Convection model observations and explanations



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- Analyze how forces influence the motion of tectonic plates
- Investigate the relationship between force, mass, and acceleration using experimental data
- Explain how energy is stored and released during geologic events such as earthquakes
- Analyze evidence used by scientists to model Earth's interior and plate motion
- Evaluate risks associated with geologic hazards and propose mitigation strategies
- Communicate scientific explanations using data, models, and evidence

2. "How can a planet that appears solid suddenly release enough energy to move entire cities?"
3. Students generate initial explanations and identify questions about the source of this energy.
4. Investigating force and motion:
5. Students conduct a hands-on investigation using dynamic carts and varying masses.
6. Groups measure how force, mass, and acceleration are related.
7. Students graph their results and identify patterns.
8. Students connect their observations to the movement of large-scale Earth systems.

Modeling convection and Earth's interior

9. Students construct and observe convection models using heated water and food coloring.
10. Students track the movement of material within the convection system.
11. Groups develop explanations for how thermal energy can drive movement in Earth's mantle.
12. Students compare their observations with accepted models of Earth's interior.

Modeling plate interactions

- Plate boundary model diagrams
- Earthquake energy release lab analysis
- Hazard mitigation design proposal
- Peer review of mitigation strategies
- Exit ticket explaining how thermal energy drives plate motion and contributes to earthquakes



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13. Students use foam sheets or plate models to investigate:
14. Divergent boundaries
15. Convergent boundaries
16. Transform boundaries
17. Students record observations about motion, forces, and energy transfer at each boundary type.
18. Groups develop diagrams illustrating the interactions occurring at each boundary.

Investigating earthquake energy release

19. Students create a simple fault model using blocks, sandpaper, and spring scales.
20. Students measure the force required to overcome friction and produce sudden movement.
21. Students analyze how energy can build gradually and then be released rapidly.
22. Groups compare their results to real earthquake data.

Engineering challenge

23. Teams are presented with a fictional community located near an active plate boundary.
24. Students analyze available geological and earthquake data.
25. Teams design recommendations for



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- reducing risk to people, infrastructure, and economic activity.
26. Constraints include budget limitations, population needs, environmental considerations, and available resources.
27. Teams present their hazard mitigation plans.
28. Students compare solutions and discuss how scientific understanding of forces and energy helps communities prepare for natural hazards.
29. Students revisit the anchoring phenomenon and explain how energy transfer, forces, and plate motion contributed to the earthquake event.

Differentiation:

- Students may access information in multiple formats including visual models, written texts, diagrams, and digital simulations to support comprehension of scientific concepts.
- Students may demonstrate understanding through multiple modalities including written explanations, verbal presentations, visual models, diagrams, or digital products.
- Instruction includes scaffolded supports such as guided notes, sentence starters for scientific explanations, and partially completed models or data tables for students who need additional structure.
- Extension opportunities are provided through open-ended investigations, analysis of real-world case studies, or application of concepts to novel or complex scenarios.

Resources Provided:

- USGS Earthquake Hazards Program resources
- EarthViewer simulation
- Plate boundary modeling templates
- Earthquake data analysis worksheets
- Engineering design challenge materials
- Graphing and data analysis templates
- CER (Claim-Evidence-Reasoning) response framework



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Lesson Plan 3 Template

Content Area: Science Lesson Title: Defending Earth — Gravity, Motion, and Predicting Meteor Impacts
Time Frame: 3 days

Lesson Components

21st Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☒ Health Literacy

21st Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

Interdisciplinary Connections:

Engineering, Environmental Science

Integration of Technology:

iPads for accessing NASA asteroid tracking data, orbital simulations, and collaborative documents
Google Sheets for organizing and analyzing motion and impact data
NASA Eyes on Asteroids and Solar System Explorer simulations
PhET Gravity Force Lab simulation
Digital graphing tools for modeling motion and gravitational relationships

Equipment Needed:

Marbles of various masses
Steel balls
Measuring tapes or meter sticks
Stopwatches
Large tarps or trays
Sand, flour, or kinetic sand for impact craters
Protractors
Calculators
String and washers for orbital motion models
Chart paper and markers
Engineering design notebooks

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Analyze how gravitational forces influence the motion of objects in space - Use mathematical and computational models to predict orbital motion	Lesson Sequence Anchoring phenomenon Students examine images and videos of the Chicxulub impact crater and recent asteroid flybys.	- Orbital motion investigation data and observations - Gravitational interaction models - Impact crater laboratory analysis - Data tables and graphs from crater investigations



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- | | | |
|--|---|--|
| <ul style="list-style-type: none">• Investigate the relationship between mass, distance, and gravitational attraction• Analyze evidence from meteorites and impact craters to explain Earth's history• Evaluate risks associated with near-Earth objects• Design and assess potential strategies for reducing the impact of asteroid threats• Communicate scientific and engineering solutions using evidence and data | <ol style="list-style-type: none">2. Students are asked: "How do scientists know whether an asteroid could collide with Earth, and what could we do if one was heading toward us?"3. Students construct simple orbital motion models using string, washers, and rotating masses to investigate how gravity influences motion.4. Students collect observations and compare the motion of objects under different conditions.5. Students use simulations to explore how mass and distance affect gravitational interactions.6. Students record patterns and develop explanations supported by evidence.7. Students create impact craters by dropping objects of different masses and heights into trays containing sand or flour.8. Groups measure crater diameter, depth, and ejecta patterns.9. Students organize data in Google Sheets and identify relationships among mass, velocity, and impact effects.10. Students examine evidence from meteorites, impact craters, and geological records.11. Groups analyze how impacts have shaped | <ul style="list-style-type: none">• Near-Earth object risk assessment worksheet• Planetary defense engineering proposal• Peer evaluation of proposed solutions• Exit ticket explaining how gravity influences orbital motion and how scientists predict potential impacts |
|--|---|--|



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Earth's history and influenced life on the planet.

12. Students compare multiple lines of scientific evidence used to reconstruct past impact events.
13. Students use provided orbital datasets and simulations to track near-Earth objects.
14. Groups evaluate the probability and consequences of potential impact scenarios.
15. Students discuss the scientific, economic, and societal challenges associated with planetary defense.

Engineering challenge

16. Teams are tasked with developing a strategy to protect Earth from a hypothetical asteroid predicted to intersect Earth's orbit.
17. Constraints include cost, available technology, implementation time, international cooperation, and potential risks.
18. Teams research proposed solutions such as kinetic impactors, gravity tractors, deflection missions, and evacuation planning.
19. Students develop evidence-based recommendations and justify their choices using scientific, engineering,



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- economic, and societal considerations.
20. Teams present their proposed planetary defense plans.
 21. Students evaluate competing solutions and provide feedback based on established criteria and constraints.
 22. Students revisit the anchoring phenomenon and explain how gravity, motion, evidence, and engineering contribute to predicting and mitigating asteroid impacts.

Differentiation:

- Students may access information in multiple formats including visual models, written texts, diagrams, and digital simulations to support comprehension of scientific concepts.
- Students may demonstrate understanding through multiple modalities including written explanations, verbal presentations, visual models, diagrams, or digital products.
- Instruction includes scaffolded supports such as guided notes, sentence starters for scientific explanations, and partially completed models or data tables for students who need additional structure.
- Extension opportunities are provided through open-ended investigations, analysis of real-world case studies, or application of concepts to novel or complex scenarios.

Resources Provided:

- NASA Eyes on Asteroids
- NASA Near-Earth Object resources
- PhET Gravity Force Lab simulation
- Impact crater investigation guide
- Planetary defense case studies
- Data analysis templates
- Engineering design planning sheets



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Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging Strongly and require higher order thinking and problem solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☒	☐	☐
Integrate 21st century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☐	☒	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☐	☒	☐

Curriculum Design Template

Content Area: Science **Grade Level:** 11 **Unit Title:** Energy, Forces, and Earth Systems: Understanding and Engineering Our Dynamic Planet

Created: 2026

Board Approved on:



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ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

IEP AND 504 ACCOMMODATIONS AND MODIFICATIONS FOR EARLY CHILDHOOD AND ELEMENTARY SCHOOL STUDENTS:

Large print textbooks
Textbooks for at-home use
Additional time for assignments
Review of directions
Use of mnemonics
Have student restate information
Concrete examples
Adaptive writing utensils
Support auditory presentations with visuals
Use of a study carrel
Assistance in maintaining uncluttered space
Weekly home-school communication tools (notebook, daily log, phone calls or email messages)
Space for movement or breaks
Study sheets and teacher outlines
Extra visual and verbal cues and prompts
Math sheets with highlighted instructions
Graph paper to assist in organizing or lining up math problems
Use of computers and calculators
Books on tape
Graphic organizers
Quiet corner or room to calm down and relax when anxious
Preferential seating
Alteration of the classroom arrangement
Reduction of distractions
Answers to be dictated
Hands-on activities
Use of manipulatives
No penalty for spelling errors or sloppy handwriting
Follow a routine/schedule
Alternate quiet and active time
Teach time management skills
Rest breaks
Verbal and visual cues regarding directions and staying on task
Agenda book and checklists
Adjusted assignment timelines
Visual daily schedule



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**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Untimed tests
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book tests
Read test and directions to student
Provide study outline prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator and/or number line for math tests
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS MODIFICATIONS:



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GLOBAL SKILLS

Breaks between tasks
Cue expected behavior
Daily feedback to student
Have contingency plans
Use de-escalating strategies
Use positive reinforcement
Use proximity/touch control
Use peer supports and mentoring
Model expected behavior by adults
Have parent sign homework
Have parent sign behavior chart
Set and post class rules
Chart progress and maintain data



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ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

IEP AND 504 ACCOMODATIONS AND MODIFICATIONS FOR MIDDLE AND HIGH SCHOOL STUDENTS:

- Large print textbooks
- Textbooks for at-home use
- Additional time for assignments
- A locker with adapted lock
- Review of directions
- Review sessions
- Use of mnemonics
- Have student restate information
- Provision of notes or outlines
- Concrete examples
- Adaptive writing utensils
- Support auditory presentations with visuals
- Weekly or bi-weekly home-school communication
- Space for movement or breaks
- Study sheets and teacher outlines
- Extra visual and verbal cues and prompts
- Lab and math sheets with highlighted instructions
- Graph paper to assist in organizing or lining up math problems
- Use of tape recorder for lectures
- Use of Interactive notebook
- Use of a scribe
- Use of computers and calculators
- Books on tape
- Graphic organizers
- Quiet corner or room to calm down and relax when anxious
- Preferential seating
- Alteration of the classroom arrangement
- Reduction of distractions
- Answers to be dictated
- Hands-on activities
- Ability to type all assignments
- Follow a routine/schedule
- Teach time management and organizational skills
- Rest breaks
- Verbal and visual cues regarding directions and staying on task
- Agenda book and checklists
- Daily check-in with case manager or special education teacher
- Adjusted assignment timelines
- Visual daily schedule



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**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book or open-note tests
Read test and directions to student
Provide study guides prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Pace long-term projects
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Allow outlining, instead of writing for an essay or major project
Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator for math tests
Film or video supplements in place of reading text
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Pass/no pass option
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS FOR STUDENTS:

- Breaks between tasks
- Cue expected behavior
- Daily feedback to student
- Have contingency plans
- Use de-escalating strategies
- Use positive reinforcement
- Use proximity/touch control
- Use peer supports and mentoring
- Model expected behavior by adults
- Have parent sign homework
- Set and post class rules
- Chart progress and maintain data



Accommodations and Modifications for ESL Students

- Give tests orally
- Give instructions/directions in writing and orally
- Assign a peer tutor, same language or English speaking
- Allow use of bilingual/translation dictionary
- Provide summaries of text or study guides of particular chapters
- Allow errors in speaking
- Allow errors in writing
- Accept writing in first language
- Highlight key vocabulary
- Reduce amount of work required
- Assess comprehension through demonstration or other alternative means (gestures, drawings)
- Rephrase questions, directions, and explanations
- Reduce multiple choices on assessments
- Provide study guides and/ or outlines
- Shorten reading assignments
- Allow extended time for test/project completion
- Use of audio books
- Use of graphic organizers
- Use reduced text, so that print is not dense
- Use visuals/pictures throughout lesson/unit/assignment
- Adapt homework to reflect language proficiency/home support
- Adapt homework to reflect home support
- Provide hands-on activities and explanations
- Allow extended time to answer questions, and permit drawing, as an explanation
- Use of translation dictionaries to locate words in the native language
- Use anecdotal records and portfolio of work as forms of assessment
- Use story retellings to assess comprehension

What Does the Gifted and Talented Experience Look Like? *Springfield Public Schools*

Mission Statement

The Gifted and Talented Program of the Springfield Public Schools aims to provide a meaningful and rigorous education that instills the value of lifelong learning and empowers all students to reach their full potential and become self-fulfilled creative leaders in accordance with the comprehensive standards of our state. We accomplish this by offering challenging, real-world experiences in a student-centered environment.

We recognize that students come from diverse socioeconomic, cultural, and ethnic backgrounds, and the mission of the gifted and talented program is to provide opportunities for students to explore their intellectual, creative, and artistic gifts and talents within the classroom and with beyond-the-classroom experiences. It is essential to provide diverse, appropriate, and ongoing learning experiences and environments that incorporate students' academic, psychological, and social needs. Our responsibility is to provide students with educational alternatives that teach, challenge, and expand their knowledge, while simultaneously stressing the development of independent and self-directed learners who continuously generate questions, analyze, synthesize, and evaluate information and ideas.

New Jersey Administrative Code 6A:8-3.1 defines students who are gifted and talented as those students who possess or demonstrate high levels of ability in one or more content areas when compared to their chronological peers in the local district and who require modification of their educational program if they are to achieve in accordance with their capabilities.

Goals:

To support our mission, we have established the following goals to guide our work:

- To infuse into the general education program a broad range of activities for high-level learning that will challenge all students to perform at advanced levels, and provide extended opportunities, resources, and support in particular areas where student interest or talent is demonstrated.
- To provide a continuum of gifted education services that will strengthen the total school program, offer enriching and challenging learning opportunities for all students, and provide specialized learning experiences
- To promote achievement of students' best potentials and increased ability.

Through a productive and collaborative relationship among the building principals, classroom teachers, and the Gifted and Talented teacher, our schools can create programming that will enhance the learning experience for every student and serve the unique and specialized needs of students currently demonstrating gifted behaviors.

Elements of the Schoolwide Enrichment Model, W.I.N (What I Need), differentiated instruction, advanced classes, or individual programs into a student's regular instruction program are integral to this overarching framework for gifted education in the Springfield School District.

Reference Board Policy and Regulation 2464 – Gifted and Talented Pupils (M)

Early Childhood Center **Edward V. Walton**

Schoolwide Virtual Enrichment

All first and second grade students have access to the [Gifted and Talented Virtual Classroom](#). This virtual classroom is a space for students to complete various challenges and enrichment opportunities at their own pace. Students can receive feedback and additional adaptable resources to meet their individual learning needs. The virtual classroom design expands accessibility to enrichment resources and allows students to choose learning activities according to their unique interests and abilities. The purpose of the activities is to encourage problem-solving, develop critical thinking

skills, and expand curiosity and imagination. Activities are aligned to the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

The Gifted and Talented teacher serves as a resource to all teachers within Edward V. Walton School. Teachers seeking resources for their high-ability learners will receive additional support from the Gifted and Talented teacher in various ways. This support may include additional units of study, challenging resources, and student projects.

Elementary Schools

James Caldwell

Thelma L. Sandmeier

The goal is to engage small groups of students in intensive learning experiences through standards-based, rigorous, and relevant units of study that supplement, not supplant, the grade-level curriculum and support students' unique learning needs.

Enrichment Experience Grade 3

Beginning in third grade, the G&T teacher will cycle through all classrooms to work on problem-solving and enrichment tasks with students. Driven by assessment data, academic performance, student interest, and teacher observation, small groups of students will meet with the G&T teacher during W.I.N. (What I Need) periods throughout the week that the teacher is assigned to their classroom teacher. Groupings will be flexible and monitored to best meet each student's needs throughout the school year. Activities will include brain teasers, puzzles, strategic thinking, problem-solving, and STEM challenges.

Targeted Gifted and Talented Programing Grades 4-5

Students may become identified as Gifted and Talented in fourth grade. Students that are identified may receive support from the G&T Teacher for up to five periods (200 minutes) a week during W.I.N. (What I Need) periods. Identified students will meet to explore grade-level content while incorporating depth and complexity in a student-centered, problem-based environment. The Gifted and Talented Program aims to provide students with various advanced and challenging learning experiences across content areas to promote independent thinking skills, refine critical thinking and communication skills, cultivate joy in learning, and expand student interests through problem-solving. The instruction that students receive incorporates 21st Century Skills and advanced content that is challenging, hands-on, and relevant to the real world.

Strategies and Practices that Support Gifted and Talented Students

- Adjusted Pace of Lessons
- Inquiry-Based Instruction
- Higher-Order Thinking Activities
- Interest-Based Content
- Real World Problem Solving/Problem Based Learning
- Independent Study/Passion Projects
- Units of Study with Like-Minded Peers

Schoolwide Virtual Enrichment

All JCS and TLS students have access to grade level-specific [Gifted and Talented Virtual Classrooms](#). These virtual classrooms are a space for students to complete various challenges and enrichment opportunities at their own pace. Students are able to receive feedback and additional opportunities based on their needs. The virtual classrooms have expanded the accessibility of enrichment resources directly to the students and allows for students to choose opportunities according to their interests and abilities. The purpose of the activities is to encourage problem solving, develop critical thinking skills, and expand curiosity and imagination in conjunction with the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

In addition to classroom support, the Gifted and Talented teacher also serves as a resource to all teachers in the building. Teachers that are seeking resources for their high ability learners will receive additional support from the Gifted and Talented teacher in various ways. This may include additional units of study, challenging resources, student projects, and meeting with the G&T teacher as needed.

Additional Enrichment Opportunities

Across all grade levels 3-5, as recommended by the classroom teacher, students exhibiting a need for additional enrichment may have the opportunity to meet with the G&T teacher as the schedule allows. Groupings will be flexible and monitored to best meet the students' needs throughout the school year. Activities will include, brain teasers, puzzles, strategic thinking activities, problem-solving challenges, and STEM challenges. Students engage in an extended process of asking questions, using resources, and developing answers that lead to thinking about what and how they are learning. Students are held accountable for how they work and use their time by demonstrating their learning through products or presentations.

Students self-select to participate in individual and/or group projects based on interest and commitment. The classroom teacher and/or the enrichment teacher will help guide and monitor student exploration of chosen topics, facilitating their learning with resources and teaching of needed skills.

Secondary Schools
Florence M. Gaudineer Middle School
Jonathan Dayton High School

Grades 6-12: Access to specific content programs with higher levels of academic challenges (i.e. Pre-Algebra, Accelerated Communication Arts, and Advanced Placement Classes)

Dual Credit Courses provide students the opportunity to obtain high school credit, and college credit, simultaneously through partnerships with several institutions.

Project Lead the Way (PLTW) students become builders of technology by engaging in real world activities. Students are empowered as design thinkers collaborating on real world projects.

Gifted and Talented Identification Criteria

The Springfield Schools Gifted and Talented Program recognizes that students require differentiated learning experiences beyond the core curriculum being taught because of their advanced abilities in one or more content areas. These students may also have other cognitive qualities such as curiosity, creativity, motivation, leadership, and passion that require modifications to their academic experience.

Multiple Measures of Eligibility

Kindergarten through grade twelve identification process for gifted and talented students includes multiple measures. Multiple measures may include but are not limited to: achievement test scores; grades; student performance or products; intelligence testing; parent, student, and/or teacher recommendation; and other appropriate measures. The identification methodology is developmentally appropriate, non-discriminatory, and related to the programs and services offered by the Springfield School District. The identification procedures are reviewed annually.

According to N.J.A.C. 6A:8-3.1, all public school districts must have a board-approved gifted and talented identification process and provide services for identified students enrolled in the grades of that school district. The regulations require that identification and services be made available to students in grades K-12.

When students are recommended for the Gifted and Talented Program there are multiple measures that are considered to determine if services are necessary and appropriate. The assessments used are as follows:

- Cognitive Abilities Test (CogAT)
- Classroom Performance/Student Portfolios
- DRA2 Level
- iReady Diagnostic Scores
- Gifted Indicators Checklist
- Start Strong/NJSLA Assessment Data

The N.J.A.C. requires that students be compared to their chronological peers in the local school district. The New Jersey Department of Education has not established state-level criteria for identifying students who are gifted, such as mandated tests or assessments, grade point averages, or IQ scores. Local school districts must use multiple measures to identify students.

Procedures

<https://www.straussesmay.com/seportal/Public/DistrictPolicy.aspx?policyid=2464&id=b8a33a9f505e4998a6db3fb8e1de778b>

Gifted and Talented Program Identification Matrix

Minimum Score Required for Consideration: 14 Points

1 Point	2 Points	3 Points
Cogat Assessment Overall Stanine Score of a 7	Cogat Assessment Overall Stanine Score of an 8	Cogat Assessment Overall Stanine Score of a 9
iReady Math Assessment Just Below Current Grade Level	iReady Math Assessment On Grade Level	iReady Math Assessment ½ Year + Above Current Level
iReady ELA On Grade Level	iReady ELA ½ Year Above Current Level	iReady ELA One Full Grade Level + Above Current Level
NJSLA Math Approaching Expectations	NJSLA Math Met Expectations	NJSLA Math Exceed Expectations
NJSLA ELA Approaching Expectations	NJSLA ELA Met Expectations	NJSLA ELA Exceed Expectations
HOPE Teacher Rating Scale Raw Score: 11 - 29	HOPE Teacher Rating Scale Raw Score: 30 - 49	HOPE Teacher Rating Scale Raw Score: 50-66

Team meetings present the opportunity to review data and assess the educational needs of all students. Teacher provides examples of student work exhibiting above and beyond grade level expectations, creativity, leadership, critical and abstract thinking. Programs for gifted and talented students will be periodically evaluated for their continuing efficacy and adjusted accordingly. The parent of any student identified as gifted or talented shall be consulted regarding any program designed to address the student's particular needs.

Resource Links

https://riversideinsights.com/cognitive_abilities_test

<https://www.curriculumassociates.com/programs/i-ready-learning>

<https://www.nj.gov/education/assessment/resources/>

<https://www.routledge.com/HOPE-Teacher-Rating-Scale-Involving-Teachers-in-Equitable-Identification/Gentry-Pereira-Peters-McIntosh-Fugate/p/book/9781618214522#:~:text=The%20HOPE%20Teacher%20Rating%20Scale.making%20it%20easy%20to%20use.>

Gifted and talented student: The "[*Strengthening Gifted and Talented Education Act*](#)" defines a gifted and talented student as a "student who possesses or demonstrates a high level of ability in one or more content areas when compared to their chronological peers in the school district and who require modifications of their educational program if they are to achieve in accordance with their capabilities."

Twice-exceptional (2E) students: A twice-exceptional (2E) student is defined as "a student who is both gifted and a student with a disability. These students may also be referred to as having dual exceptionalities or as being gifted with learning disabilities (GT/LD). This also applies to students who are gifted with ADHD or gifted with autism" (New Jersey Association for Gifted Children, www.nagc.org).

Instructional adaptation: An adjustment or modification to instruction enabling a student who is gifted and talented to participate in, benefit from, and demonstrate knowledge and application of the New Jersey Student Learning Standards in one or more content areas at the instructional level of the student, not just the student's grade level.

Identifying gifted and talented students: The focus of identification is to provide programming and services in which students' specific learning needs and potential are appropriately addressed and met. In every New Jersey school district, there are students who require modifications to the general education curriculum if they are to achieve in accordance with their abilities. By identifying a student's general intellectual ability, creativity, or specific academic area aptitudes, we are acknowledging that they need programming and services outside of the general education/grade level curriculum to advance their learning.

[NJDOE Fast Facts](#)

<https://www.nj.gov/education/standards/gifted/>

<https://www.nj.gov/education/standards/gifted/legislation.shtml>

Supplemental Resources/Programming for Gifted Students

Edward V. Walton

- PETS Program – Primary Education Thinking Skills
- Group Solutions/Group Solutions 2 – Cooperative Logic Activities
- Lollipop Logic
- Beginning Thinking Skills
- AIMS Education Programming

James Caldwell and Thelma L. Sandmeier

Math/ELA

- Project M3: Mentoring Mathematical Minds
- Junior Great Books
- AIMS Education Programming
- Borenson Hands on Equations
- BizWorld
- Perplexors
- Advanced Math Explorations grade 3-5
- Challenging Units for Gifted Learners (ELA and Math)
- Creative Curriculum Extenders
- Differentiated Lessons & Projects
- Challenge Math Grades 4+
- Differentiating Instruction with Menus (All Content Areas)
- Jacob's Ladder
- Genius Hour/Passion Project
- Spatial Reasoning
- Logic Puzzles, Brain Games, Analogies

STEM

- Engineering is Elementary
- Engineer Throughout the Year
- PBS Design Squad
- DefinedSTEM
- Project Lead the Way (PLTW)

Enrichment Events

Experience for all students to be enriched through events related to the curricular or extracurricular activities. Examples include after school clubs, PTA-sponsored events, leadership opportunities, visual and performing arts, and community service opportunities.