Unit #3: Physical Science- Energy

Content Area: **Science**
Course(s): **Grade 4**
Time Period: **Third Trimester**
Length: **12 Weeks**
Status: **Published**

Unit Overview

Thisunit provides first-hand experiences in physical science dealing with energy and change. Students investigate electricity and magnetism as related effects and engage in engineering design while learning useful applications of electromagnetism in everyday life. They explore energy transfer through waves, repeating patterns of motion, that result in sound and motion.

The five investigations focus on the concepts that energy is present whenever there is motion, electric, sound, light, or heat, and that energy can transfer from one place to other. Students conduct controlled experiments by incrementally changing variables to determine how to make an electromagnet stronger and how the amount of energy transfer changes when balls of different masses hit a stationary object. Students interpret data from graphs to build explanations from evidence and make predictions of future events. They develop models to represent how energy moves from place to place in electric circuits and in waves. Students gain experiences that will contribute to the understanding of crosscutting concepts of patterns; cause and effect; systems and system models; and energy and matter.

STAGE 1- DESIRED RESULTS

Educational Standards

2020 New Jersey Student Learning Standards- Science

Performance Expectations

Physical Sciences

SCI.4-PS4-1	Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
SCI.4-PS3-1	Use evidence to construct an explanation relating the speed of an object to the energy of that object.
SCI.4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
SCI.4-PS3	Energy
SCI.4-PS4-2	Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
SCI.4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
SCI.4-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.
SCI.4-PS4-3	Generate and compare multiple solutions that use patterns to transfer information.
SCI.4-PS4	Waves and their Applications in Technologies for Information Transfer

Life Sciences

SCI.4-LS1	From Molecules to Organisms: Structures and Processes
SCI.4-LS1-1	Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
SCI.4-LS1-2	Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Earth and Space Sciences

SCI.4-ESS1-1	Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
SCI.4-ESS3	Earth and Human Activity
SCI.4-ESS2	Earth's Systems
SCI.4-ESS2-2	Analyze and interpret data from maps to describe patterns of Earth's features.
SCI.4-ESS2-1	Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
SCI.4-ESS3-1	Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
SCI.4-ESS1	Earth's Place in the Universe
SCI.4-ESS3-2	Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Engineering Design

SCI.3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
SCI.3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
SCI.3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Science and Engineering Practices

- Practice 1: Asking Questions and Defining Problems
- Practice 2: Developing and Using Models
- Practice 3: Planning and Carrying Out Investigations
- Practice 4: Analyzing and Interpreting Data
- Practice 5: Using Mathematics and Computational Thinking
- Practice 6: Constructing Explanations and Designing Solutions
- Practice 7: Engaging in Argument from Evidence
- Practice 8: Obtaining, Evaluating, and Communicating Information

Cross Cutting Concepts

- Patterns
- Cause and Effect
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy and Matter
- Structure and Functions
- Stability and Change

Disciplinary Core Ideas

Physical Sciences

- PS1. Matter and Its Interaction
- PS1.A: Structure and Properties of Matter
- PS1.B: Chemical Reactions
- PS1.C: Nuclear Processes
- PS2. Motion and Stability: Forces of Interaction

- PS2.A: Forces and Motion
- PS2.B: Types of Interactions
- PS2.C: Stability and Instability in Physical Systems
- PS3. Energy
- PS3.A: Definitions of Energy
- PS3.B: Conservation of Energy and Energy Transfer
- PS3.C: Relationship Between Energy and Forces
- PS3.D: Energy and Chemical Processes in Everyday Life
- PS4. Waves and Their Applications in Technologies for Information Transfer
- PS4.A: Wave Properties
- PS4.B: Electromagnetic Radiation
- PS4.C: Information Technologies and Instrumentation

Life Sciences

- LS1. From Molecules to Organisms: Structure and Processes
- LS1.A: Structure and function
- LS1.B: Growth and development of organisms
- LS1.C: Growth and development of organisms
- LS1.D: Information Processing
- LS2. Ecosystems: Interactions, Energy, and Dynamics
- LS2.A: Interdependent relationships in ecosystems
- LS2.B: Cycles of matter and energy transfer in ecosystems
- LS2.C: Ecosystem dynamics, functioning, and resilience
- LS2.D: Social interactions and group behavior
- LS3. Heredity: Inheritance and Variation of Traits
- LS3.A: Inheritance of traits
- LS3.B: Variation of traits
- LS4. Biological Evolution: Unity and Diversity
- LS4.A: Evidence of common ancestry and diversity
- LS4.B: Natural selection
- LS4.C: Adaptation
- LS4.D: Biodiversity and humans

Earth and Space Sciences

- ESS1. Earth's Place in the Universe
- ESS1.A: The universe and its stars

- ESS1.B: Earth and the solar system
- ESS1.C: The history of planet Earth
- ESS2. Earth's System
- ESS2.A: Earth materials and systems
- ESS2.B: Plate tectonics and large-scale system interactions
- ESS2.C: The roles of water in Earth's surface processes
- ESS2.D: Weather and climate
- ESS2.E: Biogeology
- ESS3. Earth and Human Activity
- ESS3.A: Natural resources
- ESS3.B: Natural hazards
- ESS3.C: Human impacts on Earth systems
- ESS3.D: Global climate change

Essential Questions

Investigation 1: Energy and Circuits

Part 1: What is needed to light a bulb?

Part 2: What is needed to make a complete pathway for current to flow in a circuit?

Part 3: How can you light two bulbs brightly with one D-cell?

Part 4: Which design is better for manufacturing long strings of lights – series or parallel?

Investigation 2: The Force of Magnetism

Part 1: What materials stick to magnets?

Part 2: What happens when two or more magnets interact?

What happens when a piece of iron comes close to or touches a permanent magnet?

Part 3: What happens to the force of attraction between two magnets as the distance between them changes?

Investigation 3: Electromagnets

Part 1: How can you turn a steel rivet into a magnet that turns on and off?

Part 2: How does the number of winds of wire around a core affect the strength of the magnetism?

Part 3: How can you reinvent the telegraph using your knowledge of energy and electromagnetism?

Investigation 4: Energy Transfer

Part 1: What do we observe that provides evidence that energy is present?

Part 2: How does the starting position affect the speed of a ball rolling down a ramp?

Part 3: What happens when objects collide?

Investigation 5: Waves

Part 1: How are waves involved in energy transfer?

Part 2: How does light travel?

Part 3: How can you make a motor run faster using solar cells?

Enduring Understanding

This physical science unit develops students' understanding of how: 1) Energy is transferred and conserved; 2) Waves are used to transfer energy and information; and 3) To explain and predict interactions between objects and within systems of objects.

Students will know…

VOCABULARY

Investigation 1: Energy and Circuits

battery, bulb base, bulb casing, circuit, closed circuit, component, conductor, contact point, D-cell, electric current, electricity, energy, energy source, filament, insulator, light, lightbulb, metal, motion, motor, open circuit, parallel circuit, series circuit, shaft, short circuit, switch, system, terminal, transfer, wire

Investigation 2: The Force of Magnetism

attract, compass, force, gravity, induced magnetism, interact, iron, magnet, magnetic field, magnetism, north pole, opposite, permanent magnet, pole, repel, south pole, steel, temporary magnet

Investigation 3: Electromagnets

code, coil, core, electromagnet, electromagnetism, key, rivet, telegraph

Investigation 4: Energy Transfer

collide, collision, friction, fuel, heat, kinetic energy, potential energy, sound, stationary, transfer of energy

Investigation 5: Waves

amplitude, compression, cycle, frequency, mirror, peak, ray, reflect, reflection, refract, refraction, solar cell, trough, wave, wavelength

Students will be able to...

Investigation 1: Energy and Circuits

- Ask questions about the design of circuits to accomplish outcomes; define simple electrical circuit design problems.
- Develop and use models to understand the flow of electricity in circuits.
- Plan and carry out investigations dealing with series and parallel circuits to produce data to serve as evidence for the flow of electricity in circuits.
- Analyze and interpret data to make sense of the flow of electricity in circuits with multiple components using logical reasoning.
- Construct explanations using evidence, such as the relationships between the brightness of lightbulbs or the speed of the motion of a motor and the flow of electricity from a source to components.
- Engage in argument from evidence about the best design of a set of decorative lights.
- Obtain, evaluate, and communicate information from books and media and integrate that with their firsthand experiences to construct explanations about how electricity flows in circuits.

Investigation 2: The Force of Magnetism

- Plan and carry out investigations dealing with the effect of changing the distance between two attracting magnets. Collaboratively plan an investigation, control variables, collect data, and use the data to make predictions about what would happen if the distance between the magnets changed.
- Analyze and interpret data by using graphical displays of data to reveal patterns of attracting between two magnets and varying the distance between them; compare the data collected by different groups to discuss similarities and differences in the display of data.
- Use mathematics and computational thinking to organize quantitative data to reveal patterns that suggest a relationship between the force of attraction between two magnets and the distance between those magnets.
- Construct explanations using evidence, such as the relationship between type of material and the interaction with magnets; between the orientation of magnets and their interactions with each other; and between a free-swinging magnet and the magnetic north pole of Earth.
- Obtain, evaluate, and communicate information from books and media and integrate that with their firsthand experiences to construct explanations about how magnets and magnetic fields interact with materials.

Investigation 3: Electromagnets

- Define problems involved in the circuit design that uses an electromagnet to send a coded message.
- Develop and use models about the functioning of an electromagnet and its applications.

- Plan and carry out investigations dealing with the effect of changing the strength of an electromagnet. Collaboratively plan an investigation, control variables, collect data, and use the data to make predictions about what would happen if the variables of number of winds changed.
- Analyze and interpret data by using graphical displays of data to reveal patterns of attracting between number of winds and the strength of an electromagnet; compare the data collected by different groups to discuss similarities and differences.
- Use mathematics and computational thinking to organize quantitative data to reveal patterns that suggest a relationship between number of winds and strength of an electromagnet.
- Construct explanations and design solutions about the design of electromagnets.
- Obtain, evaluate, and communicate information from books and media and integrate that with their firsthand experiences to construct explanations about how magnets and magnetic fields interact with materials.

Investigation 4: Energy Transfer

- Ask questions about the energy of moving balls down ramps and design experiments to produce data to serve as the basis for evidence.
- Plan and carry out investigations dealing with the effect of balls of difference masses released from different starting positions on a ramp. Collaboratively plan an investigation, control variables, collect data, and use the data to make predictions about what would happen if one variable was changed.
- Analyze and interpret data by using tables to reveal patterns of transfer of energy from balls of different masses to a stationary cork. Compare the data collected independently by several groups to discuss similarities and differences in the displays of data.
- Use mathematics and computational thinking to organize quantitative data to reveal patterns that suggest a relationship between energy transferred when variables are changed.
- Construct explanations using evidence, such as the relationship between the potential energy and kinetic energy of balls rolling down ramps.
- Engage in argument from evidence about the presence of energy in different systems.
- Obtain, evaluate, and communicate information from books and media and integrate that with their firsthand experience to construct explanations about energy transfer and forces.

Investigation 5: Waves

- Ask questions and design solutions to use light waves and solar cells to transfer energy to a motor.
- Develop and use models to describe the properties of waves and how light travels.
- Plan and carry out investigations dealing with the effect of waves (ocean waves, sound waves, and light waves) in transferring energy and mirrors to redirect light waves.
- Analyze and interpret data by using these observations to make sense of how waves are involved in energy transfer and how light waves travel. Use data to evaluate and refine the circuitry involved in using solar cells to run a motor.
- Use mathematics and computational thinking to explain the properties of sound waves and relating the amplitude to volume intensity and the frequency to pitch.
- Construct explanations using evidence, such as how models help to explain the natural phenomena of energy transfer through waves. Design solutions by applying scientific ideas to solve the problem of how to design a solar cell and motor circuit to maximize the energy transfer.
- Obtain, evaluate, and communicate information from books and media and integrate that with their firsthand experiences to construct explanations about energy transfer and forces.

STAGE 2- EVIDENCE OF LEARNING

Formative Assessment Suggestions

- 3- Minute Pause
- A-B-C Summaries
- Analogy Prompt
- Choral Response
- Debriefing
- Exit Card / Ticket
- Hand Signals
- Idea Spinner
- Index Card Summaries
- Inside-Outside Circle Discussion (Fishbowl)
- Journal Entry
- Misconception Check
- Observation
- One Minute Essay
- One Word Summary
- Portfolio Check
- Questions & Answers
- Quiz
- Self-Assessment
- Student Conference
- Think-Pair-Share
- Web or Concept Map

Authentic Assessments Suggestions

Investigation 1: Energy and Circuits

- Science notebook entries
- Response sheet
- Performance assessments
- Survey
- Investigation 1 I-Check

Investigation 2: The Force of Magnetism

- Science notebook entries
- Response sheet
- Performance assessment
- Investigation 2 I-Check

Investigation 3: Electromagnets

- Response sheet
- Performance assessment
- Science notebook entries
- Investigation 3 I-Check

Investigation 4: Energy Transfer

- Performance assessment
- Science notebook entries
- Response sheet
- Investigation 4 I-Check

Investigation 5: Waves

- Science notebook entries
- Response sheet
- Performance assessment

Benchmark Assessments

Unit Posttest

STAGE 3- LEARNING PLAN

Instructional Map

Investigation 1: Energy and Circuits

Investigation 2: The Force of Magnetism

Investigation 3: Electromagnets

Investigation 4: Energy Transfer

Investigation 5: Waves

Investigation 1: Energy Circuits

Investigation 1: Part 1 – Lighting a Bulb

Students are introduced to electricity and energy. They discover how to make a complete circuit using a D-cell, wires, and a lightbulb. Upon successfully lighting their bulbs, students discuss the electricity's pathway in the circuit and the function of each of the system's components. They also take a close look at the anatomy of a lightbulb.

Content:

- An electric circuit is a system that includes a complete pathway through which electric current flows from an energy source to its components.
- Electricity transfers energy that can produce heat, light, sound, and motion. Electricity can be produced from a variety of sources.

Investigation 1: Part 2 – Conductors and Circuits

Students are introduced to a switch and a motor and make a circuit that they can turn on and off. Students use a circuit and a collection of objects to determine which materials can complete the pathway (conductors) and which cannot (insulators). After developing the rule that metals are conductors, students consider foils and use evidence to confirm that foils are indeed metal.

Content:

- An electric circuit is a system that includes a complete pathway through which electric current flows from an energy source to its components.
- Electricity transfers energy that can produce heat, light, sound, and motion. Electricity can be produced from a variety of sources.
- Conductors are materials through which electric current can flow; all metals are conductors.

Investigation 1: Part 3 – Series and Parallel Circuits

Students find ways to operate more than one lightbulb in a circuit. They devise a series circuit to operate two bulbs with one D-cell, but the lights are dim. Students learn that they can connect two bulbs in a way that allows both to shine brightly using two cells or a single D-cell. They wire two bulbs in parallel and find that many bulbs can be made to shine brightly on a single D-cell when they are wired in parallel.

Content:

- In a series circuit, there is a single pathway from the energy source to the components.
- In a parallel circuit, each component has its own direct pathway to the energy source.
- Two bulbs can be lit brightly using parallel circuitry, one in which each bulb has direct access to the energy source.

Investigation 1: Part 4 – Solving the String-of-Lights Problem

Students investigate which type of circuit would be the best design for a string of lights. They analyze the designs and make a recommendation based on their knowledge of circuitry.

Content:

- In a series circuit, all lights share a single pathway; if one light burns out, current stops flowing, causing all the bulbs to go out.
- In a parallel circuit, each light has its own pathway to the source; if one light burns out, current continues flowing, and the remaining bulbs continue to shine.

Investigation 2: The Force of Magnetism

Investigation 2: Part 1 – Magnets and Materials

Students discover that iron-containing objects stick to permanent magnets; other objects do not. They generate a rule for magnetic interaction with materials: If a magnet sticks to an object, that object is most likely made of iron or its alloy, steel. Students go outdoors and use their magnets as iron detectors.

Content:

- Magnets interact with each other and with some materials.
- Magnets stick to (attract) objects that contain iron. Iron is the only common metal that sticks to magnets. (Steel is a material made mostly of iron.)

Investigation 2: Part 2 – Magnetic Fields

Students observe that the two sides (poles) of magnets are different, attracting or repelling one another, depending on orientation. Students work with magnets and other objects to discover that magnetism acts through air, most metals, and all nonmetals. They also discover that bringing a magnet close to a piece of iron induces magnetism in the iron. Students learn that these effects are manifestations of the invisible magnetic field that surrounds every magnet.

Content:

- Magnets are surrounded by an invisible magnetic field, which acts through space and through most materials.
- When an object enters a magnetic field, the field induces magnetism in the iron object, and the object becomes a temporary magnet.
- All magnets have two poles, a north pole at one end (side) and a south pole at the other end (side). Like poles of magnets repel each other, and opposites attract.

Investigation 2: Part 3 – Magnetic Force

Students use a balance to measure the force of attraction between magnets. They increase the distance between the magnets and remeasure the force. Students learn that the force of attraction between magnets decreases as the distance between them increases.

Content:

- The magnetic force acting between magnets declines as the distance between them increases.
- Earth has a magnetic field.

Investigation 3: Electromagnets

Investigation 3: Part 1 – Building an Electromagnet

Students discover that a steel core becomes a magnet when current flows through an insulated wire wound around the steel core. They find out where to wind the wire on the core to produce the strongest magnet.

Content:

- A magnetic field surrounds a wire through which electric current is flowing.
- The magnetic field produced by a current-carrying wire can induce magnetism in a piece of iron or steel.

Investigation 3: Part 2 – Changing the Strength

Students experiment to find out how the number of winds of wire affects the strength of magnetism. After collecting data for a 20-wind, 30-wind, 40-wind electromagnet, students graph the results. They predict the strength of magnetism based on the graph.

Content:

- An electromagnet is made by sending electric current through an insulated wire wrapped around an iron core.
- The number of winds of wire in an electromagnet coil affects the strength of the magnetism induced in the core (more winds = more magnetism).
- The amount of electric current flowing in an electromagnet circuit affects the strength of the magnetism in the core (more current = stronger magnetism).

Investigation 3: Part 3 – Reinventing the Telegraph

Students apply their knowledge of circuitry and electromagnetism to build a telegraph. They invent a code and use their telegraphs to send messages to each other. Finally, they take on the long-distance challenge by wiring two telegraph units together using long wires.

Content:

- A telegraph system is an electromagnet-based technology used for long-distance communication.

Investigation 4: Energy Transfer

Investigation 4: Part 1 – Presence of Energy

Students work in centers to explore evidence of energy when sound, heat, and light are produced, and when objects are in motion.

Content:

- Energy is evident whenever there is motion, electric current, sound, light, or heat. Energy can be transferred from place to place.
- Energy can be transferred by using fossil fuels or renewable sources. As the need for energy increases, the use of renewable sources will help meet energy needs.

Investigation 4: Part 2 – Rolling Balls Down Slopes

Students roll steel balls of different sizes down ramps and explore the system's variables. They conduct structured investigations to discover how the variables of starting position on the ramp and ball size (mass) affect the speed of a rolling ball.

Content:

- Kinetic energy is energy of motion; potential energy is energy of position or condition.
- The faster an object is moving, the more kinetic energy it has.
- Objects at higher positions have more potential energy.

Investigation 4: Part 3 – Collisions

Students place an obstacle (cork) in the pathway of a steel ball rolling down a ramp, forcing them to collide. They investigate the variables that determine how far the cork will move along the runway. Using controlled experiments, students test the variables of mass and starting position to find out how these variables affect energy transfer.

Content:

- When objects collide, energy can transfer from between objects, thereby changing their motion.
- The faster an object is moving the more kinetic energy it has.
- When two objects interact, each one exerts a force on the other, and these forces can transfer energy.
- Objects at higher heights have more potential energy.

Investigation 5: Waves

Investigation 5: Part 1 – Forms of Waves

Students experience waves through firsthand experience using ropes, demonstrations with waves in water, spring toys, and a sound generator. They also use videos, animations, and readings to gather information. Through these experiences, students learn that waves are repeating patterns of motion that transfer energy from place to place. They analyze compression waves (sound waves) to learn the general properties of waves – amplitude, wavelength, and frequency.

Content:

- Waves are a repeating pattern of motion that transfer energy from place to place.
- There are sound waves, light waves, radio waves, microwaves, and ocean waves.
- Waves have properties – amplitude, wavelength, and frequency.
- Some electromagnetic waves can be detected by humans (light); others can be detected by designed technologies (radio waves).

Investigation 5: Part 2 – Light Travels

Students use mirrors to experience reflecting light. They start by using mirrors outdoors to see objects behind them and to reflect a bright image of the Sun onto walls. In the classroom, they determine that a mirror can be used to reflect light. Students then use flashlights, mirrors, and water to observe light in numerous ways, reinforcing the idea that light can reflect and refract. Students build a conceptual model about how light travels.

Content:

- Light travels in a straight line and can reflect (bounce) off surfaces.
- An object is seen only when light from that object enters and is detected by an eye.
- Light can refract (change direction) when it passes from one transparent material into another.

Investigation 5: Part 3 – Engineering with Solar Cells

Students design series and parallel solar cell circuits and observe the effect on the speed of a motor. They observe that cells in series make the motor run faster, but cells in parallel do not deliver additional power to the motor. They read about alternative energy sources.

Content:

- The energy of two energy sources (D-cells or solar cells) adds when they are wired in series, delivering more power than a single source.
- Two cells in parallel have the same power as a single cell.

Modifications/Differentiation of Instruction

Differentiation Strategies for Special Education Students

- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Differentiation Strategies for Gifted and Talented Students

- Increase the level of complexity
- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Differentiated Strategies for ELL Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials, including visuals
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Allow students to work at their own pace

- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Role play
- Provide graphic organizers, highlighted materials
- Strategy and flexible groups based on formative assessment

Differentiation Strategies for At Risk Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in "chunks"
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment

504 Plans

Students can qualify for 504 plans if they have physical or mental impairments that affect or limit any of their abilities to:

- walk, breathe, eat, or sleep
- communicate, see, hear, or speak
- read, concentrate, think, or learn
- stand, bend, lift, or work

Examples of accommodations in 504 plans include:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork
- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- adjusted class schedules or grading
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy

Modification Strategies

- Extended Time
- Frequent Breaks
- Highlighted Text
- Interactive Notebook
- Modified Test
- Oral Directions
- Peer Tutoring
- Preferential Seating
- Re-Direct
- Repeated Drill / Practice
- Shortened Assignments
- Teacher Notes
- Tutorials
- Use of Additional Reference Material
- Use of Audio Resources

High Preparation Differentiation

- Alternative Assessments
- Choice Boards
- Games and Tournaments
- Group Investigations

- Guided Reading
- Independent Research / Project
- Interest Groups
- Learning Contracts
- Leveled Rubrics
- Literature Circles
- Menu Assignments
- Multiple Intelligence Options
- Multiple Texts
- Personal Agendas
- Project Based Learning (PBL)
- Stations / Centers
- Think-Tac-Toe
- Tiered Activities / Assignments
- Varying Graphic Organizers

Low Preparation Differentiation

- Choice of Book / Activity
- Cubing Activities
- Exploration by Interest (using interest inventories)
- Flexible Grouping
- Goal Setting With Student
- Homework Options
- Jigsaw
- Mini Workshops to Extend Skills
- Mini Workshops to Re-teach
- Open-ended Activities
- Think-Pair-Share by Interest
- Think-Pair-Share by Learning Style
- Think-Pair-Share by Learning Style
- Think-Pair-Share by Readiness
- Use of Collaboration
- Use of Reading Buddies
- Varied Journal Prompts
- Varied Product Choice
- Varied Supplemental Materials
- Work Alone / Together

Horizontal Integration- Interdisciplinary Connections

New Jersey Student Learning Standards for Mathematics

N-Q.A.Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; chose and interpret the scale and the origin in graphs and data displays
2. Define appropriate quantities for the purpose of descriptive modeling.
3. Choose the level of accuracy appropriate to limitations on measurement when reporting quantities.

N-CN.A. Perform arithmetic operations with complex numbers.

1. Know there is a complex number.
2. Use the commutative, associative, and distributive properties.

A-SSE.A. Interpret the structure of expressions

1. Interpret expressions that represent a quantity in terms of its context.

A-SSE.B. Write expressions in equivalent forms to solve problems.

1. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

F-IF.A. Understand the concept of a function and use functional notation.

1. Understand that a function from one set to another set.

F-IF.B Interpret functions that arise in applications in terms of the context.

F-IF.C. Analyze functions using different representations

S-ID.A. Summarize, represent, and interpret data on a single count or measurement variable

1. Represent data with plots on a real number line.

S-ID.B. Summarize, represent, and interpret data on two categorical and quantitative variables.

S-ID.C. Interpret linear models.

S-IC.A. Understand and evaluate random processes underlying statistical experiments.

S-IC.B. Make inferences and justify conclusions from surveys, experiments, and observational studies.

English Language Arts Standards – Grade 4

RI 1: Ask and answer questions about key details.

RI 2: Identify main topic and retell key details.

RI 3: Describe the connection between two ideas.

RI 4: Ask and answer questions about unknown words.

RI 5: Identify the front cover, back cover, and title page of a book.

RI 6: Distinguish their own point of view from that of the author of the text.

RI 7: Describe the relationship between illustrations and the text.

RI 8: Identify the reasons an author gives to support points.

RI 9: Identify similarities in and differences between text on the same topic.

RI 10: Actively engage in group reading activities with purpose and understanding.

W 2: Write informative /explanatory text.

W 5: Strengthen writing by revising and editing.

W 8: Gather information to answer a question.

W 9: Draw evidence from informational text to support reflection.

SL 1: Participate in collaborative conversations.

SL 2: Ask and answer questions about key details and request clarification.

SL 4: Describe with details.

SL 5: Add drawings or other visual displays to recounts of experiences.

L 3: Use knowledge of language and its conventions when writing, speaking, reading, or listening.

L 4: Determine or clarify the meaning of unknown or multiple meaning words and phrases.

L 5: Demonstrate understanding of word relationships and nuances in word meanings.

L 6: Use acquired words and phrases.

RF 4: Read text with purpose and understanding.

2020 New Jersey Student Learning Standards- Computer Science and Design Thinking

Computer Science and Design Thinking Practices

CSDT.K-12.CSDTP1	Fostering an Inclusive Computing and Design Culture
CSDT.K-12.CSDTP2	Collaborating Around Computing and Design
CSDT.K-12.CSDTP3	Recognizing and Defining Computational Problems
CSDT.K-12.CSDTP4	Developing and Using Abstractions
CSDT.K-12.CSDTP5	Creating Computational Artifacts
CSDT.K-12.CSDTP6	Testing and Refining Computational Artifacts
CSDT.K-12.CSDTP7	Communicating About Computing and Design

8.2 Design Thinking

8.2.5.ED.1: Explain the functions of a system and its subsystems. 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models. 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task. 8.2.5.ED.4: Explain factors that influence the development and function of products and systems (e.g., resources, criteria, desired features, constraints). 8.2.5.ED.5: Describe how specifications and limitations impact the engineering design process. 8.2.5.ED.6: Evaluate and test alternative solutions to a problem using the constraints and trade-offs identified in the design process.
8.2.5.ITH.1: Explain how societal needs and wants influence the development and function of a product and a system. 8.2.5.ITH.2: Evaluate how well a new tool has met its intended purpose and identify any shortcomings it might have. 8.2.5.ITH.3: Analyze the effectiveness of a new product or system and identify the positive and/or negative consequences resulting from its use. 8.2.5.ITH.4: Describe a technology/tool that has made the way people live easier or has led to a new business or career.
8.2.5.NT.1: Troubleshoot a product that has stopped working and brainstorm ideas to correct the problem. 8.2.5.NT.2: Identify new technologies resulting from the demands, values, and interests of individuals, businesses, industries, and societies. 8.2.5.NT.3: Redesign an existing product for a different purpose in a collaborative team. 8.2.5.NT.4: Identify how improvement in the understanding of materials science impacts

technologies.
8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems. 8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources. 8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved. 8.2.5.ETW.4: Explain the impact that resources, such as energy and materials used to develop technology, have on the environment. 8.2.5.ETW.5: Identify the impact of a specific technology on the environment and determine what can be done to increase positive effects and to reduce any negative effects, such as climate change.
8.2.5.EC.1: Analyze how technology has contributed to or reduced inequities in local and global communities and determine its short- and long-term effects.

2020 New Jersey Student Learning Standards- Career Readiness, Life Literacies, and Key Skills

Career Readiness, Life Literacies, and Key Skills Practices

CRP.K-12.CRP1	Act as responsible and contributing community members and employee.
CRP.K-12.CRP2	Attend to financial well-being.
CRP.K-12.CRP3	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP4	Demonstrate creativity and innovation.
CRP.K-12.CRP5	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP6	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP7	Plan education and career paths aligned to personal goals.
CRP.K-12.CRP8	Use technology to enhance productivity, increase collaboration and communicate effectively.
CRP.K-12.CRP9	Work productively in teams while using cultural/global competence.

9.2 Career Awareness and Planning

9.2.5.CAP.1: Evaluate personal likes and dislikes and identify careers that might be suited to personal likes. 9.2.5.CAP.2: Identify how you might like to earn an income. 9.2.5.CAP.3: Identify qualifications needed to pursue traditional and non-traditional careers and occupations. 9.2.5.CAP.4: Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.

9.4 Life Literacies and Key Skills

9.4.5.CI.1: Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6). 9.4.5.CI.2: Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue (e.g., 6.3.5.CivicsPD.3, W.5.7). 9.4.5.CI.3: Participate in a brainstorming session with individuals with diverse perspectives to expand one's thinking about a topic of curiosity (e.g., 8.2.5.ED.2, 1.5.5.CR1a). 9.4.5.CI.4: Research the development process of a product and identify the role of failure as a part of the creative process (e.g., W.4.7, 8.2.5.ED.6).
9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2). 9.4.5.CT.2: Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1). 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems. 9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).
9.4.5.DC.1: Explain the need for and use of copyrights. 9.4.5.DC.2: Provide attribution according to intellectual property rights guidelines using public domain or creative commons media. 9.4.5.DC.3: Distinguish between digital images that can be reused freely and those that have copyright restrictions. 9.4.5.DC.4: Model safe, legal, and ethical behavior when using online or offline technology (e.g., 8.1.5.NI.2). 9.4.5.DC.5: Identify the characteristics of a positive and negative online identity and the lasting implications of online activity. 9.4.5.DC.6: Compare and contrast how digital tools have changed social interactions (e.g., 8.1.5.IC.1). 9.4.5.DC.7: Explain how posting and commenting in social spaces can have positive or negative

consequences. 9.4.5.DC.8: Propose ways local and global communities can engage digitally to participate in and promote climate action (e.g., 6.3.5.GeoHE.1).
9.4.5.IML.1: Evaluate digital sources for accuracy, perspective, credibility and relevance (e.g., *Social Studies Practice* - Gathering and Evaluating Sources). 9.4.5.IML.2: Create a visual representation to organize information about a problem or issue (e.g., 4.MD.B.4, 8.1.5.DA.3). 9.4.5.IML.3: Represent the same data in multiple visual formats in order to tell a story about the data. 9.4.5.IML.4: Determine the impact of implicit and explicit media messages on individuals, groups, and society as a whole. 9.4.5.IML.5: Distinguish how media are used by individuals, groups, and organizations for varying purposes. (e.g., 1.3A.5.R1a). 9.4.5.IML.6: Use appropriate sources of information from diverse sources, contexts, disciplines, and cultures to answer questions (e.g., RI.5.7, 6.1.5.HistoryCC.7, 7.1.NM. IPRET.5). 9.4.5.IML.7: Evaluate the degree to which information meets a need including social emotional learning, academic, and social (e.g., 2.2.5. PF.5).
9.4.5.TL.1: Compare the common uses of at least two different digital tools and identify the advantages and disadvantages of using each. 9.4.5.TL.2: Sort and filter data in a spreadsheet to analyze findings. 9.4.5.TL.3: Format a document using a word processing application to enhance text, change page formatting, and include appropriate images graphics, or symbols. 9.4.5.TL.4: Compare and contrast artifacts produced individually to those developed collaboratively (e.g., 1.5.5.CR3a). 9.4.5.TL.5: Collaborate digitally to produce an artifact (e.g., 1.2.5CR1d).

Vertical Integration- Discipline Mapping

PS2: Kindergarten: Materials and Motion

Grade 3: Motion and Matter

Grade 5: Earth and Sun

Grade 7: Electromagnetic Force, Gravitational, and Kinetic Forces

PS3: Kindergarten: Materials and Motion; Trees and Weather

Grade 5: Living Systems

Grade 6: Weather and Water

Grade 7: Electromagnetic Force, Gravitational, and Kinetic Forces

Grade 8: Chemical Interactions

PS4: Grade 1: Sound and Light

Grade 6: Waves

Preparation for high school science courses

Additional Materials

Visit FOSSWEB.com for list of websites, and additional readings.