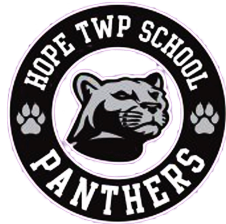


# Belvidere Clusterwide Curriculum



Science

8th Grade

Updated Summer, 2024

**All Belvidere Cluster curriculum and instruction areas are aligned to the New Jersey Student Learning Standards (NJSLS) in accordance with the NJ Department of Education's curriculum implementation requirements.**

**Curriculum Coordinator: Timm Gast**

UNITS	Duration	Essential Questions:
Unit 1: Matter and its Interactions	12 Weeks	How can one explain the structure, properties, and interactions of matter?
Unit 2: Motion and Stability: Forces and Interactions	10 Weeks	How can one describe physical interactions between objects and within systems of objects?
Unit 3: Energy	10 Weeks	How can energy be transferred and conserved?
Unit 4: Waves and Their Applications in Technologies for Information Transfer	8 Weeks	What are the characteristic properties of waves and how can they be used?
Engineering Design	Incorporated throughout the year	Students engage in practices to build, deepen, and apply their knowledge of core ideas and crosscutting concepts.

## Student Learning

### Career Education (NJDOE CTE Clusters)

#### Career Readiness, Life Literacies, and Key Skills:

- 9.4.8.CI.1: Assess data gathered on varying perspectives on causes of *climate change* (e.g., cross cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions.
- 9.4.8.CI.2: Repurpose an existing resource in an innovative way.
- 9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas
- 9.4.8.CI.4: Explore the role of creativity and innovation in career pathways and industries
- 9.4.8.CT.1: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective.
- 9.4.8.CT.2: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
- 9.4.8.CT.3: Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
- 9.4.8.TL.1: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
- 9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem
- 9.4.8.TL.3: Select appropriate tools to organize and present information digitally.
- 9.4.8.TL.4: Synthesize and publish information about a local or global issue or event
- 9.4.8.TL.5: Compare the process and effectiveness of synchronous collaboration and asynchronous collaboration.
- 9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
- 9.4.8.DC.1: Analyze the resource citations in online materials for proper use.
- 9.4.8.DC.2: Provide appropriate citation and attribution elements when creating media products
- 9.4.8.GCA.1: Model how to navigate cultural differences with sensitivity and respect
- 9.4.8.GCA.2: Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
- 9.4.8.IML.1: Critically curate multiple resources to assess the credibility of sources when searching for information.
- 9.4.8.IML.2: Identify specific examples of distortion, exaggeration, or misrepresentation of information.
- 9.4.8.IML.3: Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping
- 9.4.8.IML.4: Ask insightful questions to organize different types of data and create meaningful visualizations.
- 9.4.8.IML.5: Analyze and interpret local or public data sets to summarize and effectively communicate the data.
- 9.4.8.IML.6: Identify subtle and overt messages based on the method of communication.
- 9.4.8.IML.7: Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose.
- 9.4.8.IML.8: Apply deliberate and thoughtful search strategies to access high-quality information on *climate change*.
- 9.4.8.IML.9: Distinguish between ethical and unethical uses of information and media
- 9.4.8.IML.10: Examine the consequences of the uses of media.
- 9.4.8.IML.11: Predict the personal and community impact of online and social media activities.
- 9.4.8.IML.12: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.
- 9.4.8.IML.13: Identify the impact of the creator on the content, production, and delivery of information.
- 9.4.8.IML.14: Analyze the role of media in delivering cultural, political, and other societal messages.
- 9.4.8.IML.15: Explain ways that individuals may experience the same media message differently

#### 21st Century Themes:

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

- Creativity and Innovation
- Critical Thinking
- Problem Solving
- Communication
- Collaboration
- Information Literacy
- Media Literacy
- ICT (Information, Communication and Technology) Literacy
- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.
- 1.1.1.A.1 Relate how career choices, education choices, skills, entrepreneurship, and economic conditions affect income.
- 1.1.1.A.2 Differentiate among ways that workers can improve earning power through the acquisition of new knowledge and skills.
- 9.1.8.A.5 Relate how the demand for certain skills determines an individual's earning power.
- 9.1.8.D.5 Explain the economic principle of supply and demand.
- 1.1.1.A.1 Identify personal information that should not be disclosed to others and the possible consequences of doing or not doing so
- 1.1.1.A.2 Compare and contrast product facts versus advertising claims.
- 9.1.8.E.4 Prioritize personal wants and needs when making purchases
- 9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career

### **Reading and Writing Companion Standards**

#### **Language Domain** ([see substandards for related sub strands](#))

- L.SS.8.1. Demonstrate command of the system and structure of the English language when writing or speaking.
- L.KL.8.2. Use knowledge of language and its conventions when writing, speaking, reading, or listening.
- L.VL.8.3. Determine or clarify the meaning of unknown and multiple-meaning words or phrases based on grade 8 reading and content, including technical meanings, choosing flexibly from a range of strategies.
- L.VI.8.4. Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.

#### **Reading Domain:**

- RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text.
- RI.CR.8.1. Cite a range of textual evidence and make clear and relevant connections (including informational text features such as charts, graphs, and diagrams) that strongly support an analysis of multiple aspects of what an informational text says explicitly, as well as inferences drawn from the text.
- RL.CI.8.2. Determine a theme of a literary text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
- RI.CI.8.2. Determine a central idea of an informational text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
- RL.IT.8.3. Analyze how particular elements of a text interact (e.g., how setting shapes the characters or plot, how ideas influence individuals or events, or how characters influence ideas or events) across multiple text types, including across literary and informational texts.

- RI.IT.8.3. Analyze how particular elements of a text interact (e.g., how contexts influence individuals or events, or how individuals influence ideas or events) across multiple text types, including across literary and informational texts.
- RL.TS.8.4. Compare and contrast the structure of texts, analyzing how the differing structure of each text contributes to its meaning, tone and style.
- RI.TS.8.4. Analyze and explain how an author organizes, develops and presents ideas, establishes a point of view or builds supporting arguments through text structure.
- RL.PP.8.5. Analyze how an author conveys or develops their perspective or purpose in a text through the use of different perspectives of the characters and that of the audience or reader (e.g., created through the use of dramatic irony).
- RI.PP.8.5. Analyze how an author conveys or develops their perspective or purpose in a text and by acknowledging and responding to conflicting evidence or viewpoints.
- RL.MF.8.6. Evaluate the choices made (by the authors, directors or actors) when presenting an idea in different mediums, including the representation/s or various perspectives of a subject or a key scene in two different artistic mediums (e.g., a person's life story in both print and multimedia), as well as what is emphasized or absent in each work.
- RI.MF.8.6. Evaluate the choices made (by the authors, directors, or actors) when presenting an idea in different mediums and the advantages and disadvantages of using different mediums or formats (e.g., visually, quantitatively) to address a question or solve a problem.
- RI.AA.8.7. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced.
- RL.CT.8.8. Analyze and reflect on how the author's idea in fiction and literary nonfiction texts (e.g., practical knowledge, historical/cultural context, and background knowledge) is shaped by the author's emphasis on different evidence, advancing different interpretations of facts, or fictional portrayal of a time, place, or character and a historical account of the same period.
- RI.CT.8.8. Analyze and reflect on (e.g., practical knowledge, historical/cultural context, and background knowledge) two or more informational texts that provide conflicting information on the same topic and identify where the texts disagree on matters of fact or interpretation.

**Writing Domain:** ([see substandards for related sub strands](#))

- W.AW.8.1. Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence.
- W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- W.NW.8.3. Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.
- W.WP.8.4. With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, sustaining effort to complete complex writing tasks; seeking out assistance, models, sources or feedback to improve understanding or refine final products; focusing on how well purpose and audience have been addressed.
- W.WR.8.5. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
- W.SE.8.6. Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
- W.RW.8.7. Write routinely over extended time frames (time for research, reflection, metacognition/self-correction, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

**Speaking and Listening Domain:** ([see substandards for related sub strands](#))

- SL.PE.8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

- SL.II.8.2. Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.
- SL.ES.8.3. Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced.
- SL.PI.8.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
- SL.UM.8.5. Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
- SL.AS.8.6. Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate.

### **Climate Change Strands (6-8th Grade Science)**

- MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
- MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
- MS-ESS2-5: Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
- MS-ESS2-6: Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
- MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused climate change over the past century.
- MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be achieved.

### **Modifications and Accommodations:**

#### **Special Education**

- Printed copy of board work/notes provided
- Additional time for skill mastery
- Assistive technology
- Behavior management plan
- Center-Based Instruction
- Check work frequently for understanding
- Computer or electronic device utilization
- Extended time on tests/ quizzes

- Have student repeat directions to check for understanding
- Highlighted text visual presentation
- Modified assignment format
- Modified test content
- Modified test format
- Modified test length
- Multiple test sessions
- Multi-sensory presentation
- Preferential seating
- Preview of content, concepts, and vocabulary
- Reduced/shortened written assignments
- Secure attention before giving instruction/directions
- Shortened assignments
- Student working with an assigned partner
- Teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills Open-ended activities
- Think-Pair-Share
- Varied supplemental materials

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- **ELL**

- Allowing students to correct errors (looking for understanding)
- Teaching key aspects of a topic Eliminate nonessential information Using videos, illustrations, pictures, and drawings to explain or clarify
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slideshows, videos, etc.) to demonstrate student's learning
- Allowing students to correct errors (looking for understanding)
- Allowing the use of note cards or open-book during testing
- Decreasing the amount of work presented or required
- Having peers take notes or providing a copy of the teacher's notes
- Modifying tests to reflect selected objectives
- Providing study guides
- Reducing the number of answer choices on a multiple choice test
- Tutoring by peers
- Explain/clarify key vocabulary terms

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- **At Risk**

- Allowing students to correct errors (looking for understanding)
- Teaching key aspects of a topic Eliminate nonessential information allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slideshows, videos, etc.) to demonstrate student's learning
- Allowing students to select from given choices .
- Allowing the use of note cards or open-book during testing
- Collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test

- decreasing the amount of work presented or required .
- Having peers take notes or providing a copy of the teacher's notes
- Marking students' correct and acceptable work, not the mistakes
- Modifying tests to reflect selected objectives
- Providing study guides
- Reducing the number of answer choices on a multiple choice test
- Tutoring by peers
- Using authentic assessments with real-life problem-solving
- Using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills Open-ended activities
- Think-Pair-Share
- Varied supplemental materials
- 
- **Gifted and Talented**
- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Independent research and projects Interest groups for real world application
- Learning contracts
- Leveled rubrics
- Multiple intelligence options
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products\_\_\_\_\_
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- **504**
- Printed copy of board work/notes provided
- Additional time for skill mastery
- Assistive technology
- Behavior management plan
- Center-Based Instruction
- Check work frequently for understanding
- Computer or electronic device utilization
- Extended time on tests/ quizzes
- Have student repeat directions to check for understanding
- Highlighted text visual presentation
- Modified assignment format
- Modified test content
- Modified test format
- Modified test length
- Multiple test sessions
- Multi-sensory presentation



- Preferential seating
- Preview of content, concepts, and vocabulary
- Reduced/shortened written assignments
- Secure attention before giving instruction/directions
- Shortened assignments
- Student working with an assigned partner
- Teacher initiated weekly assignment sheet
- Use open book, study guides, test prototype
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Varied supplemental materials

## Unit 1 Overview: Matter and its Interactions

### **Unit 1 Summary:**

By the end of middle school, students will be able to apply understanding that pure substances have characteristic physical and chemical properties and are made from a single type of atom or molecule. They will be able to provide molecular level accounts to explain states of matters and changes between states, that chemical reactions involve regrouping of atoms to form new substances, and that atoms rearrange during chemical reactions. Students are also able to apply an understanding of the design and the process of optimization in engineering to chemical reaction systems. The crosscutting concepts of patterns; cause and effect; scale, proportion and quantity; energy and matter; structure and function; interdependence of science, engineering, and technology; and influence of science, engineering and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the PS1 performance expectations, students are expected to demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information. Students use these scientific and engineering practices to demonstrate understanding of the disciplinary core ideas.

**New Jersey Student Learning Standards**  
**(Please Bold all Climate related standards met throughout all Units)**

**New Jersey Student Learning Standards: Science**

- **MS- PS1 Matter and its Interactions**

**Interdisciplinary Connections:**

- **English language Arts**
- **Mathematics**
- **Social Studies**
- **Technology**
- **Visual and Performing Arts**

**Connections to other DCIs in this grade-band:**

- MS.PS3.D (MS-PS1-2),(MS-PS1-6);
- MS.LS1.C (MS-PS1-2),(MS-PS1-5);
- MS.LS2.A (MS-PS1-3);
- MS.LS2.B (MS-PS1-5);
- MS.LS4.D (MS-PS1-3);
- MS.ESS2.A (MS-PS1-2),(MS-PS1-5);
- MS.ESS2.C (MS-PS1-1),(MS-PS1-4);
- MS.ESS3.A (MS-PS1-3);
- MS.ESS3.C (MS-PS1-3)

**Articulation across grade-bands:**

- 5.PS1.A (MS-PS1-1);
- 5.PS1.B (MS-PS1-2),(MS-PS1-5);
- HS.PS1.A (MS-PS1-1),(MS-PS1-3),(MS-PS1-4),(MS-PS1-6);
- HS.PS1.B (MS-PS1-2),(MS-PS1-4),(MS-PS1-5),(MS-PS1-6);
- HS.PS3.A (MS-PS1-4),(MS-PS1-6);
- HS.PS3.B (MS-PS1-6);
- HS.PS3.D (MS-PS1-6);
- HS.LS2.A (MS-PS1-3);
- HS.LS4.D (MS-PS1-3);
- HS.ESS1.A (MS-PS1-1);
- HS.ESS3.A (MS-PS1-3)

**Common Core State Standards Connections:**

***ELA/Literacy*** –

**RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-PS1-2),(MS-PS1-3)

**RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)

**RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).  
(MS-PS1-1),(MS-PS1-2),(MS-PS1-4),(MS-PS1-5)

**WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6)

**WHST.6-8.8** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3)

### **Mathematics –**

**MP.2** Reason abstractly and quantitatively. (MS-PS1-1),(MS-PS1-2),(MS-PS1-5)

**MP.4** Model with mathematics. (MS-PS1-1),(MS-PS1-5)

**6.RP.A.3** Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1),(MS-PS1-2),(MS-PS1-5)

**6.NS.C.5** Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)

**8.EE.A.3** Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1)

**6.SP.B.4** Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-PS1-2)

**6.SP.B.5** Summarize numerical data sets in relation to their context (MS-PS1-2)

## **Performance Expectations**

**MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]

**MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.** [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]

**MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative

information.]

**MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.** [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

**MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.** [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]

**MS-PS1-6 Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.** [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

### **MS-ETS1 Engineering Design**

**MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

**MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

**MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

**MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

### **Disciplinary Core Ideas**

#### **PS1.A: Structure and Properties of Matter**

- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2),(MS-PS1-3)
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)

- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)

### **PS1.B: Chemical Reactions**

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-3),(MS-PS1-5)
- The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)
- Some chemical reactions release energy, others store energy. (MS-PS1-6)

### **PS3.A: Definitions of Energy**

- The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MS-PS1-4)
- The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system’s total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary to MS-PS1-4)

### **ETS1.B: Developing Possible Solutions**

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary to MS-PS1-6)

### **ETS1.C: Optimizing the Design Solution**

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (secondary to MS-PS1-6)
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary to MS-PS1-6)

## Unit 1 Assessments

### **Formative Assessments:**

Exit tickets; teacher produced rubrics; student self checkoff rubric; three fact fold chart; conversations with students about their thinking; CER

**Index Card/Summaries/Questions:** Periodically, distribute index cards and ask students to write on both sides, with these instructions: (Side 1) Based on our study of (unit topic), list a big idea that you understand and word it as a summary statement. (Side 2) Identify something about (unit topic) that you do not yet fully understand and word it as a statement or question.

**Hand Signals:** Ask students to display a designated hand signal to indicate their understanding of a specific concept, principal, or process: - I understand \_\_\_\_\_ and can explain it (e.g., thumbs up). - I do not yet

understand \_\_\_\_\_ (e.g., thumbs down). - I'm not completely sure about \_\_\_\_\_ (e.g., wave hand).

**One Minute Essay:** A one-minute essay question (or one-minute question) is a focused question with a specific goal that can, in fact, be answered within a minute or two.

**Analogy Prompt:** Present students with an analogy prompt: (A designated concept, principle, or process) is like \_\_\_\_\_ because \_\_\_\_\_.

**Web or Concept Map:** Any of several forms of graphical organizers which allow learners to perceive relationships between concepts through diagramming key words representing those concepts.

<http://www.graphic.org/concept.html>

**Additional Formative Assessments:**

Checklists

Observation

Round Robin Charts

Strategic Questioning

Misconception Check

Laboratory Activity

Pair share activity

Exit ticket/cards

List 10 Things

Reflection Journals

**Summative Assessments:**

**Selected response items:** Multiple choice, True/false, Matching, Short answer, Fill in the blank, One or two sentence response, Extended written response

**Performance assessment:** Laboratory activities, models, various projects End-of-unit or -chapter tests  
End-of-term or -semester exams

**Benchmark:** ELA Research Based Benchmark Interim Assessments

**Alternative:**

Self Selected Science Projects

Group Collaboration Projects

Concept Map

Demonstration Stations

Powerpoint/Google Slides

## Unit 2 Overview: Motion and Stability: Forces and Interactions

### Unit 2 Summary:

The performance expectations in PS2: Motion and Stability: Forces and Interactions focuses on helping students understand ideas related to why some objects will keep moving, why objects fall to the ground and why some materials are attracted to each other while others are not. Students answer the question, “*How can one describe physical interactions between objects and within systems of objects?*” At the middle school level, the PS2 Disciplinary Core Idea from the NRC Framework is broken down into two sub-ideas: Forces and Motion and Types of interactions. By the end of middle school, students will be able to apply Newton’s Third Law of Motion to relate forces to explain the motion of objects. Students also apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while others repel. In particular, students will develop understanding that gravitational interactions are always attractive but that, electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Students are also able to apply an engineering practice and concept to solve a problem caused when objects collide. The crosscutting concepts of cause and effect; system and system models; stability and change; and the influence of science, engineering, and technology on society and the natural world serve as organizing concepts for these disciplinary core ideas. In the PS2 performance expectations, students are expected to demonstrate proficiency in asking questions, planning and carrying out investigations, and designing solutions, and engaging in argument; and to use these practices to demonstrate understanding of the core ideas.

### New Jersey Student Learning Standards

#### New Jersey Student Learning Standards: Science

- **MS-PS2 Motion and Stability: Forces and Interactions**

#### Interdisciplinary Connections:

- English language Arts
- Mathematics
- Social Studies
- Technology
- Visual and Performing Arts

#### Connections to other DCIs in this grade-band:

- MS.PS3.A (MS-PS2-2);
- MS.PS3.B (MS-PS2-2);
- MS.PS3.C (MS-PS2-1);
- MS.ESS1.A (MS-PS2-4);
- MS.ESS1.B (MS-PS2-4);
- MS.ESS2.C (MS-PS2-2),(MS-PS2-4)

#### Articulation across grade-bands:

- 3.PS2.A (MS-PS2-1),(MS-PS2-2);
- 3.PS2.B (MS-PS2-3),(MS-PS2-5);
- 5.PS2.B (MS-PS2-4);
- HS.PS2.A (MS-PS2-1),(MS-PS2-2);



- HS.PS2.B (MS-PS2- 3),(MS-PS2-4),(MS-PS2-5);
- HS.PS3.A (MS-PS2-5);
- HS.PS3.B (MS-PS2-2),(MS-PS2-5);
- HS.PS3.C (MS-PS2-5);
- HS.ESS1.B (MS-PS2-2),(MS-PS2-4)

### **Common Core State Standards Connections:**

#### ***ELA/Literacy –***

**RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-PS2-1),(MSPS2-3)

**RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS2-1),(MS-PS2-2),(MS-PS2- 5)

**WHST.6-8.1** Write arguments focused on discipline-specific content. (MS-PS2-4)

**WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS2-1),(MS-PS2-2),(MS-PS2-5)

#### ***Mathematics –***

**MP.2** Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3)

**6.NS.C.5** Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1)

**6.EE.A.2** Write, read, and evaluate expressions in which letters stand for numbers. (MS-PS2-1),(MS-PS2-2)

**7.EE.B.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-PS2-1),(MS-PS2-2)

**7.EE.B.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-PS2-1),(MS-PS2-2)

### **Performance Expectations**

**MS-PS2-1 Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.** [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]

**MS-PS2-2 Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.** [Clarification Statement: Emphasis is on balanced (Newton’s First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton’s Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]

**MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.** [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]

**MS-PS2-4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.** [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]

**MS-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields and limited to qualitative evidence for the existence of fields.]

### **MS-ETS1 Engineering Design**

**MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

**MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

**MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

**MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

### **Disciplinary Core Ideas**

#### **PS2.A: Forces and Motion**

- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1)
- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force

needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2)

- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2)

### **PS2.B: Types of Interactions**

- Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3)
- 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. (MS-PS2-4)
- 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). (MS-PS2-5)

## Unit 2 Assessments

### **Formative Assessments:**

Exit tickets; teacher produced rubrics; student self checkoff rubric; three fact fold chart; conversations with students about their thinking; CER

**Index Card/Summaries/Questions:** Periodically, distribute index cards and ask students to write on both sides, with these instructions: (Side 1) Based on our study of (unit topic), list a big idea that you understand and word it as a summary statement. (Side 2) Identify something about (unit topic) that you do not yet fully understand and word it as a statement or question.

**Hand Signals:** Ask students to display a designated hand signal to indicate their understanding of a specific concept, principal, or process: - I understand \_\_\_\_\_ and can explain it (e.g., thumbs up). - I do not yet understand \_\_\_\_\_ (e.g., thumbs down). - I'm not completely sure about \_\_\_\_\_ (e.g., wave hand).

**One Minute Essay:** A one-minute essay question (or one-minute question) is a focused question with a specific goal that can, in fact, be answered within a minute or two.

**Analogy Prompt:** Present students with an analogy prompt: (A designated concept, principle, or process) is like \_\_\_\_\_ because \_\_\_\_\_.

**Web or Concept Map:** Any of several forms of graphical organizers which allow learners to perceive relationships between concepts through diagramming key words representing those concepts.

<http://www.graphic.org/concept.html>

### **Additional Formative Assessments:**

Checklists

Observation

Round Robin Charts

Strategic Questioning

Misconception Check

Laboratory Activity

Pair share activity

Exit ticket/cards

List 10 Things

Reflection Journals

**Summative Assessments:**

**Selected response items:** Multiple choice, True/false, Matching, Short answer, Fill in the blank, One or two sentence response, Extended written response

**Performance assessment:** Laboratory activities, models, various projects End-of-unit or -chapter tests  
End-of-term or -semester exams

**Benchmark:** ELA Research Based Benchmark Interim Assessments

**Alternative:**

Self Selected Science Projects

Group Collaboration Projects

Concept Map

Demonstration Stations

Powerpoint/Google Slides

## Unit 3 Overview: Energy

### Unit 3 Summary:

The performance expectations in PS3: Energy help students formulate an answer to the question, “*How can energy be transferred from one object or system to another?*” At the middle school level, the PS3 Disciplinary Core Idea from the NRC Framework is broken down into four sub-core ideas: Definitions of Energy, Conservation of Energy and Energy Transfer, the Relationship between Energy and Forces, and Energy in Chemical Process and Everyday Life. Students develop their understanding of important qualitative ideas about energy including that the interactions of objects can be explained and predicted using the concept of transfer of energy from one object or system of objects to another, and the total change of energy in any system is always equal to the total energy transferred into or out of the system. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students will also come to know the difference between energy and temperature, and begin to develop an understanding of the relationship between force and energy. Students are also able to apply an understanding of design to the process of energy transfer. The crosscutting concepts of scale, proportion, and quantity; systems and system models; and energy are called out as organizing concepts for these disciplinary core ideas. The performance expectations in PS3 expect students to demonstrate proficiency in developing and using models, planning investigations, analyzing and interpreting data, and designing solutions, and engaging in argument from evidence; and to use these practices to demonstrate understanding of the core ideas in PS3.

### New Jersey Student Learning Standards

#### New Jersey Student Learning Standards: Science

- MS-PS3 Energy

#### Interdisciplinary Connections:

- English language Arts
- Mathematics
- Social Studies
- Technology
- Visual and Performing Arts

#### Connections to other DCIs in this grade-band:

- MS.PS1.A (MS-PS3-4);
- MS.PS1.B (MS-PS3-3);
- MS.PS2.A (MS-PS3-1),(MS-PS3-4),(MS-PS3-5);
- MS.ESS2.A (MS-PS3-3);
- MS.ESS2.C (MS-PS3-3),(MS-PS3-4);
- MS.ESS2.D (MS-PS3-3),(MS-PS3-4);
- MS.ESS3.D (MS-PS3-4)

#### Articulation across grade-bands:

- 4.PS3.B (MS-PS3-1),(MS-PS3-3);
- 4.PS3.C (MS-PS3-4),(MS-PS3-5);
- HS.PS1.B (MS-PS3-4);
- HS.PS2.B (MS-PS3-2);
- HS.PS3.A (MS-PS3-1),(MS-PS3- 4),(MS-PS3-5);
- HS.PS3.B (MS-PS3-1),(MS-PS3-2),(MS-PS3-3),(MS-PS3-4),(MS-PS3-5);
- HS.PS3.C (MS-PS3-2)

**Common Core State Standards Connections:**

***ELA/Literacy*** –

**RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-PS3-1),(MSPS3-5)

**RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS3-3),(MS-PS3-4)

**RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS3-1)

**WHST.6-8.1** Write arguments focused on discipline content. (MS-PS3-5)

**WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS3-3),(MS-PS3-4)

**SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS3-2)

***Mathematics*** –

**MP.2** Reason abstractly and quantitatively. (MS-PS3-1),(MS-PS3-4),(MS-PS3-5)

**6.RP.A.1** Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1),(MS-PS3-5)

**6.RP.A.2** Understand the concept of a unit rate  $a/b$  associated with a ratio  $a:b$  with  $b \neq 0$ , and use rate language in the context of a ratio relationship. (MS-PS3-1)

**7.RP.A.2** Recognize and represent proportional relationships between quantities. (MS-PS3-1),(MS-PS3-5)

**8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1)

**8.EE.A.2** Use square root and cube root symbols to represent solutions to equations of the form  $x^2 = p$  and  $x^3 = p$ , where  $p$  is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that  $\sqrt{2}$  is irrational. (MS-PS3-1)

**8.F.A.3** Interpret the equation  $y = mx + b$  as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-1),(MSPS3-5)

**6.SP.B.5** Summarize numerical data sets in relation to their context. (MS-PS3-4)

## Performance Expectations

**MS-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.** [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]

**MS-PS3-2 Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.** [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]

**MS-ETS1-4** Develop a model to describe unobservable mechanisms. (MS-PS3-2)

**MS-PS3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.** [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

**MS-PS3-4 Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

**MS-PS3-5 Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

## MS-ETS1 Engineering Design

**MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

**MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they

meet the criteria and constraints of the problem.

**MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

**MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

## Disciplinary Core Ideas

### **PS3.A: Definitions of Energy**

- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1)
- A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2)
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4)

### **PS3.B: Conservation of Energy and Energy Transfer**

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5)
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4)
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3)

### **PS3.C: Relationship Between Energy and Forces**

- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)

### **ETS1.A: Defining and Delimiting an Engineering Problem**

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary to MS-PS3-3)

### **ETS1.B: Developing Possible Solutions**

- A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to MS-PS3-3)



## Unit 3 Assessments

### **Formative Assessments:**

Exit tickets; teacher produced rubrics; student self checkoff rubric; three fact fold chart; conversations with students about their thinking; CER

**Index Card/Summaries/Questions:** Periodically, distribute index cards and ask students to write on both sides, with these instructions: (Side 1) Based on our study of (unit topic), list a big idea that you understand and word it as a summary statement. (Side 2) Identify something about (unit topic) that you do not yet fully understand and word it as a statement or question.

**Hand Signals:** Ask students to display a designated hand signal to indicate their understanding of a specific concept, principal, or process: - I understand \_\_\_\_\_ and can explain it (e.g., thumbs up). - I do not yet understand \_\_\_\_\_ (e.g., thumbs down). - I'm not completely sure about \_\_\_\_\_ (e.g., wave hand).

**One Minute Essay:** A one-minute essay question (or one-minute question) is a focused question with a specific goal that can, in fact, be answered within a minute or two.

**Analogy Prompt:** Present students with an analogy prompt: (A designated concept, principle, or process) is like \_\_\_\_\_ because \_\_\_\_\_.

**Web or Concept Map:** Any of several forms of graphical organizers which allow learners to perceive relationships between concepts through diagramming key words representing those concepts.

<http://www.graphic.org/concept.html>

### **Additional Formative Assessments:**

Checklists

Observation

Round Robin Charts

Strategic Questioning

Misconception Check

Laboratory Activity

Pair share activity

Exit ticket/cards

List 10 Things

Reflection Journals

### **Summative Assessments:**

**Selected response items:** Multiple choice, True/false, Matching, Short answer, Fill in the blank, One or two sentence response, Extended written response

**Performance assessment:** Laboratory activities, models, various projects End-of-unit or -chapter tests  
End-of-term or -semester exams

**Benchmark:** ELA Research Based Benchmark Interim Assessments

### **Alternative:**

Self Selected Science Projects

Group Collaboration Projects

Concept Map

Demonstration Stations

Powerpoint/Google Slides

## Unit 4 Overview: Waves and Their Applications in Technologies for Information Transfer

### Unit 4 Summary:

The performance expectations in PS4: Waves and Their Applications in Technologies for Information Transfer help students formulate an answer to the question, “*What are the characteristic properties of waves and how can they be used?*” At the middle school level, the PS4 Disciplinary Core Idea from the NRC Framework is broken down into Wave Properties, Electromagnetic Radiation, and Information Technologies and Instrumentation. Students are able to describe and predict characteristic properties and behaviors of waves when the waves interact with matter. Students can apply an understanding of waves as a means to send digital information. The crosscutting concepts of patterns and structure and function are used as organizing concepts for these disciplinary core ideas. The performance expectations in PS4 focus on students demonstrating proficiency in developing and using models, using mathematical thinking, and obtaining, evaluating and communicating information; and to use these practices to demonstrate understanding of the core ideas.

### New Jersey Student Learning Standards

#### New Jersey Student Learning Standards: Science

- **MS-PS4 Waves and Their Applications in Technologies for Information Transfer**

#### Interdisciplinary Connections:

- **English language Arts**
- **Mathematics**
- **Social Studies**
- **Technology**
- **Visual and Performing Arts**

#### Connections to other DCIs in this grade-band:

- MS.LS1.D (MS-PS4-2)

#### Articulation across grade-bands:

- 4.PS3.A (MS-PS4-1);
- 4.PS3.B (MS-PS4-1);
- 4.PS4.A (MS-PS4-1);
- 4.PS4.B (MS-PS4-2);
- 4.PS4.C (MS-PS4-3);
- HS.PS4.A (MS-PS4-1),(MS-PS4- 2),(MS-PS4-3);
- HS.PS4.B (MS-PS4-1),(MS-PS4-2);
- HS.PS4.C (MS-PS4-3);
- HS.ESS1.A (MS-PS4-2);
- HS.ESS2.A (MS-PS4-2);
- HS.ESS2.C (MS-PS4-2);
- HS.ESS2.D (MS-PS4-2)

## Common Core State Standards Connections:

### *ELA/Literacy* –

**RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3)

**RST.6-8.2** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-PS4-3)

**RST.6-8.9** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-PS4-3)

**WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-PS4-3)

**SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1),(MS-PS4-2)

### *Mathematics* –

**MP.2** Reason abstractly and quantitatively. (MS-PS4-1)

**MP.4** Model with mathematics. (MS-PS4-1)

**6.RP.A.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1)

**6.RP.A.3** Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS4-1)

**7.RP.A.2** Recognize and represent proportional relationships between quantities. (MS-PS4-1)

**8.F.A.3** Interpret the equation  $y = mx + b$  as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS4-1)

## Performance Expectations

**MS-PS4-1** Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

**MS-PS4-2** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

**MS-PS4-3** Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and

conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]

## MS-ETS1 Engineering Design

**MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

**MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

**MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

**MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

## Disciplinary Core Ideas

### PS4.A: Wave Properties

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)
- A sound wave needs a medium through which it is transmitted. (MS-PS4-2)

### PS4.B: Electromagnetic Radiation

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2)
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2)
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

### PS4.C: Information Technologies and Instrumentation

- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)

## Unit 4 Assessments

### **Formative Assessments:**

Exit tickets; teacher produced rubrics; student self checkoff rubric; three fact fold chart; conversations with students about their thinking; CER

**Index Card/Summaries/Questions:** Periodically, distribute index cards and ask students to write on both sides, with these instructions: (Side 1) Based on our study of (unit topic), list a big idea that you understand and word it as a summary statement. (Side 2) Identify something about (unit topic) that you do not yet fully understand and word it as a statement or question.

**Hand Signals:** Ask students to display a designated hand signal to indicate their understanding of a specific concept, principal, or process: - I understand \_\_\_\_\_ and can explain it (e.g., thumbs up). - I do not yet understand \_\_\_\_\_ (e.g., thumbs down). - I'm not completely sure about \_\_\_\_\_ (e.g., wave hand).

**One Minute Essay:** A one-minute essay question (or one-minute question) is a focused question with a specific goal that can, in fact, be answered within a minute or two.

**Analogy Prompt:** Present students with an analogy prompt: (A designated concept, principle, or process) is like \_\_\_\_\_ because \_\_\_\_\_.

**Web or Concept Map:** Any of several forms of graphical organizers which allow learners to perceive relationships between concepts through diagramming key words representing those concepts.

<http://www.graphic.org/concept.html>

### **Additional Formative Assessments:**

Checklists

Observation

Round Robin Charts

Strategic Questioning

Misconception Check

Laboratory Activity

Pair share activity

Exit ticket/cards

List 10 Things

Reflection Journals

### **Summative Assessments:**

**Selected response items:** Multiple choice, True/false, Matching, Short answer, Fill in the blank, One or two sentence response, Extended written response

**Performance assessment:** Laboratory activities, models, various projects End-of-unit or -chapter tests  
End-of-term or -semester exams

**Benchmark:** ELA Research Based Benchmark Interim Assessments

### **Alternative:**

Self Selected Science Projects

Group Collaboration Projects

Concept Map

Demonstration Stations

Powerpoint/Google Slides

## Supplemental Materials/References/Links

**Generation Genius**

**IXL**

**FOSS Modules**

<https://www.nextgenscience.org/>

**Prentice Hall Science Explorer**