



# GRADE 6

# Science Curriculum

Oradell Public School District  
Oradell, NJ

2023

# Oradell Public School District

## **Grade 6 Science Curriculum Committee Credits:** Oradell Public School District

**Scott Duthie**  
**Michael Hagopian**  
**Denise Kuehner**  
**Rosemarie Cataldo**

### **Board Policy**

This revision is aligned with the New Jersey Student Learning Standards for Science, the New Jersey Student Learning Standards for Computer Science and Design Thinking, the New Jersey Student Learning Standards for Career Readiness, Life Literacies, and Key Skills, and includes connections to Social-Emotional Learning Competencies.

### **Affirmative Action**

During the development of this course of study, particular attention was paid to the elimination or exclusion of any materials which might discriminate on the basis of race, color, national origin, ancestry, age, sex, affectional or sexual orientation, gender identity or expression, marital status, familial status, genetic information, mental or physical disabilities, or in educational opportunities. Every effort has been made to uphold both the letter and spirit of Affirmative Action mandates as applied to the content, the texts and the instruction inherent in this course.

**Megan Bozios, Superintendent**  
**Michelle Hawley, Principal**  
**Amy Brancato, Director of Curriculum and Instruction**

The Science curriculum was developed by the Oradell School District and aligned to the New Jersey Student Learning Standards (NJSLs).



# Oradell Public School District

## Suggested Pacing Guide for Science

### Grade 6

Unit	Approximate Months	Unit	Skills
1	Sept-Nov	<a href="#">Physical Science</a>	Structure and Properties of Matter  *Unit 1 will take place in the classroom. Unit 1.5 will be taught simultaneously with Unit 1 exclusively in the STEAM lab as a co-taught unit with classroom teacher and STEAM coach.
1.5	Sept-Nov	<a href="#">Earth Science</a>	Climate Change  *Unit 1 will take place in the classroom. Unit 1.5 will be taught simultaneously with Unit 1 exclusively in the STEAM lab as a co-taught unit with classroom teacher and STEAM coach.
2	Dec-Feb	<a href="#">Physical Science</a>	Chemical Reactions
3	Mar-Apr	<a href="#">Physical Science</a>	Forces and Interactions
4	May-Jun	<a href="#">Earth Science</a>	Space Systems

# Grade 6 Science Curriculum

## Unit 1: Structure and Properties of Matter

### Unit Overview

- Approximately 8.5-9 weeks total (September-November)
- Structure of Matter: 2 weeks
- Chemical Properties and Interactions: 2.5 weeks
- Changes in Energy on the Molecular Level: 2 weeks
- Heat and Matter: 2 weeks

### Big Idea/Common Thread:

- Pure substances have characteristic physical and chemical properties, and are made from a single type of atom or molecule.

### Enduring Understanding:

- Matter is composed of atoms and molecules which can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter (Appendix E, NGSS, PS1A Structure of Matter, gr. 6-8)

### Essential Questions:

- How can one explain the structure, properties, and interactions of matter?
- How can one describe and model the atomic composition of simple molecules and extended structures?
- How are synthetic materials derived from natural resources and how do they impact society?
- How can one describe and model changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed?

### Assessments

Possible Ongoing Formative Assessments
<ul style="list-style-type: none"><li>● Teacher observation</li><li>● Hands-on labs and performance tasks</li><li>● Kesler Science Independent Lesson Practice</li><li>● Ongoing check-ins/quizzes</li><li>● Written and verbal responses to readings</li><li>● Simulations</li><li>● Wrap-up questions</li><li>● Daily lesson online assignments</li><li>● Chapter Reviews</li></ul>
Summative Assessments
<ul style="list-style-type: none"><li>● Unit 1 Assessment: Structure &amp; Properties of Matter</li><li>● 3-D Model of a Molecule Project</li></ul>

## Alternative Assessments

- Modified Unit 1 Assessment

## Standards (NJSLs) Addressed in this Unit

### 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-PS1-3*) (Note: This Disciplinary Core Idea is also addressed by *MS-PS1-2*.)
- 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-PS1-3*) (Note: This Disciplinary Core Idea is also addressed by *MS-PS1-2* and *MS-PS1-5*.)

#### 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 relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (*secondary to MS-PS1-4*)

## Crosscutting Concepts

### Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (*MS-PS1-4*)

### Scale, Proportion, and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (*MS-PS1-1*)

### Structure and Function

- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (*MS-PS1-3*)

## Science and Engineering Practices

### Developing and Using Models

Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to predict and/or describe phenomena. (*MS-PS1-1*), (*MS-PS1-4*)

### Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used and describe how they are supported or not supported by evidence. (*MS-PS1-3*)

## Connections to Engineering, Technology, and Applications of Science

### Interdependence of Science, Engineering, and Technology

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (*MS-PS1-3*)

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

- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (*MS-PS1-3*)

## Computer Science and Design Thinking

**8.2.8.ED.2:** Identify the steps in the design process that could be used to solve a problem.

**8.2.8.ITH.1:** Explain how the development and use of technology influences economic, political, social, and cultural issues.

**8.2.8.ITH.2:** Compare how technologies have influenced society over time.

**8.2.8.ITH.3:** Evaluate the impact of sustainability on the development of a designed product or system.

**8.2.8.ITH.4:** Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.

## Career Readiness, Life Literacies, and Key Skills

### LIFE LITERACY AND KEY SKILLS

**9.4.8.CI.2** Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3).

**9.4.8.CI.3** Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).

**9.4.8.CI.4** Explore the role of creativity and innovation in career pathways and industries.

**9.4.8.CT.2** Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).

**9.4.8.GCA.2** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.

### PRACTICES

**CLKSP4.** - Demonstrate creativity and innovation

**CLKSP8.** - Use technology to enhance productivity, increase collaboration and communicate effectively.

## Interdisciplinary Connections:

### English Language Arts

Reading Standards for Science and Technical Subjects

- **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-PS1-3*)
  - *For example, cite specific textual evidence to support analysis of science and technical texts on the characteristic properties of pure substances. Attend to precise details of explanations or descriptions about the properties of substances before and after they undergo a chemical process.*

- **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-PS1-4*)
  - *Analyze quantitative properties of substances before and after a chemical process has occurred with a version of that information expressed visually, or integrate technical information about the characteristic properties of substances before and after a chemical process has occurred with a version of that information expressed visually.*

## Mathematics

### Standards for Mathematical Practice

- **MP.2** Reason abstractly and quantitatively. (*MS-PS1-1*)
  - *Reason quantitatively with amounts, numbers, and sizes for properties like density, melting point, boiling point, solubility, flammability, and odor, and reason abstractly by assigning labels or symbols.*
- **MP.4** Model with mathematics (*MS-PS1-1*)
  - *For example, integrate quantitative or technical information about the composition of simple molecules and extended structures that is expressed in words in a text with a version of that information expressed in a model.*
  - *For example, develop a mathematical model to describe the atomic composition of simple molecules and extended structures.*

### Ratios and Proportional Relationships

- **6.RP.A.3** Use ratio and rate reasoning to solve real-world and mathematical problems. (*MS-PS1-1*)
  - *For example, use ratio and rate reasoning to describe the atomic composition of simple molecules and extended structures.*
  - *For example, use ratio and rate reasoning to determine whether a chemical reaction has occurred.*

### The Number System

- **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.
  - *For example, display numerical data for properties such as density, melting point, solubility, flammability, and order in plots on a number line, including dot plots, histograms, and box plots.*
  - *For example, summarize numerical data sets on the properties of substances before and after the substances interact to determine whether a chemical reaction has occurred. The summary of the numerical data sets must be in relation to their context.*

### Statistics and Probability



- **6.SP.A.2** Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.

## Social-Emotional Competencies

- **Self-Awareness**: ability to recognize one's emotions and know one's strengths and limitations
  - Connections:
    - Students will be working with partners or in small groups. It is important for students to understand that everyone has different strengths and areas of growth. The teacher helps support students with this.
    - Check-in on feelings (thumbs up, down, in the middle). This helps the teacher know who might need additional support.
- **Self-Management**: ability to regulate and control one's emotions and behaviors, particularly in stressful situations
  - Connections:
    - Applying Open Circle strategies such as counting when feeling upset or anxious.
    - Encourage students to take a break, get water, etc.
- **Social Awareness**: ability to take the perspective of others, demonstrate empathy, acknowledge and appreciate similarities and differences, and understand how one's actions influence and are influenced by others
  - Connections:
    - Students becoming the peer helper to support others in their work. (Ex. Helping peers to generate skills needed to solve problem.)
    - Being a good audience when others are presenting.
- **Relationship Skills**: refers to one's ability to demonstrate prosocial skills and behaviors in order to develop meaningful relationships and resolve interpersonal conflicts
  - Connections:
    - Sharing materials, taking turns, understanding that everyone may not always get a turn for every activity.
- **Responsible Decision-Making**: refers to the ability to use multiple pieces of information to make ethical and responsible decisions
  - Connections:

- Class rules
- Class discussions
- Following rules
- Active listening

## UNIT OBJECTIVES

Students will be able to ...

- Develop models to describe the atomic composition of simple molecules and extended structures. *(MS-PS1-1)*

*[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, three-dimensional ball and stick structures, or computer representations showing different molecules with different types of atoms.]*

### Disciplinary Ideas

- Understand that substances are made from different types of atoms.
  - Atoms are the basic units of matter.
- Understand that substances combine with one another in various ways
  - Molecules are two or more atoms joined together.
- Understand that atoms form molecules that range in size from two to thousands of atoms.
  - Molecules can be simple or very complex.
- Understand that solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

### Crosscutting Concepts

- Recognize that time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

### Science and Engineering Practices

- Develop a model to predict and/or describe phenomena
  
- Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. *(MS-PS1-3)*

*[Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form synthetic material. Examples of new materials could include new medicines, foods, and alternative fuels.]*

### Disciplinary Ideas

- Understand that each pure substance has characteristic physical and chemical properties that can be used to identify it.

- Understand that substances react chemically in characteristic ways.
- Understand that 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.

#### Crosscutting Concepts

- Recognize that structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

#### Science and Engineering Practices

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods.
  - Describe how these publication sources are supported or not supported by evidence.
- 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 (*MS-PS1-4*)  
*[Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gasses 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.]*

#### Disciplinary Ideas

- Understand that gasses and liquids are made of molecules or inert atoms that are moving about relative to each other.
  - In a liquid, the molecules are constantly in contact with others.
  - In a gas, the molecules 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.
- Describe and predict the changes of state that occur with variations in temperature or pressure using models of matter.
- Understand that the term “heat” as used in everyday language refers both to thermal energy and, in science, for the transfer of that thermal energy from one object to another.
- Explain how the relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.

#### Crosscutting Concepts

- Understand that cause and effect relationships may be used to predict phenomena in natural or designed systems.

#### Science and Engineering Practices

- Develop a model to predict and/or describe phenomena.

## SUGGESTED ACTIVITIES

- The Making of a Boy and his Atom - [▶ THE MAKING OF: "A BOY AND HIS ATOM"](#)  
Design Process of Manipulating Atoms

### Unit Specific Vocabulary

**matter** - anything that has mass and takes up space

**atom** - basic unit (building blocks) of an element

**proton** - positively charged part of the atom located in the nucleus

**neutron** - part of the atom without electrical charge with about the same mass as a proton

**electron** - negatively charged part of the atom with little atomic mass

**nucleus** - center of the atom that contains both neutrons and protons

**molecule** - a group of atoms bonded together, representing the smallest basic unit with particular characteristics

**substance**- a particular kind of matter with uniform (same) properties

**physical property** - observable and measurable characteristics such as color, density, texture, or state of matter that does not change the substances' structure

**chemical property** - characteristics that become evident before, during or after a chemical reaction that change the substances' identity

**thermal energy** - heat energy

**synthetic**- made by combining different substances; not naturally occurring

### Instructional Materials and Learning Activities

#### *Core Instructional Materials:*

- *Kesler Science*
- *Generation Genius*

#### *Digital Resources:*

- [www.inquiryinaction.org](http://www.inquiryinaction.org) - chemistry lab experiments
- <http://www.chem4kids.com> - background information for students
- [PhET](#) - online simulations
- [STEM Resource Finder](#) - online simulations (requires Java)
- [Classroom Resources - NGSS Hub](#) - lesson ideas
- [Next Generation Science Standards](#) - lesson ideas
- [Properties of Matter Video For Kids | 3rd, 4th & 5th Grade](#)
- [Particle Nature of Matter Video For Kids | 3rd, 4th & 5th Grade](#)
- [chemical vs. physical changes video for kids](#)

- [Generation Genius Particle Nature of Matter video -  
https://www.generationgenius.com/videolessons/particle-nature-of-matter-video-for-kids/](https://www.generationgenius.com/videolessons/particle-nature-of-matter-video-for-kids/)
- [Generation Genius Atoms & Molecules video -  
https://www.generationgenius.com/videolessons/atoms-and-molecules-video-for-kids/](https://www.generationgenius.com/videolessons/atoms-and-molecules-video-for-kids/)
- [BrainPop - Atoms video -  
https://www.brainpop.com/science/matterandchemistry/atoms/](https://www.brainpop.com/science/matterandchemistry/atoms/)
- [Generation Genius Properties of Matter video -  
https://www.generationgenius.com/videolessons/properties-of-matter-video-for-kids/](https://www.generationgenius.com/videolessons/properties-of-matter-video-for-kids/)

*Supplemental Materials:*

- National Geographic
- Spectrum Science Grade 6
- Leveled Text for Science: Physical Science by Shell Education
- Kesler Science Interactive

*Leveled Readers:*

- Reading from Kesler Science

## Suggested Modifications

*These strategies can be adapted to scaffold for students needing more support or extending the learning for higher level students. Differentiation is accomplished through content, process, product, and learning environment.*

[NGSS Appendix D - "All Standards, All Students": Making the Next Generation Science Standards Accessible to All Students](#)

## Special Education Students

- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Graphic organizers
- Sentence frames to help students explain their understanding of matter
- Copy of notes
- Preview content vocabulary
- Extended time for assignments
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions

- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebooks extensions

### Students at Risk

- Graphic organizers
- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text)
- Copy of notes
- Sentence starters and frames
- Preview content vocabulary
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions

### English Language Learners

- Graphic organizer
- Sentence frames to help students explain their understanding of matter
- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Google Translation
- Copy of notes
- Preview content vocabulary
- Support from ESL teacher
- Extended time for assignments
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (vocabulary, processes, etc.)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions

- Chromebook extensions

### **Gifted and Talented**

- Higher level text
- Higher level questioning
- Enrichment/independent/ research projects
- Challenge activities
- Independent (as opposed to guided) reading
- Peer tutoring to demonstrate mastery

### **Students with 504 Plans**

- Graphic organizers
- Kesler Science online assignment features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Copy of notes
- Sentence frames to help students explain their understanding of matter
- Preview content vocabulary.
- Extended time
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions

## Unit 1.5: Climate Change

### Unit Overview

- Approximately 2 weeks
- Climate Change

### Big Idea/Common Thread:

- Discovery of the importance of local communities taking action and implementing a multifaceted approach to solve the climate crisis. Human activities impact Earth's other systems which have caused significant and complex issues. These activities can be monitored and minimized to effect change in the human impact on the environment.

### Enduring Understanding:

- Human activities, such as the release of greenhouse gasses from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming).
- Reducing the level of climate change and reducing human vulnerability to whatever climate change do occur depend on understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities (MS-ESS3-5)

### Essential Questions:

- How can we use data to take effective action on climate change?
- What is our role in taking action to reverse climate change?
- What are the causes and impacts of climate change?
- How can we use visual data to explain and promote the actions needed to reverse climate change
- How can we inform and inspire others in our community to take the needed steps to address climate change?

### Assessments

#### Possible Ongoing Formative Assessments

- Teacher observation
- Quizzes
- Written and verbal responses to reading
- Simulations
- Wrap-up questions
- Daily online assignments
- Chapter Reviews

#### Summative Assessments



- Unit 3.5 Project Rubric

### Alternative Assessments

- Modified Unit 3.5 Project Rubric

## Standards (NJSLs) Addressed in this Unit

### Disciplinary Core Ideas

#### ESS3.B Natural Hazards

- Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (MS-ESS3-2)\*

#### ESS3.C Human Impacts on Earth Systems

- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment (MS-ESS3-3)\*
- Construct an argument supported by evidence for how increase in human population and per-capita consumption of natural resources impact Earth's Systems. (MS-ESS3-4)

#### ESS3.D: Global Climate Change

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities and other kinds of knowledge such as understanding human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)

\*This standard is only partially addressed in this unit

### Crosscutting Concepts

#### Patterns

- Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)

#### Cause and Effect

- Relationships can be classified as casual or correlational, and correlation does not necessarily imply causation (MS-ESS3-3)
- Cause and effect relationships may be used to predict phenomena in natural or designed systems (MS-ESS3-1, MS-ESS3-4)

#### Stability and Change

- Stability might be disturbed either by sudden events or gradual changes that accumulate over time. *(MS-ESS3-5)*

## Science and Engineering Practices

### Asking Questions and Defining Problems

Asking questions and defining problems in grades 6-8 builds on grade K-5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

### Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis

- Analyze and interpret data to determine similarities and differences in findings. *(MS-ESS1-3)*

### Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consisting of scientific ideas, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. *(MS-ESS3-1)*
- Apply scientific principles to design an object, tool, process or system. *(MS-ESS3-3)*

### Engaging in Argument from Evidence

Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds.

- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

## Connections to Engineering, Technology, and Applications of Science

### Interdependence of Science, Engineering, and Technology on Society and the Natural World

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. *(MS-ESS1-3)(ME-ESS1-4)*

- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires and values; by the finding of scientific research; and by differences in such factors as climate, natural resources and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2) (MS-ESS3-3)

### Connections to Nature of Science

#### Science Addresses Questions About the Natural and Material World

- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes (*MS-ESS3-4*),

### Computer Science and Design Thinking

**8.1.8.NI.4:** Explain how new security measures have been created in response to key malware events.

**8.2.8.ED.2:** Identify the steps in the design process that could be used to solve a problem

**8.2.8.ED.3:** Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

**8.2.8.ED.4:** Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.

**8.2.8.ED.5:** Explain the need for optimization in a design process.

**8.2.8.ED.6:** Analyze how trade-offs can impact the design of a product.

**8.2.8.ED.7:** Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

**8.2.8.ITH.1:** Explain how the development and use of technology influences economic, political, social, and cultural issues.

**8.2.8.ITH.2:** Compare how technologies have influenced society over time. •

**8.2.8.ITH.3:** Evaluate the impact of sustainability on the development of a designed product or system.

**8.2.8.ITH.4:** Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.

**8.2.8.ITH.5:** Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.

**8.2.8.ETW.1:** Illustrate how a product is upcycled into a new product and analyze the short- and long-term benefits and costs.

**8.2.8.ETW.2:** Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital).

**8.2.8.ETW.3:** Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.

**8.2.8.ETW.4:** Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.

**8.2.8.EC.1:** Explain ethical issues that may arise from the use of new technologies.

**8.2.8.EC.2:** Examine the effects of ethical and unethical practices in product design and development.

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

#### LIFE LITERACY 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 (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).

**9.4.8.CI.2** Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3).

**9.4.8.CI.3** Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).

**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 (e.g., MS-ETS1-2).

**9.4.8.CT.2** Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).

**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.DC.8** Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities).

**9.4.8.GCA.2** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.

#### PRACTICES

**CLKSP4.** - Demonstrate creativity and innovation

**CLKSP8.** - Use technology to enhance productivity, increase collaboration and communicate effectively.

### Interdisciplinary Connections:

#### English Language Arts

Reading Standards for Science and Technical Subjects

- **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-ESS1-3)

- For example, cite specific textual evidence to support analysis of science and technical text about scale properties of objects in the solar system.
  - **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-ESS1-3)
    - For example, include multimedia components and visual displays in presentations to describe the cyclical patterns of lunar phases, eclipses of the sun and moon, seasons, and the role of gravity in the motions within galaxies and the solar system. The presentation needs to clarify claims and findings and emphasize salient points.
    - For example, integrate quantitative or technical information expressed in words in a text about scale properties of objects in the solar system with a version of that information expressed visually in a flowchart, diagram, model, graph, or table.
- Writing- Literacy in History/SS, Science and Technical Subjects

#### Reading Standards for History and Social Studies

- **RH.6-8.1** Cite specific textual evidence to support analysis of primary and secondary sources
- **RH.6-8.7** Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.

#### Writing- Literacy in History/SS, Science and Technical Subjects

- **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

#### Standards for Mathematical Practice

- **MP.2** Reason abstractly and quantitatively. (MS-ESS1-3)
  - For example, reason quantitatively and abstractly about the sizes of an object's layers, surface features, and orbital radius where appropriate.
- **MP.4** Model with mathematics. (MS-ESS1-1),(MS-ESS1-2)
  - For example, use mathematics to model the motion of the sun, moon, and stars in the sky and the role of gravity in the motions within galaxies and the solar system.

#### Ratios and Proportional Relationships

- **6.RP.A.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS1-1),(MS-ESS1-2),(MS-ESS1-3)
  - For example, understand the concept of a ratio and use ratio language to describe a ratio relationship between the measurements of the cyclical motion between at least two bodies in the solar system and the relative sizes of objects and/or

distances between objects and the impact of gravity on the motion of these objects.

- For example, recognize and represent proportional relationships between the measurement of patterns in the cyclical motion of the sun, moon, and stars in the sky and mathematical proportions relative to the sizes of objects and the effect of gravity on the motion of these objects.

#### Expressions and Equations

- **6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS1-2)
  - Use variables to represent numbers and write expressions when solving a problem involving the role of gravity in the motions within galaxies and within the solar system. Understand that a variable can represent an unknown number, or depending on the problem, any number in a specified set.

#### Social Studies

- 6.3 Active Citizenship in the 21st Century: All students will acquire the skills needed to be active, informed citizens who value diversity and promote cultural understanding by working collaboratively to address the challenges that are inherent in living in an interconnected world. Standard 6.3 Active Citizenship in the 21st Century applies to grades K–12; at the K–2 and 3–5 levels, content is organized by disciplinary concepts. The strands and disciplinary concepts are incorporated in the alphanumeric code.

#### Social-Emotional Competencies

- **Self-Awareness:** ability to recognize one’s emotions and know one’s strengths and limitations
  - Connections:
    - Students will be working with partners or in small groups. It is important for students to understand that everyone has different strengths and areas of growth. The teacher helps support students with this.
    - Check-in on feelings (thumbs up, down, in the middle). This helps the teacher know who might need additional support.
- **Self-Management:** ability to regulate and control one’s emotions and behaviors, particularly in stressful situations
  - Connections:
    - Applying Open Circle strategies such as counting when feeling upset or anxious.
    - Encourage students to take a break, get water, etc.

- **Social Awareness**: ability to take the perspective of others, demonstrate empathy, acknowledge and appreciate similarities and differences, and understand how one’s actions influence and are influenced by others
  - Connections:
    - Students becoming the peer helper to support others in their work. (Ex. Helping peers to generate skills needed to solve problem.)
    - Being a good audience when others are presenting.
  
- **Relationship Skills**: refers to one’s ability to demonstrate prosocial skills and behaviors in order to develop meaningful relationships and resolve interpersonal conflicts
  - Connections:
    - Sharing materials, taking turns, understanding that everyone may not always get a turn for every activity.
  
- **Responsible Decision-Making**: refers to the ability to use multiple pieces of information to make ethical and responsible decisions
  - Connections:
    - Class rules
    - Class discussions
    - Following rules
    - Active listening

## UNIT OBJECTIVES

Students will be able to ...

- Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (MS-ESS3-2)
- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (MS-ESS3-3)
- Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems. (MS-ESS3-4)
- Ask questions to clarify evidence of the factors that have caused (rise in global temperatures) **climate change** over the past century (MS-ESS3-5)
  - *What is our role in taking action to reverse or reduce climate change?*
  - *What are the causes and impacts of climate change?*

- *How can we use visual data to explain and promote actions needed to reverse climate change?*
- *How can we inform and inspire others in our community to take the needed steps to address climate change?*

#### Science and Engineering Practices.

- Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3)
- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)
- Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5).

#### Disciplinary Ideas

- Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.(MS-ESS3-2)\*
- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment (MS-ESS3-3)\*
- Construct an argument supported by evidence for how increase in human population and per-capita consumption of natural resources impact Earth's Systems. (MS-ESS3-4)
- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)

#### Crosscutting Concepts

- Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)
- Relationships can be classified as casual or correlational, and correlation does not necessarily imply causation (MS-ESS3-3)
- Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)

Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (MS-ESS3-2)

#### Disciplinary Ideas



- Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.(MS-ESS3-2)\*

### Crosscutting Concepts

- Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)

### Science and Engineering Practices **Asking Questions and Defining Problems**

- Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3)
- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)

Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (MS-ESS3-3)

- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment (MS-ESS3-3)\*
- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities and other kinds of knowledge such as understanding human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)
- Relationships can be classified as casual or correlational, and correlation does not necessarily imply causation (MS-ESS3-3)
- Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3)

Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. (MS-ESS3-4)

- Construct an argument supported by evidence for how increase in human population and per-capita consumption of natural resources impact Earth's Systems. (MS-ESS3-4)

Ask questions to clarify evidence of the factors that have caused (rise in global temperatures) **climate change** over the past century(MS-ESS3-5)

- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.(MS-ESS3-5)

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming). Reducing the level of climate change and reducing vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities and other kinds of knowledge such as understanding human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5).

## SUGGESTED ACTIVITIES

- Field trip to a vertical farm, hydroelectric, alternate farming, recycling plant, windpower, hydro farm...to see how change is taking place.

### Unit Specific Vocabulary

**carbon dioxide-** a gas made of carbon and oxygen is all around us naturally. It comes from decaying and living organisms, and from volcanoes. It is released when burning fossil fuels like coal and oil. It’s the most contributor to human-caused global warming of all the greenhouse gases.

**chlorofluorocarbons-** any of several organic compounds composed of carbon, fluorine, and chlorine. CFCs were eventually discovered to pose a serious environmental threat since they were not created in nature.

**climate change-** a significant change in the measures of climate (like temperature, precipitation, wind patterns, among other effects) lasting for an extended period of time.

**global warming-** the process that causes the Earth’s temperature to rise and makes the Earth warmer. Humans play a large role in the increase in the Earth’s temperature.

**greenhouse gases-** gases in Earth’s atmosphere that trap heat. They let sunlight pass through the atmosphere, but they prevent the heat that the sunlight brings from leaving the atmosphere. The main greenhouse gases are: Water vapor, Carbon dioxide, Methane, Ozone, Nitrous oxide, Chlorofluorocarbons

**methane-** a gas made of carbon and hydrogen is a normal gas released from wetlands, growing rice, raising cattle, using natural gas, and mining coal. Scientists consider it the second most important contributor to human-caused global warming of all the greenhouse gases.

**nitrous oxide-** a natural part of the nitrogen cycle. Bacteria in the soil and the ocean make it. It is released by some types of factories, power plants, and plant fertilizer. It damages the protective layer and is a powerful greenhouse gas.

**ozone-** the layer of the atmosphere that blocks the sun’s radiation, which helps protect us from the powerful rays.

**pollutants**- a substance that pollutes something, especially water or the atmosphere.

**sector**- area or portion that is distinct from others.

**water vapor**- water in a gas form.

## Instructional Materials and Learning Activities

### *Core Instructional Materials:*

- Kesler Science
- Generation Genius

### *Digital Resources:*

- ***Changing Climate, National Geographic***
- ***Climate Action Project***
- ***Climate Change Classroom Resources, BioInteractive***
- ***Climate Change Collection, Global Oneness Project***
- ***Climate Change Education, Climate Generation***
- ***Climate Change Education, Stanford Earth***
- ***Climate Change Lesson Plans, curated by Climate Change Live***
- ***Climate Change Lesson Plans, National Center for Science Education***
- ***Climate Change Resources, National Science Teaching Association***
- ***Climate Change Resources, World Wildlife Fund***
- ***Climate Literacy and Energy Awareness Network***
- ***Environmental Education Curriculum, Think Earth***
- ***NASA Climate Education Resources***
- ***NOAA Climate Education Collections***
- ***Our Climate Our Future, Alliance for Climate Action***
- ***Precipitation Education, NASA***
- ***Resources for schools, Climate Change Connection***
- ***Teach Climate Justice Campaign, Zinn Education Project***
- ***The Teacher-Friendly Guide to Climate Change, Paleontological Research Institution***

- *Teaching About Global Climate Change, American Association of Geographers*
- *Teaching Climate, Climate.gov*
- *Water literacy training and curriculum, Ripple Effect*
- *Webinar: Climate Change Across the Curriculum and Beyond, North American Association for Environmental Education*
- *Your Plan, Your Planet, environmental sustainability lesson plans from Google*
- **Why Science Teachers Are Struggling With Climate Change** (teacher resource)
- **Teaching Middle Schoolers Climate Change Without Terrifying Them** (teacher resource)
- **Most Teachers Don't Teach Climate Change; 4 in 5 Parents Wish They Did** (teacher resource)
- **8 Ways To Teach Climate Change in Almost Any Classroom** (teacher resource)

*Supplemental Materials:*

- STEAM Integration: UNIT 8 - STEAM TANK
- National Geographic
- Generation Genius
- Newsela Social Studies

### **Suggested Modifications**

*These strategies can be adapted to scaffold for students needing more support or extending the learning for higher level students. Differentiation is accomplished through content, process, product, and learning environment.*

[NGSS Appendix D - "All Standards, All Students": Making the Next Generation Science Standards Accessible to All Students](#)

### **Special Education Students**

- Graphic organizers
- Sentence frames to help students explain their understanding
- Copy of notes
- Preview content vocabulary

- Extended time for assignments
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebooks extensions

### Students at Risk

- Graphic organizers
- Copy of notes
- Sentence starters and frames
- Preview content vocabulary
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions

### English Language Learners

- Graphic organizer
- Sentence frames to help students explain their understanding
- Google Translation
- Copy of notes
- Preview content vocabulary
- Support from ESL teacher
- Extended time for assignments
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (vocabulary, processes, etc.)
- Preferential seating
- Repeated directions

- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Chromebook extensions

### Gifted and Talented

- Higher level text
- Higher level questioning
- Enrichment/independent/ research projects
- Challenge activities
- Independent (as opposed to guided) reading
- Peer tutoring to demonstrate mastery

### Students with 504 Plans

- Graphic organizers
- Copy of notes
- Sentence frames to help students explain their understanding
- Preview content vocabulary.
- Extended time
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions

# Grade 6 Science Curriculum

## Unit 2: Chemical Reactions

### Unit Overview

- Approximately 7 weeks
- Characteristics of Chemical Reactions: 2.5 weeks
- Modeling Conservation of Energy: 2 weeks
- Energy in Chemical Reactions: 2.5 weeks

### Big Idea/Common Thread:

- Chemical reactions involve regrouping of atoms to form new substances. Atoms rearrange during chemical reactions.

### Enduring Understanding:

- Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.
- (Appendix E, NGSS, PS1.B, Chemical Reactions, gr. 6-8)

### Essential Questions:

- How do substances combine or change (react) to make new substances? How does one characterize and explain these reactions and make predictions about them?
- How can we analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred?
- How can we develop and create models to describe how the total number of atoms does not change in a chemical reaction, thus conserving mass?
- How can we design a project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes?

## Assessments

Possible Ongoing Formative Assessments
<ul style="list-style-type: none"><li>● Teacher observation</li><li>● Quizzes</li><li>● Written and verbal responses to readings</li><li>● Simulations</li><li>● Wrap-up questions</li><li>● Daily online assignments</li><li>● Chapter Reviews</li><li>● Hands-on labs</li><li>● Kesler Science Independent Lesson Practice</li></ul>
Summative Assessments
<ul style="list-style-type: none"><li>● Unit 2 Assessment</li></ul>
Alternative Assessments
<ul style="list-style-type: none"><li>● Modified Unit 2 Assessment</li></ul>

## Standards (NJSLs) Addressed in this Unit

Disciplinary Core Ideas
<p><b>PS1.A: Structure and Properties of Matter</b></p> <ul style="list-style-type: none"><li>● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (<i>MS-PS1-2</i>) (Note: This Disciplinary Core Idea is also addressed by <i>MS-PS1-3</i>)</li></ul>
<p><b>PS1.B: Chemical Reactions</b></p> <ul style="list-style-type: none"><li>● 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. (<i>MS-PS1-2</i>), (<i>MS-PS1-5</i>) (Note: This Disciplinary Core Idea is also addressed by <i>MS-PS1-3</i>)</li><li>● The total number of each type of atom is conserved, and thus the mass does not change. (<i>MS-PS1-5</i>)</li><li>● Some chemical reactions release energy, others store energy. (<i>MS-PS1-6</i>)</li></ul>
<p><b>ETS1.B: Developing Possible Solutions</b></p> <ul style="list-style-type: none"><li>● A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary to <i>MS-PS1-6</i>)</li></ul>



### 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*)

## Crosscutting Concepts

### Patterns

- Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (*MS-PS1-2*)

### Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes. (*MS-PS1-5*)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (*MS-PS1-6*)

## Science and Engineering Practices

### Developing and Using Models

Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to describe unobservable mechanisms. (*MS-PS1-5*)

### Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (*MS-PS1-2*)

### Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (*MS-PS1-6*)

### Connections to Nature of Science

#### Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (*MS-PS1-2*)

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

- Laws are regularities or mathematical descriptions of natural phenomena. (*MS-PS1-5*)

### Computer Science and Design Thinking

**8.1.8.DA.3:** Identify the appropriate tool to access data based on its file format.

**8.1.8.NI.3:** Explain how network security depends on a combination of hardware, software, and practices that control access to data and systems.

**8.1.8.NI.4:** Explain how new security measures have been created in response to key malware events.

**8.2.8.ED.2:** Identify the steps in the design process that could be used to solve a problem

**8.2.8.ED.3:** Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

**8.2.8.ED.7:** Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

**8.2.8.ITH.2:** Compare how technologies have influenced society over time. •

**8.2.8.ITH.3:** Evaluate the impact of sustainability on the development of a designed product or system.

**8.2.8.ITH.4:** Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.

**8.2.8.ITH.5:** Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.

**8.2.8.A.5** Describe how resources such as material, energy, information, time, tools, people, and capital contribute to a technological product or system.

**8.2.8.ITH.1:** Explain how the development and use of technology influences economic, political, social, and cultural issues.

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

### LIFE LITERACY AND KEY SKILLS

- 9.4.8.CI.2** Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3).
- 9.4.8.CI.3** Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).
- 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 (e.g., MS-ETS1-2).
- 9.4.8.CT.2** Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).
- 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.GCA.2** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.

## **PRACTICES**

**CLKSP4.** - Demonstrate creativity and innovation

**CLKSP8.** - Use technology to enhance productivity, increase collaboration and communicate effectively.

## **Interdisciplinary Connections:**

### **English Language Arts**

#### Reading Standards for Science and Technical Subjects

- **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*)
  - *For example, cite specific textual evidence to support analysis of science and technical texts on the design and modification of a device that controls the transfer of energy to the environment using factors such as type and concentration of a substance.*
  - *Draw evidence from informational texts to support analysis, reflection, and research on the design and modification of a device that controls the transfer of energy to the environment using factors such as type and concentration of a substance.*
  
- **RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (*MS-PS1-6*)
  - *For example, follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks related to chemical reactions that release energy and some that store energy.*
  - *Conduct research on the design and modification of a device that controls the transfer of energy to the environment using factors such as type and concentration of a substance 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.*

- **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-PS1-2),(MS-PS1-5)
  - *For example, include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points on the design and modification of a device that controls the transfer of energy to the environment.*

#### Writing- Literacy in History/SS, Science and Technical Subjects

- **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)
  - *For example, compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the design and modification of a device that controls the transfer of energy to the environment using factors such as type and concentration of a substance.*

### **Mathematics**

#### Standards for Mathematical Practice

- **MP.2** Reason abstractly and quantitatively. (MS-PS1-2),(MS-PS1-5)
  - *For example, reason quantitatively and abstractly during communication about melting or boiling points.*
  - *For example, reason quantitatively and abstractly: Reason quantitatively using numbers to represent the criteria (amount, time, and temperature of substance) when testing a device that either releases or absorbs thermal energy by chemical processes; reason abstractly by assigning labels or symbols*
- **MP.4** Model with mathematics. (MS-PS1-5)
  - *For example, use mathematics to model the law of conservation of matter*

#### Ratios and Proportional Relationships

- **6.RP.A.3** Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-2),(MS-PS1-5)
  - *For example, use ratio and rate reasoning to describe how the total number of atoms does not change in a chemical reaction, and thus mass is conserved.*
  - *For example, collect and analyze numerical data from tests of a device that either releases or absorbs thermal energy by chemical processes. 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. Pose problems with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate the numerical data with numbers in any form, convert*

*between forms as appropriate, and assess the reasonableness of answers using mental computations and estimation strategies.*

#### Statistics and Probability

- **6.SP.B.4** Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-PS1-2)
  - *Develop a probability model and use it as part of an iterative process for testing to find the probability that a promising design solution will lead to an optimal solution. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy in order to ultimately develop an optimal design.*
- **6.SP.B.5** Summarize numerical data sets in relation to their context (MS-PS1-2)
  - *For example, integrate quantitative information expressed in words about atoms before and after a chemical process with a version of that information expressed in a physical model or drawing, including digital forms.*

#### Social-Emotional Competencies

- **Self-Awareness:** ability to recognize one's emotions and know one's strengths and limitations
  - Connections:
    - Students will be working with partners or in small groups. It is important for students to understand that everyone has different strengths and areas of growth. The teacher helps support students with this.
    - Check-in on feelings (thumbs up, down, in the middle). This helps the teacher know who might need additional support.
- **Self-Management:** ability to regulate and control one's emotions and behaviors, particularly in stressful situations
  - Connections:
    - Applying Open Circle strategies such as counting when feeling upset or anxious.
    - Encourage students to take a break, get water, etc.
- **Social Awareness:** ability to take the perspective of others, demonstrate empathy, acknowledge and appreciate similarities and differences, and understand how one's actions influence and are influenced by others
  - Connections:
    - Students become the peer helper to support others in their work. (Ex.

Helping peers to generate skills needed to solve problems.)

- Being a good audience when others are presenting.
- **Relationship Skills:** refers to one's ability to demonstrate prosocial skills and behaviors in order to develop meaningful relationships and resolve interpersonal conflicts
  - Connections:
    - Sharing materials, taking turns, understanding that everyone may not always get a turn for every activity.
- **Responsible Decision-Making:** refers to the ability to use multiple pieces of information to make ethical and responsible decisions
  - Connections:
    - Class rules
    - Class discussions
    - Following rules
    - Active listening

## UNIT OBJECTIVES

Students will be able to ...

- Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. (*MS-PS1-2*)  
[Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with HCl.]

### Disciplinary Ideas

- Understand that each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- Understand that substances react chemically in characteristic ways.
- Understand that 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.

### Crosscutting Concepts

- Understand that macroscopic patterns are related to the nature of microscopic and atomic-level structure.

### Science and Engineering Practices

- Analyze and interpret data to determine similarities and differences in findings.
- Understand that scientific knowledge is based on logical and conceptual connections between evidence and evaluations.

- 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. (*MS-PS1-5*)

*[Clarification Statement: Emphasis is on law of conservation of matter, and on physical models or drawings, including digital forms, that represent atoms.]*

#### Disciplinary Ideas

- Understand that substances react chemically in characteristic ways.
- Understand that the total number of each type of atom is conserved and thus the mass does not change (the law of conservation of matter).

#### Crosscutting Concepts

- Understand that matter is conserved because atoms are conserved in physical and chemical processes.

#### Science and Engineering Practices

- Develop a model to describe unobservable mechanisms.
- Understand that laws are regularities or mathematical descriptions of natural phenomena.

- Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.\* (*MS-PS1-6*)

*[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.]*

#### Disciplinary Ideas

- Understand that some chemical reactions release energy, while others store energy.
- Understand that models of all kinds are important for testing solutions.
- Understand that there are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
- Understand that a solution needs to be tested and then modified on the basis of the test results in order to improve it.
- Understand that 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.
- Understand that 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.
- Understand that some of the characteristics identified as having the best performance may be incorporated into the new design.

#### Crosscutting Concepts

- Understand that the transfer of energy can be tracked as energy flows through a designed or natural system.

#### Science and Engineering Practices

- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.

### **SUGGESTED ACTIVITIES**

- <http://www.stevespanglerscience.com/lab/experiments/elephants-toothpaste/> - elephant toothpaste lab activity
- [Kesler 5E Lesson Plans for Chemical Changes](#)
- [Kesler 5E Lesson Plans for Periodic Table](#)
- [Kesler Chemical Changes Inquiry Lab](#)
- **Kesler 5E Lesson Plans for Counting Atoms and Balancing Chemical Equations**
  - [Kesler Lesson](#)
  - **Kesler Lesson**
- [Kesler Elements and Compounds Inquiry Lab](#)



## Unit Specific Vocabulary

**chemical reaction** - process that involves the changing of the molecular structure of a substance (something new is formed)

**density** - the degree of compactness of a substance/how tightly packed a substance is

**melting point** - temperature at which a solid changes to a liquid

**boiling point** - temperature at which a liquid changes to a gas

**solubility** - the ability to be dissolved especially in water

**flammability** - how easily something is set afire

**mass** - the quantity of matter a substance contains

## Instructional Materials and Learning Activities

### Core Instructional Materials:

- Kesler Science
- Generation Genius

### Digital Resources:

- [www.inquiryinaction.org](http://www.inquiryinaction.org) - chemistry lab experiments
- <http://www.chem4kids.com> - background information for students
- [PhET](#) - online simulations
- [STEM Resource Finder](#) - online simulations (requires Java)
- [Classroom Resources - NGSS Hub](#) - lesson ideas
- [Next Generation Science Standards](#) - lesson ideas
- [Conservation of Matter Video For Kids | 3rd, 4th & 5th Grade](#)
- [Atoms & Molecules Video For Kids | 6th, 7th & 8th Grade Science](#)
- [Chemical Reactions Video For Kids | 6th, 7th & 8th Grade Science](#)
- *BrainPop Periodic Table of Elements video* - <https://www.brainpop.com/science/matterandchemistry/periodictableofelements/>
- *Generation Genius Physical vs Chemical Changes video* - <https://www.generationgenius.com/videolessons/chemical-vs-physical-changes-video-for-kids/>
- *Generation Genius Properties of Elements video* - <https://www.generationgenius.com/videolessons/properties-of-elements-video-for-kids/>
- *Generation Genius Conservation of Matter video* - <https://www.generationgenius.com/videolessons/conservation-of-matter-video-for-kids/>

### Supplemental Materials:

- National Geographic

- Spectrum Science Grade 6
- Leveled Text for Science: Physical Science by Shell Education

*Leveled Readers:*

- Reading from Kesler Science (Level NM, M)

## Suggested Modifications

*These strategies can be adapted to scaffold for students needing more support or extending the learning for higher level students. Differentiation is accomplished through content, process, product, and learning environment.*

[NGSS Appendix D - "All Standards, All Students": Making the Next Generation Science Standards Accessible to All Students](#)

### Special Education Students

- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Graphic organizers
- Sentence frames to help students explain their understanding
- Copy of notes
- Preview content vocabulary
- Extended time for assignments
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebooks extensions

### Students at Risk

- Graphic organizers
- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text)
- Copy of notes
- Sentence starters and frames
- Preview content vocabulary
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting

- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions

### English Language Learners

- Graphic organizer
- Sentence frames to help students explain their understanding
- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Google Translation
- Copy of notes
- Preview content vocabulary
- Support from ESL teacher
- Extended time for assignments
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (vocabulary, processes, etc.)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Chromebook extensions

### Gifted and Talented

- Higher level text
- Higher level questioning
- Enrichment/independent/ research projects
- Challenge activities
- Independent (as opposed to guided) reading
- Peer tutoring to demonstrate mastery

### Students with 504 Plans

- Graphic organizers
- Kesler Science online assignment features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Copy of notes
- Sentence frames to help students explain their understanding
- Preview content vocabulary.
- Extended time
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating

- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions

# Grade 6 Science Curriculum

## Unit 3: Forces and Interactions

### Unit Overview

- Approximately 11 weeks
- Newton’s Third Law: 3 weeks
- Changes in Motion, Force, and Direction: 1.5 weeks
- Electromagnetic Forces: 2 weeks
- Gravitational Forces: 3 weeks
- Force Fields: 1.5 weeks

### Big Idea/Common Thread:

- Interactions between objects affect how objects move, and whether they are attracted to or repel each other. Different kinds of forces affect objects in different ways.

### Enduring Understanding:

- The role of the mass of an object must be qualitatively accounted for in any change of motion due to the application of a force. (Appendix E, NGSS, PS2.A, Forces and Motion, gr. 6-8)
- Forces that act at a distance involve fields that can be mapped by their relative strength and effect on an object. (Appendix E, NGSS, PS2.B, Types of Interactions, gr. 6-8)

### Essential Questions:

- How does data help determine factors that affect the strength of electric and magnetic forces?
- How could you plan an investigation to provide evidence that changes an object’s motion depended upon the sum of the forces?
- How could you apply Newton’s Third Law to design a solution to a problem involving two colliding objects?

### Assessments

#### Possible Ongoing Formative Assessments

- Teacher observation
- Quizzes
- Written and verbal responses to readings
- Simulations
- Wrap-up questions
- Daily online assignments
- Chapter Reviews

- Hands-on labs
- Kesler Science Independent Lesson Practice

### Summative Assessments

- Unit 3 Assessment

### Alternative Assessments

- Modified Unit 3 Assessment

## Standards (NJSLs) Addressed in this Unit

### 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 magnet, or a ball respectively). *(MS-PS2-5)*

### Crosscutting Concepts

#### Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. *(MS-PS2-3), (MS-PS2-5)*

### Systems and System Models

- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. *(MS-PS2-1), (MS-PS2-4)*

### Stability and Change

- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. *(MS-PS2-2)*

## Science and Engineering Practices

### Asking Questions and Defining Problems

Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. *(MS-PS2-3)*

### Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.

- Plan an investigation individually and collaboratively, and in the design identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. *(MS-PS2-2)*
- Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. *(MS-PS2-5)*

### Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.



- Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1)

### Engaging in Argument from Evidence

Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.

- Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)

### Connections to Engineering, Technology, and Applications of Science

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

- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1)

### Connections to Nature of Science

#### Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-2),(MS-PS2-4)

### Computer Science and Design Thinking

**8.1.8.DA.3:** Identify the appropriate tool to access data based on its file format.

**8.1.8.DA.5:** Test, analyze, and refine computational models.

**8.1.8.NI.3:** Explain how network security depends on a combination of hardware, software, and practices that control access to data and systems.

**8.1.8.NI.4:** Explain how new security measures have been created in response to key malware events.

**8.2.8.ED.2:** Identify the steps in the design process that could be used to solve a problem

**8.2.8.ED.7:** Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

**8.2.8.ITH.1:** Explain how the development and use of technology influences economic, political, social, and cultural issues.

## Career Readiness, Life Literacies, and Key Skills

### LIFE LITERACY AND KEY SKILLS

**9.4.8.CI.2** Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3).

**9.4.8.CI.3** Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).

**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 (e.g., MS-ETS1-2).

**9.4.8.CT.2** Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).

**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.GCA.2** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.

### PRACTICES

**CLKSP4.** - Demonstrate creativity and innovation

**CLKSP8.** - Use technology to enhance productivity, increase collaboration and communicate effectively.

## Interdisciplinary Connections:

### English Language Arts

#### Reading Standards for Science and Technical Subjects

- **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*), (*MS-PS2-3*)
  - *For example, cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions of the application of Newton's third law involving the motion of two colliding objects.*
  - *For example, draw evidence from informational texts to support analysis, reflection, and research about the application of Newton's third law when designing a solution to a problem involving the motion of two colliding objects.*
- **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*)
  - *For example, follow precisely a multistep procedure when carrying out experiments to apply Newton's third law when designing a solution to a problem involving the motion of two colliding objects, taking measurements, or performing technical tasks.*
  - *For example, follow precisely a multistep procedure when performing an investigation that provides 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, taking measurements or performing technical tasks.*

#### Writing- Literacy in History/SS, Science and Technical Subjects

- *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)*
  - *For example, compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading texts about the application of Newton's third law to the motion of two colliding objects Conduct a short research project to answer a question about the application of Newton's third law when designing a solution to a problem involving the motion of two colliding objects, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.*
  - *For example, conduct a short research project to answer a question about how the sum of the forces on the object and the mass of the object change an object's motion, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.*
  - *For example, gather relevant information from multiple print and digital sources that provide information about the application of Newton's third law when designing a solution to a problem involving the motion of two colliding objects; assess the credibility of each source and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources*

#### **Mathematics**

##### Standards for Mathematical Practice

- *MP.2 Reason abstractly and quantitatively. (MS-PS1-2),(MS-PS2-2),(MS-PS2-3)*
  - *For example, reason abstractly and quantitatively when collecting and analyzing data about the application of Newton's third law in the course of designing a solution to a problem involving the motion of two colliding objects.*

##### The Number System

- *6.NS.C.5 Understand that positive and negative 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)*
  - *For example, analyze data in the form of numbers and symbols to draw conclusions about how the sum of the forces on an object and the mass of an object change the object's motion.*

- *For example, 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 a design that applies Newton’s third law to a problem involving the motion of two colliding objects.*

#### Expressions and Equations

- **6.EE.A.2** Write, read, and evaluate expressions in which letters stand for numbers. (MS-PS2-1),(MS-PS2-2)
  - *For example, when collecting and analyzing data from investigations about how the sum of the forces on an object and the mass of the object changes the object’s motion, write, read, and evaluate expressions in which letters stand for numbers.*

### Social-Emotional Competencies

- **Self-Awareness**: ability to recognize one’s emotions and know one’s strengths and limitations
  - Connections:
    - Students will be working with partners or in small groups. It is important for students to understand that everyone has different strengths and areas of growth. The teacher helps support students with this.
    - Check-in on feelings (thumbs up, down, in the middle). This helps the teacher know who might need additional support.
- **Self-Management**: ability to regulate and control one’s emotions and behaviors, particularly in stressful situations
  - Connections:
    - Applying Open Circle strategies such as counting when feeling upset or anxious.
    - Encourage students to take a break, get water, etc.
- **Social Awareness**: ability to take the perspective of others, demonstrate empathy, acknowledge and appreciate similarities and differences, and understand how one’s actions influence and are influenced by others
  - Connections:
    - Students become the peer helper to support others in their work. (Ex. Helping peers to generate skills needed to solve problems.)
    - Being a good audience when others are presenting.

- **Relationship Skills:** refers to one’s ability to demonstrate prosocial skills and behaviors in order to develop meaningful relationships and resolve interpersonal conflicts
  - Connections:
    - Sharing materials, taking turns, understanding that everyone may not always get a turn for every activity.
  
- **Responsible Decision-Making:** refers to the ability to use multiple pieces of information to make ethical and responsible decisions
  - Connections:
    - Class rules
    - Class discussions
    - Following rules
    - Active listening

## UNIT OBJECTIVES

Students will be able to ...

- Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.\* (MS-PS2-1)

*[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.]*

### Disciplinary Ideas

- Understand that 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.

### Crosscutting Concepts

- Understand that models can be used to represent the motion of objects in colliding systems and their interactions - such as inputs, processes, and outputs - and energy and matter flows within systems.
- Understand that the uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by the differences in such factors as climate, natural resources, and economic conditions.

### Science and Engineering Practices

- Apply scientific ideas or principles to design an object, tool, process, or system.
  
- 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. (MS-PS2-2)

*[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.]*

### Disciplinary Ideas

- Understand that 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.
- Understand that the greater the mass of the object, the greater the force needed to achieve the same change in motion.
- Understand that for any given object, a larger force causes a larger change in motion.
- Understand that all positions of objects and the directions of forces and motions must be described in a chosen reference frame and chosen units of size.

### Crosscutting Concepts

- Understand that explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.

### Science and Engineering Practices

- Plan an investigation individually and collaboratively and in the design identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
  - Understand that scientific knowledge is based on logical and conceptual connections between evidence and explanations.
- Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. (MS-PS2-3)

*[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.]*

### Disciplinary Ideas

- Understand that electrical 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.

### Crosscutting Concepts

- Understand that cause and effect relationships may be used to predict phenomena in natural or designed systems.

### Science and Engineering Practices

- Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
- Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. (MS-PS2-4)  
*[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.]*

### Disciplinary Ideas

- Understand that gravitational forces are always attractive. There is a gravitational force between two masses, but it is very small except when one or both of the objects have a large mass (e.g., Earth and the sun).

### Crosscutting Concepts

- Understand that models can be used to represent systems and their interactions - such as inputs, processes, and outputs - and energy and matter flows within systems.

### Science and Engineering Practices

- Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
- Understand that scientific knowledge is based on logical and conceptual connections between evidence and explanations.
- 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. (MS-PS2-5)  
*[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.]*

### Disciplinary Ideas

- Understand that forces that act at a distance (electrical, 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, a magnet, or a ball, respectively).

#### Crosscutting Concepts

- Understand that cause and effect relationships may be used to predict phenomena in natural or designed systems.

#### Science and Engineering Practices

- Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation.

## SUGGESTED ACTIVITIES

- PHET (Forces and Motion: Basics) - [Forces and Motion: Basics](#)
- Inertia Crash Dummies kit - [Inertia Crash Dummies | Ward's Science](#)
- Building straw rockets - [Lesson: Soda Straw Rockets](#)
- Kesler 5E Balanced & Unbalanced Forces Lesson Plans - <https://lessons.keslerscience.com/courses/take/force-and-motion-5e-lessons-bundle-for-members-1/pdfs/17864180-1-engagement-objective-and-word-wall-preview>
- Kesler 5E Newton's Laws of Motion Lesson Plans - <https://lessons.keslerscience.com/courses/take/force-and-motion-5e-lessons-bundle-for-members-1/pdfs/17864160-1-engagement-objective-and-word-wall-preview>
- Kesler Acceleration Inquiry Lab - <https://lessons.keslerscience.com/courses/take/force-and-motion-inquiry-labs-bundle/pdfs/4433051-acceleration-inquiry-lab>
- Kesler Balanced & Unbalanced Forces Inquiry Lab - <https://lessons.keslerscience.com/courses/take/force-and-motion-inquiry-labs-bundle/pdfs/4738788-balanced-and-unbalanced-forces-inquiry-lab>

### Unit Specific Vocabulary

**energy** - the ability to do work (the use of a force to move an object over a distance)

**kinetic energy** - energy that matter has due to its motion.

**potential energy**- the energy of a particle (or system of particles) derived from position, or condition, rather than motion. *Example: height of an object above the ground.*

**force** - a push or pull upon an object resulting from the object's interaction with another object. If it is unopposed, it will change the motion of an object.

**balanced forces** - forces acting in opposite directions on an object, and equal in size. When the forces on an object are balanced, the object stays still or continues to move at the same speed and in the same direction.

**unbalanced forces** - forces not acting in opposite directions on an object, and/or unequal in size. When the forces on an object are unbalanced, the object changes speed and/or direction.



**Newton's First Law** - An object at rest stays at rest, and an object in motion stays in motion with the same speed and in the same direction, unless acted upon by an unbalanced force.

**Newton's Second Law** - The change in motion of an object due to an unbalanced force is proportional to the magnitude of the force, in the same direction as the force, and inversely proportional to the mass of the object.

**Newton's Third Law** - 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.

## Instructional Materials and Learning Activities

### Core Instructional Materials:

- Kesler Science
- Generation Genius

### Digital Resources:

- [STEM Resource Finder](#) - online simulations (requires Java)
- [Next Generation Science Standards](#) - lesson ideas
- [http://www.nasa.gov/pdf/630754main\\_NASAsBESTActivityGuide6-8.pdf](http://www.nasa.gov/pdf/630754main_NASAsBESTActivityGuide6-8.pdf) - NASA's Educator Guide to the Engineering Design Process
- *BrainPop Forces video* - <https://www.brainpop.com/science/energy/forces/>
- *BrainPop Newton's Laws of Motion video* - <https://www.brainpop.com/science/motionsforcesandtime/newtonslawsofmotion/>
- *Generation Genius Balanced & Unbalanced Forces video* - <https://www.generationgenius.com/videolessons/balanced-and-unbalanced-forces-video-for-kids/>
- *Generation Genius Newton's Laws of Motion video* - <https://www.generationgenius.com/videolessons/newtons-laws-of-motion-video-for-kids/>

### Supplemental Materials:

- National Geographic
- Delta Science
- Forces and Motion
- Spectrum Science Grade 6
- Leveled Text for Science: Physical Science by Shell Education
- NASA Rockets Educator Guide - activities in which students build rockets

### Leveled Readers:

- Readings from Kesler Science

## Suggested Modifications

OPS BOE Born on Date: July 2017

Revised on: July 2022

Annual Revision: OPS BOE on September 2023 Oradell Public School District GR 6 Science Curriculum 57

*These strategies can be adapted to scaffold for students needing more support or extending the learning for higher level students. Differentiation is accomplished through content, process, product, and learning environment.*

[NGSS Appendix D - "All Standards, All Students": Making the Next Generation Science Standards Accessible to All Students](#)

### **Special Education Students**

- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Graphic organizers
- Sentence frames to help students explain their understanding
- Copy of notes
- Preview content vocabulary
- Extended time for assignments
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebooks extensions

### **Students at Risk**

- Graphic organizers
- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text)
- Copy of notes
- Sentence starters and frames
- Preview content vocabulary
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion

- Sensory breaks
- Chromebook extensions

### English Language Learners

- Graphic organizer
- Sentence frames to help students explain their understanding
- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Google Translation
- Copy of notes
- Preview content vocabulary
- Support from ESL teacher
- Extended time for assignments
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (vocabulary, processes, etc.)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Chromebook extensions

### Gifted and Talented

- Higher level text
- Higher level questioning
- Enrichment/independent/ research projects
- Challenge activities
- Independent (as opposed to guided) reading
- Peer tutoring to demonstrate mastery

### Students with 504 Plans

- Graphic organizers
- Kesler Science online assignment features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Copy of notes
- Sentence frames to help students explain their understanding
- Preview content vocabulary.
- Extended time
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions

- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions

## **Grade 6 Science Curriculum**

### **Unit 4: Space Systems**

#### **Unit Overview**

- Approximately 10 weeks
- The Solar System: 2 weeks
- Earth, Sun, Moon System: 2 weeks
- Formation of the Solar System: 2 weeks
- Patterns of Motion: 2 weeks

OPS BOE Born on Date: July 2017

Revised on: July 2022

Annual Revision: OPS BOE on September 2023    Oradell Public School District GR 6 Science Curriculum 60

- The Universe: 2 weeks

**Big Idea/Common Thread:**

- Models of the solar system can explain astronomical and other observations of the cyclic patterns of eclipses, tides, and seasons.

**Enduring Understanding:**

- The solar system is part of the Milky Way, which is one of many billions of galaxies. (Appendix E. NGSS, ESS1.A, The Universe and its starts, gr 6-8)
- The solar system contains many varied objects held together by gravity. Solar system models explain and predict eclipses, lunar phases, and seasons. (Appendix E. NGSS, ESS1.B, Earth and the solar systems, gr 6-8)

**Essential Questions:**

- How can one describe and model the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons?
- How can one describe and model the role of gravity in the motions within galaxies and the solar system?
- 

**Assessments**

<b>Possible Ongoing Formative Assessments</b>
<ul style="list-style-type: none"> <li>• Teacher observation</li> <li>• Quizzes</li> <li>• Written and verbal responses to reading</li> <li>• Simulations</li> <li>• Wrap-up questions</li> <li>• Daily online assignments</li> <li>• Chapter Reviews</li> <li>• Hands-on labs</li> <li>• Kesler Science Independent Lesson Practice</li> </ul>
<b>Summative Assessments</b>
<ul style="list-style-type: none"> <li>• Unit 4 Assessment</li> </ul>
<b>Alternative Assessments</b>
<ul style="list-style-type: none"> <li>• Modified Unit 4 Assessment</li> </ul>

**Standards (NJSLs) Addressed in this Unit**

<b>Disciplinary Core Ideas</b>
--------------------------------

### ESS1.A: The Universe and Its Stars

- Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. *(MS-ESS1-1)*
- Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. *(MS-ESS1-2)*

### ESS1.B: Earth and the Solar System

- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. *(MS-ESS1-2), (MS-ESS1-3)*
- This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. *(MS-ESS1-1)*
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. *(MS-ESS1-2)*

## Crosscutting Concepts

### Patterns

- Patterns can be used to identify cause and effect relationships. *(MS-ESS1-1)*

### Scale, Proportion, and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. *(MS-ESS1-3)*

### Systems and System Models

- Models can be used to represent systems and their interactions. *(MS-ESS1-2)*

## Science and Engineering Practices

### Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. *(MS-ESS1-1), (MS-ESS1-2)*

### Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis

- Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3)

### Connections to Engineering, Technology, and Applications of Science

#### Interdependence of Science, Engineering, and Technology

- Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-ESS1-3)

### Connections to Nature of Science

#### Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-ESS1-1), (MS-ESS1-2)

### Computer Science and Design Thinking

**8.2.8.ED.1:** Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.

**8.2.8.ED.2:** Identify the steps in the design process that could be used to solve a problem.

**8.2.8.ED.3:** Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

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

#### LIFE LITERACY AND KEY SKILLS

**9.4.8.CI.2** Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3).

**9.4.8.CI.3** Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).

**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 (e.g., MS-ETS1-2).

**9.4.8.CT.2** Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).

**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.GCA.2** Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.

### **PRACTICES**

**CLKSP4.** - Demonstrate creativity and innovation

**CLKSP8.** - Use technology to enhance productivity, increase collaboration and communicate effectively.

### **Interdisciplinary Connections:**

#### **English Language Arts**

Reading Standards for Science and Technical Subjects

- **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-ESS1-3)
  - For example, cite specific textual evidence to support analysis of science and technical text about scale properties of objects in the solar system.
- **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-ESS1-3)
  - For example, include multimedia components and visual displays in presentations to describe the cyclical patterns of lunar phases, eclipses of the sun and moon, seasons, and the role of gravity in the motions within galaxies and the solar system. The presentation needs to clarify claims and findings and emphasize salient points.
  - For example, integrate quantitative or technical information expressed in words in a text about scale properties of objects in the solar system with a version of that information expressed visually in a flowchart, diagram, model, graph, or table.

#### **Mathematics**

Standards for Mathematical Practice

- **MP.2** Reason abstractly and quantitatively. (MS-ESS1-3)
  - For example, reason quantitatively and abstractly about the sizes of an object's layers, surface features, and orbital radius where appropriate.
- **MP.4** Model with mathematics. (MS-ESS1-1),(MS-ESS1-2)
  - For example, use mathematics to model the motion of the sun, moon, and stars in the sky and the role of gravity in the motions within galaxies and the solar system.

Ratios and Proportional Relationships

- **6.RP.A.1** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS1-1),(MS-ESS1-2),(MS-ESS1-3)



- For example, understand the concept of a ratio and use ratio language to describe a ratio relationship between the measurements of the cyclical motion between at least two bodies in the solar system and the relative sizes of objects and/or distances between objects and the impact of gravity on the motion of these objects.
- For example, recognize and represent proportional relationships between the measurement of patterns in the cyclical motion of the sun, moon, and stars in the sky and mathematical proportions relative to the sizes of objects and the effect of gravity on the motion of these objects.

#### Expressions and Equations

- **6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS1-2)
  - Use variables to represent numbers and write expressions when solving a problem involving the role of gravity in the motions within galaxies and within the solar system. Understand that a variable can represent an unknown number, or depending on the problem, any number in a specified set.

### Social-Emotional Competencies

**Self-Awareness:** ability to recognize one’s emotions and know one’s strengths and limitations

- Connections:
  - Regular check-ins to share feelings (Oral, Thumbs Up, Thumbs Down, Emojis, etc.)
  - Reflecting on one’s learning (Oral, Thumbs Up, Thumbs Down, Pictures, etc.)

**Self-Management:** ability to regulate and control one’s emotions and behaviors, particularly in stressful situations

- Connections:
  - Taking deep breaths and practicing patience during science labs

**Social Awareness:** ability to take the perspective of others, demonstrate empathy, acknowledge and appreciate similarities and differences, and understand how one’s actions influence and are influenced by others

- Connections:
  - Working in groups during labs

**Relationship Skills:** refers to one’s ability to demonstrate prosocial skills and behaviors in

order to develop meaningful relationships and resolve interpersonal conflicts

- Connections:
  - Class discussions
  - Incentives for individual students and small groups
  - Working in groups during labs

**Responsible Decision-Making:** refers to the ability to use multiple pieces of information to make ethical and responsible decisions

- Connections:
  - Class rules and routines
  - Class discussions
  - Following directions

## UNIT OBJECTIVES

Students will be able to ...

- Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. (*MS-ESS1-1*)  
*[Clarification Statement: Examples of models can be physical, graphical, or conceptual.]*

### Disciplinary Ideas

- Understand that patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.
- Understand that the Earth and solar system model can explain eclipses of the sun and the moon.
- Understand that Earth's spin axis is fixed in direction over the short term but tilted relative to its orbit around the sun.
- Understand that the seasons are a result of Earth's tilt and are caused by the differential intensity of sunlight on different areas of Earth throughout the year.

### Crosscutting Concepts

- Understand that patterns can be used to identify cause-and-effect relationships that exist in the apparent motion of the sun, moon, and stars in the sky.

### Science and Engineering Practices

- Develop and use a model to describe patterns in the apparent motion of the sun, moon, and stars in the sky.
- Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. (*MS-ESS1-2*)  
*[Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as*

*the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).]*  
*[Assessment Boundary: Assessment does not include Kepler's Law of orbital motion or the apparent retrograde motion of the planets as viewed from the Earth.]*

### Disciplinary Ideas

- Understand that gravity plays a role in the motions within galaxies and the solar system.
- Understand that gravity is the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them.
- Understand that the earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.
- Understand that the solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids, that are held in orbit around the sun by its gravitational pull on them.
- Understand that the solar system appears to have formed from a disk of dust and gas, drawn together by gravity.

### Crosscutting Concepts

- Models can be used to represent the role of gravity in the motions and interactions within galaxies and the solar system.

### Science and Engineering Practices

- Develop and use a model to describe phenomena.
- Analyze and interpret data to determine scale properties of objects in the solar system.  
(MS-ESS1-3)

*[Clarification Statement: Emphasis is on the analysis of the data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.]*

### Disciplinary Ideas

- Understand that the solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids, that are held in orbit around the sun by its gravitational pull on them.

### Crosscutting Concepts

- Objects in the solar system have scale properties.
- Time, space, and energy phenomena in the solar system can be observed at various scales, using models to study systems that are too large.

## Science and Engineering Practices

- Analyze and interpret data to determine similarities and differences among objects in the solar system.
- Data from Earth-based instruments, space-based telescopes, and spacecraft can be used to determine similarities and differences among solar system objects.

## SUGGESTED ACTIVITIES

- Bring the students into the Starlab portable planetarium.  
See <http://starlab.com/classic-starlab-old/classic-starlab-cylinders/> for ideas.

### Unit Specific Vocabulary

**Orbit** - the path followed by an object revolving around another object, under the influence of gravity

**Gravity** - a force which tries to pull two objects toward each other. Anything which has mass also has a gravitational pull. The more massive an object is, the stronger its gravitational pull is

**Solar System** - the collection of eight planets and their moons in orbit around the sun, together with smaller bodies such as asteroids, meteoroids, and comets

**Galaxy** - a system of millions or billions of stars, together with gas and dust, held together by gravitational attraction

**Eclipse** - the partial or total blocking of light of one celestial object by another

**Solar eclipse** - an eclipse in which the sun is partially or completely blocked from Earth's view by the moon passing between the sun and the earth

**Lunar eclipse** - an eclipse in which earth's view of the moon is partially or completely darkened when the moon passes into the earth's shadow

**Axis** - an imaginary line that passes through a planet or other object, that the object rotates around

**Rotation** - the spinning of a planet or other object on its axis

**Revolution** - the movement of a planet or other object around another object

### Instructional Materials and Learning Activities

#### *Core Instructional Materials:*

- Kesler Science
- Generation Genius

#### *Digital Resources:*

- [STEM Resource Finder](#) - online simulations (requires Java)
- [Classroom Resources - NGSS Hub](#) - lesson ideas
- [Next Generation Science Standards](#) - lesson ideas
- [MoonConnection.com](#) - lesson ideas
- [PhET](#) - online simulations

*Supplemental Materials:*

- Mission Solar System by Nancy Dickman
- National Geographic
- Spectrum Science Grade 6 Understanding Science and Nature: Space and Planets by Time Life

*Leveled Readers:*

- Readings from Kesler Science (Levels NM, M)

### **Suggested Modifications**

*These strategies can be adapted to scaffold for students needing more support or extending the learning for higher level students. Differentiation is accomplished through content, process, product, and learning environment.*

[NGSS Appendix D - "All Standards, All Students": Making the Next Generation Science Standards Accessible to All Students](#)

### **Special Education Students**

- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Graphic organizers
- Sentence frames to help students explain their understanding
- Copy of notes
- Preview content vocabulary
- Extended time for assignments
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks

- Chromebooks extensions

### Students at Risk

- Graphic organizers
- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text)
- Copy of notes
- Sentence starters and frames
- Preview content vocabulary
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions

### English Language Learners

- Graphic organizer
- Sentence frames to help students explain their understanding
- Kesler Science online Assignments features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Google Translation
- Copy of notes
- Preview content vocabulary
- Support from ESL teacher
- Extended time for assignments
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (vocabulary, processes, etc.)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Chromebook extensions

### Gifted and Talented

- Higher level text

- Higher level questioning
- Enrichment/independent/ research projects
- Challenge activities
- Independent (as opposed to guided) reading
- Peer tutoring to demonstrate mastery

### Students with 504 Plans

- Graphic organizers
- Kesler Science online assignment features (vocabulary flashcards, text-to-speech, text enlargement, dictionary look up, text highlighter, and notes next to text).
- Copy of notes
- Sentence frames to help students explain their understanding
- Preview content vocabulary.
- Extended time
- Prompting
- Reassurance and time to formulate ideas
- Visual clues (pictures with vocabulary terms)
- Preferential seating
- Repeated directions
- Step-by-step directions
- Check for understanding
- Ask pointed questions
- Instructional aides in the classroom setting
- Behavior chart to increase focus and work completion
- Sensory breaks
- Chromebook extensions