The Middletown Public Schools Curriculum for grades K-12 was completed June 2015 by a team of K-12 teachers. The team, identified as the Science Curriculum Writers referenced extensive resources to design the document that included but are not limited to:

- Next Generation Science Standards (NGSS)
- Next Generation Science Standards Appendices A-M
- A Framework for K-12 Science Education
- Common Core State Standards for English Language Arts and Literacy in History/Social Studies, Science and Technical Subjects (CCSS)
- Common Core State Standards for Mathematics (CCSS)
- University of Texas, Dana Center (science units of study)
- Best Practice, New Standards for Teaching and Learning in America’s Schools
- Classroom Instruction That Works
- Differentiated Instructional Strategies
- Model curriculum documents from several states
- Educational websites
- Webb’s Depth of Knowledge

The K-12 Curriculum identifies what all students should know and be able to do in science education. Each grade or course draws from The Next Generation Science Standards, Common Core English Language Arts and Mathematics Standards, research-based instructional strategies, resources, map (or suggested timeline), rubrics, and checklists.

The curriculum provides learners with a sequential comprehensive education in Science through the study of Next Generation Standards that includes:

- **Disciplinary Core Ideas:**
  - Physical Science
  - Life Science
  - Earth and Space Science
  - Engineering and Technology

- **Science and Engineering Practices:**
  - Asking questions and defining problems.
  - Developing and using models.
  - Planning and carrying out investigations.
  - Analyzing and interpreting data.
  - Using mathematics and computational thinking.
  - Constructing explanations and designing solutions.
  - Engaging in argument from evidence
  - Obtaining, evaluating and communicating information.

- **Crosscutting Concepts**
  - Patterns
  - Cause and Effect: Mechanism and Explanation
  - Scale, Proportion, and Quantity
  - Systems and System Models
  - Energy and Matter: Flows, Cycles, and Conservation
  - Structure and Function
  - Stability and Change

**Common Core State Standards** for English Language Arts that includes:

- **College and Career Readiness Anchor Standards for Reading**
  - Key Ideas and Details
  - Craft and Structure
  - Integration of Knowledge
  - Range of Reading

- **College and Career Readiness Anchor Standards for Writing**
  - Text Types and Purposes
  - Production and Distribution of Writing
  - Research to Build and Present Knowledge
  - Range of Writing

**Common Core State Standards** for Mathematics that includes:
Mathematical content (e.g. expressions and equations, the number system, algebra, geometry)

Mathematical practices

RESEARCH-BASED INSTRUCTIONAL STRATEGIES

The curriculum provides a list of research-based best practice instructional strategies that the teacher may model and/or facilitate, e.g.

- Employs strategies of “best practice” (student-centered, experiential, holistic, authentic, expressive, reflective, social, collaborative, democratic, cognitive, developmental, constructivist/heuristic, and challenging).
- Differentiates instruction by varying the content, process, and product and implementing
  - Anchoring
  - Cubing
  - Jig-sawing
  - Pre/post assessments
  - Think/pair/share
  - Tiered assignments
- Analyzes formative assessment to direct instruction.
- Provides exemplars and rubrics.
- Provides opportunities for independent, partner and collaborative group work.
- Addresses multiple intelligences and brain dominance (spatial, bodily kinesthetic, musical, linguistic, intrapersonal, interpersonal, mathematical/logical, and naturalist).
- Models the use of graphic organizers: sequence organizers (chains, cycle), concept development (mind map), compare/contrast organizers (Venn diagrams, comparison charts), organizers (word web, concept map), evaluation organizers (charts, scales), categorize/classify organizers (categories, tree) relational organizers (fish bone, pie chart).
- Provides science practices opportunities such as:
  - Facilitating the science and engineering practices: Appendix F
    1. Asking questions (for science) and defining problems (for engineering)
    2. Developing and using models
    3. Planning and carrying out investigations
    4. Analyzing and interpreting data
    5. Using mathematics and computational thinking
    6. Constructing explanations (for science) and designing solutions (for engineering)
    7. Engaging in argument from evidence
    8. Obtaining, evaluating, and communicating information
  - Modeling Cross-cutting concepts: Appendix G
    1. Patterns
    2. Cause and effect
    3. Scale, proportion, and quantity
    4. Systems and system models
    5. Energy and matter
    6. Structure and function
    7. Stability and change
  - Implementing “equitable learning opportunities”
    1. Value and respect the experiences that all students bring from their backgrounds
    2. Articulate students’ background knowledge with disciplinary knowledge of science
    3. Offer sufficient school resources to support student learning
COMMON and SUGGESTED ASSESSMENTS

REQUIRED COMMON ASSESSMENTS
• Common Formative Assessments
• Common Summative Assessments

SUGGESTED ASSESSMENTS
• Anecdotal records
• Compiling data
• Conferencing
• Collaboartion
• Exhibits
• Interpret data
• Interviews
• Investigations
• Graphs
• Graphic organizers
• Journals
• Labs
• Models
• Multiple Intelligences assessments, e.g.
  o Graphic organizing - visual
  o Collaboration - interpersonal
  o Role playing - bodily kinesthetic

• Oral presentations
• Predictions
• Research
• Rubrics/checklists
• Summarizing and note taking
• Tests and quizzes
• Technology
• Think-alouds
• Writing genres
  o Argument
  o Informative
• Vocabulary
RESOURCES FOR GRADE 6

**Textbook**
- *Science Day Book/Physical Science*
- *Sciencesaurus*
- *Sciencesaurus - Magnetism/Electricity/Force*
- *Sciencesaurus, Earth Science section*
- *Sciencesaurus-Forces, electricity and magnetism*

**Science Kits/Labs:**
- Lab A: Drive the Nail, Lab-Aids “Energy” kit
- Lab Aid Kit Activity 26A “Motors and Generators” covers this:
- Lab Aid Kit Activity 65A “Energy and Magnetic Fields”
- Lab-Aids “Issues and Life Science: Cell biology and Disease”
- Lab-Aids Issues and Earth Science-Weather and Atmosphere

**Supplementary Books, Teacher (T) Student (S)**
- Uncovering Student Ideas in Electricity and Magnetism - Keeley
- Uncovering Student Ideas in Physical Science – Keeley
- Formative and Summative Probes - vol. 1-4 Keeley
- Holt Science and Technology: Forces Motion and Energy
- Inheritance Gizmo, Explore Learning
- Issues and Earth Science
- Issues and Physical Science-Energy
- Magnets and Motors - STC Literacy Series
- Mouse Genetics (One Traits) Gizmo, Explore Learning

**Technology**
- Computers
- LCD projectors
- Interactive boards

**Videos and DVDs**
- Ribbon of Life (multimedia resource, FOSS web)
- Bill Nye Video--The Water Cycle

**Websites**
- explorelearning--Water Cycle Gizmo
- [http://science-class.net/archive/science-class/Physics/energy.htm](http://science-class.net/archive/science-class/Physics/energy.htm)
- [http://sciencespot.net/index.html](http://sciencespot.net/index.html)
- [http://sclinks.nasa.gov/](http://sclinks.nasa.gov/)
- [http://www.howstuffworks.com/](http://www.howstuffworks.com/)
- [www.explorelearning.com](http://www.explorelearning.com)
- [www.lab-aids.com](http://www.lab-aids.com)

- [NGSS](http://www.nextgenscience.org/) Next Generation Science Standards
- RIDE & NGSS [https://www.ride.ri.gov/InstructionAssessment/Science/NextGenerationScienceStandards.aspx](https://www.ride.ri.gov/InstructionAssessment/Science/NextGenerationScienceStandards.aspx) Explains each standard and demonstrates what it looks like at each grade
- [www.utdanacenter.org](http://www.utdanacenter.org) Log-in: Rhode; Password: Island (RI Science units)
- [https://www.pltw.org/our-programs/pltw-launch](https://www.pltw.org/our-programs/pltw-launch) K-5 PLTW STEM Presentation (Project Lead the Way)
- [http://www.nextgenscience.org/ngss-high-school-evidence-statements](http://www.nextgenscience.org/ngss-high-school-evidence-statements) NGSS Evidence Tables (HS only)

**Community**
- 

8/16/2015  Middletown Public Schools
**PS2.B PHYSICAL SCIENCE**

**Motion and Stability: Forces and Interactions**

**Types of Interactions**

<table>
<thead>
<tr>
<th>DOMAIN</th>
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<tbody>
<tr>
<td>MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.</td>
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</table>

**Performance Expectations**

Students who demonstrate understanding can:

- Demonstrate/model how electric currents and magnets can exert a force on each other.
- Define an electric current as the flow of electrons on the surface of a wire.
- Identify poles as regions on a magnet where the magnetic force is strongest.
- Explain the attractive or repulsive force between the poles of magnets:
  - like poles repel
  - opposite poles attract.
- Illustrate a magnetic field as it surrounds a magnet.
- Establish that a magnetic field is generated when an electric current flows through a wire.
- Develop testable questions.
- Understand the factors that can affect the strength of electric and magnetic forces.

**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.

**Disciplinary Core Ideas**

- **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.

**Cross Cutting Concepts**

- **Cause and Effect**
  - Cause and effect relationships may be used to predict phenomena in natural or designed systems.
## Connections to other DCIs in this grade-band:

Articulation across grade-bands: 3.PS2.B ; H5.PS2.B

Common Core State Standards Connections:

ELA/Literacy – RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions

Mathematics – MP.2 Reason abstractly and quantitatively.

### ASSESSMENTS

**Student activities/labs**

Lab Aid Kit Activity 26A “Motors and Generators” covers this:

- Issues and Physical Science-Energy activities 56A Motors and Generators” and 65A “Energy and Magnetic Fields”
- www.lab-aids.com
- Science Day Book/Physical Science
- Sciencesaurus-Forces, electricity and magnetism
- Uncovering Student Ideas in Physical Science - Keeley
- Uncovering Student Ideas in Electricity and Magnetism - Keeley
- Formative and Summative Probes - vol. 1-4 Keeley
- “Issues in Physical Science” Unit D Energy
- Magnets and Motors - STC Literacy Series
- Holt Science and Technology: Forces Motion and Energy

### Academic Vocabulary

- attract
- data
- electric current
- electromagnet
- magnetic forces
- poles
- repel
- testable question

### Specific Websites/Resources

- http://science-class.net/archive/science-class/Physics/energy.htm
- www.explorelarning.com
- http://sciencespot.net/index.html
- http://scilinks.nasa.gov/
- http://www.howstuffworks.com/

## Performance Expectations

Students who demonstrate understanding can:

**MS-PS2-5.** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

[Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.]

[Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.]
## Essential knowledge and skills
- Recognize and define that a force is a push or a pull.
- Identify magnetism as a force that exists in nature.
- Cite evidence that fields exist between objects and exert force on each other even though the objects are not in contact.
- Cite evidence that forces that exist at a distance (electric and magnetic) can be extended through space and can be mapped by their effect on a test object.

## Science and Engineering Practices
- **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.
  - 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.

## Disciplinary Core Ideas
- **PS2.B: Types of Interactions**
  - Forces that act at a distance (electric and magnetic) can be explained by fields that extend through space and can be mapped by their effect on a test object (a ball, a charged object, or a magnet, respectively).

## Cross Cutting Concepts
- **Cause and Effect**
  - Cause and effect relationships may be used to predict phenomena in natural or designed systems.

## Connections to
- Articulation across grade-bands:
- ELA/Literacy – RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- 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.

## Academic Vocabulary
- attract
- evaluate
- exerting
- experimental design
- force
- investigation
- magnetic field
- repel

## Resources
- Student activities/labs
- Issues and Physical Science-Energy activities 56A Motors and Generators” and 65A “Energy and Magnetic Fields”
- www.lab-aids.com
- Science Day Book/Physical Science
- Sciencesaurus-Forces, electricity and magnetism
- Lab Aid Kit Activity 65A “Energy and Magnetic Fields”

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<td>Specific Websites/Resources</td>
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### PS3-A

**PHYSICAL SCIENCE**

#### Energy

**Performance Expectations**

Students who demonstrate understanding can:

**MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.**

*Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup."

*Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.*

**Essential knowledge and skills**

- Interpret and construct a diagram showing how heat can be transferred from one place to another and one object to another.
- Understand temperature is a measure of the average kinetic energy of particles of matter.
- Understand that the relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
- Demonstrate how energy is spontaneously transferred out of hotter regions or objects and into colder ones.
- Understand how the transfer of energy can be tracked as energy flows through a designed or natural system.
- The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful.*
- Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. *
- A solution needs to be tested and then modified on the basis of the test results in order to improve it.*
- There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. *
### MIDDLE SCHOOL SCIENCE CURRICULUM GRADE 6

**Curriculum Writers:** Heidi Gauch and Robyn Borges

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<tr>
<td><strong>Constructing Explanations and Designing Solutions</strong></td>
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<tr>
<td>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.</td>
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<tr>
<td><strong>Disciplinary Core Ideas</strong></td>
<td>PS3.A: Definitions of Energy</td>
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<tr>
<td>PS3.A: Definitions of Energy</td>
<td>Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. PS3.B: Conservation of Energy and Energy Transfer</td>
<td>Energy is spontaneously transferred out of hotter regions or objects and into colder ones. ETS1.A: Defining and Delimiting an Engineering Problem</td>
<td>The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.</td>
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<tr>
<td><strong>Cross Cutting Concepts</strong></td>
<td>Energy and Matter</td>
<td>The transfer of energy can be tracked as energy flows through a designed or natural system.</td>
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#### Connections to
Connections to other DCIs in this grade-band: MS.PS1.B; MS.ESS2.A; MS.ESS2.C; MS.ESS2.D
Common Core State Standards Connections:
ELA/Literacy – RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
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).

#### ASSESSMENTS

**Student activities/labs**
- “Issues and Physical Science-Energy”
  Activities 59: Ice Melting C0ntest, Activity 60: Ice Preserving contest, investigation 70
  “Collecting Solar Energy”.
  • Science Day Book/Physical Science
  • Sciencesaurus
  • Uncovering Student Ideas in Physical Science - Keeley

#### Academic Vocabulary
- absorb
- apply
- constraints
- construct
- design
- energy
- heat transfer
- insulation
- kinetic energy
- reflect
- scientific principles
### Performance Expectations

Students who demonstrate understanding can:

**MS-PS3-4.** Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

*Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.]*

*Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.*

**Essential knowledge and skills**

- Explain how temperature is a measure of the average kinetic energy of particles of matter.
- Cite evidence that the relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
- Analyze how the amount of energy transfer needed to change the temperature of a matter sample depends on the nature of the matter, the size of the sample and the environment.
- Explain heat transfer through conduction

### Science and Engineering Practices

**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.

**PS3.A: Definitions of Energy**

- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.

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

**Scale, Proportion, and Quantity**

- Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
### ASSESSMENTS

#### Student activities/labs
- “Issues and Physical Science-Energy”
  - Activities 62 (Quantifying Energy) and 63 (Measuring Calories)

#### Academic Vocabulary
- conduction
- energy transfer
- investigation
- kinetic energy
- matter
- particles
- relationship
- system
- temperature

#### Specific Websites/Resources
- www.lab-aids.com
### PS3.B

#### PHYSICAL SCIENCE

#### Energy

**Performance Expectations**
Students who demonstrate understanding can:

**MS-PS3-5. Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object.**

- [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.]

- [Assessment Boundary: Assessment does not include calculations of energy.]

**Essential knowledge and skills**
- Explain how energy occurs in different forms
- Analyze how energy transfers from one object to another
- Understand that energy can transform from one type to another.
- Cite evidence about when the motion energy of an object changes, there is inevitably some other changes in energy at the same time
- Understand how Kinetic energy is related to the mass of an object and to the speed of an object.
- Understand kinetic energy has a relationship to mass separate from its relationship to speed.
- Motion energy is properly called kinetic energy; argue that it is proportional to the mass of the moving object and grows with the square of the object’s speed.
- Analyze the Proportional relationships among different types of quantities and how they provide information about the magnitude of properties and processes.

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
<th>Cross Cutting Concepts</th>
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<tbody>
<tr>
<td>Engaging in Argument from Evidence</td>
<td>PS3.B: Conservation of Energy and Energy Transfer</td>
<td></td>
</tr>
<tr>
<td>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.</td>
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</tr>
<tr>
<td>• Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon.</td>
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</tr>
<tr>
<td>Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence</td>
<td>• When the motion energy of an object changes, there is inevitably some other change in energy at the same time.</td>
<td></td>
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<tr>
<td></td>
<td>Energy and Matter</td>
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<tr>
<td></td>
<td>• Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).</td>
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## MIDDLE SCHOOL SCIENCE CURRICULUM GRADE 6

Curriculum Writers: Heidi Gauch and Robyn Borges

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<tr>
<td>• Science knowledge is based upon logical and conceptual connections between evidence and explanations</td>
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### Connections to other DCIs in this grade-band:
- MS.PS2.A

### Common Core State Standards Connections:
- ELA/Literacy – RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions
- WHST.6-8.1 Write arguments focused on discipline content.
- Mathematics –
  - MP.2 Reason abstractly and quantitatively.
  - 6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.
  - 6.RP.A.2 Understand the concept of a unit rate $a/b$ associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship.
  - 8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line, give examples of functions that are not linear.

### ASSESSMENTS

**Student activities/labs**
- Lab A: Drive the Nail, Lab-Aids “Energy” kit

**Academic Vocabulary**
- argument
- claim
- construct
- energy transfer
- energy transformation
- kinetic energy
- motion energy (mechanical energy)
- temperature

### LS1.A LIFE SCIENCE

### Structure, Function, and Information Processing

**Performance Expectations**

Students who demonstrate understanding can:

**MS-LS1.1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.**

[Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living cells, and understanding that living things may be made of one cell or many and varied cells.]

**Essential knowledge and skills**
- Develop evidence that living things are made of cells
- Distinguish between living and non-living things (characteristics of life)

### ASSESSMENTS

**Academic Vocabulary**

**Performance Expectations**

**LS1.A**

**Structure, Function, and Information Processing**

**Features of living organisms**

**Essential vocabulary**

**Common Core State Standards Connections**

**ASSESSMENTS**

**Student activities/labs**
- Lab A: Drive the Nail, Lab-Aids “Energy” kit

**Academic Vocabulary**
- argument
- claim
- construct
- energy transfer
- energy transformation
- kinetic energy
- motion energy (mechanical energy)
- temperature

**Specific Websites/Resources**

**Teacher Notes**

See complete instructional strategies list in the introduction

**Resource Notes**

See complete resource list in the introduction

**ASSESSMENT NOTES**

See complete assessment list in the introduction

**Required Common Assessments**
### Science and Engineering Practices

**Planning and Carrying Out Investigations**

Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation.

### Disciplinary Core Ideas

**LS1.A: Structure and Function**

- All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).

### Cross Cutting Concepts

**Scale, Proportion, and Quantity**

- Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1)

**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.

### Connections to Other DCIs in This Grade-Band

NA

### Articulation Across Grade-Bands

- HS.LS1.A
- Connections: 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-LS1-1)
- Mathematics -
### 6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-1),(MS-LS1-2),(MS-LS1-3),(MS-LS1-6)

**ASSESSMENTS**

**Student activities/labs**
- Lab-Aids “Issues and Life Science: Cell biology and Disease”
- Sciencesaurus

**Specific Websites/Resources**
- TBD

**Academic Vocabulary**
- conduct
- investigation
- characteristics
- evidence
- cells
- multicellular
- unicellular
- organism
- living
- nonliving
- reproduction

### Performance Expectations

Students who demonstrate understanding can:

**MS-LS1.2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.**

[Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.]

[Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]

**Essential knowledge and skills**
- Develop and use a model of a cell as a whole
- Identify and explain the role of the parts of a cell: nucleus, chloroplast (plant cell only), cell wall (plant cell only), mitochondria, cell membrane
- Explain the function of the cell as a system
- Differentiate between a plant and animal cell
- Explain how the structure of the cell membrane relates to its function
  - (the cell membrane forms the boundary that controls what enters and leaves the cell)
- Identify and model the structure, function, and relationships of parts of the cell
  - mitochondria
  - nucleus
### Domain: Cell Structure and Function

- **Cell Wall**
- **Organelles** (chloroplasts)
- **Cell Membrane**

#### 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

#### Disciplinary Core Ideas
- **LS1.A: Structure and Function**
  - All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).

#### Cross Cutting Concepts
- **Structure and Function**
  - Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural and designed structures/systems can be analyzed to determine how they function.

### Connections to
- Connections to other DCIs in this grade-band: MS.LS3.A
- Common Core State Standards Connections:
  - SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
  - Mathematics – 6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

### Assessments
- **Student activities/labs**
  - Lab-Aids “Issues and Life Science: Cell biology and Disease”
  - Specific Websites/Resources TBD

- **Academic Vocabulary**
  - model
  - function
  - cell
  - system
  - nucleus
  - chloroplasts
  - mitochondria
  - cell membrane
  - cell wall
  - organelle
  - semi permeable membrane

---

**Middletown Public Schools**

**INSTRUCTIONAL STRATEGIES**

**RESOURCES**

**ASSESSMENTS**
### Performance Expectations

Students who demonstrate understanding can:

**MS-LS1.3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.**

[Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.]

[Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]

**Essential knowledge and skills**

- Develop understanding that cells form tissues
- Understand how tissues form organs specialized for particular body functions
- Understand how in multicellular organisms, the body is a system of multiple interacting subsystems
- Develop a model displaying organization from cell to organism
- In multicellular organisms, the body is a system of multiple, interacting subsystems.
  - Subsystems are groups of cells that work together to form tissues.
  - Organs are groups of tissues that work together to perform a particular body function.
  - Tissues and organs are specialized for particular body functions.
  - Systems may interact with other systems.
- Understand that systems may have subsystems and be part of larger complex systems.
- Understand that interactions are limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.
- Understand that scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.

### Cross Cutting Concepts

**Science and Engineering Practices**

- 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.
  - Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.

**Disciplinary Core Ideas**

- LS1.A: Structure and Function
  - In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

**Systems and System Models**

- Systems may interact with other systems; they may have sub-systems and be part of larger complex systems.

**Connections to Nature of Science**

- Science is a Human Endeavor
  - Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.
### MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

[Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

**Essential knowledge and skills**

- Understand how each sense receptor responds to different inputs (electromagnetic, mechanical, chemical) transmitting them as signals that travel along nerve cells to the brain.
- Understand how signals are processed in the brain, resulting in immediate behaviors or memories
- Recognize that sense receptors respond to different inputs (electromagnetic, mechanical, chemical).
- Recognize that sense receptors transmit responses as signals that travel along nerve cells to the brain.
### Science and Engineering Practices

#### Disciplinary Core Ideas

- **LS1.D: Information Processing**
  - Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

#### Cross Cutting Concepts

- **Cause and Effect**
  - Cause and effect relationships may be used to predict phenomena in natural systems.

### Connections to

- **Connections to other DCIs in this grade-band:** NA
- **Articulation across grade-bands:** 4.LS1.D, HS.LS1.A
- **Common Core State Standards Connections:** WHST.6-8.8 Gather relevant information from multiple print and digital sources; 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.

### ASSESSMENTS

- **Student activities/labs**
- **Specific Websites/Resources**
  - TBD

### Academic Vocabulary

- synthesize
- sensory receptors
- stimuli
- memories
- senses
- nerve cells
- input
- behaviors
- processing
**Performance Expectations**

Students who demonstrate understanding can:

**MS-LS1.4.** Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

[Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds; and, creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]

**Essential knowledge and skills**

- Understand plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.
- Define reproduction as the process in which organisms produce offspring, e.g. plants, bees, budding.
- Explain how specialized structures for plants affect their probability of successful reproduction.
- Explain how animals engage in characteristic behaviors that affect the probability of successful reproduction.
- Explain that there are a variety of characteristic animal behaviors that affect the probability of successful reproduction. - There are a variety of animal behaviors that attract a mate.
- Explain how successful reproduction of animals and plants may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.

**Science and Engineering Practices**

- **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 world(s).
  - Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.

**Disciplinary Core Ideas**

- **LS1.B: Growth and Development of Organisms**
  - Animals engage in characteristic behaviors that increase the odds of reproduction.
  - Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.

**Cross Cutting Concepts**

- **Cause and Effect**
  - Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Connections to other DCIs in this grade-band: MS.LS2.A
Common Core State Standards Connections:
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts
RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.
WHST.6-8.1 Write arguments focused on discipline content. (MS-LS1-3),(MS-LS1-4)
Mathematics –
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. (MSL1-4),(MS-LS1-5)
6.SP.B.4 Summarize numerical data sets in relation to their context. (MS-LS1-4),(MS-LS1-5)

**ASSESSMENTS**

- **Student activities/labs**
  - TBD
- **Specific Websites/Resources**
  - TBD

**Academic Vocabulary**
- argument
- empirical evidence
- scientific reasoning
- characteristic
- animal behaviors
- specialized plant structure
- reproduction
- pollen
- seeds
- germination
- nectar
- fruit
- seed dispersal
- probability

**Performance Expectations**

Students who demonstrate understanding can:

**MS-LS1.5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.**

[Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.]

[Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]

**Essential knowledge and skills**
- Explain how genetic factors as well as local conditions affect the growth of organisms
- Explain how a variety of local environmental conditions affect the growth of organisms.
**DOMAIN**  
Middletown Public Schools

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- Explain how genetic factors affect the growth of organisms (plant and animal).
- Explain that the factors that influence the growth of organisms may have more than one cause.
- Recognize that cause-and-effect relationships in plant and animal systems can only be described using probability.

**Science and Engineering Practices**  
**Disciplinary Core Ideas**  
**Cross Cutting Concepts**

**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.

- 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.

**LS1.B: Growth and Development of Organisms**

- Genetic factors as well as local conditions affect the growth of the adult plant.

**Cause and Effect**

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

**Connections to**

Connections to other DCIs in this grade-band: MS.LS2.A  
Common Core State Standards Connections:  
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.  
RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.  
WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.  
WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.  
SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.  
Mathematics – 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.  
6.SP.B.4 Summarize numerical data sets in relation to their context.

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- scientific explanation  
- evidence  
- environmental  
- genetic factors  
- organisms |
### Performance Expectations

Students who demonstrate understanding can:

**MS-LS3-2.** Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

[Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

**Essential knowledge and skills**

- Organisms reproduce, either sexually or asexually and transfer their genetic information to their offspring.
- Differentiate between asexual and sexual reproduction
  - asexual reproduction - Asexual reproduction results in offspring with identical genetic information.
  - simple cell division in which the offspring is identical to the original cell.
  - sexual reproduction - results in offspring with genetic variation
  - the offspring receives genetic material from both parents.
- Explain that variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.
- Explain that with sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring.
- Understand that individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.
- Develop a model using Punnett squares, diagrams, and simulations to describe the cause-and-effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.

### Cross Cutting Concepts

- **LS1.B: Growth and Development of Organisms**
  - Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MS-LS3-2)
- **Cause and Effect**
  - Cause and effect relationships may be used to predict phenomena in natural systems.
## MIDDLE SCHOOL SCIENCE CURRICULUM GRADE 6
Curriculum Writers: Heidi Gauch and Robyn Borges

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| to describe, test, and predict more abstract phenomena and design systems.  
- Develop and use a model to describe phenomena. | | | | |

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

### Articulation across grade-bands

### Common Core State Standards Connections

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
- RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
- 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).
- SL.8.5 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

### Mathematics –
- MP.4 Model with mathematics.
- 6.SP.B.5 Summarize numerical data sets in relation to their context.

### ASSESSMENTS

#### Student activities/labs
- Inheritance Gizmo, Explore Learning
- Mouse Genetics (One Traits) Gizmo, Explore Learning

#### Specific Websites/Resources

### Academic Vocabulary
- model
- asexual reproduction
- offspring
- genetic
- sexual reproduction
- offspring
- genetic variation
- species
- gene transmission
- chromosomes
- alleles
- genes
- inherited
- traits

### EARTH AND SPACE SCIENCE

#### Earth’s Systems

**Performance Expectations**

Students who demonstrate understanding can:

- MS-ESS2-4. Develop a model to describe the cycling of water through Earth’s systems driven by energy from the sun and the force of gravity.

  [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.]
### ESS2.C The Rules of Water in Earth’s Surface Processes

[Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]

**Essential knowledge and skills**
- Relate how water continually cycles among land, ocean and atmosphere via transpiration, evaporation, condensation, crystallization and precipitation, as well as downhill flows on land.
- Explain global movements of water and its changes in form are propelled by sunlight and gravity.
- Explain that the cycling of water through Earth’s systems is driven by energy from the sun and the force of gravity.
- Understand that within Earth’s systems, the transfer of energy drives the motion and/or cycling of water.

**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 a model to describe unobservable mechanisms.

**Disciplinary Core Ideas**
- ESS2.C: The Roles of Water in Earth’s Surface Processes
  - Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
  - Global movements of water and its changes in form are propelled by sunlight and gravity.

**Cross Cutting Concepts**
- Energy and Matter
  - Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.

**Connections to**
- Connections to other DCIs in this grade-band: MS.PS1.A; MS.PS2.B; MS.PS3.A; MS.PS3.D
- Common Core State Standards Connections: N/A

**ASSESSMENTS**
- Student activities/labs
  - Lab-Aids Issues and Earth Science-Weather and Atmosphere
  - Lesson 60- Changing States of Water
  - Lesson 61-Investigating Groundwater
  - Lesson 62--Traveling on the Water Cycle
  - explorelearning--Water Cycle Gizmo
  - Bill Nye Video--The Water Cycle

**Academic Vocabulary**
- atmosphere
- cloud
- condensation
- crystallization
- cycle
- evaporation
- freezing(crystallization)
- gravity
- groundwater run-off
- melting
- precipitation
- transpiration
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<td>Weather and Climate</td>
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<td>MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.</td>
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|                               |                           | [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).]
|                               |                           | [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.] |           |             |
|                               |                           | Essential knowledge and skills |           |             |
|                               |                           | • Analyze complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms and ocean temperatures and currents, are major determinants of local weather patterns. |           |             |
|                               |                           | • Explain that weather can only be predicted probabilistically because patterns of the changes and the movement of water in the atmosphere are so complex |           |             |
|                               |                           | • Explain how the motions and complex interactions of air masses result in changes in weather conditions. |           |             |
|                               |                           | • Differentiate between warm fronts and cold fronts (tie to air masses) |           |             |
|                               |                           | • Demonstrate how examples of data that can be used to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions (include weather maps.) |           |             |
|                               |                           | • Collect data to serve as the basis for evidence for how the motions and complex interactions of air masses result in changes in weather conditions. |           |             |
|                               |                           | • Relate that air masses flow from regions of high pressure to regions of low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time. |           |             |
|                               |                           | • Explain how sudden changes in weather can result when different air masses collide. |           |             |
|                               |                           | • Explain how cause-and-effect-relationships may be used to predict changes in weather. |           |             |
### Planning and Carrying Out Investigations

Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.
- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.

### ESS2.C: The Roles of Water in Earth’s Surface Processes

- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.

### ESS2.D: Weather and Climate

- Because these patterns are so complex, weather can only be predicted probabilistically.

### Cause and Effect

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

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

### Articulation of DCIs across grade-bands:
- 3.ESS2.D; 5.ESS2.A; HS.ESS2.C; HS.ESS2.D

### Common Core State Standards Connections:
- ELA/Literacy –
  - RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-5)
  - RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-5)

### Mathematics –
- MP.2 Reason abstractly and quantitatively.
- 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.

### Student activities/labs

- Lab-Aids Issues and Earth Science-Weather and Atmosphere
- --Activity 68

### Specific Websites/Resources

- [www.explorehubucking](#) Gizmo--Weather Maps, Global W

### ASSESSMENTS

- air mass
- evidence
- high pressure
- humidity
- landforms
- low pressure
- motions and complex interactions
- ocean currents
- precipitation
- probabilistic
- temperature
- weather
## Performance Expectations

Students who demonstrate understanding can:

**MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.**

[Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.]

[Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]

**Essential knowledge and skills**

- Cite evidence showing variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents, e.g. Gulf Streams
- Example of above: Explaining the Gulf Stream
- Explain how weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms and living things.
- Understand that interactions vary with latitude, altitude, and local and regional geography and that all affect oceanic and atmospheric flow patterns.
- Relate how the ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents (example: The Gulf Stream)
- Develop a model to show how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
- Develop a model to show how patterns of atmospheric and oceanic circulation that determine regional climates vary by latitude, altitude, and geographic land distribution.
- Develop a model to show that atmospheric circulation that, in part, determines regional climates is the result of sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds.
- Develop a model to show how Ocean circulation, in part, determines regional climates and is the result of the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents.
- Develop models that can be used to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates using diagrams, maps and globes, or digital representations.
**Models can be used to represent atmospheric and oceanic systems and their interactions—such as inputs, processes, and outputs—and energy, matter, and information flows within those systems.**

### Developing and Using Models

**Science and Engineering Practices**

- **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.**

**ESS2.C: The Roles of Water in Earth’s Surface Processes**

- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.

**ESS2.D: Weather and Climate**

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.

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


### Common Core State Standards Connections:

- ELA/Literacy – SL.8.5: Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

### ASSESSMENTS

- **Student activities/labs**
  - Sciencesaurus, Earth Science section
  - Issues and Earth Science--Activity 68 “Worldwide Wind”
  - Activity 58--The Causes of Climate
  - Activity 57--Oceans and Climate
  - Activity 56--Ocean Temperatures
  - Activity 53--Weather and Climate

### Academic Vocabulary

- air current
- altitude
- atmospheric system
- climate
- convection
- Coriolis effect
- density
- differential heating
- gravity
- Gulf Stream
- landforms and geography
**EARTH AND SPACE SCIENCE**

**ESS3.C**

**Human Impacts on Earth’s Surface**

**Performance Expectations**

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

*Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers) or the co*

**Essential knowledge and skills**

- Explain why human activities have significantly altered the biosphere, sometimes damaging or destroying the natural habitats and causing the extinction of other species.
- Infer why changes to Earth’s environments can have different impacts (negative and positive) for different living things.
- Cite evidence why as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise.

**Science and Engineering Practices**

**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.

**Disciplinary Core Ideas**

**ESS3.C: Human Impacts on Earth Systems**

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things.

**Cross Cutting Concepts**

**Cause and Effect**

- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.

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

- Influence of Science, Engineering, and Technology on Society and the Natural World
### MIDDLE SCHOOL SCIENCE CURRICULUM GRADE 6

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<tbody>
<tr>
<td>• Apply scientific principles to design an object, tool, process or system.</td>
<td>• Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.</td>
<td>• 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.</td>
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</table>

#### Connections to

Connections to other DCIs in this grade-band: MS.LS2.A; MS.LS2.C; MS.LS4.D


Common Core State Standards Connections:

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-ESS3-3)

WHST.6-8.8 Gather relevant information from multiple print and digital sources; 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 –

MP.2 Reason abstractly and quantitatively.

6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.

7.RP.A.2 Recognize and represent proportional relationships between quantities.

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.

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

#### ASSESSMENTS

- Student activities/labs

#### Academic Vocabulary

- biosphere
- habitats
- human impact
- natural resources

#### Specific Websites/Resources

#### Performance Expectations

Students who demonstrate understanding can:

**MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific
### ETS1.A

**principles and potential impacts on people and the natural environment that may limit possible solutions**

**Essential knowledge and skills**

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<th>Science and Engineering Practices</th>
<th>Disciplinary Core Ideas</th>
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<tr>
<td>Asking Questions and Defining Problems</td>
<td>ETS1.A: Defining and Delimiting Engineering Problems</td>
<td>Influence of Science, Engineering, and Technology on Society and the Natural World</td>
</tr>
<tr>
<td>Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.</td>
<td>• The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.</td>
<td>• 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. • The uses of technologies and 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.</td>
</tr>
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</table>

**Connections to**

Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include: Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:

**Physical Science:** MS-PS5-3
Connections to MS-ETS1.B: Developing Possible Solutions Problems include:

**Physical Science:** MS-PS1-6, MS-PS3-3
**Life Science:** MS-LS2-5
Connections to MS-ETS1.C: Optimizing the Design Solution include:

**Physical Science:** MS-PS1-6
Articulation of DCIs across grade-bands: 3-5.ETS1.A; 3-5.ETS1.C; HS.ETS1.A; HS.ETS1.B

Common Core State Standards Connections:

**ELA/Literacy** – RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. WHST.6-8.8 Gather relevant information from multiple print and digital sources; 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** – MP.2 Reason abstractly and quantitatively.

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

### ASSESSMENTS

<table>
<thead>
<tr>
<th><strong>Academic Vocabulary</strong></th>
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<tbody>
<tr>
<td>constraints</td>
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<tr>
<td>criteria</td>
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<tr>
<td>impacts</td>
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</table>
## ETS1.B

### Performance Expectations

Students who demonstrate understanding can:

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

**Essential knowledge and skills**

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<tr>
<td>Evidence</td>
<td></td>
<td>ETS1.B: Developing Possible Solutions</td>
</tr>
</tbody>
</table>
| 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 world.  
• Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (TS1-2) | There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem |

### Connections to

Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:

- **Physical Science**: MS-PS3-3
  - Connections to MS-ETS1.B: Developing Possible Solutions Problems include:
    - Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5
  - Connections to MS-ETS1.C: Optimizing the Design Solution include:
    - Physical Science: MS-PS1-6

Common Core State Standards Connections:

- ELA/Literacy –
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<tr>
<td>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. 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. WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. Mathematics – MP.2 Reason abstractly and quantitatively. 7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.</td>
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ASSESSMENTS

Student activities/labs

Academic Vocabulary
- competing solutions
- constraints
- criteria
- evaluate
- problem
- systemic process

Specific Websites/Resources

Performance Expectations

Students who demonstrate understanding can:

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

Essential knowledge and skills

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<tr>
<td>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</td>
<td>ETS1.B: Developing Possible Solutions • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.</td>
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### MIDDLE SCHOOL SCIENCE CURRICULUM GRADE 6

Curriculum Writers: Heidi Gauch and Robyn Borges

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<td>ETS1.C: Optimizing the Design Solution</td>
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</table>
- 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 those characteristics may be incorporated into the new design. |

**Connections to**
- Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:
  - Physical Science: MS-PS3-3
- Connections to MS-ETS1.B: Developing Possible Solutions Problems include:
  - Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5
- Connections to MS-ETS1.C: Optimizing the Design Solution include:
  - Physical Science: MS-PS1-6

**Common Core State Standards Connections:**
- ELA/Literacy –
  - RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. 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).
  - RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
- Mathematics –
  - MP.2 Reason abstractly and quantitatively.
  - 7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

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### ASSESSMENTS

**Student activities/labs**

**Specific Websites/Resources**

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### Academic Vocabulary

- analyze
- characteristics
- criteria
- data
- design solutions
- differences
- similarities
- solution
- tests

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### Performance Expectations

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

**Essential knowledge and skills**

### Science and Engineering Practices

- **Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.**
- **Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.**

### Disciplinary Core Ideas

- **ETS1.B: Developing Possible Solutions**
  - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.
  - Models of all kinds are important for testing solutions.
- **ETS1.C: Optimizing the Design Solution**
  - 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.

### Cross Cutting Concepts

**Connections to**

Students who demonstrate understanding can:

- Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:
  - **Physical Science:** MS-PS3-3
- Connections to MS-ETS1.B: Developing Possible Solutions Problems include:
  - **Physical Science:** MS-PS1-6, MS-PS3-3, **Life Science:** MS-LS2-5
- Connections to MS-ETS1.C: Optimizing the Design Solution include:
  - **Physical Science:** MS-PS1-6
- **Common Core State Standards Connections:**
  - **ELA/Literacy – SL.8.5** Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.
  - **Mathematics – MP.2** Reason abstractly and quantitatively.
  - **7.SP** Develop a probability model and use it to find probabilities

### ASSESSMENTS

- **Student activities/labs**
- **Specific Websites/Resources**

### Academic Vocabulary

- data
- develop
- generate
- iterative testing modification optimal design
- model