Township of Union Public Schools
Administration Building

## K - 5
# CURRICULUM GUIDE APPROVAL REQUEST FORM

Please present the attached guide to the Board of Education for approval. The guide has been reviewed by all involved parties and is aligned with the New Jersey Core Curriculum Content Standards.

**Title:** Science Curriculum Guide

**Department/Grade:** Grade 4

**Supervisor:** Terri Matthews

**Submission Date:** May 5, 2015

**Board Approval Date:** _____

# TOWNSHIP OF UNION PUBLIC SCHOOLS

# Science Grade 4
# Curriculum Guide
# 2015

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## Mission Statement

The Township of Union Board of Education believes that every child is entitled to an education designed to meet his or her individual needs in an environment that is conducive to learning. State standards, federal and state mandates, and local goals and objectives, along with community input, must be reviewed and evaluated on a regular basis to ensure that an atmosphere of learning is both encouraged and implemented. Furthermore, any disruption to or interference with a healthy and safe educational environment must be addressed, corrected, or when necessary, removed in order for the district to maintain the appropriate educational setting.

## Philosophy Statement

The Township of Union Public School District, as a societal agency, reflects democratic ideals and concepts through its educational practices. It is the belief of the Board of Education that a primary function of the Township of Union Public School System is to formulate a learning climate conducive to the needs of all students in general, providing therein for individual differences. The school operates as a partner with the home and community.

# Statement of District Goals

- Develop reading, writing, speaking, listening, and mathematical skills.
- Develop a pride in work and a feeling of self-worth, self-reliance, and self discipline.
- Acquire and use the skills and habits involved in critical and constructive thinking.
- Develop a code of behavior based on moral and ethical principles.
- Work with others cooperatively.
- Acquire a knowledge and appreciation of the historical record of human achievement and failures and current societal issues.
- Acquire a knowledge and understanding of the physical and biological sciences.
- Participate effectively and efficiently in economic life and the development of skills to enter a specific field of work.
- Appreciate and understand literature, art, music, and other cultural activities.
- Develop an understanding of the historical and cultural heritage.
- Develop a concern for the proper use and/or preservation of natural resources.
- Develop basic skills in sports and other forms of recreation.

# Course Description

The fourth grade science standards place increasing emphasis on conducting investigations. Students are expected to be able to develop questions, formulate simple hypotheses, make predictions, gather data, draw conclusions and communicate results. Measuring, interpreting data in the form of tables, charts and graphs, as well as using number sense during investigations is also emphasized throughout the units of study.

The curriculum is integrated to include *Life Science, Environmental Studies, Earth and Space Science and Physical Science.* Through the use of hands-on investigations and cooperative learning structures, the nature of science and S.T.E.M., the fourth grade students will explore the following content topics that are aligned with the *Next Generation Science Standards.*

- Life and Environmental Science: Students investigate and understand how plants and animals in an n ecosystem interact with one another and the nonliving environment. Concepts include: *behavioral and structural adaptations; organization of communities; flow of energy through food webs; habitats and niches; and the influence of human activity on ecosystems.* Human body systems are also introduced and students begin to develop an understanding of how all parts work together in a system for the benefit of the whole.
- Earth and Space Science: Students investigate and understand the relationships among the Earth, moon, and sun. Concepts include: the motions of the earth, moon, and sun (revolution and rotation); the causes for the Earth's seasons and phases of the moon; the relative size, position, age, and makeup of the Earth, moon, and sun; and historical contributions in understanding the Earth-moon-sun system.
- Physical Science: Students investigate light, sound and electricity through simple hands-on experiences as well as the concept of motion and forces.

All units integrate reading, writing, and math skills as well as critical thinking skills. Safe practices are equally important as are the attitudes students develop toward learning Science.

**Recommended Textbook**

Science Fusion

# Course Proficiencies

**EACH STUDENT WILL BE ABLE TO:**

- Apply logical sequence of steps to investigate a question (i.e. carry out an investigation to determine how environmental factors impact plant growth)
- Conduct fair tests on stimulus/response behavior and communicate results
- Describe and always follow appropriate safety procedures for carrying out experiments
- Compare and contrast food webs from diverse ecosystems; illustrate a food web correctly using energy arrow
- Predict how changes within a food web impact the entire ecosystem
- Describe how adaptations (structures) help organism function in a given ecosystem
- Identify predator/prey and parasite/host relationships within an ecosystem
- Illustrate an ecosystem including producers, consumers and decomposers
- (List parts of a body system and identify their functions)
- Predict how a change in one part of a system would change the functioning of the entire system
- Investigate man's use of renewable and non-renewable resources
- Describe ways that technological advances have impacted the environment
- Conduct investigations to identify conductors and insulators
- Build simple circuits and trace the flow of electricity; construct parallel and series circuits
- Recognize variables that would cause a circuit to malfunction
- Use a schematic to represent a circuit
- Communicate the design process used to build an electrical project; carry out the project applying knowledge of circuitry
- Identify inventors associated with electricity and describe their contributions
- Identify the solar system and its members and describe their characteristics
- Describe how the motions of the earth and moon cause the phases of the moon
- Relate revolution/rotation of the earth to days/years/seasons
- Identify the states of matter; use numerical data to measure, describe, and compare the physical properties of matter
- Identify the difference between physical and chemical changes
- Name the various forms of energy, describe transformations and uses of energy in everyday life
- Describe the properties of sound and light, and the flow of electricity and heat
- Understand the concepts of force: push, pull, raise; describe the properties of magnets

**Curriculum Units**

**Unit 1:** Studying Science

**Unit 2:** Engineering Process

**Unit 3:** Plants & Animals

**Unit 4:** Energy & Ecosystems

**Unit 5:** Weather

**Unit 6:** Earth & Space

**Unit 7:** Properties of Matter

**Unit 8:** Changes in Matter

**Unit 9:** Energy

**Unit 10:** Electricity

**Unit 11:** Motion

# Pacing Guide

| Content | Number of Days |
|---|---|
| **Unit 1:** Studying Science | **14** |
| **Unit 2:** Engineering Process | **10** |
| **Unit 3:** Plants & Animals | **16** |
| **Unit 4:** Energy & Ecosystems | **16** |
| **Unit 5:** Weather | **12** |
| **Unit 6:** Earth & Space | **14** |
| **Unit 7:** Properties of Matter | **12** |
| **Unit 8:** Changes in Matter | **12** |
| **Unit 9:** Energy | **16** |
| **Unit 10:** Electricity | **14** |
| **Unit 11:** Motion | **8** |

## Unit 1: Studying Science

### Big Idea: Scientist answer questions about the world around us by carrying out careful investigations.

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>What do scientists do? | • Describe that science focuses on the natural world only.<br>• Explain that scientists make observations, ask questions, conduct investigations, and produce evidence that guides scientific thought and theory.<br>• Communicate that scientists conduct multiple types of investigations (traditional experiments involving fair testing, inventing, documenting, trial and error, etc.)<br>• Recognize that scientific knowledge requires evidence. | • Flip Chart P. 2 - Spin-A-Copter<br>• Digital Lesson<br>• Summarize Ideas p. 5; 7; 9; 11; 13<br>• Develop Inquiry Skills p. 5; 9; 11; 13 | Sum It Up! P. 14<br><br>Brain Check Pp. 15-16<br><br>Lesson 1 Quiz p. AG 1 |
| **Lesson 2**<br>What skills do scientists use? | • Explain that inquiry skills are used in daily life.<br>• Identify examples of skills used to carry out common tasks. | • Flip Chart P.3 - Pendulum Swing<br>• Digital Lesson<br>• Summarize Ideas p. 19; 21; 23<br>• Develop Inquiry Skills 19; 23 | Sum it Up! P. 24<br><br>Brain Check Pp. 25-26<br><br>Lesson 2 Quiz p. AG 2 |
| **Lesson 3**<br>How do scientists collect and use data? | • Determine that scientists often conduct research as part of an investigation.<br>• Identify different tools that | • Flip Chart P. 4 - Rain, Rain, Come Again<br>• Digital Lesson | Sum It Up! P.38<br><br>Brain Check Pgs. 39-40 |

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| | scientists use to study objects and properties.<br>• Communicate that data gathered are based on measurement and observation, not inferences.<br>• Record data in appropriate tables and charts based on the purpose of the data.<br>• Describe that measurements and recording methods need to be accurate because data are used as evidence for scientific explanation. | • Summarize Ideas p. 29; 31; 33; 35; 37<br>• Develop Inquiry Skills 29; 35; 37 | Lesson 3 Quiz p. AG 3 |
| **Lesson 4 Inquiry Flip Chart**<br>Why do scientists compare results? | • Measure an object using several different types of tools (Standard and non-standard units of measurement) and compare the results with other groups of students.<br>• Communicate the importance o accuracy in measurements and reasons why differences may occur. | • Flip Chart P. 5 - Why do Scientist Compare Results?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 41-42 | Lesson 4 Quiz p. AG 4 |
| **Lesson 5**<br>What kinds of models do scientists use? | • Communicate that scientists use different types of models depending upon the subject they are studying.<br>• Identify differences between examples models such as a picture, replica, and animation. | • Flip Chart P. 6 - Bridge Building<br>• Digital Lesson<br>• Summarize Ideas p. 47; 49; 51<br>• Develop Inquiry Skills 47; 51 | Sum It Up! P. 52<br><br>Brain Check Pp. 53-54<br><br>Lesson 5 Quiz p. AG 5 |

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| **Lesson 6 Inquiry**<br>**Flip Chart**<br>How can you model a school? | • Measure the classroom using metric tools such as tape measures and meter sticks.<br>• Construct a model of the classroom.<br>• Compare the models made and note differences, based on spatial awareness or measurements made. | • Flip Chart p. 7 - How Can you Model a School?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 55-56 | Lesson 6 Quiz p. AG 6 |
| **Additional Assessments:**<br>Unit 1 Review Student Edition, pp. 57-60<br>Unit 1 Test AG pp. AG 7 – AG 11<br><br>**Performance Assessment**<br>Teacher Edition, p. 59<br>Assessment Guide, pp. AG 12 – AG 13 | | | |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4 | | | |

## Unit 2: The Engineering Process

### Big Idea: Engineers use a process to design products and processes that solve human problems.

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>What is an Engineering Design Process? | • Describe how to use the design process to create a solution to a problem. | • Flip Chart P. 8 - Design a Solution to a Problem<br>• Digital Lesson<br>• Summarize Ideas p. 65; 67; 69; 71<br>• Develop Inquiry Skills p. 65; 67; 71. | Sum It Up! P. 72<br><br>Brain Check Pp. 73-76<br><br>Lesson 1 Quiz p. AG 14 |
| **Lesson 2 Inquiry Flip Chart**<br>How can you design a solution? | • Design an apparatus that gently absorbs the force of motion.<br>• Build and test prototypes based on their designs. | • Flip Chart p. 9 – How Can you Design a Solution to a Problem?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 77-78 | Lesson 2 Quiz p. AG 15 |
| **Lesson 3**<br>What is technology? | • Identify examples of tools that help people produce, shape, or build things.<br>• Identify needs that technology helps us meet.<br>• Identify technological products, processes, and systems.<br>• Describe how technology has changed your community.<br>• Identify the benefits and risks of using technology. | • Flip Chart P. 10 - Goals, Inputs, and Outputs<br>• Digital Lesson<br>• Summarize Ideas p. 81; 83; 85; 87; 89<br>• Develop Inquiry Skills p. 81; 83; 85; 89 | Sum It Up! P. 90<br><br>Brain Check Pp. 91-92<br><br>Lesson 3 Quiz p. AG 16 |

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| **Lesson 4 Inquiry**<br>**Flip Chart**<br>How do we use technology? | • Identify design criteria.<br>• Evaluate solutions to a problem.<br>• Test a model using a unit of measurement. | • Flip Chart p. 11 – How Do We Use Technology?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 93-94 | Lesson 4 Quiz p. AG 17 |
| **Additional Assessments:**<br>Unit 2 Review Student Edition, pp. 97-100<br>Unit 2 Test AG pp. AG 18 – AG 22<br><br>**Performance Assessment**<br>Teacher Edition, p. 99<br>Assessment Guide, pp. AG 23 – AG 24 | | | |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4 | | | |

## Unit 3: Plants and Animals

## Big Idea: Living things are adapted for survival in their environment.

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>What are some plant structures? | • Describe the structures of typical plants.<br>• Describe the process of photosynthesis. | • Flip Chart P. 12 - What Pulls the Water Up?<br>• Digital Lesson<br>• Summarize Ideas p. 105; 107; 109; 111<br>• Develop Inquiry Skills p. 104 | Sum It Up! P. 112<br><br>Brain Check Pp. 113-114<br><br>Lesson 1 Quiz p. AG 25 |
| **S.T.E.M. – ENGINEERING & TECHNOLOGY**<br>How It Works:<br>Water Irrigation System | • Identify problems that an irrigation system can help solve.<br>• Compare past and present types of irrigation systems.<br>• Identify technology that resulted in improved irrigation systems. | • Develop Inquiry Skills p. 116<br>• Summarize Ideas p. 116* | Summarize Ideas p. 116*<br><br>*Can be used as either an activity or as an assessment. |
| **Lesson 2**<br>How do plants reproduce? | • Recognize that all seed-plant life cycles include germination, maturity, reproduction, and death.<br>• Identify the stages in the life cycle of a flowering plant.<br>• Identify the stages in the life cycle of a non flowering, seed-bearing plant (such as a conifer) | • Flip Chart P.14 - Finding Out About Flowers<br>• Digital Lesson<br>• Summarize Ideas p. 119; 121; 123; 125; 127<br>• Develop Inquiry Skills p.119; 121; 122; 124; 125; 127 | Sum it Up! P. 128<br><br>Brain Check Pp. 129-132<br><br>Lesson 2 Quiz p. AG 26 |

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| | • Describe the role of pollination in the sexual reproduction of seed plants.<br>• Describe ways that plants are pollinated.<br>• Describe reproduction in seedless plants. | | |
| **Lesson 3 Inquiry Flipchart**<br>How can we observe a plant's life cycle? | • Compare the rate of germination of different types of seeds.<br>• Observe a developing plant embryo. | • Flip Chart p. 15 – How Can We Observe a Plant's Life Cycle?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 133-134 | Lesson 3 Quiz p. AG 27 |
| **Lesson 4**<br>How do Animals Reproduce? | • Understand that some animals are born live whereas other animals hatch from eggs.<br>• Understand that some animals go through metamorphosis as part of their life cycle.<br>• Compare and contrast complete metamorphosis and incomplete metamorphosis, and provide examples of animals that undergo each type. | • Flip Chart P. 16- Breeding Brine Shrimp<br>• Digital Lesson<br>• Summarize Ideas p. 137; 139;141; 143; 145<br>• Develop Inquiry p. 138; 142; 144 | Sum It Up! P.146<br><br>Brain Check Pp. 147-148<br><br>Lesson 4 Quiz p. AG 84 |
| **Lesson 5**<br>How are living things adapted to their environment? | • Define and explain the terms environment and adaptation,<br>• Define and explain physical and behavioral adaptations.<br>• Recognize physical and behavioral adaptations in | • Flip Chart P. 17 - Cold as Ice<br>• Digital Lesson<br>• Summarize Ideas p. 153; 155; 157; 159; 161<br>• Develop Inquiry p. 152; 157; 161 | Sum It Up! P. 162<br><br>Brain Check Pp. 163-164<br><br>Lesson 5 Quiz p. AG 29 |

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| | plants and animals. | | |
| **Lesson 6 Inquiry Flipchart**<br>Why do bird beaks differ? | • Describe the variations that can be observed in different types of bird beaks.<br>• Identify which tool works best for which food.<br>• Relate different bird beaks with different types of food.<br>• Explain why some birds are better suited to a certain habitat than other birds are. | • Flip Chart p. 18 – Why Do Bird Beaks Differ?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 165-166 | Lesson 6 Quiz p. AG 30 |
| **Additional Assessments:**<br>Unit 3 Review Student Edition, pp. 167-170<br>Unit 3 Test AG pp. AG 31 – AG 35<br><br>**Performance Assessment**<br>Teacher Edition, p. 169<br>Assessment Guide, pp. AG 36 – AG 37 | | | |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4, 5.5, 5.10 | | | |

## **Unit 4:** Energy & Ecosystems

## Big Idea: Ecosystems are made up of both living and nonliving parts that impact one another.

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>What are Populations, Habitats, and Niches? | • Distinguish between habitat and niche.<br>• Distinguish between population and community.<br>• Explain the organization of populations, communities, and ecosystems.<br>• Describe the organism's niche at various stages of its life cycle. | • Flip Chart P. 19 - Bottle Ecosystems<br>• Digital Lesson<br>• Summarize Ideas p. 175; 177; 179; 181; 183<br>• Develop Inquiry Skills p. 175; 176; 177; 179; 180; 183 | Sum It Up! P. 184<br><br>Brain Check Pp. 185-188<br><br>Lesson 1 Quiz p. AG 38 |
| **Lesson 2**<br>What are Food Chains? | • Demonstrate that a food chain shows how energy moves from producers to consumers.<br>• Recognize that energy for most food chains begins with energy from the sun.<br>• Distinguish between herbivores, carnivores, and omnivores.<br>• Recognize that organisms higher in the food chain are affected by changes in the number of organisms lower in the food chain.<br>• Explain why all animals | • Flip Chart P.20 - Model a Food Web<br>• Digital Lesson<br>• Summarize Ideas p. 191; 193; 195; 197; 199<br>• Develop Inquiry Skills p. 190; 192; 194; 199 | Sum it Up! P. 200<br><br>Brain Check Pp. 201-204<br><br>Lesson 2 Quiz p. AG 39 |

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| | depend on producers such as plants. | | |
| **Lesson 3 Inquiry**<br>**Flip Chart**<br>How Can We Model a Food Web? | • Investigate food webs.<br>• Model a food web. | • Flip Chart p. 21 – How Can We Model a Food Web?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 205-206 | Lesson 3 Quiz p. AG 40 |
| **Lesson 4**<br>What are Natural Resources? | • Define and explain the term natural resource.<br>• Explain the importance of natural resources such as water, animals, and plants.<br>• Explain the importance of rocks, minerals, and ores.<br>• Explain the importance of energy sources.<br>• Explain the importance of forests, soil, and land. | • Flip Chart P. 22 - Recycle Resources Yourself<br>• Digital Lesson<br>• Summarize Ideas p. 209; 211; 213; 215; 217<br>• Develop Inquiry Skills p. 208; 211; 214; 215 | Sum It Up! P.218<br><br>Brain Check Pp. 219-220<br><br>Lesson 4 Quiz p. AG 41 |
| **Lesson 5**<br>How do People Impact Ecosystems? | • Define pollution and conservation. | • Flip Chart P. 23 - How Does Water Pollution Affect Plants?<br>• Digital Lesson<br>• Summarize Ideas p. 223; 225; 227; 229;<br>• Develop Inquiry Skills p. 225; 226; 229; | Sum It Up! P. 230<br><br>Brain Check Pp. 231-232<br><br>Lesson 5 Quiz p. AG 42 |
| **Lesson 6 Inquiry**<br>**Flip Chart**<br>How Do People Affect Their Environment? | • Observe and compare the rate of decay of different materials.<br>• Record numerical data in a data table and descriptive data in sketches. | • Flip Chart p. 24 - How Do People Affect Their Environment?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 233-234 | Lesson 6 Quiz p. AG 43 |

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| | • Understand that some environmental changes are beneficial and some are harmful.<br>• Understand the impact that trash can have on the environment. | | |
| **Additional Assessments:**<br>Unit 4 Review Student Edition, pp. 239-242<br>Unit 4 Test AG pp. AG 44 – AG 48<br><br>**Performance Assessment**<br>Teacher Edition, p. 241<br>Assessment Guide, pp. AG 49 – AG 50 | | | |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4, 5.5, 5.10 | | | |

## Unit 5: Weather

## Big Idea: Water moves in a regular cycle that influences the weather.

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>What is the Water Cycle? | • Describe the water cycle and the role that evaporation, condensation and precipitation play in it<br>• Explain how the sun provides energy for the water cycle<br>• Explain how the oceans and other bodies of water interact through the water cycle<br>• Describe the path of precipitation from cloud to ground to runoff to ground water | • Flip Chart p. 26 – Watching the Water Cycle<br>• Digital Lesson<br>• Summarize Ideas p. 247; 249; 251; 253<br>• Develop Inquiry Skills p. 251; 253 | Sum It Up p. 254<br><br>Brain Check p. 255-258<br><br>Lesson 1 Quiz AG p. AG 51 |
| **Lesson 2**<br>What are types of Weather? | • Describe the composition of the atmosphere<br>• Identify the factors that make up the weather<br>• Explain how weather conditions are measured<br>• Explain how different types of precipitation form | • Flip Chart p. 27 – Dry Under Pressure<br>• Digital Lesson<br>• Develop Inquiry Skills p. 263; 265; 269<br>• Summarize Ideas p. 261; 263; 265; 267; 269 | Sum It Up! p. 270<br><br>Brain Check p. 271-272<br><br>Lesson 2 Quiz - AG p. AG52 |

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| | • Describe some forms of severe weather | | |
| **Lesson 3**<br>How is weather predicted? | • Explain how air masses form<br>• Explain how fronts affect weather<br>• Explain how meteorologists obtain and analyze weather data<br>• Describe types of severe weather such as hurricanes | • Flip Chart p. 28 – Model An Air Mass<br>• Digital Lesson<br>• Develop Inquiry Skills p. 275; 279<br>• Summarize Ideas p. 275; 277; 279; 281 | Sum It Up! p. 282<br><br>Brain Check p. 283-284<br><br>Lesson 3 Quiz - AG p. AG53 |
| **Lesson 4**<br>What are Natural Resources? | • Define and explain the term natural resource.<br>• Explain the importance of natural resources such as water, animals, and plants.<br>• Explain the importance of rocks, minerals, and ores.<br>• Explain the importance of energy sources.<br>• Explain the importance of forests, soil, and land. | • Flip Chart P. 22 Recycle Resources Yourself<br>• Digital Lesson | Sum It Up! P.218<br><br>Brain Check Pp. 219-220<br><br>Lesson 4 Quiz p. AG 41 |
| **S.T.E.M. – ENGINEERING & TECHNOLOGY**<br>Stormy Weather: Beaufort Wind Scale | • Explain that information about the Natural World can be gained through repeated observations<br>• Explain how the Beaufort Scale System works<br>• Explain how wind speed is measured today | • Develop Inquiry Skills p. 285<br>• Summarize Ideas p. 286* | Summarize Ideas p. 286*<br><br>*Can be used as either an activity or as an assessment. |

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| **S.T.E.M. – ENGINEERING & TECHNOLOGY**<br>Design It:<br>Build a Weather Vane | • Use the steps of the design process to build a wind vane<br>• Understand the importance of wind vanes in understanding the weather | • Flip Chart p. 29<br>• Develop Inquiry Skills p. 286B<br>• Develop the Engineering Design Process p. 286B | Extend & Evaluate p. 286B |
| **Lesson 4 Inquiry Flip Chart**<br>How can we observe weather patterns? | • Measure and record weather conditions using weather tools<br>• Use evidence from weather observations to make weather predictions<br>• Analyze weather data<br>• Verify observations made by others | • Flip Chart p. 30 – How Can We Observe Weather Patterns?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 287-288 | Lesson 4 Quiz - AG p. AG54 |
| **Additional Assessments:**<br>Unit 5 Review Student Edition pp. 291-294<br>Unit 5 Test AG pp. AG55-AG59<br><br>**Performance Assessment**<br>Teacher Edition, p. 293<br>Assessment Guide, pp. AG 60 – AG 61 | | | |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4, 5.8, 5.10 | | | |

## Unit 6: Earth and Space

### Big Idea: Objects in space including earth and its moon move in regular observable patterns.

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>How do the Earth, Sun and Moon interact? | • Describe the motions of the Earth, the Moon and the Sun in space<br>• Explain how the rotation of the Earth causes Day and Night<br>• Recognize that the Seasons result from the tilt and the orbit of the Earth around the Sun<br>• Identify the historical contributions to the understanding of the Earth-Moon-Sun System | • Flip Chart p. 31 – Spin & Model<br>• Digital Lesson<br>• Develop Inquiry Skills p. 299; 300; 302;303; 305; 307<br>• Summarize Ideas p. 299; 301; 303; 305; 307 | Sum It Up! p. 308<br><br>Brain Check p. 309-312<br><br>Lesson 1 Quiz - AG p. AG62 |
| **Lesson 2**<br>What are Moon Phases? | • Identify and predict changes in the appearance of the Moon. | • Flip Chart p. 32 – From Full to New and Back Again<br>• Digital Lesson<br>• Develop Inquiry Skills p. 317; 319; 321<br>• Summarizing Ideas p. 317; 319; 321 | Sum It Up! p. 322<br><br>Brain Check p. 323-324<br><br>Lesson 2 Quiz - AG p. AG63 |

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| **Lesson 3 Inquiry Flip Chart**<br>How does the Moon move around the Earth? | • Observe and Sketch apparent changes in the shape of the Moon<br>• Predict when and how the shape of the Moon appears to change | • Flip Chart p. 33 – How does the Moon move around the Earth?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 325-326 | Lesson 3 Quiz - AG p. AG64 |
| **Lesson 4**<br>What are the Planets in Our Solar System? | • Identify the major components of the Solar System<br>• Describe the characteristics of planets in the Solar System<br>• Compare and Contrast the Inner and Outer Planets | • Flip Chart p. 34 – How Can We Model the Orbit of Comets and Planets?<br>• Digital Lesson<br>• Develop Inquiry Skills p. 333; 337<br>• Summarize Ideas p. 329; 331; 333; 335; 337 | Sum It Up! p. 338<br><br>Brain Check p. 339-340<br><br>Lesson 4 Quiz - AG p. AG65 |
| **S.T.E.M. – ENGINEERING & TECHNOLOGY**<br>Space Exploration | • Identify the benefits and risks of Crewed Space Exploration<br>• Identify the benefits and risks of Crewless Space Exploration<br>• Compare and Contrast the benefits and risks of Crewed and Crewless Space Exploration | • Develop Inquiry Skills p. 341<br>• Summarize Ideas p. 342* | Summarize Ideas p. 342*<br><br>*Can be used as either as an activity or as an assessment. |
| **S.T.E.M. – ENGINEERING & TECHNOLOGY**<br>Design It: Build A Sundial | • Use the steps of the design process to make a Sundial<br>• Understand the purpose of Sundials in telling time | • Flip Chart p. 35<br>• Develop Inquiry Skills p. 342B<br>• Develop the Engineering Design Process p. 342B | Extend & Evaluate p. 342B |

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| **Lesson 5 Inquiry**<br>**Flip Chart**<br>How can we model the Sun and the Planets? | • Model the size of the Sun and the Planets in the Solar System<br>• Compare and Contrast the size of the Sun and the Inner and Outer Planets | • Flip Chart p. 36 – How can we model the Sun and the Planets?<br>• Virtual Lab<br>• Develop Inquiry Skills p. 343-344 | Lesson 5 Quiz - AG p. AG66 |
| **Additional Assessments:**<br>Unit 6 Review Student Edition p. 345-348<br>Unit 6 Test AG pp. AG67-AG71<br><br>**Performance Assessment**<br>Teacher Edition, p. 347<br>Assessment Guide, pp. AG 72 – AG 73 | | | |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4, 5.8, 5.10 | | | |

## Unit 7: Properties of Matter

**Big Idea: The Physical Properties of Matter can be used to identify it even if it has changed states or has been mixed with other matter.**

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>What are Physical Properties of Matter? | • Explain how Physical Properties can be used to Identify Matter<br>• Define Matter, Mass, Density, and Volume<br>• Compare objects by their Physical Properties | • Flip Chart p. 37 – Measuring Liquids<br>• Digital Lesson<br>• Develop Inquiry Skills p. 353; 355; 361<br>• Summarize Ideas p. 353; 355; 357; 359; 361 | Sum It Up! p. 362<br>Brain Check p. 363-366<br>Lesson 1 Quiz - AG p. AG74 |
| **Lesson 2**<br>How are Physical Properties Observed? | • Classify a group of objects by their observable properties<br>• Use standard measurements to quantify observable properties of an object | • Flip Chart p. 38 – How are Physical Properties Observed?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 367-368 | Lesson 2 Quiz - AG p. AG75 |
| **Lesson 3 Inquiry Flip Chart**<br>What is Conservation of Mass? | • Use a balance to illustrate the Law of Conservation of Mass (Two Identical Objects on either end of the balance: one is whole; the other is | • Flip Chart p. 39 – What is Conservation of Mass?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills P. 371-372 | Lesson 3 Quiz – AG p. AG76 |

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| **Lesson 4**<br>What are the States of Water? | • Describe the three States of Water<br>• Explain how heating and cooling change the States of Matter<br>• Explain that Matter isn't lost or gained as it changes States | • Flip Chart p. 40 – Melt, Boil and Evaporate<br>• Digital Lesson<br>• Develop Inquiry Skills p. 377; 379<br>• Summarize Ideas p. 375; 377; 379 | Sum It Up! p. 380<br><br>Brain Check p. 381-382<br><br>Lesson 4 Quiz - AG p. AG77 |
| **S.T.E.M. – ENGINEERING & TECHNOLOGY**<br>Baby, Its Cold Inside Refrigeration | • Identify and Describe how refrigeration has changed over time<br>• Describe how refrigerators and similar devices help meet people's needs | • Develop Inquiry Skills p. 384<br>• Summarize Ideas p. 384* | Summarize Ideas p. 384*<br><br>*Can be used as either an activity or as an assessment. |
| **S.T.E.M. – ENGINEERING & TECHNOLOGY**<br>Improvise It: Build a Rubber Band Scale | • Use the steps of the design to build a Rubber Band Scale<br>• Understand the purpose of Spring Scales in measuring weight | • Flip Chart p. 41<br>• Develop Inquiry Skills p. 384B<br>• Develop the Engineering Design Process p. 384B | Extend & Evaluate p. 384B |
| **Additional Assessments:**<br>Unit 7 Review Student Edition pp. 385-388<br>Unit 7 Test AG pp. AG78-AG82<br><br>**Performance Assessment**<br>Teacher Edition, p. 387<br>Assessment Guide, pp. AG 83 – AG 84 | | | |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4, 5.6, 5.10 | | | |

## **Unit 8:** Changes In Matter

## Big Idea: Matter can undergo both Physical and Chemical Changes.

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>What are some Physical Changes? | • Recognize that during a Physical Change, the composition of a substance does not change<br>• Identify examples of Physical Changes | • Flip Chart p. 42 – Drop by Drop<br>• Digital Lesson<br>• Develop Inquiry Skills p. 393; 395; 397; 399<br>• Summarize Ideas p. 393; 395; 397; 399 | Sum It Up! p. 400<br>Brain Check p. 401-402<br>Lesson 1 Quiz -AG p. AG85 |
| **Lesson 2**<br>How can we make a Solution? | • Distinguish between a Mixture and a Solution<br>• Measure Physical Properties of Matter | • Flip Chart p.43 – How Can We Make A Solution?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 403-404 | Lesson 2 Quiz - AG p. AG86 |
| **Lesson 3**<br>What are some Chemical Changes? | • Recognize that after a Chemical Change, new substances form with different characteristics<br>• Explain Conservation of Mass<br>• Describe examples of Chemical Changes<br>• Explain how Chemical | • Flip Chart p. 44 – Kitchen Chemistry<br>• Digital Lesson<br>• Develop Inquiry Skills p. 407; 408; 411; 413<br>• Summarize Ideas p. 407; 409; 411 ; 413 | Sum It Up! p. 414<br>Brain Check p. 415-416<br>Lesson 3 Quiz - AG p. AG87 |

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| | Changes differ from Physical Changes | | |
| **S.T.E.M. – ENGINEERING & TECHNOLOGY**<br>Body Armor | • Describe how tools and materials are used to develop and improve safety equipment | • Develop Inquiry Skills p. 417<br>• Summarize Ideas p. 418* | Summarize Ideas p. 418*<br><br>*Can be used as either and activity or as an assessment. |
| **S.T.E.M. – ENGINEERING & TECHNOLOGY**<br>Build In Some Science: Making Carbon Dioxide | • Use the steps of the design process to produce and use Carbon Dioxide<br>• Understand that Chemical Reactions can be a part of a useful product | • Flip Chart p. 45 – Build In Some Science: Making Carbon Dioxide<br>• Develop Inquiry Skills p. 418B<br>• Develop the Engineering Design Process p. 418B | Extend & Evaluate p. 418B |
| **Lesson 4 Inquiry Flip Chart**<br>How can you tell when a new substance forms? | • Identify Changes In An Object's Properties that signals a Chemical Change<br>• Compare and Contrast the appearance of steel wool before and after the formation of rust | • Flip Chart p. 46 – How Can You Tell When A New Substance Forms?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 417-420 | Lesson 4 Quiz AG p. 88 |
| **<u>Additional Assessments:</u>**<br>Unit 8 Review Student Edition p. 423-426<br>Unit 8 Test AG pp. AG89-AG93<br><br>**<u>Performance Assessment</u>**<br>Teacher Edition, p. 425<br>Assessment Guide, pp. AG 94 – AG 95 | | | |
| **<u>NJCCCS:</u>** 5.1, 5.2, 5.3, 5.4, 5.6, 5.10 | | | |

## Unit 9: Energy

## Big Idea: Heat is a form of energy that can be transferred between objects..

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>What are some forms of energy? | • Identify energy uses and their sources.<br>• Describe the uses of chemical and mechanical energy and how chemical energy can be changed to other forms of energy.<br>• Differentiate between potential and kinetic energy.<br>• Understand that sound is a form of energy produced through vibrations. | • Flip Chart p. 47 – Energy Sources<br>• Digital Lesson<br>• Develop Inquiry Skills p. 435;<br>• Summarize Ideas p. 431; 433; 435; 437; 439 | Sum It Up! p. 440<br><br>Brain Check p. 441-444<br><br>Lesson 1 Quiz -AG p. 96 |
| **Lesson 2 Inquiry Flip Chart**<br>Where does energy come from? | • Identify how potential energy is transferred into kinetic energy.<br>• Investigate how energy has the ability to cause motion. | • Flip Chart p.48 – Where does energy come from?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 445-446 | Lesson 2 Quiz - AG p.97 |
| **Lesson 3**<br>What is heat? | • Define temperature and heat.<br>• Describe three ways to transfer heat. | • Flip Chart p. 49 – Heating Things Up<br>• Digital Lesson<br>• Develop Inquiry Skills p. | Sum It Up! p. 454<br><br>Brain Check p. 455-458 |

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| | • Identify sources of heat. | 449; 451; 453;<br>• Summarize Ideas p. 449; 451; 453; | Lesson 3 Quiz - AG p. 98 |
| **Lesson 4 Inquiry Flip Chart**<br>How is heat produced? | • Observe that an object's temperature increases when it is exposed to a heat source. | • Flip Chart p. 50 – How is Heat Produced?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 459-460 | Lesson 4 Quiz – AG p. 99 |
| **Lesson 5**<br>What are conductors and insulators? | • Identify materials that conduct heat well.<br>• Determine which materials can be used to prevent the transfer of energy as heat. | • Flip Chart p. 51 – Sunny Side Up!<br>• Digital Lesson<br>• Develop Inquiry Skills p. 465; 467; 469.<br>• Summarize Ideas p. 465; 467; 469. | Sum It Up! p. 470<br>Brain Check p. 471-472<br>Lesson 5 Quiz - AG p. 100 |
| **Lesson 6 Inquiry Flip Chart**<br>Which materials are conductors? | • Recognize that some materials conduct heat better than others.<br>• Classify a small group of objects by the observable property: objects that conduct heat well and those that do not. | • Flip Chart p. 52 – What Materials Are Conductors?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 473-474 | Lesson 6 Quiz - A G p. 101 |
| **S.T.E.M. – ENGINEERING &** | • Explain that energy can be | • Flip Chart p. 53 – Design It: | Extend & Evaluate p. 476B |

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| **TECHNOLOGY**<br>How it Works: Piezoelectricity | transformed.<br>• Identify products and processes that help us transform energy.<br>• Describe how mechanical energy is transformed into electrical energy using a piezoelectric device. | Solid Water Heater<br>• Develop Inquiry Skills p. 476B<br>• Develop the Engineering Design Process p. 476B | |
| **Additional Assessments:**<br>Unit 9 Review Student Edition p. 477-480<br>Unit 9 Test AG pp. AG102-AG108<br><br>**Performance Assessment**<br>Teacher Edition, p. 479 | | | |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4, 5.7, 5.10 | | | |

## Unit 10: Electricity

## Big Idea: Electric currents and magnets can be used for many purposes.

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>What is electricity? | • Explain what causes static electricity.<br>• Describe how charged particles interact with one another.<br>• Relate electricity to magnetism. | • Flip Chart p. 54 – Static Cereal!<br>• Digital Lesson<br>• Develop Inquiry Skills p. 485; 487; 488;<br>• Summarize Ideas p. 485; 487; 489; 491. | Sum It Up! p. 492<br>Brain Check p. 493-496<br>Lesson 1 Quiz -AG p. 109 |
| **Lesson 2 Inquiry Flip Chart**<br>How do electric charges interact? | • Describe the interaction between a charged object and an uncharged object.<br>• Describe the interaction between two objects with the same charge.<br>• Demonstrate the ability of a charged object to attract or repel another object, even is the two objects are not touching. | • Flip Chart p.55 – How do electric charges interact?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 497-498 | Lesson 2 Quiz - AG p.110 |
| **Lesson 3 Inquiry Flip Chart**<br>What is an electric circuit? | • Build a simple series circuit.<br>• Determine that electricity flows through a circuit only | • Flip Chart p. 56 – What is an electric circuit?<br>• Virtual Lab Experience | Lesson 3 Quiz - AG p.111 |

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| | when the circuit is closed.<br>• Test materials and identify them as either conductors or insulators of electricity.<br>• Explain that observations can be used as evidence to support a scientific explanation. | • Develop Inquiry Skills p. 499-500 | |
| **Lesson 4**<br>What are electric circuits, conductors, and insulators? | • Analyze circuits and explain how they work.<br>• Identify elements in a circuit that transform electrical energy into heat, light, sound, and motion.<br>• Identify conductors and insulators of electricity. | • Flip Chart p. 57 – Compare Two Circuits<br>• Digital Lesson<br>• Develop Inquiry Skills p. 507; 508<br>• Summarize Ideas p. 503; 505; 507; 509 | Sum It Up! p. 510<br>Brain Check p. 511-514<br>Lesson 4 Quiz - AG p. 112 |
| **Lesson 5**<br>How do we use electricity? | • Identify ways in which electrical energy can be transformed into heat, light, sound, and motion.<br>• Describe how electricity is generated.<br>• Explain why energy conservation is important and identify some ways to conserve electricity. | • Flip Chart p. 58 – Build an Electromagnet & Is There Current?<br>• Digital Lesson<br>• Develop Inquiry Skills p. 521; 522; 523; 525;<br>• Summarize Ideas p. 519; 521; 523; 525 | Sum It Up! p. 526<br>Brain Check p. 527-528<br>Lesson 5 Quiz - AG p. 113 |
| **S.T.E.M. – ENGINEERING & TECHNOLOGY** | • Identify the parts that make up a modern electric grid. | • Flip Chart p. 59 – Build in Some Science: An Attractive | Extend & Evaluate p. 530B |

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| How it Works: The Electric Grid | • Identify processes and products of technology that make electricity production and distribution possible. | Option<br>• Develop Inquiry Skills p. 530B<br>• Develop the Engineering Design Process p. 530B | |
| **Additional Assessments:**<br>Unit 10 Review Student Edition p. 531-534<br>Unit 10 Test AG pp. AG114-AG120<br><br>**Performance Assessment**<br>Teacher Edition, p. 533<br>Assessment Guide, pp. AG 114-AG120 | | | |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4, 5.7, 5.10 | | | |

## Unit 11: Motion

**Big Idea: Motion can be measured and described. It is influenced by forces such as friction.**

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| **Lesson 1**<br>What is motion? | • Observe and record changes in position.<br>• Explain how to measure motion.<br>• Compare the motion of various objects.<br>• Describe how velocity and acceleration are related. | • Flip Chart p. 60 – Fast Walk, Slow Walk.<br>• Digital Lesson<br>• Develop Inquiry Skills p. 545; 547<br>• Summarize Ideas p. 539; 541; 543; 545; 547. | Sum It Up! p. 548<br>Brain Check p. 549-552<br>Lesson 1 Quiz -AG p. 121 |
| **Lesson 2 Inquiry Flip Chart**<br>What is speed? | • Determine the speed of moving object by measuring the distance it travels and the time required.<br>• Determine how to increase or decrease the speed of the object they are investigating. | • Flip Chart p.61 – What is Speed?<br>• Virtual Lab Experience<br>• Develop Inquiry Skills p. 553-554 | Lesson 2 Quiz - AG p.122 |
| **S.T.E.M. – ENGINEERING & TECHNOLOGY**<br>How it Works: Gyroscopes | • Identify examples of gyroscopes.<br>• Describe the parts of a gyroscope and explain their functions. | • Flip Chart p. 62 – Improvise It: A game of skill and motion<br>• Develop Inquiry Skills p. 558B<br>• Develop the Engineering | Extend & Evaluate p. 558B |

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| | | Design Process p. 558B | |
| **Additional Assessments:**<br>Unit 11 Review Student Edition p. 559-562<br>Unit 11 Test AG pp. AG123-AG129<br><br>**Performance Assessment**<br>Teacher Edition, p. 560<br>Assessment Guide, pp. AG 129-AG130 | | | |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4, 5.7, 5.10 | | | |

## Supplemental: Human Body

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| How do the interactions of the Human Body Systems carry out every day life activities?*<br><br>*www.state.nj.us/education/cccs/standards/5/5.pdf | • Identification and Understanding of the essential functions of the Digestive, Circulatory, Respiratory, Nervous, Muscular, Skeletal and Reproductive Systems* | • Teacher Discretion | Teacher Discretion |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4, 5.5, 5.10 | | | |

## **Supplemental:** Simple Machines

| Essential Questions | Instructional Objectives/ Skills and Benchmarks *(CPIs)* | Activities | Assessments |
|---|---|---|---|
| How do simple machines help us? | • The students will be able to identify the basic simple machines with complete accuracy. | • Teacher Discretion | Teacher Discretion |
| **NJCCCS:** 5.1, 5.2, 5.3, 5.4, 5.7, 5.10 | | | |

NEXT GENERATION SCIENCE STANDARDS
For States, By States

## Fourth Grade

The performance expectations in fourth grade help students formulate answers to questions such as: "What are waves and what are some things they can do? How can water, ice, wind and vegetation change the land? What patterns of Earth's features can be determined with the use of maps? How do internal and external structures support the survival, growth, behavior,
and reproduction of plants and animals? What is energy and how is it related to motion? How is energy transferred? How can energy be used to solve a problem?" Fourth grade performance expectations include PS3, PS4, LS1, ESS1, ESS2, ESS3, and ETS1 Disciplinary Core Ideas from the NRC Framework. Students are able to use a model of waves to describe patterns of waves
in terms of amplitude and wavelength, and that waves can cause objects to move. Students are expected to develop understanding of the effects of weathering or the rate of erosion by water,
ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and
compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth's features, students analyze and interpret data from maps. Fourth graders are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of patterns; cause and effect; energy and

matter; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the fourth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

# 4-PS3 Energy

## 4-PS3 Energy

Students who demonstrate understanding can:

**4-PS3-1.** **Use evidence to construct an explanation relating the speed of an object to the energy of that object.** [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]

**4-PS3-2.** **Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

**4-PS3-3.** **Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

**4-PS3-4.** **Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

### Science and Engineering Practices

**Asking Questions and Defining Problems**
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3)

**Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2)

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)
- Apply scientific ideas to solve design problems. (4-PS3-4)

### Disciplinary Core Ideas

**PS3.A: Definitions of Energy**

- The faster a given object is moving, the more energy it possesses. (4-PS3-1)
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3)

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

- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2),(4-PS3-3)
- Light also transfers energy from place to place. (4-PS3-2)
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4)

**S3.C: Relationship Between Energy and Forces**

- When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)

**PS3.D: Energy in Chemical Processes and Everyday Life**

- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)

**ETS1.A: Defining Engineering Problems**

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (secondary to 4-PS3-4)

### Crosscutting Concepts

**Energy and Matter**

- Energy can be transferred in various ways and between objects. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4)

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

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

- Engineers improve existing technologies or develop new ones. (4-PS3-4)

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**Connections to Nature of Science**

**Science is a Human Endeavor**

- Most scientists and engineers work in teams. (4-PS3-4)
- Science affects everyday life. (4-PS3-4)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **K.PS2.B** (4-PS3-3); **K.ETS1.A** (4-PS3-4); **2.ETS1.B** (4-PS3-4); **3.PS2.A** (4-PS3-3); **5.PS3.D** (4-PS3-4); **5.LS1.C** (4-PS3-4); **MS.PS2.A** (4-PS3-3); **MS.PS2.B** (4-PS3-2); **MS.PS3.A** (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4); **MS.PS3.B** (4-PS3-2),(4-PS3-3),(4-PS3-4); **MS.PS3.C** (4-PS3-3); **MS.PS4.B** (4-PS3-2); **MS.ETS1.B** (4- PS3-4); **MS.ETS1.C** (4-PS3-4)

Common Core State Standards Connections: ELA/Literacy –

**RI.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1)

**RI.4.3** Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4- PS3-1)

**RI.4.9** Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS3-1)

**W.4.2** Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)

**W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),(4-PS3-3),(4-PS3-4)

**W.4.8** Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4)

**W.4.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1)

Mathematics –

**4.OA.A.3** Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (4-PS3-4)

# 4-PS4 Waves and their Applications in Technologies for Information Transfer

## 4-PS4 Waves and their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

**4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.** [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]

**4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.** [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]

**4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.*** [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)
- Develop a model to describe phenomena. (4-PS4-2)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)

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**Connections to Nature of Science**

**Scientific Knowledge is Based on Empirical Evidence**

- Science findings are based on recognizing patterns. (4-PS4-1)

### Disciplinary Core Ideas

**PS4.A: Wave Properties**

- Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (Note: This grade band endpoint was moved from K–2.) (4-PS4-1)
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)

**PS4.B: Electromagnetic Radiation**

- An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)

**PS4.C: Information Technologies and Instrumentation**

- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)

**ETS1.C: Optimizing The Design Solution**

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (secondary to 4-PS4-3)

### Crosscutting Concepts

**Patterns**

- Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)
- Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)

**Cause and Effect**

- Cause and effect relationships are routinely identified. (4-PS4-2)

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

**Interdependence of Science, Engineering, and Technology**

- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)

Connections to other DCIs in fourth grade: **4.PS3.A** (4-PS4-1); **4.PS3.B** (4-PS4-1); **4.ETS1.A** (4-PS4-3)

Articulation of DCIs across grade-levels: **K.ETS1.A** (4-PS4-3); **1.PS4.B** (4-PS4-2); **1.PS4.C** (4-PS4-3); **2.ETS1.B** (4-PS4-3); **2.ETS1.C** (4-PS4-3); **3.PS2.A** (4-PS4-3); **MS.PS4.A** (4-PS4-1); **MS.PS4.B** (4-PS4-2); **MS.PS4.C** (4-PS4-3); **MS.LS1.D** (4-PS4-2); **MS.ETS1.B** (4-PS4-3)

Common Core State Standards Connections: ELA/Literacy –

**RI.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS4-3)

**RI.4.9** Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)

**SL.4.5** Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-PS4-1),(4-PS4-2) Mathematics –

**MP.4** Model with mathematics. (4-PS4-1),(4-PS4-2)

**4.G.A.1** Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. (4-PS4-1),(4-PS4-2)

# 4-LS1 From Molecules to Organisms: Structures and Processes

## 4-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

**4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.** [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

**4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.** [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

### Science and Engineering Practices

**Developing and Using Models**

Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.

- Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)

**Engaging in Argument from Evidence**

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).

- Construct an argument with evidence, data, and/or a model. (4-LS1-1)

### Disciplinary Core Ideas

**LS1.A: Structure and Function**

- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)

**LS1.D: Information Processing**

- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)

### Crosscutting Concepts

**Systems and System Models**

- A system can be described in terms of its components and their interactions. (4-LS1-1),(4-LS1-2)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **1.LS1.A** (4-LS1-1); **1.LS1.D** (4-LS1-2); **3.LS3.B** (4-LS1-1); **MS.LS1.A** (4-LS1-1),(4-LS1-2); **MS.LS1.D** (4-LS1-2)

Common Core State Standards Connections:

ELA/Literacy –

**W.4.1** Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)

**SL.4.5** Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. (4-LS1-2)

Mathematics –

**4.G.A.3** Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. (4-LS1-1)

# 4-ESS1 Earth's Place in the Universe

## 4-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

**4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.** [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

### Science and Engineering Practices

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Identify the evidence that supports particular points in an explanation. (4-ESS1-1)

### Disciplinary Core Ideas

**ESS1.C: The History of Planet Earth**

- Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)

### Crosscutting Concepts

**Patterns**

- Patterns can be used as evidence to support an explanation. (4-ESS1-1)

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**Connections to Nature of Science**

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

- Science assumes consistent patterns in natural systems. (4-ESS1-1)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **2.ESS1.C** (4-ESS1-1); **3.LS4.A** (4-ESS1-1); **MS.LS4.A** (4-ESS1-1); **MS.ESS1.C** (4-ESS1-1) **MS.ESS2.A** (4-ESS1-1); **MS.ESS2.B** (4-ESS1-1)

Common Core State Standards Connections: ELA/Literacy –

**W.4.7** Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1)

**W.4.8** Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS1-1)

**W.4.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS1-1)

Mathematics –

**MP.2** Reason abstractly and quantitatively. (4-ESS1-1)

**MP.4** Model with mathematics. (4-ESS1-1)

**4.MD.A.1** Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS1-1)

# 4-ESS2 Earth's Systems

## 4-ESS2 Earth's Systems

Students who demonstrate understanding can:

**4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.** [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]

**4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.** [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

### Science and Engineering Practices

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)

**Analyzing and Interpreting Data**

Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)

### Disciplinary Core Ideas

**ESS2.A: Earth Materials and Systems**

- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1)

**ESS2.B: Plate Tectonics and Large-Scale System Interactions**

- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)

**ESS2.E: Biogeology**

- Living things affect the physical characteristics of their regions. (4-ESS2-1)

### Crosscutting Concepts

**Patterns**

- Patterns can be used as evidence to support an explanation. (4-ESS2-2)

**Cause and Effect**

- Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **2.ESS1.C** (4-ESS2-1); **2.ESS2.A** (4-ESS2-1); **2.ESS2.B** (4-ESS2-2); **2.ESS2.C** (4-ESS2-2); **5.ESS2.A** (4-ESS2-1); **5.ESS2.C** (4-ESS2-2); **MS.ESS1.C** (4-ESS2-2); **MS.ESS2.A** (4-ESS2-2); **MS.ESS2.B** (4-ESS2-2)

Common Core State Standards Connections:

ELA/Literacy –

| | |
|---|---|
| **RI.4.7** | Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2) |
| **W.4.7** | Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS2-1) |
| **W.4.8** | Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS2-1) |

Mathematics –

| | |
|---|---|
| **MP.2** | Reason abstractly and quantitatively. (4-ESS2-1) |
| **MP.4** | Model with mathematics. (4-ESS2-1) |
| **MP.5** | Use appropriate tools strategically. (4-ESS2-1) |
| **4.MD.A.1** | Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. (4-ESS2-1) |
| **4.MD.A.2** | Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. (4-ESS2-1),(4-ESS2-2) |

# 4-ESS3 Earth and Human Activity

## 4-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

**4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

**4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.*** [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

### Science and Engineering Practices

**Constructing Explanations and Designing Solutions**
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)

**Obtaining, Evaluating, and Communicating Information**
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.

- Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)

### Disciplinary Core Ideas

**ESS3.A: Natural Resources**

- Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)

**ESS3.B: Natural Hazards**

- A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) (Note: This Disciplinary Core Idea can also be found in 3.WC.)

**ETS1.B: Designing Solutions to Engineering Problems**

- Testing a solution involves investigating how well it performs under a range of likely conditions. (secondary to 4-ESS3-2)

### Crosscutting Concepts

**Cause and Effect**

- Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)
- Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2)

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

**Interdependence of Science, Engineering, and Technology**

- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1)

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

- Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1)
- Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

Connections to other DCIs in fourth grade: **4.ETS1.C** (4-ESS3-2)

Articulation of DCIs across grade-levels: **K.ETS1.A** (4-ESS3-2); **2.ETS1.B** (4-ESS3-2); **2.ETS1.C** (4-ESS3-2); **5.ESS3.C** (4-ESS3-1); **MS.PS3.D** (4-ESS3-1); **MS.ESS2.A** (4-ESS3-1),(4- ESS3-2); **MS.ESS3.A** (4-ESS3-1); **MS.ESS3.B** (4-ESS3-2); **MS.ESS3.C** (4-ESS3-1); **MS.ESS3.D** (4-ESS3-1); **MS.ETS1.B** (4-ESS3-2)

Common Core State Standards Connections: ELA/Literacy –

| | |
|---|---|
| **RI.4.1** | Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2) |
| **RI.4.9** | Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2) |
| **W.4.7** | Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS3-1) |
| **W.4.8** | Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS3-1) |
| **W.4.9** | Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-ESS3-1) Mathematics – |
| **MP.2** | Reason abstractly and quantitatively. (4-ESS3-1),(4-ESS3-2) |
| **MP.4** | Model with mathematics. (4-ESS3-1),(4-ESS3-2) |
| **4.OA.A.1** | Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-1),(4-ESS3-2) |

# 3-5-ETS1 Engineering Design

## 3-5-ETS1 Engineering Design

Students who demonstrate understanding can:

**3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.**

**3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**

**3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

### Science and Engineering Practices

**Asking Questions and Defining Problems**

Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

**Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints

### Disciplinary Core Ideas

**ETS1.A: Defining and Delimiting Engineering Problems**

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

**ETS1.B: Developing Possible Solutions**

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

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

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

### Crosscutting Concepts

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

- People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

Connections to 3-5-ETS1.A: Defining and Delimiting Engineering Problems include:
**Fourth Grade:** 4-PS3-4

Connections to 3-5-ETS1.B: Designing Solutions to Engineering Problems include:
**Fourth Grade:** 4-ESS3-2

Connections to 3-5-ETS1.C: Optimizing the Design Solution include:
**Fourth Grade:** 4-PS4-3

| |
|---|
| Articulation of DCIs across grade-bands: **K-2.ETS1.A** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **K-2.ETS1.B** (3-5-ETS1-2); **K-2.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.A** (3-5-ETS1-1); **MS.ETS1.B** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3) |
| Common Core State Standards Connections: |
| ELA/Literacy – |
| **RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (3-5-ETS-2) |
| **RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (3-5-ETS-2) |
| **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS-2) |
| **W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1),(3-5-ETS1-3) |
| **W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (3-5-ETS1-1),(3-5-ETS1-3) |
| **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. (3-5-ETS1-1),(3-5-ETS1-3) |
| Mathematics – |
| **MP.2** Reason abstractly and quantitatively. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3) |
| **MP.4** Model with mathematics. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3) |
| **MP.5** Use appropriate tools strategically. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3) |
| **3-5.OA** Operations and Algebraic Thinking (3-5-ETS1-1),(3-5-ETS1-2) |

# New Jersey Core Curriculum Content Standards for Science

## INTRODUCTION

### Science Education in the 21st Century

"Today more than ever before, science holds the key to our survival as a planet and our security and prosperity as a nation" (Obama, 2008).

Scientific literacy assumes an increasingly important role in the context of globalization. The rapid pace of technological advances, access to an unprecedented wealth of information, and the pervasive impact of science and technology on day-to-day living require a depth of understanding that can be enhanced through quality science education. In the 21st century, science education focuses on the practices of science that lead to a greater understanding of the growing body of scientific knowledge that is required of citizens in an ever-changing world.

Mission: Scientifically literate students possess the knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity.

Vision: A quality science education fosters a population that:

- Experiences the richness and excitement of knowing about the natural world and understanding how it functions.
- Uses appropriate scientific processes and principles in making personal decisions.
- Engages intelligently in public discourse and debate about matters of scientific and technological concern.
- Applies scientific knowledge and skills to increase economic productivity.

### Intent and Spirit of the Science Standards

"Scientific proficiency encompasses understanding key concepts and their connections to other fundamental concepts and principles of science; familiarity with the natural and designed world for both its diversity and unity; and use of scientific knowledge and scientific ways of thinking for individual and social purposes" (American Association for the Advancement of Science, 1990).

All students engage in science experiences that promote the ability to ask, find, or determine answers to questions derived from natural curiosity about everyday things and occurrences. The underpinning of the revised standards lies in the premise that science is experienced as an active process in which inquiry is central to learning and in which students engage in observation, inference, and experimentation on an ongoing basis, rather than as an isolated a process. When engaging in inquiry, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their

ideas to others in their community and around the world. They actively develop their understanding of science by identifying their assumptions, using critical and logical thinking, and considering alternative explanations.

Revised Standards

The revision of the science standards was driven by two key questions:

- What are the core scientific concepts and principles that all students need to understand in the 21st century?

- What should students be able to do in order to demonstrate understanding of the concepts and principles?

In an attempt to address these questions, science taskforce members examined the scientific concepts and principles common to the National Science Education Standards, Benchmarks and Atlases for Science Literacy , and the National Assessment of Educational Progress (NAEP) Framework .This resulted in narrowing the breadth of content from 10 standards to four standards that include 17 clearly-defined key concepts and principles.

- Science Practices (standard 5.1) embody the idea of "knowledge in use" and include understanding scientific explanations, generating scientific evidence, reflecting on scientific knowledge, and participating productively in science. Science practices are integrated into the Cumulative Progress Indicators within each science domain in recognition that science content and processes are inextricably linked; science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge.
- Science content is presented in Physical Science (standard 5.2), Life Science (standard 5.3), and Earth Systems (standard 5.4). The most current research on how science is learned informed the development of learning progressions for each strand, which increase in depth of understanding as students' progress through the grades.

Laboratory Science in the 21stCentury

Laboratory science is a practice not a place. It is important to emphasize that standards-driven lab science courses do not include student manipulation or analysis of data created by a teacher as a replacement or substitute for direct interaction with the natural or designed world.

The revised standards and course descriptions emphasize the importance of students independently creating scientific arguments and explanations for observations made during investigations. Science education thereby becomes a sense-making enterprise for students in which they are systematically provided with ongoing opportunities to:

- Interact directly with the natural and designed world using tools, data-collection techniques, models, and theories of science.
- Actively participate in scientific investigations and use cognitive and manipulative skills associated with the formulation of scientific explanations.

• Use evidence, apply logic, and construct arguments for their proposed explanations.

The 2009 Science Standards implicitly and explicitly point to a more student-centered approach to instructional design that engages learners in inquiry. Inquiry, as defined in the revised standards, envisions learners who:
• Are engaged by scientifically-oriented questions.
• Prioritize evidence that addresses scientifically-oriented questions.
• Formulate explanations from that evidence to address those scientifically-oriented questions.
• Evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding.
• Communicate and justify their proposed explanations.

Fundamental principles of instructional design assist students in achieving their intended learning goals through lab-science experiences that:
• Are designed with clear learning outcomes in mind.
• Are sequenced thoughtfully into the flow of classroom science instruction.
• Integrate learning of science content with learning about science practices.
• Incorporate ongoing student reflection and discussion (National Research Council, 2007).
Students K-12 lab-science experiences should include the following:
• Physical manipulation of authentic substances or systems: This may include such activities as chemistry experiments, plant and animal observations, and investigations of force and motion.
• Interaction with simulations: In 21st-century laboratory science courses, students can work with computerized models, or simulations, that represent aspects of natural phenomena that cannot be observed directly because they are very large, very small, very slow, very fast, or very complex. Students may also model the interaction of molecules in chemistry or manipulate models of cells, animal or plant systems, wave motion, weather patterns, or geological formations using simulations.
• Interaction with authentic data: Students may interact with authentic data that are obtained and represented in a variety of forms. For example, they may study photographs to examine characteristics of the Moon or other heavenly bodies or analyze emission and absorption spectra in the light from stars. Data may be incorporated in films, DVDs, computer programs, or other formats.
• Access to large databases: In many fields of science, researchers have arranged for empirical data to be normalized and aggregated - for example, genome databases, astronomy image collections, databases of climatic events over long time periods, biological field observations. Some students may be able to access authentic and timely scientific data using the Internet and can also manipulate and analyze authentic data in new forms of laboratory experiences (Bell, 2005).

• Remote access to scientific instruments and observations: When available, laboratory experiences enabled by the Internet can link students to remote instruments, such as the environmental scanning electron microscope (Thakkar et al., 2000), or allow them to control automated telescopes (Gould, 2004).