Grade Six Science

Theme ***Order and Organization***

Strand Connection

All matter is made of small particles called atoms. The properties of matter are based on the order and organization of atoms and molecules. Cells, minerals, rocks, and soil are all examples of matter.

Science Inquiry and Applications:

- Identify questions that can be answered through scientific investigations
- Design and conduct a scientific investigation
- Use appropriate mathematics, tools, and techniques to gather data and information
- Analyze and interpret data; develop descriptions, models, explanations, and predictions
- Think critically and logically to connect evidence and explanations
- Recognize and analyze alternative explanations and predications
- Communicate scientific procedures and explanations

Reading in Science

Key Ideas and Details:

1. Cite specific textual evidence to support analysis of science and technical texts.
2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Craft and Structure:

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.
5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

Integration of Knowledge and Ideas:

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).
8. Distinguish among facts, reasoned judgment based on research

Writing in Science

Text Types and Purposes:

1. Write arguments focused on discipline-specific content.
   a. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
   b. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
   c. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
   d. Establish and maintain a formal style.
   e. Provide a concluding statement or section that follows from and supports the argument presented.
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
   a. Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.

findings, and speculation in a text.

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.

Range of Reading and Level of Text Complexity:

10. By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.

   b. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
   c. Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.
   d. Use precise language and domain-specific vocabulary to inform about or explain the topic.
   e. Establish and maintain a formal style and objective tone.
   f. Provide a concluding statement or section that follows from and supports the information or explanation presented.

3. Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In science and technical subjects, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results.

Production and Distribution of Writing:

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5. With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

Research to Build and Present Knowledge:

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.
8. Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.
9. Draw evidence from informational texts to support analysis, reflection, and research.

	Range of Writing: 10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Grade Six Science

Topic ***Rocks, Minerals, and Soil***	**Pacing**
This topic focuses on the study of rocks, minerals, and soil, which make up the lithosphere. Classifying and identifying different types of rocks, minerals, and soil can decode the past environment in which they formed.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)
Content Statement ***1. Minerals have specific, quantifiable properties.*** Minerals are naturally occurring, inorganic solids that have a defined chemical composition. Minerals have properties that can be observed and measured. Minerals form in specific environments. **Learning Targets:** • I can test properties (luster, hardness, cleavage, streak, magnetism, fluorescence, crystal shape) of minerals. • I can use a key to identify minerals by their properties. • I can compare and contrast rocks and minerals.	**Content Elaborations** ***Prior Concepts Related to Mineral Properties*** PreK-2: Objects have physical properties, properties of objects can change, and Earth's nonliving resources have specific properties. Grades 3-5: Rocks and soil have characteristics, soil contains pieces of rocks, and objects are composed of matter and may exhibit electrical conductivity and magnetism. ***Grade 6 Concepts*** Most rocks are composed of one or more minerals. Minerals have specific properties that can be used for identification. The properties that can be used for testing minerals include luster, hardness, cleavage, streak, magnetism, fluorescence, and/or crystal shape. The emphasis is on learning how to identify the mineral by conducting tests (not through memorization). Common minerals (including those on Mohs' hardness scale) must be used in the identification process. A representative sample of minerals can be used so that different testing methods can be applied and demonstrated. Appropriate tools and safety procedures must be used to test mineral properties. Technology can provide identification information and research materials to assist in mineral investigations. Minerals present in rocks can help identify the rocks correctly. Minerals can indicate the type of environment in which the rock and/or minerals formed. Some minerals (e.g., halite, varieties of gypsum) form through evaporation and some (e.g., calcite) form through a variety of chemical processes. Other minerals (e.g., feldspar varieties, magnetite, varieties of quartz) form in an igneous environment and some minerals (e.g., epidote) form in a metamorphic environment.

	Future Application of Concepts Grades 7-8: Biogeochemical cycles, igneous environments, and the history of Earth (including the changing environments) from the interpretation of the rock record are studied. High School: The formation of elements, chemical bonding, and crystal structure are found in the Physical Sciences. In grades 11-12 Physical Geology, mineralogy is explored at depth.
Content Vocabulary • chemical composition • cleavage • crystal shape • evaporation • fluorescence • hardness • inorganic • luster • magnetism • Mohs' hardness scale • properties • streak	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/	**Enrichment Strategies** • Games • Flashcards

• District Approved Science Texts	• Graphic Organizers • Websites
Integrations • **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	**Intervention Strategies** • Games • Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Rocks, Minerals, and Soil***	**Pacing**
This topic focuses on the study of rocks, minerals, and soil, which make up the lithosphere. Classifying and identifying different types of rocks, minerals, and soil can decode the past environment in which they formed.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)
Content Statement ***2. Igneous, metamorphic, and sedimentary rocks have unique characteristics that can be used for identification and/or classification.*** Most rocks are composed of one or more minerals, but there are a few types of sedimentary rocks that contain organic material, such as coal. The composition of the rock, types of mineral present, mineral arrangement, and/or mineral shape and size can be used to identify the rock and to interpret its history of formation, breakdown (weathering), and transport (erosion). **Learning Targets:** • I can identify and classify rocks by investigation. • I can describe the environment in which a rock was formed.	**Content Elaborations** ***Prior Concepts Related to Rocks*** PreK-2: Objects have physical properties, properties of objects can change, and Earth's nonliving resources have specific properties. Grades 3-5: Rocks and soil have characteristics, soil contains pieces of rocks, rocks form in different ways, and objects are composed of matter and may exhibit electrical conductivity and magnetism. ***Grade 6 Concepts*** Rock identification and classification must be experiential and investigative. Common samples to use in identification should be representative of each type of rock. Igneous samples must include varieties of granite, rhyolite, basalt, obsidian, pumice, and andesite. Metamorphic samples must include varieties of schist, gneiss, slate, marble, anthracite, and phyllite. Sedimentary samples must include varieties of limestone, sandstone, shale, conglomerate, and breccia. Other rock samples such as bituminous coal, coquina, and chert must be included in identification investigations, but these may not always fall neatly into one specific rock category. Proper safety protocol and testing procedures must be used. It is important to use the identification of the minerals, mineral arrangement (within the rock), and quantifiable characteristics of the rock to identify the rock. Analysis of specific rock characteristics can be conducted in the classroom or in nature with rock samples. Technology can be used to research current identification methods and techniques and assist in methods of determining the quantifiable characteristics of specific rocks. The purpose of rock identification must be related to understanding the environment in which the rock formed.

	Future Application of Concepts Grades 7-8: Sedimentary, metamorphic, and igneous environments and the history of Earth (including the changing environments) from the interpretation of the rock record are studied. High School: The formation of elements, chemical bonding, and crystal structure are found in the Physical Sciences. In grades 11/12 Physical Geology, depositional environments, volcanics, characteristics of rocks, and mineralogy are explored in depth.
Content Vocabulary • composition • erosion • igneous • metamorphic • minerals • quantifiable characteristics • sedimentary • weathering	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos	**Enrichment Strategies** • Games

• PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	• Flashcards • Graphic Organizers • Websites
Integrations • **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	**Intervention Strategies** • Games • Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Rocks, Minerals, and Soil***	**Pacing**
This topic focuses on the study of rocks, minerals, and soil, which make up the lithosphere. Classifying and identifying different types of rocks, minerals, and soil can decode the past environment in which they formed.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)
Content Statement ***3. Igneous, metamorphic, and sedimentary rocks form in different ways.*** Magma or lava cools and crystallizes to form igneous rocks. Heat and pressure applied to existing rock forms metamorphic rocks. Sedimentary rock forms as existing rock weathers chemically and/or physically and the weathered material is compressed and then lithifies. Each rock type can provide information about the environment in which it was formed. **Learning Targets:** • I can illustrate the rock cycle. • I can use rock samples to identify Ohio's past environments.	**Content Elaborations** ***Prior Concepts Related to Rocks*** PreK-2: Objects have physical properties, properties of objects can change, and Earth's nonliving resources have specific properties. Grades 3-5: Rocks and soil have characteristics, soil contains pieces of rocks, and objects are composed of matter and may exhibit electrical conductivity and magnetism. ***Grade 6 Concepts*** Rocks and minerals in rocks form in specific types of environments. The rock cycle can be used for a general explanation of the conditions required for igneous, metamorphic, and sedimentary rocks to form, but additional information should be added for relevancy. For example, the typical pattern of coal formation is an important connection to energy in Ohio and should be included. Another example would be the formation of Ohio sandstone and limestone indicating that a shallow sea once covered Ohio. Ohio's geologic history and past environmental conditions play an important role in understanding the existing bedrock in Ohio. Conducting field investigations, taking field trips, geologic maps, virtual field trips, physical maps, and topographic maps can be used to illustrate how types of geologic structures and features help identify the types of rock that may be found in specific areas. This must be connected to an understanding about the environmental conditions that needed to exist during the formation. ***Future Application of Concepts*** Grades 7-8: Sedimentary, metamorphic, and igneous environments and the history of Earth (including the changing environments) from the interpretation of the rock record are studied. High School: The formation of elements, chemical bonding, and crystal

	structure are found in the Physical Sciences. In grades 11/12 Physical Geology, depositional environments, volcanics, characteristics of rocks, and mineralogy are explored in depth.
Content Vocabulary • compressed • crystalize • igneous • lava • lithifies • magma • metamorphic • sedimentary	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites

Integrations	Intervention Strategies
• **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	• Games • Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Rocks, Minerals, and Soil***	**Pacing**
This topic focuses on the study of rocks, minerals, and soil, which make up the lithosphere. Classifying and identifying different types of rocks, minerals, and soil can decode the past environment in which they formed.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)
Content Statement ***4. Soil is unconsolidated material that contains nutrient matter and weathered rock.*** Soil formation occurs at different rates and is based on environmental conditions, types of existing bedrock, and rates of weathering. Soil forms in layers known as horizons. Soil horizons can be distinguished from one another based on properties that can be measured. Note: The introduction to soil is found in grade 3. **Learning Targets:** • I can test properties (texture, color, composition, permeability, porosity) of soil. • I can compare and contrast uses (agriculture, brick making, creating a pond) of soils. • I can identify soil horizons based on differences in soil properties.	**Content Elaborations** ***Prior Concepts Related to Soil*** PreK-2: Objects have physical properties, properties of objects can change, and Earth's nonliving resources have specific properties. Grades 3-5: Rocks and soil have characteristics. Soil contains pieces of rocks. Soil investigations measure color, texture, ability for water to pass through soil, moisture content, and soil composition. Objects are composed of matter. ***Grade 6 Concepts*** Soil sampling and testing must be used to investigate soil. Soil forms at different rates and has different measurable properties, depending on the environmental conditions. Properties in soil that are useful in soil identification include texture, color, composition, permeability, and porosity. Uses of soil depend upon their properties. For example, some soils may be recommended for agriculture, while others may be used for brick making or creating a pond. Observing and identifying soil horizons are based upon understanding the different properties of soil and when the properties change. Soil sampling testing methods and equipment are included within this content statement. Soil maps (paper or digital) combined with geologic, aerial, or topographic maps can assist in local identification of soil formations. A connection must be made to environmental conditions, types of bedrock, and soil properties. Appropriate tools and safety procedures must be used in all soil investigations. Note: It is important to use the term "soil," not "dirt." Dirt and soil are not synonymous.

	Future Application of Concepts Grades 7-8: Biogeochemical cycles and the role of soil within them, soil erosion and runoff issues, hydrologic cycle including percolation and infiltration rates, and sedimentary environments are studied. High School: The formation of elements, the importance of soil in an ecosystem, and issues with soil degradation and soil loss are explored. In grades 11/12 Physical Geology, depositional environments, soil mechanics, issues with mass wasting including soil/sediment contamination issues, and the classification of soil is found.
Content Vocabulary • aerial map • bedrock soil • dirt • geologic map • nutrient matter • permeability • porosity • properties texture color composition • soil • soil core • soil horizons • soil map • topographic map • unconsolidated • weathered	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also “draw a conclusion”) • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners’ progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.

Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites
Integrations • **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	**Intervention Strategies** • Games • Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Rocks, Minerals, and Soil***	**Pacing**
This topic focuses on the study of rocks, minerals, and soil, which make up the lithosphere. Classifying and identifying different types of rocks, minerals, and soil can decode the past environment in which they formed.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)
Content Statement ***5. Rocks, minerals, and soils have common and practical uses.*** Nearly all manufactured material requires some kind of geologic resource. Most geologic resources are considered nonrenewable. Rocks, minerals, and soil are examples of geologic resources that are nonrenewable. Note: Nonrenewable energy sources should be included (such as fossil fuels). **Learning Targets:** • I can identify common and practical uses of rocks, minerals, and soils (construction, energy, transportation, agriculture, domestic use, technology).	**Content Elaborations** ***Prior Concepts Related to Uses of Rocks, Minerals, and Soil*** PreK-2: Objects have physical properties, properties of objects can change, and Earth's nonliving resources have specific properties. Grades 3-5: Rocks and soil have characteristics, Earth's resources can be used for energy, renewable and nonrenewable resources, some of Earth's resources are limited. ***Grade 6 Concepts*** Rocks, minerals, and soils have specific physical properties that determine how they can be used. The different methods of extracting the resources should be included. Uses of the resources should include construction (e.g., gypsum, metals, gravel, sand, lime, clay), energy (e.g., fossil fuels, radioactive materials), transportation (e.g., road salt, asphalt), agriculture (e.g., lime, peat, minerals for fertilizers, pesticides), domestic use (e.g., metals and gems for jewelry, clay for pottery or sculpting, natural dyes for clothing or paint), and technology (e.g., lithium, silica). The conservation of resources through the management of the resources, which includes extraction methods, use, storage, and disposal, is an important part of understanding the uses of rocks, minerals, and soil. ***Future Application of Concepts*** Grades 7-8: Biogeochemical cycles (including the hydrologic cycle) are related to erosion and weathering of rock, minerals, and soil. The history of Earth (including the formation of nonrenewable resources) from the interpretation of the rock record are studied. High School: The formation of elements, chemical bonding, and nuclear energy are found in the Physical Sciences. In grades 11/12 Physical Geology, Earth's resources, and specific laws pertaining to the resources

	are explored at a greater depth.
Content Vocabulary • geologic resources extracting	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites
Integrations • **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations,	**Intervention Strategies** • Games • Flashcards

procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	• Graphic Organizers • Websites

Grade Six Science

Topic ***Cellular to Multicellular***	**Pacing**
This topic focuses on the study of the basics of Modern Cell Theory. All organisms are composed of cells, which are the fundamental unit of life. Cells carry on the many processes that sustain life. All cells come from preexisting cells.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)

Content Statement	**Content Elaborations**
1. Cells are the fundamental unit of life. All living things are composed of cells. Different body tissues and organs are made of different kinds of cells. The ways cells function are similar in all living organisms. Note 1: Specific information about the organelles that need to be addressed at this grade level will be found in the model curriculum. Note 2: Emphasis should be placed on the function and coordination of these components, as well as on their roles in overall cell function. **Learning Targets:** • I can compare the cell structure of various organisms (single-cell vs. multicellular, plant vs. animal). • I can compare the cells of various tissues and organs. • I can use microscopes, micrographs, models, and illustrations to observe cell components (cell wall, cell membrane, nucleus, mitochondria, chloroplast, ribosome, plasma membrane, vacuole, lysosome). • I can describe the function and structure of organelles and their role in the cell's overall activity.	***Prior Concepts Related to Species and Reproduction*** PreK-2: Living things have specific traits and are made up of a variety of structures. Grades 3-5: Organisms are made of parts. ***Grade 6 Concepts*** The content statements for sixth-grade Life Science are each partial components of a large concept. The parts have been isolated to call attention to the depth of knowledge required to build to one of biology's foundational theories, Modern Cell Theory. It is recommended that the content statements be combined and taught as a whole. For example, the energy needs of cells can be interwoven with the function of mitochondria. Modern Cell Theory states that all living things are made of cells. Cells are the basic unit of structure and function of all living things. Many organisms are single-celled and that one cell must carry out all the basic functions of life. Other organisms are multicellular and the cells that form these organisms can be organized at various levels to carry out all the basic functions of life. Different body tissues and organs can be made up of different kinds of cells. The cells in similar tissues and organs in animals are similar. The tissues and organs found in plants differ slightly from similar tissues in animals. Use Modern Cell theory to exemplify how scientific theories are developed over time. Microscopes, micrographs, safety procedures, models, and illustrations must be used to observe cells from many different types of organisms. Representative cells from eubacteria (cynaobacteria), protista (algae, amoeba, diatoms, euglena, volvox), and fungi (common mushrooms, bread molds) must

	be observed for cell structures such as the cell wall, cell membrane, and nucleus. Plantae cells (mosses, ferns, and angiosperms) must be observed for the following cell components: nucleus, mitochondria, chloroplast, ribosome, plasma membrane, vacuole, and lysosome. Mitochondria and ribosomes are not visible under regular light microscopes but may be viewed using micrographs or illustrations. The differences in sizes and shapes of various cells and organelles must be noted. Size is a useful tool in identification of cells. The relationship between structure and function is a crosscutting theme for science and should be explored when investigating the structure and function of cellular organelles. Emphasis must be placed on the function and coordination of these components, as well as on the overall cell function, before introducing and reinforcing the names of these components (e.g., plant and algae cells contain plastids where the manufacture and storage of chemical compounds important to the cell occur). The most commonly described plastids are chloroplasts in green plant cells. Microscopes must be used to view a variety of cells (see above), tissues (xylem, phloem, connective, muscle, nervous), and organs (leaf, stem, flower, spore, ganglia, blood vessels, eyes) to compare and contrast their similarities and differences. Real-world applications, new technology, and contemporary science must be used in this content (e.g., the presence of microbes in potable water can be a way to connect the solutions to real-world problems and biology). ***Future Application of Concepts*** High School: Details of cellular processes such as photosynthesis, chemosynthesis, cellular respiration, cell division, and differentiation are studied. Cellular organelles studied are cytoskeleton, Golgi complex, and endoplasmic reticulum.
Content Vocabulary • blood vessels • cell membrane • cell wall • chloroplast • connective • eubacteria	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also “draw a conclusion”) • constant

• eyes • flower • fungi • ganglia • leaf • lysosome • microbes • micrographs • mitochondria • modern cell theory • multicellular • muscle • nervous • nucleus • organelles • organs • phloem • plantae cells • plasma membrane • plastids • potable water • single-celled • spore • stem • tissues • vacuole • xylem	• control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites

Integrations	Intervention Strategies
• **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	• Games • Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Cellular to Multicellular***	**Pacing**
This topic focuses on the study of the basics of Modern Cell Theory. All organisms are composed of cells, which are the fundamental unit of life. Cells carry on the many processes that sustain life. All cells come from preexisting cells.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)

Content Statement

2. All cells come from preexisting cells.

Cells repeatedly divide resulting in more cells and growth and repair in multicellular organisms.

Note: This is not a detailed discussion of the phases of mitosis or meiosis. The focus should be on reproduction as a means of transmitting genetic information from one generation to the next, cellular growth and repair.

Learning Targets:

- I can explain that cells come from existing cells (mitosis: body cells; meiosis: reproductive cells).
- I can state the purpose of cell multiplication in single-celled organisms (making a new organism) and multicellular organisms (for growth and repair).
- I can explain that all cells contain genetic material (chromosomes) that are passed on to the next generation through reproduction.
- I can observe cells dividing (microscopes, micrographs, models, illustrations).

Content Elaborations

Prior Concepts Related to Species and Reproduction

PreK-2: Living things are made up of a variety of structures.

Grades 3-5: Individual organisms inherit many traits from their parents indicating a reliable way to transfer information from one generation to the next.

Grade 6 Concepts

The content statements for sixth-grade life science are each partial components of a larger concept. The parts have been isolated to call attention to the depth of knowledge required to build to one of biology's important foundational theories: Modern Cell Theory. It is recommended that the content statements be combined and taught as a whole.

Modern Cell Theory states that all living things come from preexisting cells. Individual organisms do not live forever; therefore, reproduction is necessary for the continuation of every species. Traits are passed onto the next generation through reproduction. In single-celled organisms, the process of binary fission produces a new organism. In multicellular organisms, cells multiply for growth and repair.

In this grade, mitosis is explored. All cells contain genetic materials. The genetic material must be described as chromosomes. The chemicals and chemical processes associated with the genetic material are reserved for high school biology. Chromosomes must be described as structures in cells that contain the genetic material. Microscopes, micrographs, models, and illustrations can be used to observe cells from different organisms in the process of dividing. It is not appropriate to learn the names of the stages of mitosis. The focus is on observing cells dividing as evidence that cells come

	from preexisting cells and genetic material is transmitted from parent cell to daughter cells. The misconception of spontaneous generation can be included in discussions on this topic. The experiments of Redi and Pasteur can be used to explain how evidence can lead to new knowledge, better explanations, and spur new technology. ***Future Application of Concepts*** Grade 8: More details about asexual and sexual reproduction will be studied.
Content Vocabulary • binary fission • cellular growth • chromosomes • generation • genetic information • genetic material • meiosis • mitosis • multicellular organisms • reproduction • single-celled organisms • spontaneous • traits	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.

Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites
Integrations • **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	**Intervention Strategies** • Games • Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Cellular to Multicellular***	**Pacing**
This topic focuses on the study of the basics of Modern Cell Theory. All organisms are composed of cells, which are the fundamental unit of life. Cells carry on the many processes that sustain life. All cells come from preexisting cells.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)
Content Statement	**Content Elaborations**
3. Cells carry on specific functions that sustain life. Many basic functions of organisms occur in cells. Cells take in nutrients and energy to perform work, like making various molecules required by that cell or an organism. Every cell is covered by a membrane that controls what can enter and leave the cell. Within the cell are specialized parts for the transport of materials, energy capture and release, protein building, waste disposal, information feedback, and movement. Note: Emphasis should be placed on the function and coordination of cell components, as well as on their roles in overall cell function. **Learning Targets:** • I can describe the function of cell components/organelles. • I can explain the role of cells in tissues, organs, and organ systems.	***Prior Concepts Related to Organisms and Reproduction*** PreK-2: Living things have specific traits. Living things require energy, water, and a particular temperature range. Grades 3-5: Organisms are made of parts. ***Grade 6 Concepts*** The content statements for sixth-grade life science are each partial components of a larger concept. The parts have been isolated to call attention to the depth of knowledge required to build to one of biology's important foundational theories: Modern Cell Theory. In classrooms, it is recommended that the content statements be combined and taught as a whole (e.g., the energy requirements of cells can be interwoven with the function of mitochondria). Cells have particular structures that are related to their functions. These functions are regulated and controlled (e.g., a cell membrane controls what can enter and leave the cell). The organization of living systems includes explanation of the role of cells, tissues, organs, and organ systems that carry out life functions for organisms. These roles include maintaining homeostasis, gas exchange, energy transfers and transformation, transportation of molecules, disposal of wastes, and synthesis of new molecules. Connections are to be made between cellular organelles and processes. Explore (3-D or virtually) conditions that optimize and/or minimize cellular function in a cell or an organism. Technology also can be used to run simulations to investigate specific outcomes and develop predictions about changes in functions.

	Future Application of Concepts Grade 7-8: Photosynthesis and respiration are compared. High School: Details of cellular processes are studied. Molecules enter and leave the cell by the mechanisms of diffusion, osmosis, and active transport.
Content Vocabulary • energy transfers • energy transformation • gas exchange • homoeostasis • organ systems • organs • synthesis of new molecules • tissues • transportation of molecules	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites

Integrations	Intervention Strategies
• **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	• Games • Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Cellular to Multicellular***	**Pacing**
This topic focuses on the study of the basics of Modern Cell Theory. All organisms are composed of cells, which are the fundamental unit of life. Cells carry on the many processes that sustain life. All cells come from preexisting cells.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)
Content Statement	**Content Elaborations**
4. Living systems at all levels of organization demonstrate the complementary nature of structure and function. The level of organization within organisms includes cells, tissues, organs, organ systems, and whole organisms. Whether the organism is single-celled or multicellular, all of its parts function as a whole to perform the tasks necessary for the survival of the organism. Organisms have diverse body plans, symmetry, and internal structures that contribute to their being able to survive in their environments. **Learning Targets:** • I can explain the role of cells, tissues, organs, and organ systems. • I can compare tissues, organs, cell structures, systems, and symmetry for a variety of plants and animals. • I can categorize organisms by body plans, symmetry, internal structures, and processes.	***Prior Concepts Related to Organisms and Reproduction*** PreK-2: Living things have specific traits. Living things require energy, water, and a particular temperature range. Grades 3-5: Organisms are made of parts. ***Grade 6 Concepts*** The content statements for sixth-grade life science are each partial components of a larger concept. The parts have been isolated to call attention to the depth of knowledge required to build to one of biology's important foundational theories: Modern Cell Theory. It is recommended that the content statements be combined and taught as a whole (e.g., levels of organization can be interwoven with the concept of cells as the fundamental unit of life). Cells perform specialized functions in multicellular organisms. Groups of specialized cells form a tissue such as muscle. Different tissues are, in turn, grouped together to form larger functional units called organs. Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole. Organisms have diverse body plans, symmetry, and internal structures. General distinctions among organisms (e.g., body plans, symmetry, internal structures) that support classifying them into a scientifically based system (a distinction of this grade level from Pre-K to 5) are explored. Organisms sorted into groups share similarities in external structures, internal structures, and processes.

	The commonality of life can be investigated through observing tissues, organs, cell structures (see limits in previous content statements), systems, and symmetry (an approximate balanced distribution of duplicate body parts) for plants and animals. Part of the exploration of the commonality of living systems can include comparison of cells, types of tissues, organs, and organ systems between organisms (see other grade 6 content statements for details). Inquiry and mathematical relationships should be drawn between cell size and the cell's ability to transport necessary materials into its interior. This link is critical for laying the foundation for the cell cycle in grade 8. ***Future Application of Concepts*** Grade 8: Cellular reproduction is studied. High School: The unity and diversity of life and the evolutionary mechanisms that contribute to the organization of living things are studied.
Content Vocabulary • cells • diverse body plans • external structures • internal structures • multicellular • organ system • organs • single-celled • specialized functions • symmetry • tissues	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize

	• table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites
Integrations • **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	**Intervention Strategies** • Games • Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Matter and Motion***	**Pacing**
This topic focuses on the study of foundational concepts of the particulate nature of matter, linear motion, and kinetic and potential energy.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)

Content Statement

1. All matter is made up of small particles called atoms.

Each atom takes up space, has mass, and is in constant motion. Mass is the amount of matter in an object.

Elements are a class of substances composed of a single kind of atom

Molecules are the combination of two or more atoms that are joined together chemically.

Compounds are composed of two or more different elements. Each element and compound has properties, which are independent of the amount of the sample.

Note: What is the difference between a compound and a molecule?

A molecule is formed when two or more atoms join together chemically. A compound is a molecule that contains at least two different elements. All compounds are molecules but not all molecules are compounds

Molecular hydrogen (H_2), molecular oxygen (O_2), and molecular nitrogen (N_2) are not compounds because each is composed of a single element. Water (H_2O), carbon dioxide (CO_2), and methane (CH_4) are compounds because each is made from more than one element. The smallest bit of each of these substances would be referred to as a molecule. For example, a single molecule of molecular hydrogen is made from two atoms of hydrogen while a single molecule of water is made from two atoms of hydrogen and one atom of oxygen.

Learning Targets:

- I can explain the relationship between mass, volume, and density.
- I can calculate the density of various substances.

Content Elaborations

Prior Concepts Related to Matter

PreK-2: Properties are descriptions that can be observed using the senses. Materials can be sorted according to their properties. Changes in materials are investigated.

Grades 3-5: Objects are composed of matter, which has mass* and takes up space. Matter includes solids, liquids, and gases (air). Volume is the amount of space an object takes up. The total amount of matter and mass remains the same when it undergoes a change.

Grade 6 Concepts

All matter is made of atoms, which are particles that are too small to be seen, even with a light microscope. There is empty space between the atoms that make up a substance. An element is a chemical substance that cannot be broken down into simpler substances.

There are approximately 90 different naturally occurring elements that have been identified. There are additional elements that were made in a laboratory, but these elements are not stable. All atoms of any one element are alike but are different from atoms of other elements.

All substances are composed of one or more elements. Compounds are composed of elements joined together chemically. Each compound has its own unique, unchanging composition of type and number of elements and atoms. Both elements and compounds can form molecules (e.g., elemental hydrogen is made up of molecules containing two atoms of hydrogen joined together chemically, water is a compound made up of molecules containing two atoms of hydrogen joined with one atom of oxygen). In addition to molecules, atoms may join together in large three-dimensional networks (addressed further in high school). All particles of a pure substance have nearly identical mass. Particles of different substances usually have different

	masses, depending upon their atomic composition. Computer simulations can be used to visualize this abstract material. Matter has properties of mass and volume. Mass measures the amount of matter in an object (e.g., a wood block) or substance (e.g., water), and volume measures the three-dimensional space that matter occupies. Equal volumes of different substances usually have different masses. Some materials, like lead or gold, have a lot of mass in a relatively small space. Other materials, like Styrofoam® and air, have a small mass in a relatively large amount of space. This concept of comparing substances by the amount of mass the substance has in a given volume is known as density. While the mass and volume of a material can change depending upon how much of the material there is, the density generally remains constant no matter how much of the material is present. Therefore, density can be used to identify a material. The density of any object (e.g., a wood block) or substance (e.g., water) can be calculated from measurements by dividing the mass by the volume. Mass vs. volume graphs can be constructed and interpreted (e.g., to determine which material has the greater density). Note 1: Appropriate background knowledge such as graphics representing the atomic composition of the substances involved or descriptions of how the matter can be formed, decomposed, or separated should accompany questions asking to classify matter as an element, compound, or mixture. The nature of chemical bonding is not appropriate at this grade. Note 2: Constructing and analyzing mass vs. volume graphs aligns with fifth-grade common core mathematics standards (Geometry 1 and 2). The volume of solids can be determined by water displacement or calculated from the dimensions of a regular solid (grade 5 Common Core Mathematics Standards, Measurement, and Data 5). Note 3: The structure of the atom, including protons, neutrons, and electrons, is addressed in the high school physical science syllabus. ***Future Application of Concepts*** Grade 7-8: Differences between pure substances and mixtures and acids and bases are explored. Elements in the periodic table can be classified as a

	metal, nonmetal, or nonreactive gas based on their properties and position on the periodic table. Atoms can be joined together to form separate molecules or large three-dimensional networks. Changes are classified into two groups, chemical or physical, depending upon whether the atomic composition of the materials changes. High School: Protons, neutrons, and electrons make up atoms. The relationship between atomic structure and the periodic table is explored. The nature of ionic, covalent, and metallic bonding is also studied. *While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.
Content Vocabulary • atom • composition atomic • compounds • density • elements • mass • matter • molecules • volume	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test

Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites
Integrations • **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	**Intervention Strategies** • Games • Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Matter and Motion***	**Pacing**
This topic focuses on the study of foundational concepts of the particulate nature of matter, linear motion, and kinetic and potential energy.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)

Content Statement

2. Changes of state are explained by a model of matter composed of atoms and/or molecules that are in motion.

When substances undergo changes of state, neither atoms nor molecules themselves are changed in structure.

Thermal energy is a measure of the motion of the atoms and molecules in a substance.

Mass is conserved when substances undergo changes of state.

Note: Thermal energy can be connected to kinetic energy at this grade level.

Learning Targets:

- I can explain the relationship between thermal and kinetic energy.
- I can model the arrangement of particles in solids, liquids, and gases.
- I can explain that the mass of a substance stays the same when it undergoes a change in state.
- I can explain that particles must collide in order to form new substances.

Content Elaborations

Prior Concepts Related to States of Matter

PreK-2: Properties can be observed and used to sort materials. Changes in materials are investigated, including solid-liquid phase changes.

Grades 3-5: Matter has mass* and volume. Properties of solids, liquids, and gases and phase changes are reversible and do not change the identity of the material. The total amount of matter remains the same when it undergoes a change. Mass* stays constant during phase changes.

Grade 6 Concepts

Thermal energy is the total amount of kinetic energy present in a substance (the random motion of its atoms and molecules). When thermal energy increases, the total kinetic energy of the particles in the system increases. The thermal energy of a substance depends upon the mass of the substance, the nature of the material making up the substance, and the average kinetic energy of the particles of the substance. Thermal energy cannot be directly measured; however, changes in thermal energy can be inferred based on changes in temperature. The higher the temperature of a particular substance, the greater the average kinetic energy and motion of the particles. Thermal energy depends on the amount of the substance, whereas temperature does not depend on the amount of the substance.

Solids, liquids, and gases vary in the motion of and the spacing and attractions between particles. Solid particles are close together and held more rigidly in a space by the attractions between the particles. However, solid particles can still vibrate back and forth within this space. Liquid particles may be slightly farther apart but move with more speed than solid particles. In liquids, particles can move from one side of the sample to another. Gas particles are much farther apart and move with greater speed than liquid or solid particles. Because of the larger spaces between the particles, gases are easily compressed into smaller volumes by pushing the particles closer together.

	Most substances can exist as a solid, liquid, or gas depending on temperature. Generally, for a specific temperature, materials that exist as solids have the greatest attraction between the particles. Substances that exist as gases generally have the weakest attraction between the particles. During phase changes, the mass of the substance remains constant because the particles (atoms and molecules) are not created or destroyed. There is simply a change in the motion of and spacing between the particles. Experiments and investigations (3-D and virtual) must be used to demonstrate phase changes. For substances to rearrange and form new substances, often the particles of the substances must first collide. The higher the temperature, the greater the average motion and the more likely the particles are to collide and rearrange to form new substances. In a solid, particles are rigidly held in fixed position. When the solid dissolves in water, the particles of the solid separate and move freely with the water particles. Therefore, particles in the dissolved state are more likely to collide with other particles and rearrange to form a new substance than they are as a solid. Since moving atoms and molecules cannot be observed directly, provide the opportunity to experiment with temperature, phase changes, and particle motion using virtual labs. Note 1: Purdue University provides a table that can help in differentiating the properties of solids, gases, and liquids. ***Future Application of Concepts*** Grade 7-8: Acids, bases, mixtures, and pure substances are investigated. Elements are classified as metals, nonmetals, or nonreactive gases based on their properties and position on the periodic table. Atoms can be joined together into separate molecules or large three-dimensional networks. Changes are classified as chemical or physical, depending upon whether the atomic composition of the materials changes. *While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and

	weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.
Content Vocabulary • collide • fixed position • gases • infer • kinetic energy • liquids • solids • temperature • thermal energy	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites
Integrations • **ELA**: Nonfiction texts and literature. Students should write about what	**Intervention Strategies** • Games

they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	• Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Matter and Motion***	**Pacing**
This topic focuses on the study of foundational concepts of the particulate nature of matter, linear motion, and kinetic and potential energy.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)
Content Statement ***3. There are two categories of energy: kinetic and potential.*** Objects and substances in motion have kinetic energy. Objects and substances can have energy as a result of their position (potential energy). Note: Kinetic and potential energy should be introduced at the macroscopic level for this grade. Chemical and elastic potential energy should not be included at this grade; this is found in PS grade 8. **Learning Targets:** • I can explain the difference between potential and kinetic energy. • I can explain that all forms of energy (e.g., electrical, sound) can be classified as either kinetic or potential.	**Content Elaborations** ***Prior Concepts Related to Energy*** PreK-2: A variety of sounds and motions are experienced. The sun is the principal source of energy (ESS). Plants get energy from sunlight (LS). Grades 3-5: Objects with energy have the ability to cause change. Heat, electrical energy, light, sound, and magnetic energy are forms of energy. Earth's renewable and nonrenewable resources can be used for energy (ESS). All processes that take place within organisms require energy (LS). ***Grade 6 Concepts*** There are many forms of energy, but all can be put into two categories: kinetic and potential. Kinetic energy is associated with the motion of an object. The kinetic energy of an object changes when its speed changes. Potential energy is the energy of position between two interacting objects. Gravitational potential energy is associated with the height of an object above a reference position. The gravitational potential energy of an object changes as its height above the reference changes. Electrical energy is associated with the movement of electricity through the wires of an electrical device. Thermal energy refers to the total amount of kinetic energy a substance has because of the random motion of its atoms and molecules. Sound energy is associated with the back and forth movement of the particles of the medium through which it travels. Provide opportunities to explore many types of energy. Virtual experiments that automatically quantify energy can be helpful since using measurements to calculate energy is above grade level. Note: Using the word "stored" to define potential energy is misleading. The word "stored" implies that the energy is kept by the object and not given away to another object. Therefore, kinetic energy also can be classified as "stored" energy. A rocket moving at constant speed through empty space has kinetic energy and is not transferring any of this energy to another object.

	Future Application of Concepts Grade 7-8: Conservation of energy and methods of energy transfer, including waves, are introduced. Chemical and elastic potential energy is explored. High School: Standard formulas are used to calculate energy for different objects and systems.
Content Vocabulary • electrical energy • gravitational energy • kinetic energy • potential energy • sound energy • stored energy (misleading) • thermal energy	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites

Integrations	Intervention Strategies
• **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	• Games • Flashcards • Graphic Organizers • Websites

Grade Six Science

Topic ***Matter and Motion***	**Pacing**
This topic focuses on the study of foundational concepts of the particulate nature of matter, linear motion, and kinetic and potential energy.	5-7 days (Suggested pacing. This will be refined after the 2012-2013 school year.)
Content Statement	**Content Elaborations**
4. An object's motion can be described by its speed and the direction in which it is moving. An object's position and speed can be measured and graphed as a function of time. Note 1: This begins to quantify student observations using appropriate mathematical skills. Note 2: Velocity and acceleration rates should not be included at this grade level; these terms are introduced in high school. **Learning Targets:** • I can conduct experiments to determine how the position of an object changes over time. • I can create and interpret graphs to describe the motion of an object.	***Prior Concepts Related to Uses of Forces and Motion*** PreK-2: Sound is produced from vibrating motions. Motion is a change in an object's position with respect to another object. Forces are pushes and pulls that are necessary to change the motion of an object. Greater changes of motion for an object require larger forces. Grades 3-5: The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted. The speed of an object can be calculated from the distance traveled in a period of time. ***Grade 6 Concepts*** When speed is calculated from a distance measurement, the distance is always measured from some reference point. To describe more thoroughly the motion of an object, the direction of motion can be indicated along with the speed. Experiments (inside and outside of the classroom) and creating/interpreting graphs must be used to investigate motion. Plotting position (vertically) and time (horizontally) can be used to compare and analyze motion. No motion is represented by a horizontal line. Fast motion is represented by steep lines and slow motion is represented by lines that are more gradual. The relative speeds and positions of different objects can be determined from comparing their position vs. time graphs. Position vs. time graphs should not be rules to memorize, but interpretations based on data-driven graphs. Motion detectors can be used to compare the resulting graphs from different types of motion. Plotting the speed (vertical axis) and time (horizontal axis) allows for comparison and analysis of speed. One can determine the speed of an object at any given time or determine the time at which an object has a particular speed from reading a speed vs. time graph. No motion would be shown with a straight horizontal line on the horizontal axis. Constant speed would be

	represented with a straight line above or below the horizontal axis. The faster the motion, the farther away the line will be from the horizontal axis. Speeding up would be represented with a line moving away from the horizontal axis. Slowing down would be represented with a line moving toward the horizontal axis. Speed vs. time graphs should not be rules to memorize but interpretations based on data-driven graphs. If a force on an object acts toward a single center, the object's path may curve into an orbit around the center. A sponge attached to the end of a string will travel in a circular path when whirled. The string continually pulls the sponge toward the center, resulting in circular motion. Note 1: This content is a precursor to the introduction of vectors. Using the word "vector" and exploring other aspects of vectors are not appropriate at this grade. Note 2: Constructing and analyzing motion graphs aligns with fifth-grade common core mathematics standards (Geometry 1 and 2) At this grade, interpretations of position vs. time graphs should be limited to comparing lines with different slopes to indicate whether objects are moving relatively fast, relatively slow, or not moving at all. More complex interpretations of position vs. time graphs will be made at higher grade levels. At this grade, interpretations of speed vs. time graphs should be limited to differentiating between standing still, moving at a constant relatively fast speed, moving at a constant relatively slow speed, speeding up, and slowing down. More complex interpretations of speed vs. time graphs will be made at higher grade levels. ***Future Application of Concepts*** Grade 7-8: The concept of fields is introduced to describe forces at a distance. The concept of force is expanded to include magnitude and direction. High School: Acceleration is introduced. Complex problems involving motion in two-dimensions and free fall will be solved. Complex position vs. time graphs, velocity vs. time graphs, and acceleration vs. time graphs will be analyzed conceptually and mathematically with connections made to the laws of motion. *While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term

	"weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.
Content Vocabulary • constant speed • horizontal axis • motion • relative speed • speed • vertical axis	**Academic Vocabulary** Language to be used in class; not for assessments like spelling or vocabulary. • analyze • chart • compare • conclusion (also "draw a conclusion") • constant • control • graph • hypothesize • infer • label • measure • observe • predict • procedure • reaction • relationship • results • summarize • table • test
Formative Assessments • Formative assessments should help the teacher and students better understand the learners' progress towards mastery.	**Summative Assessments** • Assessments should reflect the learning targets found in the Content Statement section.
Resources • Gizmos • PhET Simulations at http://phet.colorado.edu/ • District Approved Science Texts	**Enrichment Strategies** • Games • Flashcards • Graphic Organizers • Websites

Integrations	Intervention Strategies
• **ELA**: Nonfiction texts and literature. Students should write about what they are learning in science class (i.e., predictions, observations, procedures, conclusions). • **Math**: Measuring and graphing. Number sense. • **Social Studies**:	• Games • Flashcards • Graphic Organizers • Websites