

**Township of Union Public Schools
Administration Building**

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: Grade 5 Science

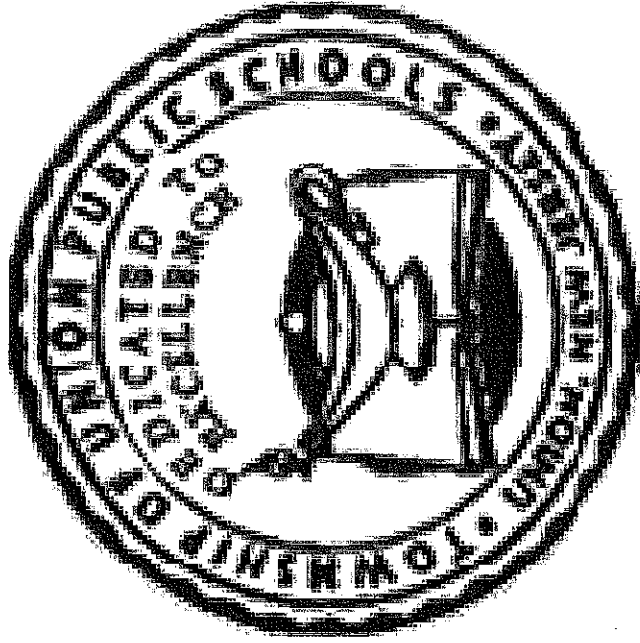
Department/Grade: Science, Grade 5

Supervisor: Deborah Ford

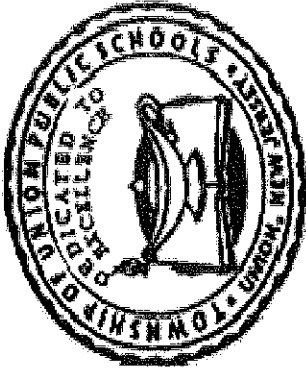
Submission Date: 6/30/14

Board Approval Date: _____

TOWNSHIP OF UNION PUBLIC SCHOOLS



**Grade 5 Science
Curriculum Guide
2014 – 2015**



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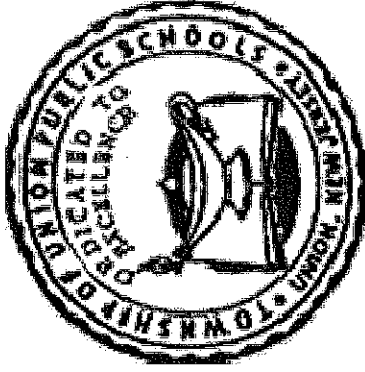
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TOWNSHIP OF UNION PUBLIC SCHOOLS

Administration

- Acting District Superintendent Mr. Gregory Tatum**
- Assistant Superintendent Dr. Noreen Lishak**
- Director of Student Information/Technology Ms. Ann M. Hart**

DEPARTMENT SUPERVISORS

Nicole Ahern School Counseling
Jason Killian Special Services: PreK - 8
Joseph Seugling Special Services: 9 - 12
Donna Wozniak Special Services: PreK - 8

10-Month

Maureen Corbett English: PreK - 2, Social Studies: PreK - 2
Deborah Ford Mathematics: 3 - 5, Science: 3 - 5
Libby Galante Social Studies: 6 - 12, Business
Robert Ghiretti English: 3 - 5, Social Studies: 3 - 5
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Yvonne Lorenzo Career Ed, World Lang., ESL, Computers, G&T
Mary Malyska English: 6-12, Library/Media
Theresa Matthews Mathematics: PreK - 2, Science: PreK - 2
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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 fifth grade science standards stress the importance of using information, analyzing data, and validating experimental results. Defining variables in experimentation is emphasized, and making simple predictions from picture, bar, and line graphs is underscored. Questioning and hypothesizing become more detailed at this level.

The curriculum is integrated to include *Life Science, Physical Science, Astronomy & Space and Environmental Studies, Through* the use of hands-on investigations and cooperative learning structures, the fifth grade students will explore the following content topics that are aligned with the *2009 New Jersey Core Curriculum Science Standards and the 2011 Elementary Grades Science Practices (5.1) Clarifications*.

- Cells
- Human body systems
- Classification of living things
- Forces and Motion
- Energy transformations (Heat, sound and electricity)
- Astronomy and Space
- Biomes
- Protecting Ecosystems

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 Textbooks

HMH Science Fusion 2012

Curriculum Units

Unit 3: Cells to Body Systems

Unit 4, Lessons 1, 3, 5: Living Things Grow and Reproduce

Unit 6: Energy and Ecosystems

Unit 7: Natural Resources

Unit 8: Changes to Earth's Surface

Unit 11, Lesson 4: Earth's Oceans

Unit 12, Lesson 3: The Solar System and the Universe

Unit 15, Lesson 4: Forces and Motion

Unit 1, Lesson 3: How Scientists Work

Pacing Guide- Course

<u>Content</u>	<u>Number of Days</u>
<u>Unit 3:</u> Cells to Body Systems	September-October
<u>Unit 4, Lessons 1, 3, 5:</u> Living Things Grow and Reproduce	November
<u>Unit 6:</u> Energy and Ecosystems	December-January
<u>Unit 7:</u> Natural Resources	February-March
<u>Unit 8:</u> Changes to Earth's Surface	April-May
<u>Unit 11, Lesson 4:</u> Earth's Oceans	May
<u>Unit 12, Lesson 3:</u> The Solar System and the Universe	June
<u>Unit 15, Lesson 4:</u> Forces and Motion	June
<u>Unit 1, Lesson 3:</u> How Scientists Work	June

*Allow 3 days for review and administration of common assessment

Science Practices:
Unit 3 Cells to Body Systems

Essential Questions	Instructional Objectives/ Skills and Benchmarks (CPIs)	Activities	Assessments
What are Cells?	<ul style="list-style-type: none"> • Describe how cells are the basic unit of structure and function in living things • Identify the parts of plant and animal cells • Explain the cell theory 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. • Create animal and plant cell models/pictures. Label all parts and emphasize the differences. • Implement Unit 3 Lesson 1 Digital Lesson 	<ul style="list-style-type: none"> • Brain check (p.117-120) • Unit 3 Lesson 1 Quiz (Assessment Book) • Unit 3 Online Unit Self Quiz • Exam Pro Test Maker • Unit 3 Review (p.169-172)
How can we observe cells?	<ul style="list-style-type: none"> • Use a microscope to observe cell structures of different kinds of cells 	<ul style="list-style-type: none"> • Use p.14 on Flipchart to complete experiment p.123-124 • Complete Virtual Laboratory 	<ul style="list-style-type: none"> • Unit 3 Lesson 2 Quiz (Assessment Book) • Unit 3 Online Unit Self Quiz

			<ul style="list-style-type: none"> • Exam Pro Test Maker • Unit 3 Review (p.169-172)
<p>How do cells work together?</p>	<ul style="list-style-type: none"> • Describe the relationship between organs, organ systems, and organisms • Describe nervous system structures and their functions • Explain how the parts of the integumentary system help it function 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. • Implement Unit 3 Lesson 3 Digital Lesson • Complete Taste Bud Experiment with pages 132 - 133 • Complete Fingerprinting Activity with class page 134 	<ul style="list-style-type: none"> • Brain check (p.137-138) • Unit 3 Lesson 3 Quiz (Assessment Book) • Unit 3 Online Unit Self Quiz • Exam Pro Test Maker • Unit 3 Review (p.169-172)

<p>How do our bodies move, breathe, and circulate blood?</p>	<ul style="list-style-type: none"> • Describe the structures of the skeletal system and their functions. • Explain how the muscular system functions. • Describe how the human body respire. • Describe how nutrients and oxygen are obtained and transported through the human body. 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. <ul style="list-style-type: none"> • Implement Unit 3 digital lesson 4 • Complete 3-d skeletal model activity with p. 140-141. • Complete bone/muscle song activity with p. 140-143. • Complete muscle demonstration workout activity with p. 142-143. • Complete smoker/non-smoker respiration activity with p. 144-145. • Complete pulse activity with p. 148-149. 	<ul style="list-style-type: none"> • Brain Check p. 151-152 • Unit 3 Lesson 4 quiz (assessment book) • Unit 3 online unit self-quiz • Exam pro test maker • Unit 3 review p. 169-172
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How do our bodies digest food, remove wastes, and send messages?

- Sequence the path of digestion in humans, and know the function of each organ involved with the process.
- Describe the role of the kidneys and bladder in the process of waste removal.
- Describe the function of the endocrine system and the role of hormones as chemical messengers.

- Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- Determine the main idea of a text and explain how it is supported by key details; summarize the text.
- Implement Unit 3 digital lesson 5
- Complete RDA food label activity with p. 156-157.
- Complete food guide plate project with p. 156-157.
- Complete writing connection activity with p. 160-161.

- Brain Check p. 163-164.
- Unit 3 Lesson 5 quiz (assessment book)
- Unit 3 online self-quiz
- Exam pro test maker
- Unit 3 review p. 169-172

<p>How does the body stay cool?</p>	<ul style="list-style-type: none"> • Demonstrate the effects of evaporative cooling on body temperature. • Identify a control group and explain why it is necessary in an experiment. • Explain the difference between personal interpretation and verified observation. 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. <ul style="list-style-type: none"> • Implement Unit 3 digital Lesson 6 • Utilize inquiry flipchart p. 18 with text pages 167-168. • Complete "easy" inquiry "evaporative cooling on skin" p. 168A with lesson. 	<ul style="list-style-type: none"> • Unit 3 Lesson 6 quiz (assessment book) • Unit 3 online self-quiz • Exam pro test maker • Unit 3 review p. 169-172
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Unit 4, Lessons 1,3,and 5 - Living Things Grow and Reproduce

Essential Questions	Instructional Objectives/ Skills and Benchmarks (CPIs)	Activities	Assessments
How are living things grouped?	<ul style="list-style-type: none"> • Identify characteristics used to classify a group of objects. • Describe the basic characteristics of the six kingdoms of organisms. • Describe how scientists classify living things. 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. • Implement Unit 4 digital lesson 1. • Complete shoe or bean classification activity with p. 176-177. • Assign animal classification poster project with p. 178- 	<ul style="list-style-type: none"> • Unit 4 Lesson 1 quiz (assessment book) • Brain check p. 187-188. • Unit 4 online self-quiz • Exam pro test maker • Unit 4 review p. 241-244.

<p>How do plants grow and reproduce?</p>	<ul style="list-style-type: none"> • Know the reproductive structures of some vascular plants. • Describe fertilization and seed development in plants. • Explain the life cycle of simple plants. 	<p>179.</p> <ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. • Implement Unit 4 digital lesson 3. • Complete red/blue food dye celery experiment to determine vascularity of plants with p. 192-193. • Complete lima bean in Ziploc bag p. 200-201. 	<ul style="list-style-type: none"> • Brain Check p. 203-204. • Unit 4 Lesson 3 quiz (assessment book) • Unit 4 online self-quiz • Exam pro test maker • Unit 4 review p.241-244.
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How do animals grow and reproduce?

- Describe how vertebrates and invertebrates are classified, and identify members of each group.
- Recognize that animal growth involves life cycles.
- Identify the stages of complete and incomplete metamorphosis.

- Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- Determine the main idea of a text and explain how it is supported by key details; summarize the text.
- Implement Unit 4 digital lesson 5.
- Complete 3-D model backbone activity found in inquiry flipchart p.24.
- Complete butterfly life cycle habitat project.
- Implement music connection "animals in a song" p. 222a

- Brain Check p.221-222.
- Unit 4 Lesson 3 quiz (assessment book)
- Unit 4 online self-quiz
- Exam pro test maker
- Unit 4 review p.241-244.

Unit 6 Energy and Ecosystems

Essential Questions	Instructional Objectives/ Skills and Benchmarks (CPIs)	Activities	Assessments
<p>What are roles of organisms in ecosystems?</p>	<ul style="list-style-type: none"> • Identify producers and consumers • Define and describe photosynthesis • Learn how organisms obtain nutrients 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. • Implement Unit 6 Lesson 1 Digital Lesson • True Colors Experiment (Flip Chart p.31) 	<ul style="list-style-type: none"> • Brain check (p.303-304) • Unit 6 Lesson 1 Quiz (Assessment Book) • Unit 6 Online Unit Self Quiz • Exam Pro Test Maker • Unit 6 Review (p.323-326)
<p>How does energy move through ecosystems?</p>	<ul style="list-style-type: none"> • Describe how energy moves through an ecosystem • Understand food chains and food webs 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key 	<ul style="list-style-type: none"> • Brain check (p.315-318) • Unit 6 Lesson 2 Quiz (Assessment Book) • Unit 6 Online Unit Self Quiz • Exam Pro Test Maker • Unit 6 Review (p.323-326)

Unit 7 Natural Resources

Essential Questions	Instructional Objectives/ Skills and Benchmarks (CPIs)	Activities	Assessments
How do people use resources?	<ul style="list-style-type: none"> • Explain what a resource is. • Identify some of the resources found in the United States. • Describe air, water, and land pollution. 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. • Implement Unit 7 Lesson 1 Digital Lesson • Catch That Dirt! Experiment (Flip Chart p.35) • Write a letter to your community's citizens about the importance of preventing pollution. Describe how the use of renewable and nonrenewable resources can lead to water, land, and air pollution. 	<ul style="list-style-type: none"> • Brain check (p.339-340) • Unit 7 Lesson 1 Quiz (Assessment Book) • Unit 7 Online Unit Self Quiz • Exam Pro Test Maker • Unit 7 Review (p.359-362)

<p>How do people conserve resources?</p>	<ul style="list-style-type: none"> • Understand conservation and its importance. • Identify ways in which people can contribute to conservation efforts. 	<p>Suggest steps to prevent pollution.</p> <ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. • Create a poster to show the public how they can conserve resources in their own homes and businesses. 	<ul style="list-style-type: none"> • Brain check (p.353-354) • Unit 7 Lesson 2 Quiz (Assessment Book) • Unit 7 Online Unit Self Quiz • Exam Pro Test Maker • Unit 7 Review (p.359-362)
<p>What career can I go into in the field of science?</p>	<ul style="list-style-type: none"> • Describe the role of scientists • Describe that scientists come from all backgrounds • Determine the role of technology in the work of scientists. 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is 	<ul style="list-style-type: none"> • Unit 7 Online Unit Self Quiz • Exam Pro Test Maker • Unit 7 Review (p.359-362)

		supported by key details; summarize the text. Pages 355-356.	
How can we conserve natural resources?	<ul style="list-style-type: none"> • Draw conclusions about how recycled paper can conserve resources. 	<ul style="list-style-type: none"> • Use p. 38 on Flipchart to complete experiment p.357-358 • Complete Virtual Laboratory 	<ul style="list-style-type: none"> • Unit 7 Lesson 3 Quiz (Assessment Book) • Unit 7 Online Unit Self Quiz • Exam Pro Test Maker • Unit 7 Review (p.359-362)

Unit 8 Changes to Earth's Surface

Essential Questions	Instructional Objectives/ Skills and Benchmarks (CPIs)	Activities	Assessments
How do weathering and erosion shape earth's surface?	<ul style="list-style-type: none"> • Explain what is weathering and how it can change rock. • Explain how erosion and deposition change Earth's surface. • Describe how landforms can change over time. • Contrast physical 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key 	<ul style="list-style-type: none"> • Brain check (p.379 -382) • Unit 8 Lesson 1 Quiz (Assessment Book) • Unit 8 Online Unit Self Quiz • Exam Pro Test Maker • Unit 8 Review (p.407 -

	<p>weathering and erosion</p>	<p>details; summarize the text.</p> <ul style="list-style-type: none"> • Implement Unit 8 Lesson 1 Digital Lesson • Complete Comparing rock sizing activity page 370 	<p>410)</p>
<p>How does water change earth's surface?</p>	<ul style="list-style-type: none"> • Compare the effect of water moving at different speeds. • Hypothesize about the causes and effects of water speed and slope in erosion. 	<ul style="list-style-type: none"> • Use Inquiry Flipchart page 41 to complete experiment on pages 385 and 386. • Complete Virtual Laboratory 	<ul style="list-style-type: none"> • Unit 8 Lesson 2 Quiz (Assessment Book) • Unit 8 Online Unit Self Quiz • Exam Pro Test Maker • Unit 8 Review (p.407 - 410)
<p>How do movements of the crust change earth?</p>	<ul style="list-style-type: none"> • Describe what is below Earth's surface. • Explain how the movement of Earth's crust can change Earth's surface. 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key 	<ul style="list-style-type: none"> • Brain check (p.401 - 402) • Unit 8 Lesson 3 Quiz (Assessment Book) • Unit 8 Online Unit Self Quiz • Exam Pro Test Maker • Unit 8 Review (p.407 -

<p>How do plates move?</p>	<ul style="list-style-type: none"> • Model the movement of plates • Recognize what happens to Earth's surface when plates move. 	<p>details; summarize the text.</p> <ul style="list-style-type: none"> • Implement Unit 8 Lesson 3 Digital Lesson • Create a scale model/picture of Earth's Interior. Label all parts and emphasize the differences. 	<p>410)</p>
		<ul style="list-style-type: none"> • Use Inquiry Flipchart page 43 to complete experiment on pages 405 and 406. • Complete Virtual Laboratory 	<ul style="list-style-type: none"> • Unit 8 Lesson 4 Quiz (Assessment Book) • Unit 8 Online Unit Self Quiz • Exam Pro Test Maker • Unit 8 Review (p.407 - 410)

Chapter 11, Lesson 4 - Earth's Ocean

Essential Questions	Instructional Objectives/ Skills and Benchmarks (CPIs)	Activities	Assessments
<p>What are some ocean ecosystems?</p>	<ul style="list-style-type: none"> • Recognize different ocean ecosystems. • Understand how the environment affects ocean ecosystems. 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. • Implement Unit 11 Lesson 4 Digital Lesson • Create/Draw an Ocean Ecosystem. 	<ul style="list-style-type: none"> • Brain check (p. 529 - 530) • Unit 11 Lesson 4 Quiz (Assessment Book) • Unit 11 Online Unit Self Quiz • Exam Pro Test Maker

Unit 12, Lesson 3 - The Solar System and the Universe

Essential Questions	Instructional Objectives/ Skills and Benchmarks (CPIs)	Activities	Assessments
<p>What are stars and galaxies?</p>	<ul style="list-style-type: none"> • Explain that stars are very large and appear small in the sky because they are far away. • Explain what galaxies are and how they are classified. • Describe the solar system's place in the Milky Way galaxy. 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. • Implement Unit 12 Lesson 3 Digital Lesson 	<ul style="list-style-type: none"> • Brain check (p. 569 - 570) • Unit 12 Lesson 3 Quiz (Assessment Book) • Unit 12 Online Unit Self Quiz • Exam Pro Test Maker

Unit 15, Lesson 4 Forces and Motion

Essential Questions	Instructional Objectives/ Skills and Benchmarks (CPIs)	Activities	Assessments
<p>What are Newton's laws?</p>	<ul style="list-style-type: none"> • Explain the laws of motion. • Describe inertia. • Relate motion in space to the lack of gravity in orbit around the Earth. 	<ul style="list-style-type: none"> • Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. • Determine the main idea of a text and explain how it is supported by key details; summarize the text. • Implement Unit 15 Lesson 4 Digital Lesson Forces of Loose Change Experiment (Flip Chart p.79) • Demonstrate Newton's ideas by having a student lie still on the floor and then perform a pushup. Explain why lying still represents inertia. • Draw/cut out a picture of a person kicking/throwing a ball. Label the picture 	<ul style="list-style-type: none"> • Brain check (p.733-734) • Unit 15 Lesson 4 Quiz (Assessment Book) • Exam Pro Test Maker

with one heavy arrow showing the direction of the balls motion. Add other arrows to show the opposite forces being applied by the foot/hand and by the ball.

Unit 1, Lesson 3 - How Do Scientist Work

<p>What are some types of investigations?</p>	<ul style="list-style-type: none">• Explain that there are many methods to investigate phenomena, and compare various forms of investigations.• Design controlled experiments and explain the importance of a control.• Demonstrate the ability to predict; hypothesize; identify and control variables; experiment; formulate and use models; and collect, record, and interpret data.	<ul style="list-style-type: none">• Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.• Determine the main idea of a text and explain how it is supported by key details; summarize the text.• Implement Unit 1 digital lesson 3.• Complete "think like a scientist" in inquiry flipchart p. 3-4.• Carry out the procedure identifying controls and variables with solvents p.30-33.• Complete "do the math" drawing double bar graphs p. 35	<ul style="list-style-type: none">• Brain check p. 37-38• Unit 1 Lesson 3 quiz (assessment book)• Unit 1 online self-quiz• Exam pro test maker• Unit 1 review p.57-60
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New Jersey Core Curriculum Content Standards Grade 5 Science

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 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 21st Century

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).

New Jersey Scoring Rubric

SCIENCE RUBRIC

Exceeds – must receive no more than one 3 and the rest 4s in the other areas of the rubric.
Meets – may receive no more than one 2 and a combination of 3s and 4s in the other areas of the rubric.
Approaches – may receive no more than one 1 and a combination of 2s, 3s, or 4s, in the other areas of the rubric.
Begins – must receive at least a 1 in all 3 areas of the rubric.

	<u>KNOWLEDGE</u>	<u>APPLICATION</u>	<u>COMMUNICATION</u>
4	<p>Knows and understands scientific terms, facts, concepts, principles, theories and methods</p> <ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are complete and correct. 	<p>Applies scientific knowledge, skills and methods to manipulate, analyze, synthesize, create and evaluate</p> <ul style="list-style-type: none"> • Applications are thorough, appropriate, and accurate. 	<p>Communicates scientific knowledge and applications through writing, speech, and visual displays.</p> <ul style="list-style-type: none"> • Written, oral and/or visual communication is well-organized and effective.
3	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are mostly complete and correct. 	<ul style="list-style-type: none"> • Applications are mostly thorough, appropriate, and accurate. 	<ul style="list-style-type: none"> • Most of the written, oral and/or visual communication is well-organized and effective.
2	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are somewhat complete and correct. 	<ul style="list-style-type: none"> • Applications are somewhat appropriate and accurate. 	<ul style="list-style-type: none"> • Some of the written, oral and/or visual communication is organized and effective.
1	<ul style="list-style-type: none"> • Descriptions of scientific terms, facts, concepts, principles, theories and methods are minimally present or correct. 	<ul style="list-style-type: none"> • Applications are minimally, appropriate and accurate. 	<ul style="list-style-type: none"> • Little of the written, oral and/or visual communication is organized and effective.
0	<ul style="list-style-type: none"> • All descriptions of scientific terms, facts, concepts, principles, theories and methods are missing and/or incorrect. 	<ul style="list-style-type: none"> • All applications are missing and/or incorrect. 	<ul style="list-style-type: none"> • All of the written, oral or visual communication is missing and/or lacks organization.
Score			