

Introduction to Indiana's Academic Standards for Science – 2010

Indiana's Academic Standards for Science were last revised in 2000. This new document, Indiana's Academic Standards for Science – 2010, reflects the ever-changing science content and the underlying premise that science education should be an inquiry-based, hands-on experience. These standards were adopted by the Indiana State Board of Education in April, 2010, and will be implemented in the 2011-12 school year.

Indiana's Academic Standards for Science – 2010 reflect a few significant changes that are worth noting. Primarily, there are fewer standards and each grade level focuses on the big ideas for each of these sub-disciplines: physical science; earth science; life science; and science, technology and engineering. The overarching organization of the standards has also changed; they are divided into two sections: Process Standards and Content Standards, which are described in greater detail below.

Process Standards

The Process Standards are the processes and skills that students are expected to learn and be able to do within the context of the science content. The separation of the Process Standards from the Content Standards is intentional; in doing so we want to make explicit the idea that what students are doing while they are learning science is extremely important. The Process Standards reflect the way in which students are learning and doing science and are designed to work in tandem with the science content, resulting in robust instructional practice.

The Process Standards are organized in the following grade bands: K-2, 3-5, 6-8. Within each grade band, the Process Standards address a particular topic or topics. Kindergarten introduces The Nature of Science, while grades 1 through 5, reflect two parts: The Nature of Science and The Design Process. In grades 6 through 8, Reading for Literacy in Science and Writing for Literacy in Science have been added to emphasize these processes in science. For high school, the Process Standards include Reading and Writing for Literacy in Science as well as The Nature of Science.

As noted in the previous paragraph, grades 6 through 8 and high school content courses will include Reading and Writing for Literacy in Science. It is important to note that these Process Standards emerged with the adoption of the Common Core State Standards in the area of Reading and Writing for Literacy in Science. The Literacy Standards establish that instruction in reading, writing, speaking, listening, and language is a shared responsibility. The Literacy Standards are predicated on teachers in the content areas using their unique disciplinary expertise to help students meet the particular challenges of reading, writing, speaking, listening, and language in their respective fields. It is important to note that the literacy standards are meant to complement rather than supplant content standards in the disciplines.

Part of the motivation behind the disciplinary approach to literacy promulgated by the Literacy Standards is extensive research establishing the need for college- and career-ready students to be proficient in reading complex informational text independently in a variety of content

areas. Most of the required reading in college and workforce training programs is informational in structure and challenging in content. Postsecondary education programs typically provide students with both a higher volume of such reading than is generally required in K-12 schools and comparatively little scaffolding.

The Literacy Standards make clear that significant reading of informational texts should also take place outside ELA classrooms in order for students to be ready for college and careers. Future assessments will apply the sum of all the reading students do in a grade, not just their reading in the ELA context. The Literacy Standards demand that a great deal of reading should occur in all disciplines.

The Literacy Standards also cultivate the development of three mutually reinforcing writing capacities: writing to persuade, to explain, and to convey real or imagined experience. College and career readiness requires that writing focus significantly on writing to argue and to inform or explain.

The Literacy Standards use grade level bands to present the standards. Teachers teaching at the beginning of the grade band may need to provide scaffolding for students to be successful, where teachers teaching at the end of the grade band should expect students to demonstrate the standards independently.

Content Standards

In grades 1 through 8, the Content Standards are organized in four distinct areas: 1) physical science; 2) earth science; 3) life science; and 4) science, technology and engineering. Kindergarten has only the first three areas: physical, earth and life science. In each of these areas there is at least one core standard, which serves as the big idea at that grade level for that content area. For the high school science courses, the content standards are organized around the core ideas in each particular course, which are represented by the core standard. The core standard is not meant to stand alone or be used as an individual standard, but instead is meant to help teachers organize their instruction around the “big ideas” in that content area and for grades K-8, at that particular grade level. Beneath each core standard are indicators which serve as the more detailed expectations within each of the content areas.

Finally, in the development of these revised science standards, careful attention was paid to how ideas are articulated across the grade levels so that content and skills that students will need to succeed in a particular sub-discipline are introduced in an appropriate manner in the early elementary grades and then progressed as students move towards high school.

Kindergarten

Students in kindergarten study the physical properties of objects, observe the patterns present in night and day and the seasons and examine characteristics of plants and animals. Within this study students employ the key principles of the nature of science and the design process.

Process Standards

The Nature of Science

Students gain scientific knowledge by observing the natural and constructed world, performing and evaluating investigations and communicating their findings. The following principles should guide student work and be integrated into the curriculum along with the content standards on a daily basis.

- Use a scientific notebook to record predictions, questions and observations about data with pictures, numbers or in words.
- Conduct investigations that may happen over time as a class, in small groups, or independently.
- Generate questions and make observations about natural processes.
- Make predictions based on observations.
- Discuss observations with peers and be able to support your conclusion with evidence.
- Make and use simple equipment and tools to gather data and extend the senses.
- Recognize a fair test.

The Design Process

As citizens of the constructed world, students will participate in the design process. Students will learn to use materials and tools safely and employ the basic principles of the engineering design process in order to find solutions to problems.

- Identify a need or problem to be solved.
- Document the design throughout the entire design process.
- Brainstorm potential solutions.
- Select a solution to the need or problem.
- Select the materials to develop a solution.
- Create the solution.
- Evaluate and test how well the solution meets the goal.
- Communicate the solution with drawings or prototypes.
- Communicate how to improve the solution.

Content Standards

Standard 1: Physical Science

Core Standard:

Observe, manipulate, sort and generate questions about objects and their physical properties.

K.1.1. Use all senses as appropriate to observe, sort and describe objects according to their composition and physical properties, such as size, color and shape. Explain these choices to others and generate questions about the objects.

K.1.2 Identify and explain possible uses for an object based on its properties and compare these uses with other students' ideas.

Standard 2: Earth and Space Science

Core Standard:

Observe, record, and recognize patterns and generate questions about night and day and the seasons.

K.2.1 Observe and record during sunny days when the sun shines on different parts of the school building.

K.2.2 Describe and compare objects seen in the night and day sky.

K.2.3 Describe in words and pictures the changes in weather from month to month and season to season.

Standard 3: Life Science

Core Standard:

Observe living organisms, compare and contrast their characteristics, and ask questions about them.

K.3.1 Observe and draw physical features of common plants and animals.

K.3.2 Describe and compare living animals in terms of shape, texture of body covering, size, weight, color and the way they move.

K.3.3 Describe and compare living plants in terms of growth, parts, shape, size, color and texture.

Grade 1

Students in first grade study the composition of objects, the nature of solids and liquids, the properties of soil, and the relationship of living things to one another and to their environment. Students learn about naturally occurring and human made materials and design and construct a habitat for an animal. Within this study students employ the key principles of the nature of science and the design process.

Process Standards

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- Communicate how to improve the solution.

Content Standards

Standard 1: Physical Science

Core Standard:

Describe objects in terms of the materials that compose them and in terms of their physical properties.

- 1.1.1 Use all senses as appropriate to identify the component parts of objects and the materials from which they are made.
- 1.1.2 Characterize materials as solid or liquid, investigate their properties, record observations and explain the choices to others based on evidence (i.e., physical properties).
- 1.1.3 Experiment with simple methods for separating solids and liquids based on their physical properties.

Standard 2: Earth and Space Science

Core Standard:

Observe, describe and ask questions about soil components and properties.

- 1.2.1 Observe and compare properties of sand, clay, silt and organic matter. Look for evidence of sand, clay, silt and organic matter as components of soil samples.
- 1.2.2 Choose, test and use tools to separate soil samples into component parts.
- 1.2.3 Observe a variety of soil samples and describe in words and pictures the soil properties in terms of color, particle size and shape, texture, and recognizable living and nonliving items.
- 1.2.4 Observe over time the effect of organisms like earthworms in the formation of soil from dead plants. Discuss the importance of earthworms in soil.

Standard 3: Life Science

Core Standard:

Observe, describe and ask questions about living things and their relationships to their environments.

- 1.3.1 Classify living organisms according to variations in specific physical features (e.g., body coverings, appendages) and describe how those features may provide an advantage for survival in different environments.
- 1.3.2 Observe organisms closely over a period of time in different habitats such as terrariums, aquariums, lawns and trees. Draw and write about observations.
- 1.3.3 Observe and explain that plants and animals have basic needs for growth and survival: plants need to take in water and need light, and animals need to take in water and food and have a way to dispose of waste.
- 1.3.4 Describe how animals' habitats, including plants, meet their needs for food, water, shelter and an environment in which they can live.
- 1.3.5 Observe and describe ways in which animals and plants depend on one another for survival.

Standard 4: Science, Engineering and Technology

Core Standard:

Determine properties of natural and man-made materials and their most important uses.

- 1.4.1 Use all senses as appropriate to sort objects as being composed of materials that are naturally occurring, human made or a combination of the two.
- 1.4.2 Choose two animals that build shelters within their habitats. Compare the shelters in terms of the materials and tools they use and the type and purpose of shelter they provide.
- 1.4.3 Construct a simple shelter for an animal with natural and human-made materials.

Grade 2

Students in second grade study changes in physical properties of materials and the affect of force on the motion of an object. They investigate patterns in the weather, in the position of the sun and the moon in the sky during the day and in the shape of the moon over the course of about a month. Students study the life cycles of plants and animals and compare the different body plans. Students investigate simple tools and how they can be used to meet human needs. Within this study students employ the key principles of the nature of science and the design process.

Process Standards

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- Conduct investigations that may happen over time as a class, in small groups, or independently.
- Generate questions and make observations about natural processes.
- Make predictions based on observations.
- Discuss observations with peers and be able to support your conclusion with evidence.
- Make and use simple equipment and tools to gather data and extend the senses.
- Recognize a fair test.

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- Select the materials to develop a solution.
- Create the solution.
- Evaluate and test how well the solution meets the goal.
- Communicate the solution with drawings or prototypes.
- Communicate how to improve the solution.

Content Standards

Standard 1: Physical Science

Core Standard:

Observe and describe that the properties of materials can change, but not all materials respond in the same way to the same action. (2.1.1, 2.1.1, 2.1.3)

Core Standard:

Observe and describe the motion of an object and how it changes when a force is applied to it. (2.1.4, 2.1.5, 2.1.6, 2.1.7)

- 2.1.1. Observe, describe and measure ways in which the properties of a sample of water (including volume) change or stay the same as the water is heated and cooled and then transformed into different states.
- 2.1.2. Predict the result of combining solids and liquids in pairs. Mix; observe, gather, record and discuss evidence of whether the result may have different properties than the original materials.
- 2.1.3. Predict and experiment with methods (e.g. sieving, evaporation) to separate solids and liquids based on their physical properties.
- 2.1.4 Observe, sketch, demonstrate and compare how objects can move in different ways (e.g., straight, zig-zag, back-and-forth, rolling, fast and slow).
- 2.1.5 Describe the position or motion of an object relative to a point of reference (e.g., background, another object).
- 2.1.6 Observe, demonstrate, sketch and compare how applied force (i.e., push or pull) changes the motion of objects.
- 2.1.7 Investigate the motion of objects when they are acted upon at a distance by forces like gravity and magnetism.

Standard 2: Earth Science

Core Standard:

Day to day and over the seasons, observe, measure, record and recognize patterns and ask questions about features of weather. (2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6)

Core Standard:

Investigate how the position of the sun and moon and the shape of the moon change in observable patterns. (2.2.7, 2.2.8, 2.2.9)

- 2.2.1 Construct and use tools to observe and measure weather phenomena like precipitation, changes in temperature, wind speed and direction.
- 2.2.2 Experience and describe wind as the motion of the air.
- 2.2.3 Chart or graph weather observations such as cloud cover, cloud type and type of precipitation on a daily basis over a period of weeks.
- 2.2.4 Ask questions about charted observations and graphed data. Identify the day-to-day patterns and cycles of weather. Understand seasonal time scales in terms of temperature and amounts of rainfall and snowfall.
- 2.2.5 Ask questions and design class investigations on the effect of the sun heating the surface of the earth.
- 2.2.6 Learn about, report on and practice severe weather safety procedures.
- 2.2.7 Investigate how the sun appears to move through the sky during the day by observing and drawing the length and direction of shadows.
- 2.2.8 Investigate how the moon appears to move through the sky during the day by observing and drawing its location at different times.
- 2.2.9 Investigate how the shape of the moon changes from day to day in a repeating cycle that lasts about a month.

Standard 3: Life Science

Core Standard:

Observe, ask questions about and describe how organisms change their forms and behaviors during their life cycles.

- 2.3.1 Observe closely over a period of time and then record in pictures and words the changes in plants and animals throughout their life cycles-including details of their body plan, structure and timing of growth, reproduction and death.
- 2.3.2 Compare and contrast details of body plans and structures within the life cycles of plants and animals.

Standard 4: Science, Engineering and Technology

Core Standard:

Describe how technologies have been developed to meet human needs.

- 2.4.1 Identify parts of the human body that can be used as tools—like hands for grasping and teeth for cutting and chewing.
- 2.4.2 Identify technologies developed by humans to meet human needs. Investigate the limitations of technologies and how they have improved quality of life.
- 2.4.3 Identify a need and design a simple tool to meet that need.

Grade 3

Students in third grade study sound and light and recognize them as forms of energy. They investigate rocks and minerals and develop an understanding of how natural materials can meet the needs of plants and animals. Students study plant growth and development. Students investigate the uses and types of simple machines and study ways to solve real world problems. Within this study students employ the key principles of the nature of science and the design process.

Process Standards

The Nature of Science

Students gain scientific knowledge by observing the natural and constructed world, performing and evaluating investigations, and communicating their findings. The following principles should guide student work and be integrated into the curriculum along with the content standards on a daily basis.

- Make predictions and formulate testable questions.
- Design a fair test.
- Plan and carry out investigations—often over a period of several lessons—as a class, in small groups or independently.
- Perform investigations using appropriate tools and technologies that will extend the senses.
- Use measurement skills and apply appropriate units when collecting data.
- Test predictions with multiple trials.
- Keep accurate records in a notebook during investigations and communicate findings to others using graphs, charts, maps and models through oral and written reports.
- Identify simple patterns in data and propose explanations to account for the patterns.
- Compare the results of an investigation with the prediction.

The Design Process

As citizens of the constructed world, students will participate in the design process. Students will learn to use materials and tools safely and employ the basic principles of the engineering design process in order to find solutions to problems.

- Identify a need or problem to be solved.
- Brainstorm potential solutions.
- Document the design throughout the entire design process.
- Select a solution to the need or problem.
- Select the most appropriate materials to develop a solution that will meet the need.
- Create the solution through a prototype.
- Test and evaluate how well the solution meets the goal.
- Evaluate and test the design using measurement.

- Present evidence by using mathematical representations (e.g., graphs, data tables).
- Communicate the solution (including evidence) using mathematical representations (graphs, data tables), drawings or prototypes.
- Communicate how to improve the solution.

Content Standards

Standard 1: Physical Science

Core Standard:

Observe and describe how sound is produced by vibrations. (3.1.1, 3.1.2, 3.1.3)

Core Standard:

Observe and describe how light travels from point to point. (3.1.4, 3.1.5, 3.1.6)

- 3.1.1 Generate sounds using different materials, objects and techniques. Record the sounds and then discuss and share the results.
- 3.1.2 Investigate how the loudness and pitch of sound changes when the rate of vibrations changes.
- 3.1.3 Investigate and recognize that sound moves through solids, liquids and gases (e.g., air).
- 3.1.4 Investigate how light travels through the air and tends to maintain its direction until it interacts with some other object or material.
- 3.1.5 Observe and describe how light is absorbed, changes its direction, is reflected back and passes through objects. Observe and describe that a shadow results when light cannot pass through an object.
- 3.1.6 Describe evidence to support the idea that light and sound are forms of energy.

Standard 2: Earth Science

Core Standard:

Observe, describe and identify rocks and minerals by their specific properties. (3.2.1, 3.2.2, 3.2.3, 3.2.4)

Core Standard:

Observe and describe how natural materials meet the needs of plants and animals (including humans). (3.2.5, 3.2.6)

- 3.2.1 Examine the physical properties of rock samples and sort them into categories based on size using simple tools such as sieves.
- 3.2.2 Observe the detailed characteristics of rocks and minerals. Identify rocks as being composed of different combinations of minerals.
- 3.2.3 Classify and identify minerals by their physical properties of hardness, color, luster and streak.
- 3.2.4 Identify fossils and describe how they provide evidence about the plants and animals that lived long ago and the nature of their environment at that time.
- 3.2.5 Describe natural materials and give examples of how they sustain the lives of plants and animals.
- 3.2.6 Describe how the properties of earth materials make them useful to humans in different ways. Describe ways that humans have altered these resources to meet their needs for survival.

Standard 3: Life Science

Core Standard:

Observe, describe and ask questions about plant growth and development.

- 3.3.1 Identify the common structures of a plant including its roots, stems, leaves, flowers, fruits and seeds. Describe their functions.
- 3.3.2 Investigate plant growth over time, take measurements in SI units, record the data and display the data in graphs. Examine factors that might influence plant growth.

Standard 4: Science, Engineering and Technology

Core Standard:

Define a real world problem and list criteria for a successful solution.

- 3.4.1 Choose and use the appropriate tools to estimate and measure length, mass and temperature in SI units.
- 3.4.2 Define the uses and types of simple machines and utilize simple machines in the solution to a “real world” problem.

Grade 4

Students in fourth grade study heat and electricity as forms of energy and they construct simple electric circuits. They study how the shape of the land changes over time and how natural resources are in limited supply. Students study how the physical characteristics of organisms affect survival and reproduction. Students investigate transportation systems, design a moving system and measure its motion. Within this study students employ the key principles of the nature of science and the design process.

Process Standards

The Nature of Science

Students gain scientific knowledge by observing the natural and constructed world, performing and evaluating investigations, and communicating their findings. The following principles should guide student work and be integrated into the curriculum along with the content standards on a daily basis.

- Make predictions and formulate testable questions.
- Design a fair test.
- Plan and carry out investigations—often over a period of several lessons—as a class, in small groups or independently.
- Perform investigations using appropriate tools and technologies that will extend the senses.
- Use measurement skills and apply appropriate units when collecting data.
- Test predictions with multiple trials.
- Keep accurate records in a notebook during investigations and communicate findings to others using graphs, charts, maps and models through oral and written reports.
- Identify simple patterns in data and propose explanations to account for the patterns.
- Compare the results of an investigation with the prediction.

The Design Process

As citizens of the constructed world, students will participate in the design process. Students will learn to use materials and tools safely and employ the basic principles of the engineering design process in order to find solutions to problems.

- Identify a need or problem to be solved.
- Brainstorm potential solutions.
- Document the design throughout the entire design process.
- Select a solution to the need or problem.
- Select the most appropriate materials to develop a solution that will meet the need.
- Create the solution through a prototype.
- Test and evaluate how well the solution meets the goal.
- Evaluate and test the design using measurement.

- Present evidence by using mathematical representations (e.g., graphs, data tables).
- Communicate the solution (including evidence) using mathematical representations (graphs, data tables), drawings or prototypes.
- Communicate how to improve the solution.

Standard 1: Physical Science

Core Standard:

Provide evidence that heat and electricity are forms of energy. (4.1.1, 4.1.2)

Core Standard:

Design and assemble electric circuits that provide a means of transferring energy from one form or place to another. (4.1.3, 4.1.4, 4.1.5)

- 4.1.1 Describe and investigate the different ways in which heat can be generated.
- 4.1.2 Investigate the variety of ways in which heat can be generated and moved from one place to another. Explain the direction the heat moved.
- 4.1.3 Construct a complete circuit through which an electrical current can pass as evidenced by the lighting of a bulb or ringing of a bell.
- 4.1.4 Experiment with materials to identify conductors and insulators of heat and electricity.
- 4.1.5 Demonstrate that electrical energy can be transformed into heat, light, and sound.

Standard 2: Earth Science

Core Standard:

Observe, investigate and give examples of ways that the shape of land changes over time. (4.2.1, 4.2.2, 4.2.3)

Core Standard:

Describe how the supply of natural resources is limited and investigate ways that humans protect and harm the environment. (4.2.4, 4.2.5, 4.2.6)

- 4.2.1 Demonstrate and describe how smaller rocks come from the breakage and weathering of larger rocks in a process that occurs over a long period of time.
- 4.2.2 Describe how wind, water and glacial ice shape and reshape earth's land surface by eroding rock and soil in some areas and depositing them in other areas in a process that occurs over a long period of time.

- 4.2.3 Describe how earthquakes, volcanoes and landslides suddenly change the shape of the land.
- 4.2.4 Investigate earth materials that serve as natural resources and gather data to determine which ones are limited by supply.
- 4.2.5 Describe methods that humans currently use to extend the use of natural resources.
- 4.2.6 Describe ways in which humans have changed the natural environment. Explain if these changes have been detrimental or beneficial.

Standard 3: Life Science

Core Standard:

Observe, describe and ask questions about structures of organisms and how they affect their growth and survival.

- 4.3.1 Observe and describe how offspring are very much, but not exactly, like their parents or one another. Describe how these differences in physical characteristics among individuals in a population may be advantageous for survival and reproduction.
- 4.3.2 Observe, compare and record the physical characteristics of living plants or animals from widely different environments. Describe how each plant or animal is adapted to its environment.
- 4.3.3 Design investigations to explore how organisms meet some of their needs by responding to stimuli from their environments.
- 4.3.4 Describe a way that a given plant or animal might adapt to a change arising from a human or non-human impact on its environment.

Standard 4: Science, Engineering and Technology

Core Standard:

Design a moving system and measure its motion.

- 4.4.1 Investigate transportation systems and devices that operate on or in land, water, air and space and recognize the forces (lift, drag, friction, thrust and gravity) that affect their motion.

- 4.4.2 Make appropriate measurements to compare the speeds of objects in terms of the distance traveled in a given amount of time or the time required to travel a given distance.
- 4.4.3 Investigate how changes in speed or direction are caused by forces: the greater the force exerted on an object, the greater the change.
- 4.4.4 Define a problem in the context of motion and transportation. Propose a solution to this problem by evaluating, reevaluating and testing the design. Gather evidence about how well the design meets the needs of the problem. Document the design so that it can be easily replicated.

Grade 5

Students in fifth grade study the relationship between weight and volume and the differences between weight and mass. They study the solar system and patterns in the sun-moon-earth system. Students study the roles and relationships of producers and consumers in an ecosystem. They investigate the human musculoskeletal system and how to design and build prototypes. Within this study students employ the key principles of the nature of science and the design process.

Process Standards

The Nature of Science

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- Make predictions and formulate testable questions.
- Design a fair test.
- Plan and carry out investigations—often over a period of several lessons—as a class, in small groups or independently.
- Perform investigations using appropriate tools and technologies that will extend the senses.
- Use measurement skills and apply appropriate units when collecting data.
- Test predictions with multiple trials.
- Keep accurate records in a notebook during investigations and communicate findings to others using graphs, charts, maps and models through oral and written reports.
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- Evaluate and test the design using measurement.

- Present evidence by using mathematical representations (e.g., graphs, data tables).
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- Communicate how to improve the solution.

Content Standards

Standard 1: Physical Science

Core Standard:

Describe the weight and volume and measure the weight and volume of various objects.
(5.1.1, 5.1.2)

Core Standard:

Demonstrate that mass is conserved even when a substance has undergone a change in its state. (5.1.3, 5.1.4)

- 5.1.1 Describe and measure the volume and weight of a sample of a given material.
- 5.1.2 Describe the difference between weight and mass. Understand that weight is dependent on gravity and mass is the amount of matter in a given substance or material.
- 5.1.3 Demonstrate that regardless of how parts of an object are assembled the weight of the whole object is identical to the sum of the weight of the parts; however, the volume can differ from the sum of the volumes.
- 5.1.4 Determine if matter has been added or lost by comparing weights when melting, freezing or dissolving a sample of a substance.

Standard 2: Earth Science

Core Standard:

Observe, describe and ask questions about patterns in the sun-moon-earth system.

- 5.2.1 Recognize that our earth is part of the solar system in which the sun, an average star, is the central and largest body. Observe that our solar system includes the sun, moon, seven other planets and their moons, and many other smaller objects like asteroids and comets.
- 5.2.2 Observe and use pictures to record how the sun appears to move across the sky in the same general way every day but rises and sets in different places as the seasons change.

- 5.2.3 In monthly intervals, observe and draw the length and direction of shadows cast by the sun at several chosen times during the day. Use the recorded data as evidence to explain how those shadows were affected by the relative position of the earth and sun.
- 5.2.4 Use a calendar to record observations of the shape of the moon and the rising and setting times over the course of a month. Based on the observations, describe patterns in the moon cycle.

Standard 3: Life Science

Core Standard:

Observe, describe and ask questions about how changes in one part of an ecosystem create changes in other parts of the ecosystem.

- 5.3.1 Observe and classify common Indiana organisms as producers, consumers, decomposers, predator and prey based on their relationships and interactions with other organisms in their ecosystem.
- 5.3.2 Investigate the action of different decomposers and compare their role in an ecosystem with that of producers and consumers.

Standard 4: Science, Engineering and Technology

Core Standard:

Design a prototype that replaces a function of a human body part.

- 5.4.1 Investigate technologies that mimic human or animal musculoskeletal systems in order to meet a need.
- 5.4.2 Investigate the purpose of prototypes and models when designing a solution to a problem and how limitations in cost and design features might affect their construction.
- 5.4.3 Design solutions to problems in the context of musculoskeletal body systems. Using suitable tools, techniques and materials, draw or build a prototype or model of a proposed design.

Grade 6

Students in sixth grade study the differences between kinetic and potential energy and study three states of matter: solid, liquid and gas. They study sun-earth-moon relationships and the reason for seasonal changes. Students investigate biomes and how organisms obtain energy within an ecosystem. Students design and construct a simple, mechanical device. Within this study students employ the key principles of the nature of science and the design process.

Process Standards

The Nature of Science

Students gain scientific knowledge by observing the natural and constructed world, performing and evaluating investigations, and communicating their findings. These principles should guide student work and be integrated into the curriculum along with the content standards on a daily basis.

- Make predictions and develop testable questions based on research and prior knowledge.
- Plan and carry out investigation—often over a period of several class lessons—as a class, in small groups or independently.
- Collect quantitative data with appropriate tools or technologies and use appropriate units to label numerical data.
- Incorporate variables that can be changed, measured or controlled.
- Use the principles of accuracy and precision when making measurements.
- Test predictions with multiple trials
- Keep accurate records in a notebook during investigations.
- Analyze data, using appropriate mathematical manipulation as required, and use it to identify patterns. Make inferences based on these patterns.
- Evaluate possible causes for differing results (i.e., valid data).
- Compare the results of an experiment with the prediction.
- Communicate findings through oral and written reports by using graphs, charts maps and models.

The Design Process

As citizens of the constructed world, students will participate in the design process. Students will learn to use materials and tools safely and employ the basic principles of the engineering design process in order to find solutions to problems.

- Identify a need or problem to be solved.
- Brainstorm potential solutions.
- Throughout the entire design process, document the design with drawings (including labels) in a portfolio or notebook so that the process can be replicated.
- Select a solution to the need or problem.

- Select the most appropriate materials to develop a solution that will meet the need.
- Create the solution through a prototype.
- Test and evaluate how well the solution meets the goal.
- Evaluate and test the design.
- Present evidence using mathematical representations like graphs and data tables.
- Communicate the solution (including evidence) using mathematical representations (e.g., graphs, data tables), drawings or prototypes.
- Redesign to improve the solution based on how well the solution meets the need.

Reading and Writing Standards for Literacy in Science

The Reading and Writing Standards for Literacy in Science are presented in grade-level bands. Students at the beginning of a grade-band continuum will require a blend of scaffolding and direct, explicit instruction. By the end of the grade-band continuum, students should demonstrate proficiency of the literacy standards independently.

The grades 6-8 standards below define what students should understand and be able to do by end of 8th grade. These are to serve as a complement to the specific content demands of the science standards and be taught as skills that allow students to communicate and comprehend the science content.

Reading for Literacy in Science

Students need to develop the skills that allow them to read complex informational science texts with independence and confidence. Students need to build an appreciation of the norms and conventions of reading in science, an understanding of domain-specific words and phrases, an attention to precise details, the capacity to evaluate detailed arguments, synthesize complex information and follow detailed descriptions and procedures. Students need to be able to gain knowledge from challenging texts that make use of elaborate diagrams and data to convey information and illustrate concepts.

Key Ideas and Details

- 6-8.RS.1** Cite specific textual evidence to support analysis of science texts.
- 6-8.RS.2** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
- 6-8.RS.3** Follow precisely a multistep procedure when carrying out experiments or taking measurements.

Craft and Structure

- 6-8.RS.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific context relevant to *grades 6-8 texts and topics*.

6-8.RS.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.

6-8.RS.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

6-8.RS.7 Integrate quantitative 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).

6-8.RS.8 Distinguish among facts, reasoned judgment based on research findings and speculation in a text.

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Text Types and Purposes

6-8.WS.1 Write arguments to focus on discipline-specific content.

- 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.
- Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
- Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
- Establish and maintain a formal style.
- Provide a concluding statement or section that follows from and supports the argument presented.

6-8.WS.2 Write informative/explanatory texts, including scientific procedures/experiments.

- 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.
- 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.
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6-8.WS.3 Note: 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, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations that others can replicate them and (possibly) reach the same results.

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6-8.WS.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

6-8.WS.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.

6-8.RS.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

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

Content Standards

Standard 1: Physical Science

Core Standard

Explain that all objects and substances in the natural world are composed of matter in different states with different properties. (6.1.1, 6.1.2, 6.1.3)

Core Standard

Understand that there are different forms of energy with unique characteristics. (6.1.4, 6.1.5, 6.1.6, 6.1.7)

- 6.1.1 Understand that the properties and behavior of matter can be explained by a model that depicts particles representing atoms or molecules in motion.
- 6.1.2 Explain the properties of solids, liquids and gases using drawings and models that represent matter as particles in motion whose state can be represented by the relative positions and movement of the particles.
- 6.1.3 Using a model in which matter is composed of particles in motion, investigate that when substances undergo a change in state, mass is conserved.
- 6.1.4 Recognize that objects in motion have kinetic energy and objects at rest have potential energy.
- 6.1.5 Describe with examples that potential energy exists in several different forms (e.g., gravitational potential energy, elastic potential energy and chemical potential energy).
- 6.1.6 Compare and contrast potential and kinetic energy and how they can be transformed from one form to another.
- 6.1.7 Explain that energy may be manifested as heat, light, electricity, mechanical motion, and sound and is often associated with chemical reactions.

Standard 2: Earth and Space Science

Core Standard

Understand the relationships between celestial bodies and the force that keeps them in regular and predictable motion.

- 6.2.1 Describe and model how the position, size and relative motions of the earth, moon and sun cause day and night, solar and lunar eclipses, and phases of the moon.
- 6.2.2 Recognize that gravity is a force that keeps celestial bodies in regular and predictable motion, holds objects to earth's surface and is responsible for tides.
- 6.2.3 Understand that the sun, an average star where nuclear reactions occur, is the central and largest body in the solar system.
- 6.2.4 With regard to their size, composition, distance from sun, surface features and ability to support life, compare and contrast the planets of the solar system with one another and with asteroids and comets.
- 6.2.5 Demonstrate that the seasons in both hemispheres are the result of the inclination of the earth on its axis, which causes changes in sunlight intensity and length of day.

Standard 3: Life Science

Core Standard

Describe that all organisms, including humans, are part of complex systems found in all biomes (i.e., freshwater, marine, forest, desert, grassland and tundra). (6.3.1, 6.3.2, 6.3.3)

Core Standard

Understand that the major source of energy for ecosystems is light produced by major nuclear reactions in the sun. (6.3.4, 6.3.5, 6.3.6)

- 6.3.1 Describe specific relationships (i.e., predator and prey, consumer and producer, and parasite and host) between organisms and determine whether these relationships are competitive or mutually beneficial.
- 6.3.2 Describe how changes caused by organisms in the habitat where they live can be beneficial or detrimental to themselves or to native plants and animals.
- 6.3.3 Describe how certain biotic and abiotic factors—such as predators, quantity of light and water, range of temperatures and soil composition—can limit the number of organisms an ecosystem can support.

- 6.3.4 Recognize that plants use energy from the sun to make sugar (i.e., glucose) by the process of photosynthesis.
- 6.3.5 Describe how all animals, including humans, meet their energy needs by consuming other organisms, breaking down their structures, and using the materials to grow and function.
- 6.3.6 Recognize that food provides the energy for the work that cells do and is a source of the molecular building blocks that can be incorporated into a cell's structure or stored for later use.

Standard 4
Science, Engineering and Technology

Core Standard

Apply a form of energy to design and construct a simple mechanical device.

- 6.4.1 Understand how to apply potential or kinetic energy to power a simple device.
- 6.4.2 Construct a simple device that uses potential or kinetic energy to perform work.
- 6.4.3 Describe the transfer of energy amongst energy interactions.

Grade 7

Students in seventh grade study different forms of energy and how forces act between objects. They study how different earth processes have shaped the land and how this affects our ability to measure geological time. Students study the cellular structure and function of single-celled and multicellular organisms. Students investigate how to convert energy from one form to another. Within this study students employ the key principles of the nature of science and the design process.

Process Standards

The Nature of Science

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Text Types and Purposes

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- d. Establish and maintain a formal style.
- e. Provide a concluding statement or section that follows from and supports the argument presented.

6-8.WS.2 Write informative/explanatory texts, including scientific procedures/experiments.

- 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.
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- 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.
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6-8.WS.3 Note: 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, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations that others can replicate them and (possibly) reach the same results.

Production and Distribution of Writing

- 6-8.WS.4** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
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Research to Build and Present Knowledge

- 6-8.WS.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.
- 6-8.WS.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.
- 6-8.WS.9** Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

- 6-8.WS.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.
- 6-8.RS.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

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

Content Standards

Standard 1: Physical Science

Core Standard

Explain that energy cannot be created or destroyed but instead can only be changed from one form into another or transferred from place to place. (7.1.1, 7.1.2, 7.1.3, 7.1.4)

Core Standard

Describe and investigate how forces between objects can act at a distance or by means of direct contact between objects. (7.1.5, 7.1.6, 7.1.7)

- 7.1.1 Explain that when energy is transferred from one system to another, the total quantity of energy does not change.
- 7.1.2 Describe and give examples of how energy can be transferred from place to place and transformed from one form to another through radiation, convection and conduction.
- 7.1.3 Recognize and explain how different ways of obtaining, transforming and distributing energy have different environmental consequences.
- 7.1.4 Recognize and provide evidence of how light, sound and other waves have energy and how they interact with different materials.
- 7.1.5 Describe and investigate how forces between objects—such as magnetic, electrical or gravitational forces—can act at a distance or by means of direct contact between objects.
- 7.1.6 Explain that forces have magnitude and direction and those forces can be added to determine the net force acting on an object.
- 7.1.7 Demonstrate and describe how an object's speed or direction of motion changes when a force acts upon it. Demonstrate and describe that an object's speed and direction of motion remain unchanged if the net force acting upon it is zero.

Standard 2: Earth and Space Systems

Core Standard

Describe how earth processes have shaped the topography of the earth and have made it possible to measure geological time.

- 7.2.1 Describe how the earth is a layered structure composed of lithospheric plates, a mantle and a dense core.
- 7.2.2 Recognize that the earth possesses a magnetic field that is detectable at the surface with a compass.
- 7.2.3 Characterize the immensity of geologic time and recognize that it is measured in eras and epochs.
- 7.2.4 Explain how convection currents in the mantle cause lithospheric plates to move and cause fast changes like earthquakes and volcanic eruptions and slow changes like the creation of mountains and formation of new ocean floors.
- 7.2.5 Describe the origin and physical properties of igneous, metamorphic and sedimentary rocks and how they are related through the rock cycle.
- 7.2.6 Describe physical and chemical characteristics of soil layers and how they are influenced by the process of soil formation (including the action of bacteria, fungi, insects and other organisms).
- 7.2.7 Use geological features such as karst topography and glaciation to explain how large-scale physical processes have shaped the land.
- 7.2.8 Compare and contrast fossils with living organisms in a given location to explain how earth processes have changed environments over time.

Standard 3: Life Science

Core Standard

Understand the cellular structure of single-celled and multicellular organisms.

- 7.3.1 Explain that all living organisms are composed of one cell or multiple cells and that the many functions needed to sustain life are carried out within cells.
- 7.3.2 Understand that water is a major component within all cells and is required to carry out many cellular functions.
- 7.3.3 Explain that, although the way cells function is similar in all living organisms, multicellular organisms have specialized cells whose specialized functions are directly related to their structure.

- 7.3.4 Compare and contrast similarities and differences among specialized sub cellular components within plant and animal cells (including organelles and cell walls that perform essential functions and give cells shape and structure).
- 7.3.5 Explain that cells in multicellular organisms repeatedly divide to make more cells for growth and repair.
- 7.3.6 Explain that after fertilization a small cluster of cells divides to form the basic tissues of an embryo and further develops into all the specialized tissues and organs within a multicellular organism.
- 7.3.7 Describe how various organs and tissues serve the needs of cells for nutrient and oxygen delivery and waste removal.

Standard 4: Science, Engineering and Technology

Core Standard:

Design and construct a device that converts energy from one form to another to perform work.

- 7.4.1 Understand that energy is the capacity to do work.
- 7.4.2 Explain that energy can be used to do work using many processes (e.g., generation of electricity by harnessing wind energy).
- 7.4.3 Explain that power is the rate that energy is converted from one form to another.
- 7.4.4 Explain that power systems are used to provide propulsion for engineered products and systems.

Students in eighth grade study atoms, elements, compounds and molecules; and the relationship between atomic structure and chemical properties. They study the water cycle and the role of the sun's energy in driving this process. Students investigate how genetic information is transmitted from parents to offspring. Students study the physical properties of natural and engineered materials. Within this study students employ the key principles of the nature of science and the design process.

Process Standards

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 - d. Establish and maintain a formal style.
 - e. Provide a concluding statement or section that follows from and supports the argument presented.
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 - 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.

- 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.
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Range of Writing

- 6-8.WS.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.
- 6-8.RS.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

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

Content Standards

Standard 1: Physical Science

Core Standard

Describe how atomic structures determine chemical properties and how atoms and molecules interact.

- 8.1.1 Explain that all matter is composed of particular arrangements of atoms and that there are approximately one hundred types of atoms (i.e., elements).
- 8.1.2 Understand that elements are organized on the periodic table based on atomic number.
- 8.1.3 Explain how the arrangement of atoms and molecules determines chemical properties of substances.
- 8.1.4 Describe the structure of atoms and relate the arrangement of electrons to how atoms interact with other atoms.
- 8.1.5 Explain that atoms join together to form molecules and compounds and illustrate with diagrams the relationship between atoms and compounds and between atoms and molecules.
- 8.1.6 Explain that elements and compounds have characteristic properties such as density, boiling points and melting points that remain unchanged regardless of sample size.
- 8.1.7 Explain that chemical changes occur when substances react and form one or more different products, whose physical and chemical properties are different from those of the reactants.

- 8.1.8 Demonstrate that in a chemical change the total numbers of each kind of atom in the product are the same as in the reactants and that the total mass of the reacting system is conserved.

Standard 2: Earth and Space Systems

Core Standard

Explain how the sun's energy heats the air, land and water and drives the processes that result in wind, ocean currents and the water cycle. (8.2.1, 8.2.2, 8.2.3, 8.2.4, 8.2.5)

Core Standard

Describe how human activities have changed the land, water, and atmosphere. (8.2.6, 8.2.7)

- 8.2.1 Recognize and demonstrate how the sun's energy drives convection in the atmosphere and in bodies of water, which results in ocean currents and weather patterns.
- 8.2.2 Describe and model how water moves through the earth's crust, atmosphere and oceans in a cyclic way as a liquid vapor and solid.
- 8.2.3 Describe the characteristics of ocean currents and identify their effects on weather patterns.
- 8.2.4 Describe the physical and chemical composition of the atmosphere at different elevations.
- 8.2.5 Describe the conditions that cause Indiana weather and weather-related events such as tornadoes, lake effect snow, blizzards, thunderstorms and flooding.
- 8.2.6 Identify, explain and discuss some effects human activities (e.g., air, soil, light, noise and water pollution) have on the biosphere.
- 8.2.7 Recognize that some of Earth's resources are finite and describe how recycling, reducing consumption and the development of alternatives can reduce the rate of their depletion.
- 8.2.8** Explain that human activities, beginning with the earliest herding and agricultural activities, have drastically changed the environment and have affected the capacity of the environment to support native species. Explain current efforts to reduce and eliminate these impacts and encourage sustainability.

Standard 3: Life Science

Core Standard

Understand the predictability of characteristics being passed from parents to offspring. (8.3.1, 8.3.2, 8.3.3, 8.3.4, 8.3.5, 8.3.6, 8.3.7)

Core Standard

Explain how a particular environment selects for traits that increase the likelihood of survival and reproduction by individuals bearing those traits. (8.3.8, 8.3.9, 8.3.10)

- 8.3.1 Explain that reproduction is essential for the continuation of every species and is the mechanism by which all organisms transmit genetic information.
- 8.3.2 Compare and contrast the transmission of genetic information in sexual and asexual reproduction.
- 8.3.3 Explain that genetic information is transmitted from parents to offspring mostly by chromosomes.
- 8.3.4 Understand the relationship between deoxyribonucleic acid (DNA), genes and chromosomes.
- 8.3.5 Identify and describe the difference between inherited traits and the physical and behavioral traits that are acquired or learned.
- 8.3.6 Observe anatomical structures of a variety of organisms and describe their similarities and differences. Use the data collected to organize the organisms into groups and predict their relatedness.
- 8.3.7 Recognize and explain that small genetic differences between parents and offspring can accumulate in successive generations so that descendants may be different from their ancestors.
- 8.3.8 Examine traits of individuals within a population of organisms that may give them an advantage in survival and reproduction in given environments or when the environments change.
- 8.3.9 Describe the effect of environmental changes on populations of organisms when their adaptive characteristics put them at a disadvantage for survival. Describe how extinction of a species can ultimately result from a disadvantage.
- 8.3.10 Recognize and describe how new varieties of organisms have come about from selective breeding.

Standard 4
Science, Technology and Engineering

Core Standard

Identify the appropriate materials to be used to solve a problem based on their specific properties and characteristics.

- 8.4.1 Understand how the strength of attractive forces among particles in a material helps to explain many physical properties of the material, such as why different materials exist as gases, liquids or solids at a given temperature.
- 8.4.2 Rank the strength of attractions among the particles of room-temperature materials.
- 8.4.3 Investigate the properties (i.e., mechanical, chemical, electrical, thermal, magnetic and optical) of natural and engineered materials.