

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.

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.

Writing for Literacy in Science

Students need to be able use writing as a key means to defend and assert claims, showing what they know about a subject and conveying what they have experienced, imagined, thought, and felt. They must be adept at gathering information, evaluating sources, and citing material accurately, reporting findings from their research and analysis of sources in clear manner.

Text Types and Purposes

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

- a. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
- b. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
- c. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
- d. Establish and maintain a formal style.
- e. Provide a concluding statement or section that follows from and supports the argument presented.

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.
- b. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.

- c. Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.
- d. Use precise language and domain-specific vocabulary to inform about or explain the topic.
- e. Establish and maintain a formal style and objective tone.
- f. Provide a concluding statement or section that follows from and supports the explanation or information presented.

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.
- 6-8.WS.5** With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
- 6-8.WS.6** Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

Research to Build and Present Knowledge

- 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 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.