

IA_Core Curriculum - Science (2009)

Middle

Strand 1 Science as Inquiry

Concept 1.1 Identify and generate questions that can be answered through scientific investigations.

Skill 1.1.1 Students should develop the ability to refine and refocus broad and ill-defined questions. An important aspect of this ability consists of clarifying questions and inquiries and directing them toward objects and phenomena that can be described, explained, or predicted by scientific investigations.

Skill 1.1.2 Students should develop the ability to connect their questions with scientific ideas, concepts, and quantitative relationships that guide investigations.

Concept 1.2 Design and conduct different kinds of scientific investigations.

Skill 1.2.1 Students understand that different kinds of questions suggest different kinds of scientific investigations.

Skill 1.2.2 Students should develop general abilities such as making systematic observations, taking accurate measurements, and identifying and controlling variables.

Skill 1.2.3 Students should develop the ability to clarify ideas that are influencing and guiding their inquiry, and to understand how those ideas compare with current scientific knowledge.

Skill 1.2.4 Students formulate questions, design investigations, execute investigations, interpret data, use evidence to generate explanations, propose alternative explanations, and critique explanations and procedures.

Skill 1.2.5 Students use appropriate safety procedures when conducting investigations.

Concept 1.3 Understand that different kinds of questions suggest different kinds of scientific investigations.

Skill 1.3.1 Some investigations involve observing and describing objects, organisms and events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models.

Concept 1.4 Select and use appropriate tools and techniques to gather, analyze and interpret data.

Skill 1.4.1 The use of tools and techniques, including computers, will be guided by the questions asked and the investigations students design. Students should be able to access, gather, store, retrieve, and organize data, using computer hardware and software designed for these purposes.

Concept 1.5 Incorporate mathematics in scientific inquiry.

Skill 1.5.1 Mathematics is used to gather, organize and present data and to construct convincing explanations.

Concept 1.6 Use evidence to develop descriptions, explanations, predictions, and models.

Skill 1.6.1 Students should base their explanations on observations and they should be able to differentiate between description and explanation.

Skill 1.6.2 Developing explanations establishes connections between the content of science and the contexts in which students develop new knowledge.

Skill 1.6.3 Models are often used to think about processes that happen too slowly, too quickly, or on too small a scale to observe directly, or are too vast to be changed deliberately, or are potentially dangerous.

Skill 1.6.4 Different models can be used to represent the same thing.

Concept 1.7 Think critically and logically to make the relationships between evidence and explanations.

Skill 1.7.1 Students decide what evidence should be used and develop the ability to account for anomalous data.

Skill 1.7.2 Students should be able to review data from an experiment, summarize the data, and form a logical argument between cause and effect relationships.

Skill 1.7.3 Students should begin to state some explanations in terms of relationships between two or more variables.

Concept 1.8 Recognize and analyze alternative explanations and predictions.

Skill 1.8.1 Students should develop the ability to listen to and respect the explanations proposed by other students. They should remain open to and acknowledge different ideas and explanations, be able to accept the skepticism of others, and consider alternative explanations.

Concept 1.9 Communicate and defend procedures and explanations.

Skill 1.9.1 Students should become competent in communicating experimental methods, describing observations and summarizing the results of investigations. Explanations can be communicated through various methods.

Concept 1.10 Use appropriate safety procedures when conducting investigations.

Strand 2 Earth and Space

Concept 2.1 Understand and apply knowledge of the structure and processes of the earth system and the processes that change the earth and its surface.

Skill 2.1.1 The solid earth consists of layers including a lithosphere; a hot, convecting mantle and a dense metallic core.

Skill 2.1.2 Tectonic plates constantly move at rates of centimeters per year in response to movements in the mantle. Major geological events, such as earthquakes, volcanic eruptions, and mountain building, are results of these plate motions.

Skill 2.1.3 Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.

Skill 2.1.4 Some changes in the earth can be described as the “rock cycle.” Rocks at the earth’s surface weather, forming sediments that are buried, then compacted, heated, and often re-crystallized into new rock. Eventually, those new rocks may be brought to the surface by the forces that drive plate motions, and the rock cycle continues.

Skill 2.1.5 Soil consists of weathered rocks and decomposed organic matter from dead plants, animals, and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.

Skill 2.1.6 Living organisms have played many roles in the earth system, including affecting the composition of the atmosphere, producing some types of rocks, and contributing to the weathering of rocks.

Concept 2.2 Understand and apply knowledge of the water cycle, including consideration of events that impact groundwater quality.

Skill 2.2.1 Water, which covers the majority of the earth’s surface, circulates through the crust, oceans, and atmosphere in what is known as the “water cycle.” Water evaporates from the earth’s surface, rises and cools as it rises to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil and in soil and rocks underground.

Skill 2.2.2 Water is a solvent. As it passes through the water cycle, especially as it moves on the earth’s surface and underground, it dissolves minerals and gases and carries them to the oceans, rivers, and other surface water.

Skill 2.2.3 Natural and human forces can contribute to contamination of surface water and groundwater.

Concept 2.3 Understand and apply knowledge of earth history based on physical evidence.

Skill 2.3.1 The earth processes we see today including erosion, movement of tectonic plates, and changes in atmospheric composition are similar to those that occurred in the past.

Skill 2.3.2 Earth history is also influenced by occasional catastrophes such as the impact of an asteroid or a comet.

Skill 2.3.3 Fossils provide important evidence of how life and environmental conditions have changed.

Concept 2.4 Understand and apply knowledge of the earth’s atmospheric properties and how they influence weather and climate.

Skill 2.4.1 The atmosphere is a mixture of nitrogen, oxygen, and trace gasses that include water vapor. The atmosphere has different properties at different elevations.

Skill 2.4.2 Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate because water in the oceans holds a large amount of heat.

Skill 2.4.3 Clouds, formed by the condensation of water vapor, affect weather and climate.

Concept 2.5 Understand and apply knowledge of the components of our solar system.

Skill 2.5.1 The earth is the third planet from the sun in a system that includes the moon, the sun, seven other planets and their moons, and smaller objects, such as asteroids and comets. The sun, an average star, is the central and largest body in the solar system.

Skill 2.5.2 Gravity is the force that keeps planets in orbit around the sun and governs the rest of the motion in the solar system. Gravity alone holds us to the earth's surface and explains the phenomena of the tides.

Skill 2.5.3 The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotation on its axis and the length of the day.

Skill 2.5.4 Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.

Strand 3 Physical Science

Concept 3.1a elements, compounds, mixtures, and solutions based on the nature of their physical and chemical properties.

Concept 3.1b physical and chemical changes and their relationship to the conservation of matter and energy.

Skill 3.1b.1 A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.

Skill 3.1b.2 Substances react chemically in characteristic ways with other substances to form new substances (compounds) with different characteristic properties. In chemical reactions, the total mass is conserved. Substances often are placed in categories or groups if they react in similar ways; metals is an example of such a group.

Skill 3.1b.3 Chemical elements do not break down during normal laboratory reactions involving such treatments as heating, exposure to electric current, or reaction with acids. There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances that we encounter.

Concept 3.2 Understand and apply knowledge of forms of energy and energy transfer.

Skill 3.2.1 Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.

Skill 3.2.2 Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.

Skill 3.2.3 Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object- emitted by or scattered from it- must enter the eye.

Skill 3.2.4 Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced.

Skill 3.2.5 In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers.

Skill 3.2.6 The sun is a major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches the earth, transferring energy from the sun to the earth. The sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation.

Concept 3.3 Understand and apply knowledge of motions and forces.

Skill 3.3.1 The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.

Skill 3.3.2 An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.

Skill 3.3.3 If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in speed or direction of an object's motion.

Strand 4 Life Science

Concept 4.1 Understand and apply knowledge of the basic components and functions of cells, tissues, organs, and organ systems.

Skill 4.1.1 Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems.

Skill 4.1.2 All organisms are composed of cells. Most organisms are single cells; other organisms, including humans are multi-cellular.

Skill 4.1.3 Cells carry on the many functions needed to sustain life. They grow and divide, thereby producing more cells. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or an organism needs.

Skill 4.1.4 Specialized cells perform specialized functions in multi-cellular organisms. Groups of specialized cells cooperate to form a tissue, such as muscle. Different tissues are, in turn, grouped together to form larger functional units, called organs. Each type of cell, tissue, and organ has a distinct structure and set of functions that serve the organism as a whole.

Concept 4.2 Understand and apply knowledge of how different organisms pass on traits (heredity).

Skill 4.2.1 Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another.

Skill 4.2.2 Hereditary information is contained in genes, located in the chromosomes of each cell. Each gene carries a single unit of information. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes.

Skill 4.2.3 The characteristics of an organism can be described in terms of a combination of traits. Some traits are inherited and others result from interactions with the environment.

Concept 4.3 Understand and apply knowledge of the complementary nature of structure and function and the commonalities among organisms.

Skill 4.3.1 Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems. Organisms are classified according to common characteristics.

Concept 4.4a interdependency of organisms, changes in environmental conditions, and survival of individuals and species.

Concept 4.4b the cycling of matter and energy in ecosystems.

Skill 4.4b.1 All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.

Skill 4.4b.2 Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive.

Skill 4.4b.3 Behavior is one kind of response an organism can make to an internal or environmental stimulus. A behavioral response requires coordination and communication on many levels, including cells, organ systems, and whole organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.

Skill 4.4b.4 Species acquire many of their unique characteristics through biological adaptation which involves the selection of naturally occurring variations in populations.

Skill 4.4b.5 Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

Skill 4.4b.6 For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.

Concept 4.5 Understand and demonstrate knowledge of the social and personal implications of environmental issues.

Skill 4.5.1 Chapter 12 of the Iowa Administrative Code states that science instruction shall include conservation of natural resources; and environmental awareness.

Skill 4.5.2 The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition. Given adequate biotic and abiotic resources and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.

Concept 4.6 Understand and apply knowledge of the functions and interconnections of the major human body systems including the breakdown in structure or function that disease causes.

Skill 4.6.1 The human organism has systems for digestion, respiration, reproduction, circulation, excretion, movement, control, and coordination, and for protection from disease. These systems interact with one another.

Skill 4.6.2 Disease is a breakdown in structures or functions of an organism. Some diseases are the result of intrinsic failures of the system. Others are the result of damage by infection by other organisms.