INDIANA DEPARTMENT *of* EDUCATION

2024 INDIANA CONTENT CONNECTORS

SCIENCE

GRADE 8

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Indiana Content Connectors Context and Purpose

Introduction

The Indiana Content Connectors for Grade 8 Science are the result of a process designed to identify, evaluate, synthesize, and create high-quality learning expectations for Indiana students with significant cognitive disabilities.

The Indiana Department of Education (IDOE) convened stakeholder committees to review proposed revisions to Indiana's Alternative Standards, known as content connectors. The content connectors are designed to measure the knowledge and skills of students with the most significant cognitive disabilities and are assessed with the state's alternate assessment. The content connectors are designed to ensure that all Indiana students in this population are prepared with essential knowledge and skills needed to access employment, enrollment, or enlistment leading to service.

What are the Content Connectors and how should they be used?

The Indiana Content Connectors are designed to help educators, parents, students, and community members understand the necessary content for each grade level, and within each content area domain, to access employment, enrollment, or enlistment leading to service. These content connectors should form the basis for strong core instruction for all students at each grade level and content area. The content connectors identify the minimum academic content or skills to which Indiana students need access in order to be prepared for success after graduation, but they are not an exhaustive list.

While the Indiana Content Connectors establish key expectations for knowledge and skills and should be used as the basis for curriculum, the content connectors by themselves do not constitute a curriculum. It is the responsibility of the local school corporation to select and formally adopt curricular tools, including textbooks and any other supplementary materials, that align with Indiana Content Connectors. Additionally, corporation and school leaders should consider the appropriate instructional sequence of the content connectors as well as the length of time needed to teach each one. Every content connector has a unique place in the continuum of learning, but each content connector will not require the same amount of time and attention. A deep understanding of the vertical articulation of the standards will enable educators to make the best instructional decisions. These content connectors must also be complemented by robust, evidence-based instructional practices to support overall student development. By utilizing strategic and intentional instructional practices, other areas such as STEM and employability skills can be integrated with the content connectors.

Acknowledgments

IDOE appreciates the time, dedication, and expertise offered by Indiana's K-12 general and special educators, higher education professors, representatives from business and industry, families, and other stakeholders who contributed to the development of the Indiana Content Connectors. We wish to specially acknowledge the committee members, as well as participants in the public comment period, who dedicated many hours to the review and evaluation of these content connectors designed to prepare Indiana students for success after graduation.

Grade 8 Science

Standards and content connectors identified as essential for mastery by the end of the grade level are indicated with gray shading and an "E."

Indiana Academic Standards	Content Connectors
Matter and its Interactions	
MS-PS1-1: Matter and its Interactions Students who demonstrate understanding can: Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] (E)	**MS-PS1-1a:** Use a model to compare the atomic composition of various molecules and extended structures. (E)
MS-PS1-2: Matter and its Interactions Students who demonstrate understanding can: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] (E)	**MS-PS1-2a:** Use data to identify evidence that proves a chemical reaction has occurred. (E)

MS-PS1-3: Matter and its Interactions Students who demonstrate understanding can: Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.]	**MS-PS1-3a:** Use information to describe that synthetic materials are developed from natural materials. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.]
MS-PS1-4: Matter and its Interactions Students who demonstrate understanding can: Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]	**MS-PS1-4a:** Use a model to describe changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]
MS-PS1-5: Matter and its Interactions Students who demonstrate understanding can: Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.]	**MS-PS1-5a:** Use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
MS-PS1-6: Matter and its Interactions Students who demonstrate understanding can: Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.	**MS-PS1-6a:** Plan how to test and/or modify a device that either releases or absorbs thermal energy by chemical processes. [Clarification Statement: Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.]

[Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.]	
From Molecules to Organisms: Structures and Processes	
MS-LS1-4: From Molecules to Organisms: Structures and Processes Students who demonstrate understanding can: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively. [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]	**MS-LS1-4a:** Use evidence to identify behaviors animals engage in (e.g., vocalization) or specialized plant structures (e.g., bright flower parts) that increase the likelihood of reproduction.
MS-LS1-5: From Molecules to Organisms: Structures and Processes Students who demonstrate understanding can: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of	**MS-LS1-5a:** Identify evidence (e.g., a scientific explanation) in support of how genetic or environmental factors affect the growth of plants or animals. (E)

genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] (E)	
Heredity: Inheritance and Variation of Traits	
MS-LS3-1: Heredity: Inheritance and Variation of Traits Students who demonstrate understanding can: Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.]	**MS-LS3-1a:** Use a model to describe why changes to genes (mutations) result in harmful, beneficial, or neutral effects to the structure and function of the organism.
MS-LS3-2: Heredity: Inheritance and Variation of Traits Students who demonstrate understanding can: Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause-and-effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.] (E)	**MS-LS3-2a:** Describe that a variety of inherited traits passed from parents to offspring lead to differences among offspring (e.g., eye color), using models such as Punnett squares, diagrams, and simulations. (E) **MS-LS3-2b:** Describe the transfer of genetic information to offspring shown in a model of asexual reproduction.
Biological Evolution: Unity and Diversity	
MS-LS4-1: Biological Evolution: Unity and Diversity Students who demonstrate understanding can: Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms	**MS-LS4-1a:** Use data to identify patterns of changes of different plants or animals that lived at different times as located in different sedimentary layers.

throughout the history of life on Earth under the assumption that natural laws operate today as in the past. [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.]	**MS-LS4-1b:** Use data to identify changes in populations of living organisms (e.g., the presence or absence of large numbers of organisms or specific types of organisms) that lived in a specific location at different times as observed in the fossil record.
MS-LS4-2: Biological Evolution: Unity and Diversity Students who demonstrate understanding can: Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]	**MS-LS4-2a:** Use similarities in anatomical structures to explain evolutionary relationships between living and fossilized organisms.
MS-LS4-3: Biological Evolution: Unity and Diversity Students who demonstrate understanding can: Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.]	**MS-LS4-3a:** Use pictorial data to compare similarities in early development stages of multiple species as evidence that the species are related.
MS-LS4-4: Biological Evolution: Unity and Diversity Students who demonstrate understanding can: Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.] (E)	**MS-LS4-4a:** Use evidence to describe how genetic variations increase some individuals' probability of surviving and reproducing. (E)

MS-LS4-5: Biological Evolution: Unity and Diversity Students who demonstrate understanding can: Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]	**MS-LS4-5a:** Identify technologies that have changed the way humans influence the inheritance of desired traits in plants or animals.
MS-LS4-6: Biological Evolution: Unity and Diversity Students who demonstrate understanding can: Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.]	**MS-LS4-6a:** Explain how natural selection may lead to increasing and decreasing probability of specific traits in populations over time.
Earth's Systems	
MS-ESS2-4: Earth's Systems Students who demonstrate understanding can: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] (E)	**MS-ESS2-4a:** Use a model to describe components of the water cycle, including those driven by energy from the sun and/or the force of gravity. (E)
	MS-ESS2-4b: Use a model to describe relationships between components in a model of energy flows and matter cycles within and among Earth’s systems. (E)

MS-ESS2-5: Earth's Systems Students who demonstrate understanding can: Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] (E)	**MS-ESS2-5a:** Use data to show how patterns in the changes and the movement of air masses in the atmosphere (e.g., temperature, pressure, humidity, precipitation, wind) influence local weather patterns. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] (E)
MS-ESS2-6: Earth's Systems Students who demonstrate understanding can: Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.]	**MS-ESS2-6a:** Use a model to describe how the sun's energy warms the air over the land (expands and rises), the air over the ocean (cooler air) rushes in to take its place and is called wind.
Earth and Human Activity	
MS-ESS3-3: Earth and Human Activity Students who demonstrate understanding can: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification	**MS-ESS3-3a:** Apply scientific principles to determine how well a solution functions to minimize the impact of a human activity on the environment using data.

Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]	
MS-ESS3-4: Earth and Human Activity Students who demonstrate understanding can: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]	**MS-ESS3-4a:** Identify evidence of the effects of increases in human population and per-capita consumption of natural resources over time from a variety of resources. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

MS-ESS3-5: Earth and Human Activity Students who demonstrate understanding can: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over time. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.] (E)	**MS-ESS3-5a:** Ask questions to identify evidence of the factors that have caused the rise in global temperatures over time. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.] (E)
Engineering Design	
MS-ETS1-1: Engineering Design Students who demonstrate understanding can: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (E)	**MS-ETS1-1a:** Define criteria and constraints (e.g., scientific principles, potential impacts on people, the natural environment) of a problem to ensure a successful solution. (E)
MS-ETS1-2: Engineering Design Students who demonstrate understanding can: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	**MS-ETS1-2a:** Select the best solution to a problem using evidence of alignment to criteria and constraints.

MS-ETS1-3: Engineering Design Students who demonstrate understanding can: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	**MS-ETS1-3a:** Combine the best characteristics from multiple solutions into a new solution to better meet the criteria for success.
MS-ETS1-4: Engineering Design Students who demonstrate understanding can: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	**MS-ETS1-4a:** Use a model to generate data on how a design proposal can be modified for improvements through iterative testing.