Grade 6 Teacher's Guide to the Nebraska College and Career Ready Standards for Science 2024

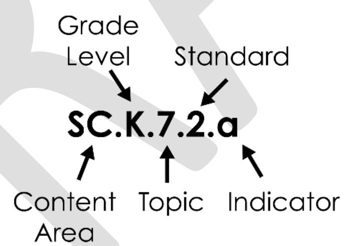
Last Revised 2/13/2025

Content Area Standards Structure

The overall structure of Nebraska's College and Career Ready Standards for Science (CCR-Science) reflects the two-tier structure common across all Nebraska content area standards. The two levels within the structure include **standards** and **indicators**. The **standards** are broad, overarching content-based statements that describe the basic cognitive, affective, or psychomotor expectations of student learning. The standards, across all grade levels, reflect long-term goals for learning. **Indicators** further describe what students must know and be able to do to meet the standard. These performance-based statements provide clear expectations related to student learning in each content area. Additionally, indicators provide guidance related to the assessment of student learning. This guidance is articulated by including ***assessment boundary*** statements.

The CCR-Science standards describe the knowledge and skills that students should learn, but they do not prescribe particular curriculum, lessons, teaching techniques, or activities. Standards describe what students are expected to know and be able to do, while the local curriculum describes how teachers will help students master the standards. A wide variety of instructional resources may be used to meet the state content area standards. Decisions about curriculum and instruction are made locally by individual school districts and classroom teachers. The Nebraska Department of Education provides guidance related to high-quality instructional materials selection and implementation. Please visit the Nebraska Instructional Materials Collaborative.

In addition to a common structure for content area standards, a consistent numbering system is used for content area standards. The numbering system is as follows:



Content Area Standards Overview

Nebraska Revised Statute 79-760.01 requires the State Board of Education to adopt measurable academic content standards for the areas of reading, writing, mathematics, science, and social studies. Standards describe grade-level expectations for given content areas and provide a framework upon which Nebraska districts develop, establish, and implement curriculum. For effective teaching and learning to occur, the content area standards should drive local decisions related to instructional materials, resources, and interim, formative, and summative assessments.

The Nebraska Department of Education has identified quality criteria in the development of content area standards. These criteria ensure that standards are grounded in a strong research base of human cognition, motivation, and teaching and learning and describe essential knowledge and skills for college, career, and civic readiness. The revised science standards, written by teams of Nebraska educators and reviewed by local and national experts, were developed with the following indicators of quality:

Measurable: Standards provide benchmarks against which student progress toward learning goals can be measured.

Appropriately challenging: Standards must build in complexity so that by the end of grade 12, students are prepared for postsecondary education and the workforce.

Connected: Student learning is most effective when it connects knowledge and skills to related topics and authentic applications.

Clearly worded: Content area standards must effectively communicate what students should know and be able to do.

Scaffolded: Indicators in the Nebraska content area standards scaffold student learning by sequencing connected knowledge and skills across grades so that students build and deepen understanding and ability over time.

Specific: Specificity assures that the language used in standards and indicators is sufficiently detailed to be accurately interpreted by educators

Organization and Structure of College and Career Ready Standards for Science (CCR-Science)

Nebraska's College and Career Ready Standards for Science (CCR-Science) are organized by grade level for grades K-8 and by grade span in high school. K-5 standards are organized to reflect the developmental nature of learning for elementary students and attend to the learning progressions that build foundational understandings of science. By the time students reach middle school (Grades 6-8), they build on this foundation in order to develop more sophisticated understandings of science concepts through high school. The topic progression for the CCR-Science standards is included in Appendix A: Topic Progression.

Within each grade level/span the standards are organized around topics, and each standard addresses one topic. Each CCR-Science standard begins with the common stem: "Gather, analyze, and communicate…" This stem highlights long-term learning goals associated with rigorous science standards and provides guidance for high quality classroom instruction. To facilitate high-quality instruction, students actively gather evidence from multiple sources related to the topics. Evidence is carefully analyzed in order to describe and explain natural phenomena, and then, students communicate their understanding of the content using a variety of tools and strategies. It is important to note that while topics are introduced in a spiraled model, they are connected, and deeper understanding at subsequent grade levels and spans requires foundational understanding of multiple topics.

The indicators reflect the three dimensions of science learning outlined in *A Framework for K-12 Science Education*[1]*.* Each CCR-Science indicator includes a disciplinary core idea, <u>a crosscutting concept</u> (<u>underline</u>), and a **science and engineering practice** (**bold**).

Disciplinary Core Ideas (DCI)

The disciplinary core ideas are the focused, limited set of science ideas identified in the Framework as necessary for ALL students throughout their education and beyond their K-12 school years to achieve scientific literacy. The limited number of disciplinary core ideas allows more time for students and teachers to engage in the science and engineering practices as they deeply explore science ideas. To allow students to continually build on and revise their knowledge and abilities, the disciplinary core ideas are built on developmental learning progressions (Appendix A).

Crosscutting Concepts (CCC)

The crosscutting concepts are used to organize and make sense of disciplinary core ideas. They serve as tools that bridge disciplinary boundaries and deepen understanding of science content. With grade-appropriate proficiency, students are expected to use patterns (cause and effect, scale, proportion, and quantity), systems and system models (energy and matter, structure and function) and stability and change as they gather, analyze, and communicate scientific understanding. These crosscutting concepts provide structure for synthesizing knowledge from various fields into a coherent and scientifically based view of the world.

Science and Engineering Practices (SEP)

The science and engineering practices are used by students to demonstrate understanding of the disciplinary core ideas and crosscutting concepts. Engaging in the practices of science and engineering helps students understand the wide range of approaches used to investigate natural phenomena and develop solutions to challenges. Students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information as they gather, analyze, and communicate scientific information.

Each science indicator focuses on one crosscutting concept and one science and engineering practice as an example to guide assessment. Curriculum, instruction, and assessment should reflect authentic science practice and be phenomena-based. Furthermore, curriculum, instruction, and assessment should use crosscutting concepts and science and engineering practices that go beyond what is stated in the indicator to better reflect authentic science practice. Utilizing the range of SEPs and CCCs will support deeper learning and greater understanding of the DCIs.

The following table lists the disciplinary core ideas, crosscutting concepts, and **science and engineering practices**:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Asking Questions and Defining Problems • Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Using Mathematics and Computational Thinking • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	LS1: From Molecules to Organisms: Structures and Processes LS2: Ecosystems: Interactions, Energy, and Dynamics LS3: Heredity: Inheritance and Variation of Traits LS4: Biological Evolution: Unity & Diversity PS1: Matter and Its Interactions PS2: Motion and Stability: Forces and Interactions PS3: Energy PS4: Waves and Their Applications in Technologies for Information Transfer ESS1: Earth's Place in the Universe ESS2: Earth's Systems ESS3: Earth and Human Activity ETS1: Engineering Design	Patterns Cause and Effect Scale, Proportion, and Quantity Systems and System Models Energy and Matter Structure and Function Stability and Change

[1] *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Washington, DC: The National Academies Press, 2012.

Icon Titles & Descriptions

Nebraska Connections

Opportunities to teach science using topics directly relevant to our state (e.g. Ogallala Aquifer, agriculture, Nebraska-specific flora and fauna, Nebraska's rich geologic history, etc.) are listed throughout the CCR-Science standards as "Nebraska Connections." These connections allow educators to use local, regional, and state-specific contexts for teaching, learning, and assessment. Educators should use these as recommendations for investigation with students. Additionally, assessment developers have the opportunity to use the Nebraska contexts to develop Nebraska-specific examples or scenarios from which students would demonstrate their general understanding. This approach provides the opportunity for educators to draw upon Nebraska's natural environment and rich history and resources in engineering design and scientific research to support student learning.

Educator Support & Resources

Implementation

Effective science teaching, learning, and assessments should integrate disciplinary core ideas, crosscutting concepts, and **science and engineering practices**. Integration of the three dimensions will allow students to explain scientific phenomena, engage in sensemaking, design solutions to problems, and build a foundation upon which they can continue to learn and be able to apply science knowledge and skills within and outside the K-12 education arena. While each indicator incorporates the three dimensions, this alone does not drive student outcomes. Ultimately, student learning depends on how the standards are translated to instructional practices.

To support educators while they explore and implement content standards, the Nebraska Department of Education has developed the Content Area Standards Implementation Framework. The Framework is based on implementation science and includes stages from "Exploration" to "Deep Implementation," the types of work and activities associated with each stage, and roles of educators in ensuring successful implementation. The goal of the framework is to guide the alignment of standards, instruction, materials, and assessment to create a coherent system of learning.

Phenomenon-based Instruction

Three-dimensional instruction offers authentic learning experiences when students engage in describing and explaining the natural world. This involves focusing the conceptual learning on anchoring and investigative phenomena to better comprehend their observations. Students utilize evidence in the sensemaking process to build concepts in their minds. Phenomena are natural, observable events that we can explain or predict using our science knowledge (the singular form of phenomena is phenomenon).

Teachers are encouraged to adopt phenomenon-based instruction to fully engage students in three-dimensional science learning. This method can be summarized in three steps:

1. Introduce a new unit or concept with a phenomenon: Start by presenting a phenomenon that is relevant to students' lives. This engages

them in asking questions about their observations and fosters a desire to learn more. Many teachers already use this approach by introducing new units or concepts with tangible examples such as pictures, videos, demonstrations, or laboratory experiences.

2. Engaging in science and engineering practices: Provide opportunities for students to gather and reason about information to explain the phenomenon. Sensemaking represents a shift in science instruction where teachers refrain from giving students direct answers. Instead, they should offer multiple opportunities for students to explore the phenomenon individually and in groups, while scaffolding their learning. This approach supports students in developing an understanding of scientific concepts and constructing their own explanations for the phenomenon.

3. Communicating understanding: Ensure students have multiple opportunities to articulate their thinking about why the phenomenon occurs. To deepen their understanding, check that student explanations progress from simple descriptions of what they observe to more complex explanations and predictions of what they think is happening with the phenomenon.

Throughout this process, teachers should not provide direct answers about the phenomenon. Instead, they should facilitate experiences that help students reach an appropriate understanding. Often, this involves engaging students in scientific arguments where they challenge each other's claims and explanations using their observations and collected evidence.

Teacher Guides

The Teacher Guides were created to provide guidance for developing effective instruction aligned to Nebraska's College and Career Ready Science Standards. They are intended to support teachers, administrators, science specialists, ESU's, instructional coaches, parents, and other stakeholders as they plan instruction and assessment at a local level.

The Teacher Guides are meant as a resource document which unwraps the indicators to support teacher's understanding of the standards. They are not meant to be used by students, and therefore they are not written in student-friendly language.

Nebraska Science Classroom Formative Task Repository

The Nebraska Science Classroom Formative Task Repository is a collection of K-12 formative tasks aligned to the indicator level of the standards. Tasks were developed by Nebraska educators and cover the breadth of the standards giving students an opportunity to provide evidence of what they can know and can do related to that standard.

Graduation Requirements

The high school life science, physical science, and Earth and space science standards are intended for **ALL** students to have learned by the end of 30 credit hours of high school science courses.

Rule 10

003.05 Graduation Requirements. Each high school must require from grades nine through twelve at least 200 credit hours for graduation, for which at least 80 percent must be from the core curriculum. The number of credit hours given for a course may be less than the number of instructional units and may be increased up to 25 percent above the number of instructional units.

003.05A3 Science. Thirty credit hours of science with course content that includes biological, earth/space, and physical science concepts with corresponding science inquiry skills and laboratory experience.

Course examples that offer the scope and sequence to include all three domains are included in Appendix B: HS Integrated Science Course Model.

Explanation of the Teacher's Guide to the Nebraska CCR-Science Standards 2024

Standard

Standard Code [Content Area].[Grade Level].[Topic].[Standard]

The standard description is listed here to give broader context to this and other indicators in the standard. The standard description articulates the core ideas and theme. Standards represent significant areas of learning within grade-level progressions and content areas. Each standard introduction is an orientation for the teacher in order to provide an overall view of the concepts needed for foundational understanding.

Indicator

Indicator Code [Content Area].[Grade Level].[Topic].[Standard].[Indicator]

Within each standard are indicators. The indicator is listed here as found in the CCR-Science Standards. Indicators in the CCR-Science Standards are written as student performance expectations that describe what students must know and be able to do by the end of an instructional sequence. An indicator represents a proficiency level for that grade. An indicator articulates how a learner may demonstrate their proficiency, incorporating not only the disciplinary core idea but also a crosscutting concept and a science and engineering practice. While some indicators within a standard may be more comprehensive than others, all indicators are essential for a comprehensive understanding of a standard's purpose.

The DCIs will be in ordinary text. The CCCs will be underlined. **The SEPs will be in bold.** Indicators also include clarification statements and assessment boundaries when needed. Clarification statements offer further clarification to the indicators content or offer examples and are indicated with gray text. Assessment boundaries are the limitations given to the state-developed assessments and are indicated with red text.

NGSS Comparison: [NGSS Code]

The CCR-Science Standards are strongly influenced by the Next Generation Science Standards (NGSS). Teachers can use the NGSS code to find instructional resources. There are many resources that have been created that compare to each NGSS code. It is important to note that the NGSS codes use dashes and end in a number (e.g., 5-PS1-3), and the DCIs use dots and end in a letter (e.g., PS1.A).

Other Indicators in this Standard

Each standard requires all of the indicators to provide the full understanding of the concept knowledge, skills, and lenses needed to demonstrate proficiency for that standard. The indicators included in the standard will be listed here under their code.

Concepts and Skills to Master

Foundation Boxes:

The foundation boxes provide clarity for planning by explicitly and intentionally identifying the three dimensions found in the standard. Teachers should frame their planning around what students will be doing to demonstrate 3D learning. The table identifies the minimum level of complexity expected for proficiency in each of the three dimensions of a standard. Individual classroom instruction can and should use additional Science and Engineering Practices (SEPs) and Crosscutting Concepts (CCCs) to support student sense-making. The information in this table is based on research found in A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (NRC, 2012), adds specificity on how a standard should be interpreted and provides additional ideas of instructional practices related to the standard. The intent is to help the teacher move students into deeper and more focused use of the SEP, CCC, and DCI. The use of supporting SEPs and CCCs is an integral part of robust instruction. The purpose of supporting SEPs and CCCs are to allow multiple ways to approach knowledge, skills, and abilities. Teachers should use the focal SEPs and CCCs during instruction but may utilize supporting SEPs and CCCs to broaden instruction.

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
[Science and Engineering Practice Name]: • **The science and engineering practice(s) found in the indicator written in the context of the content (DCI).** • Students do and use the Science and Engineering Practice (SEP). Practices refer to the things that scientists and engineers do and how they actively engage in their work. This section provides more clarification for what students should be doing to engage in this practice. There are various ways that each practice can be used, as articulated in the K-12 Framework for Science Education (NRC, 2012). This information primarily comes from the NSTA's SEP Matrix.	**[Crosscutting Concept Name]:** • **The crosscutting concept(s) found in the indicator written in the context of the content (DCI).** • Students think and connect through the Crosscutting Concept (CCC) in order to reason. Crosscutting concepts provide a lens to focus student thinking in order to support students to make sense of science and engineering concepts to be able to explain phenomena. Teachers encourage students to frame their thinking around the terminology of the CCCs through questions and classroom discussions. This information primarily comes from the NSTA's CCC Matrix.
Disciplinary Core Idea (DCI)	
([DCI Code]): [DCI Name] • **Students know and apply the Disciplinary Core Idea (DCI) in their thinking and reasoning.** • These are the core ideas from the K-12 Framework for Science Education (NRC, 2012) that align to this standard. This section is NOT a checklist of content for students to memorize. The purpose of this section is to articulate what core ideas students should know and be able to use to support the explanation of phenomena. If a standard identifies multiple DCIs, this section will be repeated for each core idea. This information primarily comes from the K-12 Framework for Science Education.	
Possible Science and/or Engineering Phenomena to Support 3D Instruction	
In 3D classroom instruction, a real-world phenomenon centered around a scientific concept or engineering problem is used as the starting point for student learning. The phenomenon encourages students to ask questions, investigate, and ultimately construct explanations for why the phenomenon occurs. Each core guide lists potential phenomena that could be used during instruction. It is important for teachers to understand that the best phenomena are those that are relevant to the context of their students' lives and experiences. Phenomena are also a critical component of science assessment. When developing classroom assessments, teachers should select different phenomena than those used during standard instruction but require the use of the same concepts. This allows the assessment to measure student proficiency in each of the three dimensions through a novel situation rather than simply assessing students' ability to recall a previous classroom experience. This document provides a list of possible phenomena; however, teachers should not consider this list all-inclusive. Many appropriate phenomena could be used to investigate and assess each standard.	

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

This section provides statements that delineate what students should be able to know and do to demonstrate proficiency of an indicator. These statements can be used for learning goals, tasks, and assessments during the instructional sequence and should address how the three dimensions interact. These proficiency statements are not intended to be used as curriculum.

Critical Background Knowledge

Grade Band Progressions:

This section illustrates how the three dimensions of science, aligned specifically to an indicator, progress developmentally through grade bands and grade levels. Progressions provide insight into what background knowledge and experience students should have had in prior grades, where teachers should focus science learning in the current grade level, and where students will extend their learning in future grades. Grade band progressions identify where teachers should focus instruction for that grade level in each of the three dimensions. Additionally, progressions are intended to be used to identify areas for student intervention. By looking at previous grade bands, teachers can support students where they are currently and scaffold them to where they need to be by the end of the grade level. The progression table is not intended as a guide for supporting accelerated learning by looking to future grade bands. Accelerated learning should remain in the appropriate grade band, but students could be provided with more depth in their learning experience. This information primarily comes from the NGSS Appendices.

Science and Engineering Practices (SEPs): [SEP name]

The SEPs progress over a student's K-12 science experience. The SEP progressions inform teachers as to how students should be engaging in science and engineering practices. These progressions emphasize the importance of teaching science skills at every grade level because it cannot be assumed that students will develop proficiency in using science and engineering practices independently. With increased developmental ability, students can engage in these practices in more complex ways. Teachers can use the progressions to pre-assess student learning from previous grade bands, adjust instruction, and develop necessary interventions. The science and engineering practices should be addressed to an appropriate developmental level in every grade and science course. In each grade within a grade band, students should be progressing towards mastery of these expectations. Each row of the SEP table delineates a different component of the SEP and how it developmentally progresses.

K-2	3-5	6-8	9-12
[SEP name] in K–2 builds on prior experiences and progresses to ...	**[SEP name] in 3–5 builds on K–2 experiences and progresses to ...**	**[SEP name] in 6– 8 builds on K–5 experiences and progresses to...**	**[SEP name] in 9-12 builds on K–8 experiences and progresses to college or career experiences.**

Crosscutting Concepts (CCCs): [CCC name]

The CCCs progress over a student's K-12 science experience. These progressions inform teachers as to how students should frame their thinking and reasoning. These progressions emphasize the importance of teaching science at every grade level because it cannot be assumed that students will independently be able to use the CCCs to frame their thinking. With increased developmental ability, students will be able to use the crosscutting concepts to think and reason about more complex tasks and phenomena. Teachers can use the progressions to pre-assess student learning from previous grade bands, adjust instruction, and develop interventions as needed. The crosscutting concepts should be addressed to an appropriate developmental level in every grade and science course. In each grade within a grade band, students should be progressing towards mastery of these expectations.

K-2	3-5	6-8	9-12
[CCC name] in K–2 builds on prior experiences and progresses to ...	**[CCC name] in 3–5 builds on K–2 experiences and progresses to ...**	**[CCC name] in 6– 8 builds on K–5 experiences and progresses to...**	**[CCC name] in 9-12 builds on K–8 experiences and progresses to college or career experiences.**

Disciplinary Core Ideas (DCIs): [DCI code] [DCI title]

The core ideas progress over a student's K-12 science experience. These progressions inform teachers as to what core ideas the student should know and be able to use in this grade band. This progression emphasizes the importance of teaching science and engineering at every level because it cannot be assumed that students will develop science and engineering conceptual understanding independently. The core ideas build in complexity as students progress through grade bands. Thus, core ideas must be taught sequentially. Teachers can use the progressions to pre-assess student learning from previous grade bands, adjust instruction, and develop interventions as needed. Note: Most core ideas are taught, at minimum, once within a grade band and not necessarily in sequential grade levels. For example, the DCI PS1.A is taught in 2nd-grade, 5th-grade, 6th-grade, 8th-grade, and chemistry. To clarify this, the provided table identifies the grade and standard for which the DCI is taught in each grade band.

K-2	3-5	6-8	9-12
[NGSS DCI code] in K–2 builds on prior experiences and progresses to ...	**[NGSS DCI code] in 3–5 builds on K–2 experiences and progresses to ...**	**[NGSS DCI code] in 6– 8 builds on K–5 experiences and knowledge and progresses to...**	**[NGSS DCI code] in 9–12 builds on K–8 experiences and knowledge and progresses to...**

Connection to other grade level indicators

This section helps teachers identify potential integration with other indicators that have related disciplinary core ideas at the same grade level or band. When designing curriculum around an anchoring phenomenon and investigative phenomena, identifying how other DCIs relate is pivotal for student understanding of the phenomena and the indicators as significant areas of learning culminating in standards.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

This section helps teachers identify potential integration with other content area standards within their grade level. The expectation of the CCR-Science Standards is for all students to be scientifically literate. Scientists use literacy, mathematics, and critical thinking components for gathering, reasoning, and communicating information. In science, students use reading, writing, speaking, listening, and language in ways specific to the discipline of science. ISTE computer science standards are also included when appropriate.

Academic Language Development

Effective science instruction requires discipline-specific communication skills. This means that effective science learning occurs when students are expected to speak, listen, read, and write in ways that are appropriate to science. The tools in this section help teachers facilitate the acquisition of science discourse, which includes academic scientific language. Teaching words or concepts in isolation or prior to experiences that give context (frontloading) robs students of sense-making opportunities that lead to a greater depth of conceptual understanding.

Below is a list of words that students should use during science discourse. These words are not meant to be used as a vocabulary list or to frontload vocabulary prior to instruction. The teacher should introduce these words only after students have first experienced the related concept and used their own words to describe it.

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- Supporting discourse words will be listed here.

Supporting resources to aide in student discourse:

- STEM Teaching Tool 48: How can teachers guide classroom conversations to support students' science learning?
- STEM Teaching Tool 41: Prompts for Integrating Crosscutting Concepts Into Assessment and Instruction (Download the PDF for example prompts).

Assessment Considerations

Formative Assessment:

A link is provided to the Nebraska-created formative task repository sign-in on the Nebraska Department of Education's website. Exemplar assessments developed by Nebraska teachers are aligned to the indicator. Formative assessments are available for every standard, not every indicator, for grades K-8, and in the domains of physical science, earth science, and life science at the high school level.

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

"This website houses tools, information, and resources developed as part of the Stackable, Instructionally-embedded, Portable Science (SIPS) Assessments project funded for a 36-month period from 2020 through 2023 by a Competitive Grants for State Assessments Grant from the Office of Elementary and Secondary Education at the US Department of Education, awarded to the Nebraska Department of Education." https://sipsassessments.org/

The principled design process found on this website explains how NSCAS tasks and the formative task repository tasks are developed. The SCILLSS Digital Workbook on Designing High Quality Three-dimensional Science Assessments for Classroom Use are found in the "Resources" tab, then select the "Assessment Resources." There are curriculum, instruction, and assessment resources for fifth and eighth grade found in the "Resources" tab, then select "SIPS Resources."

Knowledge, Skills, and Abilities:

These are statements developed from the Evidence Statements when writing tasks that specify what is expected of students to demonstrate (i.e., knowledge, skills, and abilities) to provide evidence that they have learned one or more aspects of the CCR-Science Indicator. These are example broad statements that scaffold the logic of the concept and skill development. These statements can be a representation of the sensemaking process.

Achievement Level Descriptors:

Achievement Level Descriptors are scaled evidence statements of the SEPs and CCCs combined by grade that are used in test score interpretation to determine if a student is performing in the categories of developing, on task, or advanced. Currently these statements are only available in fifth grade and eighth grade.

Grade 6 Teacher's Guide to the Nebraska CCR-Science Standards

The grade 6 standards and indicators help students gather, analyze, and communicate evidence as they formulate answers to questions tailored to student interest and current topics that may include but are not limited to:

How can energy be transferred from one object or system to another?
Students are expected to know the difference between energy and temperature and begin to develop an understanding of the relationship between force and energy. Students are also expected to apply an understanding of design to the process of energy transfer.

How do the structures of organisms contribute to life's functions?
Students are expected to understand that all organisms are made of cells, that special structures are responsible for particular functions in organisms, and that for many organisms the body is a system of multiple interacting subsystems that form a hierarchy from cells to the body.

How do organisms grow, develop, and reproduce?
Students are expected to explain how select structures, functions, and behaviors of organisms change in predictable ways as they progress from birth to old age.

What factors interact and influence weather and climate?
Students are expected to construct and use models to develop an understanding of the factors that determine weather and climate.
A systems approach is also important here, examining the feedbacks between systems as energy from the sun is transferred between systems and circulates through the oceans and atmosphere.

How does water move through Earth's systems?
Students understand how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems.

Standard

Topic: SC.6.4 Energy

Standard Code: SC.6.4.1 Gather, analyze, and communicate evidence of energy.

Students will design and test a device to control thermal energy transfer, define design criteria considering impacts on people and the environment, and plan investigations to explore relationships among energy, matter, mass, and temperature. They will also argue that changes in kinetic energy involve energy transfer.

Indicator

Indicator Code: SC.6.4.1.a

Apply scientific principles to **design, construct, and test a device** that either minimizes or maximizes thermal energy transfer. Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup. Assessment does not include calculating the total amount of thermal energy transferred.

NGSS Comparison: MS-PS3-3

Other Indicators in this Standard

SC.6.4.1.b, SC.6.4.1.c, SC.6.4.1.d

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Constructing Explanations and Designing Solutions: • Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.	**Energy & Matter:** • The transfer of energy can be tracked as energy flows through a designed or natural system. Copy and paste CCC description from foundation box.

Disciplinary Core Idea (DCI)

PS3.A: Definitions of Energy

- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.

PS3.B: Conservation of Energy and Energy Transfer

- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena
- Tile feels colder on your feet than carpet.
- An ice cube melts faster when placed directly on the countertop than on a towel.
- Engineering Problem: A first grader brings an ice cream sandwich to school and keeps it in her desk. She wants to eat it at lunch. Design a solution to keep the ice cream from melting.

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.4.1.a	Apply scientific principles to **design, construct, and test a device** that either minimizes or maximizes thermal energy transfer.	
1	Using scientific knowledge to generate design solutions	
	a	Given a problem to solve that requires either minimizing or maximizing thermal energy transfer, students design and build a solution to the problem. In the designs, students:

		i. Identify that thermal energy is transferred from hotter objects to colder objects.
		ii. Describe* different types of materials used in the design solution and their properties (e.g., thickness, heat conductivity, reflectivity) and how these materials will be used to minimize or maximize thermal energy transfer.
		iii. Specify how the device will solve the problem.
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe* the given criteria and constraints that will be taken into account in the design solution:
		i. Students describe* criteria, including:
		1. The minimum or maximum temperature difference that the device is required to maintain.
		2. The amount of time that the device is required to maintain this difference.
		3. Whether the device is intended to maximize or minimize the transfer of thermal energy.
		ii. Students describe* constraints, which may include:
		1. Materials.
		2. Safety.
		3. Time.
		4. Cost.
3	Evaluating potential solutions	
	a	Students test the device to determine its ability to maximize or minimize the flow of thermal energy, using the rate of temperature change as a measure of success.
	b	Students use their knowledge of thermal energy transfer and the results of the testing to evaluate the design systematically against the criteria and constraints.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Constructing Explanations and Designing Solutions

K-2	3-5	6-8	9-12
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions.	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

Crosscutting Concepts (CCCs): Energy and Matter

K-2	3-5	6-8	9-12
In grades K-2, students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.	In grades 3-5, students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.	In grades 6-8, students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system; the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.	In grades 9-12, students learn that the total amount of energy and matter in closed systems is conserved. They can describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Disciplinary Core Ideas (DCIs): PS3.A: Definitions of Energy DCI code: PS3.B: Conservation of Energy and Energy Transfer: ETS1.B: Developing Possible Solutions

K-2	3-5	6-8	9-12
Content found in PS3.D **PS3.D** Sunlight warms Earth's surface.	**PS3.A and PS3.B** Moving objects contain energy. The faster the object moves, the more energy it has. Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form.	**PS3.A and PS3.B** Kinetic energy can be distinguished from the various forms of potential energy. Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.	**PS3.A** The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects).

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.SL.1 Prepare for and participate in structured discussions and collaborations about 6th grade topics and texts.
- LA.10.W.6 Gather and use credible evidence from multiple authoritative sources and assess its relevance in answering the research question(s).

Mathematics Connections:

- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.

Social Studies Connections:

- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.2 Thermal Energy)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- minimize, maximize, conduction, convection, radiation, thermal energy, heat, temperature, energy transfer, conductor, insulator, problem, design solution, criteria, constraints, prototype, data, test, modification, optimizing design solution

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/resources/

Knowledge, Skills, and Abilities:

- **KSA1:** Students will identify how thermal energy is transferred from the hot object to the cold object for the problem being solved.
- **KSA2:** Students will describe the properties of the materials needed to prevent or maximize transfer of thermal energy.
- **KSA3:** Students will describe the criteria of the solution by the minimum or maximum temperature difference the solution is required to maintain, the amount of time the solution will maintain this temperature difference and identify whether the solution will minimize or maximize the transfer of thermal energy.
- **KSA4:** Students will describe the constraints of the problem by the limitations of materials, time, safety, and cost.
- **KSA5:** Students will describe how the solution design will prevent or maximize the flow of thermal energy.
- **KSA 6:** Students will evaluate a design solution by testing the device to determine its ability to maximize or minimize the flow of thermal energy, using the rate of temperature change as a measure of success.
- **KSA 7:** Students will use the results of the testing to evaluate the design systematically against the criteria and constraints.

Standard

Topic: SC.6.4 Energy

Standard Code: SC.6.4.1 Gather, analyze, and communicate evidence of energy.

Students will design and test a device to control thermal energy transfer, define design criteria considering impacts on people and the environment, and plan investigations to explore relationships among energy, matter, mass, and temperature. They will also argue that changes in kinetic energy involve energy transfer.

Indicator

Indicator Code: SC.6.4.1.b

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principle and potential impacts on people and the natural environment that may limit possible solutions.

NGSS Comparison: MS-ETS1-1

Other Indicators in this Standard

SC.6.4.1.a, SC.6.4.1.c, SC.6.4.1.d

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)

Asking Questions and Defining Problems:

- Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables and clarifying arguments and models.

Crosscutting Concept (CCC)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.

Disciplinary Core Idea (DCI)

ETS1.A: Defining and Delimiting an Engineering Problem

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Link to List of Phenomena that are links to videos and lessons
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena
- An 8 oz. cup of hot chocolate cools faster than a 16 oz. cup.
- Lake Mcconaughy is larger than Johnson Lake. Under the same conditions, Johnson Lake would freeze first.

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.4.1.b Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principle and potential impacts on people and the natural environment that may limit possible solutions.		
1	Identifying the problem to be solved	
	a	Students describe* a problem that can be solved through the development of an object, tool, process, or system.
2	Defining the process or system boundaries and the components of the process or system	
	a	Students identify the system in which the problem is embedded, including the major components and relationships in the system and its boundaries, to clarify what is and is not part of the problem. In their definition of the system, students include:

		i. Which individuals or groups need this problem to be solved.
		ii. The needs that must be met by solving the problem.
		iii. Scientific issues that are relevant to the problem.
		iv. Potential societal and environmental impacts of solutions.
		v. The relative importance of the various issues and components of the process or system.
3	Defining criteria and constraints	
	a	Students define criteria that must be taken into account in the solution that:
		i. Meet the needs of the individuals or groups who may be affected by the problem (including defining who will be the target of the solution).
		ii. Enable comparisons among different solutions, including quantitative considerations when appropriate.
	b	Students define constraints that must be taken into account in the solution, including:
		i. Time, materials, and costs.
		ii. Scientific or other issues that are relevant to the problem.
		iii. Needs and desires of the individuals or groups involved that may limit acceptable solutions.
		iv. Safety considerations.
		v. Potential effect(s) on other individuals or groups.
		vi. Potential negative environmental effects of possible solutions or failure to solve the problem.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Asking Questions and Defining Problems

K-2	3-5	6-8	9-12
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables and clarifying arguments and models.	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

Disciplinary Core Ideas (DCIs): ETS1.A: Defining and Delimiting an Engineering Problem

K-2	3-5	6-8	9-12
ETS1.A A situation that people want to change or create can be approached	**ETS1.A** Possible solutions to a problem are limited by available materials and	**ETS1.A** The more precisely a design task's criteria and constraints can be defined, the more likely it is that the	**ETS1.A** Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible

as a problem to be solved through engineering. Such problems may have many acceptable solutions. Asking questions, making observations, and gathering information are helpful in thinking about problems.	resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account	designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.	and stated in such a way that one can tell if a given design meets them. Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.SL.1 Prepare for and participate in structured discussions and collaborations about 6th grade topics and texts.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.

Mathematics Connections:

- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.

Social Studies Connections:

- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.2 Thermal Energy)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- Criteria, constraints, design problem, precision, scientific principles, impacts, prototype, functionality, durability, cost-effectiveness, ethical considerations, sustainability, innovation, adaptable, performance, reliable, simulation, boundary, solution, limit, potential, impact

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA1:** Students will describe the problem that impacts people and the natural environment which can be solved through the development of an object, tool, process, or system.
- **KSA2:** Students will identify the individuals or groups that this problem affects as part of the system boundaries.

- **KSA3:** Students will describe the needs that need to be met by the solution as part of the system boundaries.
- **KSA4:** Students will describe the potential societal and environmental impacts of solutions as part of the system boundaries.
- **KSA5:** Students will describe the relative importance of the various issues and components of the process or system as part of the system boundaries.
- **KSA6:** Students will define the criteria by how they meet the needs of the individuals or groups who may be affected by the problem.
- **KSA7:** Students will define the constraints of the solution such as time, materials, and cost; what issues are relevant to the problem; the needs and desires of the individuals or groups that limit acceptable solutions; safety considerations; potential effects on other individuals or groups; and/or potential negative environmental effects of possible solutions or failure to the solve the problem.
- **KSA8:** Students will brainstorm solutions to enable comparisons between them that include quantitative considerations when appropriate.

Standard

Topic: SC.6.4 Energy
Standard Code: SC.6.4.1 Gather, analyze, and communicate evidence of energy.

Students will design and test a device to control thermal energy transfer, define design criteria considering impacts on people and the environment, and plan investigations to explore relationships among energy, matter, mass, and temperature. They will also argue that changes in kinetic energy involve energy transfer.

Indicator

Indicator Code: SC.6.4.1.c

Plan an investigation to determine the relationships among the energy transferred, type of matter, mass, and change in average kinetic energy of particles as measured by the temperature of the sample. Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added. Assessment does not include calculating the total amount of thermal energy transferred.

NGSS Comparison: MS-PS3-4

Other Indicators in this Standard

SC.6.4.1.a, SC.6.4.1.b, SC.6.4.1.d

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Planning and Carrying Out Investigations: • Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. ***Connections to the nature of science*** **Scientific Knowledge is Based on Empirical Evidence**	**Scale, Proportion, and Quantity:** • Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes

• Science knowledge is based upon logical and conceptual connections between evidence and explanations Copy and paste description from foundation box	

Disciplinary Core Idea (DCI)

PS3.A: Definitions of Energy

- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.

PS3.B: Conservation of Energy and Energy

- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena
- Water is warmer in the shallow end of a pool vs the deep end.
- Water temperature of a small swimming pool is warmer compared to a larger pool.
- Playground equipment is made with plastic now instead of metal.
- Same amount of Ice melts faster in a larger glass of water than a smaller glass.
- Earthship building materials

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.4.1.c Plan an investigation to determine the relationships among the energy transferred, type of matter, mass, and change in average kinetic energy of particles as measured by the temperature of the sample.		
1	Identifying the phenomenon under investigation	
	a	Students identify the phenomenon under investigation involving thermal energy transfer.
	b	Students describe* the purpose of the investigation, including determining the relationships among the following factors:
		i. The transfer of thermal energy.
		ii. The type of matter.
		iii. The mass of the matter involved in thermal energy transfer.
		iv. The change in the average kinetic energy of the particles.
2	Identifying the evidence to address the purpose of the investigation	
	a	Individually or collaboratively, students develop an investigation plan that describes* the data to be collected and the evidence to be derived from the data, including:
		i. That the following data are to be collected:
		1. Initial and final temperatures of the materials used in the investigation.

		2. Types of matter used in the investigation.
		3. Mass of matter used in the investigation.
		ii. How the collected data will be used to:
		1. Provide evidence of proportional relationships between changes in temperature of materials and the mass of those materials.
		2. Relate the changes in temperature in the sample to the types of matter and to the change in the average kinetic energy of the particles.
3	Planning the investigation	
	a	In the investigation plan, students describe*:
		i. How the mass of the materials are to be measured and in what units.
		ii. How and when the temperatures of the materials are to be measured and in what units.
		iii. Details of the experimental conditions that will allow the appropriate data to be collected to address the purpose of the investigation (e.g., time between temperature measurements, amounts of sample used, types of materials used), including appropriate independent and dependent variables and controls.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Planning and Carrying Out Investigations

K-2	3-5	6-8	9-12
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

Crosscutting Concepts (CCCs): Scale, Proportion, and Quantity

K-2	3-5	6-8	9-12

In grades K-2, students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.	In grades 3-5, students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.	In grades 6-8, students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.	In grades 9-12, students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Disciplinary Core Ideas (DCIs): PS3.A: Definitions of Energy: PS3.B: Conservation of Energy and Energy

K-2	3-5	6-8	9-12
PS3.A - N/A **PS3.B - CONTENT FOUND IN PS3.D** **PS3.D** Sunlight warms Earth's surface.	**PS3.A and PS3.B** Moving objects contain energy. The faster the object moves, the more energy it has. Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form.	**PS3.A and PS3.B** Kinetic energy can be distinguished from the various forms of potential energy. Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.	**PS3.A** The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects). **PS3.B** Systems move toward stable states.

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question
- LA.6.SL.1 Prepare for and participate in structured discussions and collaborations about 6th grade topics and texts.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.

Mathematics Connections:

- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.

Social Studies Connections:

- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.2 Thermal Energy)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- matter, energy, heat, temperature, particles, heat transfer, average particle motion, evidence, data, observation, measurement, experiment, kinetic, initial, added, mass, material

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA1:** Students will define the purpose of the thermal energy transfer investigation by determining the relationships among the following factors: how thermal energy is transferred, the type of matter, mass of the matter involved in the transfer, and the change in the average kinetic energy of the particles.
- **KSA2:** Students will identify the independent, dependent, and constant variables of the investigation.
- **KSA3:** Students will describe how the mass of the materials will be measured and in what units as part of the investigation plan.
- **KSA4:** Students will describe how and when the temperatures of the materials are to be measured and in what units as part of the investigation plan.

- **KSA5:** Students will describe the experimental conditions such as time between the initial and final temperatures of materials, mass of the matter, types of materials used as part of the investigation plan.
- **KSA6:** Students will use the data to provide evidence of proportional relationships between changes in the temperature of materials and the mass of those materials.
- **KSA7:** Students will use the data to relate the changes in temperature to the types of matter and to the change in the average kinetic energy of the particles.

Standard

Topic: SC.6.4 Energy
Standard Code: SC.6.4.1 Gather, analyze, and communicate evidence of energy.

Students will design and test a device to control thermal energy transfer, define design criteria considering impacts on people and the environment, and plan investigations to explore relationships among energy, matter, mass, and temperature. They will also argue that changes in kinetic energy involve energy transfer.

Indicator

Indicator Code: SC.6.4.1.d

Construct, use, and present arguments to support the claim that when kinetic energy of an object changes, energy is transferred to or from the object.
Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object. Assessment does not include calculations of energy.

NGSS Comparison: MS-PS3-5

Other Indicators in this Standard

SC.6.4.1.a, SC.6.4.1.b, SC.6.4.1.c

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Engaging in Argument from Evidence: • Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. ***Connections to the nature of science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations	**Energy and Matter:** **and Matter** • Energy may take different forms (e.g. energy in fields, thermal energy, of motion

Disciplinary Core Idea (DCI)
PS3.B: Conservation of Energy and Energy Transfer:

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena
- Water is warmer in the shallow end of a pool vs the deep end.
- Water temperature of a small swimming pool is warmer compared to a larger pool.
- Playground equipment is made with plastic now instead of metal.
- Same amount of Ice melts faster in a larger glass of water than a smaller glass.
- Earthship building materials

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.4.1.d	**Construct, use, and present arguments** to support the claim that when kinetic energy of an object changes, energy is transferred to or from the object.	
1	Supported claims	
	a	Students make a claim about a given explanation or model for a phenomenon. In their claim, students include idea that when the kinetic energy of an object changes, energy is transferred to or from that object.
2	Identifying scientific evidence	
	a	Students identify and describe* the given evidence that supports the claim, including the following when appropriate:
		i. The change in observable features (e.g., motion, temperature, sound) of an object before and after the interaction that changes the kinetic energy of the object.
		ii. The change in observable features of other objects or the surroundings in the defined system.
3	Evaluating and critiquing the evidence	
	a	Students evaluate the evidence and identify its strengths and weaknesses, including:
		i. Types of sources.
		ii. Sufficiency, including validity and reliability, of the evidence to make and defend the claim.
		iii. Any alternative interpretations of the evidence and why the evidence supports the given claim as opposed to any other claims.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the necessary and sufficient evidence and construct the argument. Students describe* a chain of reasoning that includes:
		i. Based on changes in the observable features of the object (e.g., motion, temperature), the kinetic energy of the object changed.
		ii. When the kinetic energy of the object increases or decreases, the energy (e.g., kinetic, thermal, potential) of other objects or the surroundings within the system increases or decreases, indicating that energy was transferred to or from the object.
	b	Students present oral or written arguments to support or refute the given explanation or model for the phenomenon.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Engaging in Argument from Evidence

K-2	3-5	6-8	9-12
Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s)	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

Crosscutting Concepts (CCCs): Energy and Matter

K-2	3-5	6-8	9-12
In grades K-2, students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.	In grades 3-5, students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.	In grades 6-8, students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system; the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.	In grades 9-12, students learn that the total amount of energy and matter in closed systems is conserved. They can describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Disciplinary Core Ideas (DCIs): PS3.B: Conservation of Energy and Energy Transfer

K-2	3-5	6-8	9-12
PS3.B - CONTENT FOUND IN PS3.D **PS3.D** Sunlight warms Earth’s surface.	**PS3.A and PS3.B** Moving objects contain energy. The faster the object moves, the more energy it has. Energy can be moved from place to place by moving objects, or through	**PS3.A and PS3.B** Kinetic energy can be distinguished from the various forms of potential energy. Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system	**PS3.B** Systems move toward stable states.

	sound, light, or electrical currents. Energy can be converted from one form to another form.	depends on the types, states, and amounts of matter.	

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.
- LA.6.RI.5 Compare and contrast one author's presentation of information with that of another.
- LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.6.RI.7 Compare and contrast regional, national, and/or multicultural perspectives within and across informational texts.

Mathematics Connections:

- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.

Social Studies Connections:

- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.
- SS 6.4.2.a Identify evidence from multiple perspectives and sources to better understand the complexities of world history.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.2 Thermal Energy)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- Kinetic energy, potential energy, energy transfer, friction, thermal energy, sound energy, temperature, motion, conservation of energy, empirical evidence

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA1:** Students will develop a claim in connection to the phenomenon/model that includes when kinetic energy changes, energy was transferred to or from objects.
- **KSA2:** Students will identify and describe evidence to support the claim that changes in motion, temperature, or sound of an object before and after the interaction changes the kinetic energy of the object and changes observable features of other objects in the system.

- **KSA3:** Students will evaluate evidence for kinetic energy change by transfer of energy by identifying its strengths and weaknesses such as source types, validity and reliability, and alternative interpretations of the evidence.
- **KSA4:** Students will use reasoning to connect the evidence for kinetic energy change by transfer of energy to or from other objects in the system.

Standard

Topic: SC.6.6 Structure and Function and Information Processing

Standard Code: SC.6.6.2 Gather, analyze, and communicate evidence of the relationship between structure and function in living things.

Students will investigate to show that living things are made of cells, develop models to explain cell functions, and argue that the body is a system of interacting cell groups. They will also explain how sensory receptors send messages to the brain for behavior or memory.

Indicator

Indicator Code: SC.6.6.2.a

Conduct an investigation to provide evidence that living things are made of cells; either one or many varied cells. Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.

NGSS Comparison: MS-LS1-1

Other Indicators in this Standard

SC.6.6.2.b, SC.6.6.2.c, SC.6.6.2.d

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Planning and Carrying Out Investigations: • Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.	**Scale, Proportion, and Quantity:** • Phenomena that can be observed at one scale may not be observable at another scale. ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.

Disciplinary Core Idea (DCI)

LS1.A: **Structure and Function**

- All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- A sample of pond water has individual, moving organisms when viewed under a microscope.
- White blood cells can chase and consume/kill bacteria.
- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena

- https://www.ngssphenomena.com/searchable-phenomena

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.6.2.a	**Conduct an investigation** to provide evidence that living things are made of cells; either one or many varied cells.	
1	Identifying the phenomenon under investigation	
	a	From the given investigation plan, students identify and describe* the phenomenon under investigation, which includes the idea that living things are made up of cells.
	b	Students identify and describe* the purpose of the investigation, which includes providing evidence for the following ideas: that all living things are made of cells (either one cell or many different numbers and types of cells) and that the cell is the smallest unit that can be said to be alive.
2	Identifying the evidence to address the purpose of the investigation	
	a	From the given investigation plan, students describe* the data that will be collected and the evidence to be derived from the data, including:
		i. The presence or absence of cells in living and nonliving things.
		ii. The presence or absence of any part of a living thing that is not made up of cells.
		iii. The presence or absence of cells in a variety of organisms, including unicellular and multicellular organisms.
		iv. Different types of cells within one multicellular organism.
	b	Students describe* how the evidence collected will be relevant to the purpose of the investigation.
3	Planning the investigation	
	a	From the given investigation plan, students describe* how the tools and methods included in the experimental design will provide the evidence necessary to address the purpose of the investigation, including that due to their small-scale size, cells are unable to be seen with the unaided eye and require engineered magnification devices to be seen.
	b	Students describe* how the tools used in the investigation are an example of how science depends on engineering advances.
4	Collecting the data	
	a	According to the given investigation plan, students collect and record data on the cellular composition of living organisms.
	b	Students identify the tools used for observation at different magnifications and describe* that different tools are required to observe phenomena related to cells at different scales.
	c	Students evaluate the data they collect to determine whether the resulting evidence meets the goals of the investigation, including cellular composition as a distinguishing feature of living things.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Planning and Carrying Out Investigations

K-2	3-5	6-8	9-12
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

Crosscutting Concepts (CCCs): Scale, Proportion, and Quantity

K-2	3-5	6-8	9-12
In grades K-2, students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length.	In grades 3-5, students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume.	In grades 6-8, students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations.	In grades 9-12, students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

Disciplinary Core Ideas (DCIs): LS1.A: Structure and Function

K-2	3-5	6-8	9-12
LS1.A All organisms have external parts that they use to perform daily functions.	**LS1.A** Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.	**LS1.A** All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.	**LS1.A** Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.

Mathematics Connections:

- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.
- SS 6.4.1.b Analyze the impact of historical events in the world using symbols, maps, documents, and artifacts.
- S 6.4.2.a Identify evidence from multiple perspectives and sources to better understand the complexities of world history

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.6 Cells and Systems)
    - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):
Cell, microscope, microscopic, organism, multicellular, unicellular, tissue, organ

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA1:** Students will be given an investigation plan to identify and describe the phenomenon that living things are made up of cells.
- **KSA2:** Students will identify the purpose of the investigation is to provide evidence for the following ideas: that all living things are made of cells (either one cell or many different numbers and types of cells) and that the cell is the smallest unit that can be said to be alive.
- **KSA3:** Students will describe the data that will be collected or derived as the presence of cells in living things and the absence of cells in nonliving things.
- **KSA4:** Students will describe the data that will be collected or derived as the presence or absence of cells in a variety of organisms, including unicellular and multicellular organisms.

- **KSA5:** Students will describe the data that will be collected or derived showing different types of cells within one multicellular organism.
- **KSA6:** Students will plan the investigation by describing how the tools and methods used will provide the necessary evidence to prove that cells are small scale and invisible to the unaided eye without magnification devices and how science depends on engineering advances.

Standard

Topic: SC.6.6 Structure and Function and Information Processing

Standard Code: SC.6.6.2 Gather, analyze, and communicate evidence of the relationship between structure and function in living things.

Students will investigate to show that living things are made of cells, develop models to explain cell functions, and argue that the body is a system of interacting cell groups. They will also explain how sensory receptors send messages to the brain for behavior or memory.

Indicator

Indicator Code: SC.6.6.2.b

Develop and use a model to describe the function of a cell as a whole and ways parts of a cell contribute to the function.
Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.

NGSS Comparison: MS-LS1-2

Other Indicators in this Standard

SC.6.6.2.a, SC.6.6.2.c, SC.6.6.2.d

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Developing and Using Models: • Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	**Structure and Function:** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.

Disciplinary Core Idea (DCI)

LS1.A: Structure and Function:

- Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Why do scabs/cuts heal on their own
- Why do some organisms grow differently and have different appearances
- Some plants/animals can regenerate new parts

- Photosynthesis
- Plants stand upright without a skeleton
- Both plants and animals derive energy in different ways
- Plants are rigid, animals are squishy/soft
- Plants can grow without food, animals need to eat
- Some animals/people sunburn easily, and others do not
- How does a sunburn disappear
- The leaves of a plant are typically green, but the roots are typically not green.
- Red blood cells do not have a nucleus.
- After soaking some living objects like carrots in a saturated salt solution significant changes can occur
- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.6.2.B Develop and use a model to describe the function of a cell as a whole and ways parts of a cell contribute to the function.		
1	Components of the model	
	a	To make sense of a phenomenon, students develop a model in which they identify the parts (i.e., components; e.g., nucleus, chloroplasts, cell wall, mitochondria, cell membrane, the function of a cell as a whole) of cells relevant for the given phenomenon.
2	Relationships	
	a	In the model, students describe* the relationships between components, including:
		i. The particular functions of parts of cells in terms of their contributions to overall cellular functions (e.g., chloroplasts' involvement in photosynthesis and energy production, mitochondria's involvement in cellular respiration).
		ii. The structure of the cell membrane or cell wall and its relationship to the function of the organelles and the whole cell.
3	Connections	
	a	Students use the model to describe* a causal account for the phenomenon, including how different parts of a cell contribute to how the cell functions as a whole, both separately and together with other structures. Students include how components, separately and together, contribute to:
		i. Maintaining a cell's internal processes, for which it needs energy.
		ii. Maintaining the structure of the cell and controlling what enters and leaves the cell.
		iii. Functioning together as parts of a system that determines cellular function.
	b	Students use the model to identify key differences between plant and animal cells based on structure and function, including:
		i. Plant cells have a cell wall in addition to a cell membrane, whereas animal cells have only a cell membrane. Plants use cell walls to provide structure to the plant.
		ii. Plant cells contain organelles called chloroplasts, while animal cells do not. Chloroplasts allow plants to make the food they need to live using photosynthesis.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Developing and Using Models

K-2	3-5	6-8	9-12
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

Crosscutting Concepts (CCCs): Structure and Function

K-2	3-5	6-8	9-12
In grades K-2, students observe the shape and stability of structures of natural and designed objects are related to their function(s).	In grades 3-5, students learn different materials have different substructures, which can sometimes be observed; and substructures have shapes and parts that serve functions	In grades 6-8, students model complex and microscopic structures and systems and visualize how their function depends on the shapes, composition, and relationships among its parts. They analyze many complex natural and designed structures and systems to determine how they function. They design structures to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.	In grades 9-12, students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.

Disciplinary Core Ideas (DCIs): [LS1.A](LS1.A): Structure and Function

K-2	3-5	6-8	9-12

LS1.A All organisms have external parts that they use to perform daily functions.	**LS1.A** Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.	**LS1.A** All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.	**LS1.A** Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.W.3 Write in a variety of literary forms to convey real or imagined experiences or events in which the development and structure are appropriate to the task, purpose, and audience.

Mathematics Connections:

- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.N.1.c Model integers using drawings, words, number lines, models, and symbols.

Social Studies Connections:

- SS 6.4.1.b Analyze the impact of historical events in the world using symbols, maps, documents, and artifacts
- SS 6.1.1 Investigate the foundations, structures, and functions of governmental institutions.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.6 Cells and Systems)
    - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- Model, function, whole cell function, part cell function, nucleus, chloroplasts, mitochondria, cell membrane, cell wall, organelles

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA1:** Students will develop a model of the cell to make sense of the phenomenon where parts of the cell are identifiable, which may include the chloroplast, nucleus, cell wall, cell membrane, mitochondria, vacuole, and other organelles.
- **KSA2:** Students will use the model to describe the function of separate cell parts contributing to whole cell function.
- **KSA3:** Students will use the model to describe the relationship between cell parts contributing to whole cell function.
- **KSA4:** Students will use the model to describe how parts of the cell separately and together contribute to whole cell function to maintain internal processes which require energy.

- **KSA5:** Students will use the model to describe how parts of the cell separately and together contribute to whole cell function to maintain the structure of the cell and control when enters and leaves the cell.
- **KSA6:** Students will use the model to describe the cell functioning together with other cells as parts of a larger system (tissue, organ, organ system, organism) that determines cellular function.
- **KSA7:** Students will use the model to identify key differences in structure and function between plant and animal cells that includes how plant cells have a cell wall for structure and a cell membrane for a semi-permeable barrier whereas animal cells only have a cell membrane.
- **KSA8:** Students will use the model to identify key differences in structure and function between plant and animal cells that includes how plant cells have chloroplasts to make their food needed to live via photosynthesis while animal cells do not.

Standard

Topic: SC.6.6 Structure and Function and Information Processing
Standard Code: SC.6.6.2 Gather, analyze, and communicate evidence of the relationship between structure and in living things.

Students will investigate to show that living things are made of cells, develop models to explain cell functions, and argue that the body is a system of interacting cell groups. They will also explain how sensory receptors send messages to the brain for behavior or memory.

Indicator

Indicator Code: SC.6.6.2.c

Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems. Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.

NGSS Comparison: MS-LS1-3

Other Indicators in this Standard

SC.6.6.2.a, SC.6.6.2.b, SC.6.6.2.d

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Engaging in Argument from Evidence: • Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument	**System and System Models:**

that supports or refutes claims for either explanations or solutions about the natural and designed world(s). ***Connections to the nature of science*** **Science is a Human Endeavor** • Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.	• Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. and paste CCC description from foundation box.

Disciplinary Core Idea (DCI)

LS1.A: Structure and Function:

- In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- I can feel a difference in my pulse in my neck after I exercise.
- I often sweat during and after I exercise.
- A chicken foot does not have large muscles.
- My friend has a hard time breathing, she uses an inhaler
- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena

Evidence Statements

What does it look like to demonstrate proficiency on this indicator? Use argument supported by evidence for how the body is a <u>system</u> of interacting subsystems composed of groups of cells.

6.6.2.c	**Use argument supported by evidence** for how the body is a <u>system</u> of interacting subsystems composed of a group of cells.	
1	Supported claims	
	a	Students make a claim to be supported, related to a given explanation or model of a phenomenon. In the claim, students include the idea that the body is a system of interacting subsystems composed of groups of cells.
2	Identifying scientific evidence	
	a	Students identify and describe* the given evidence that supports the claim (e.g., evidence from data and scientific literature), including evidence that:
		i. Specialized groups of cells work together to form tissues (e.g., evidence from data about the kinds of cells found in different tissues, such as nervous, muscular, and epithelial, and their functions).
		ii. Specialized tissues comprise each organ, enabling the specific organ functions to be carried out (e.g., the heart contains muscle, connective, and epithelial tissues that allow the heart to receive and pump blood).
		iii. Different organs can work together as subsystems to form organ systems that carry out complex functions (e.g., the heart and blood vessels work together as the circulatory system to transport blood and materials throughout the body).
		iv. The body contains organs and organ systems that interact with each other to carry out all necessary functions for survival and growth of the organism (e.g., the digestive, respiratory, and circulatory systems are involved in the breakdown and transport of food and the transport of oxygen throughout the body to cells, where the molecules can be used for energy, growth, and repair).
3	Evaluating and critiquing the evidence	

	a	Students evaluate the evidence and identify the strengths and weaknesses of the evidence, including:
		i. Types of sources.
		ii. Sufficiency, including validity and reliability, of the evidence to make and defend the claim.
		iii. Any alternative interpretations of the evidence and why the evidence supports the student's claim, as opposed to any other claims.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the appropriate evidence to the claim. Students describe* the following chain of reasoning in their argumentation:
		i. Every scale (e.g., cells, tissues, organs, organ systems) of body function is composed of systems of interacting components.
		ii. Organs are composed of interacting tissues. Each tissue is made up of specialized cells. These interactions at the cellular and tissue levels enable the organs to carry out specific functions.
		iii. A body is a system of specialized organs that interact with each other and their subsystems to carry out the functions necessary for life.
	b	Students use oral or written arguments to support or refute an explanation or model of a phenomenon.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Engaging in Argument from Evidence

K-2	3-5	6-8	9-12
Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s)	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

Crosscutting Concepts (CCCs): System and System Models

K-2	3-5	6-8	9-12
In grades K-2, students understand objects and organisms can be described in terms of their parts; and systems in the natural and	In grades 3-5, students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts	In grades 6-8, students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as	In grades 9-12, students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy,

designed world have parts that work together.	cannot. They can also describe a system in terms of its components and their interactions.	inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study	matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.

Disciplinary Core Ideas (DCIs): LS1.A: Structure and Function

K-2	3-5	6-8	9-12
LS1.A All organisms have external parts that they use to perform daily functions.	**LS1.A** Organisms have both internal and external macroscopic structures that allow for growth, survival, behavior, and reproduction.	**LS1.A** All living things are made up of cells. In organisms, cells work together to form tissues and organs that are specialized for particular body functions.	**LS1.A** Systems of specialized cells within organisms help perform essential functions of life. Any one system in an organism is made up of numerous parts. Feedback mechanisms maintain an organism's internal conditions within certain limits and mediate behaviors.

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.
- LA.6.RP.6 Analyze a literary text to answer and develop inferential and evaluative questions to enhance the comprehension of self and others, quoting or paraphrasing specific evidence from the text.
- LA.6.RI.2 Explain how a key individual, event, or idea or concept is introduced and developed, drawing on specific supporting details in an informational text.
- LA.6.RI.3 Explain how an author establishes and conveys a perspective or purpose in an informational text. LA.6.RI.4 Analyze how a particular sentence, paragraph, chapter, or section fits into the overall structure of a text and contributes to the development of the ideas.
- LA.6.RI.5 Compare and contrast one author's presentation of information with that of another. LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.

Mathematics Connections:

- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.
- SS 6.4.1.b Analyze the impact of historical events in the world using symbols, maps, documents, and artifacts.
- S 6.4.2.a Identify evidence from multiple perspectives and sources to better understand the complexities of world history

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.6 Cells and Systems)
    - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- System, subsystem, cell, tissue, organ, organ system, interaction, function, specialization, circulatory system, excretory system, digestive system, respiratory system, muscular system, nervous system, homeostasis, integration, regulation

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA1:** Students will make a claim that the body is a system of interacting subsystems composed of groups of cells related to an explanation or model of a phenomenon.
- **KSA2:** Students will describe the evidence from data or scientific literature that supports the claim that shows specialized groups of cells work together to form tissues, specialized tissues comprise each organ enabling the specific organ functions to be carried out, different organs work together as subsystems to form organ systems that carry out complex functions, and the body contains organs and organ systems that interact with each other to carry out all necessary functions for survival and growth of the organism.
- **KSA3:** Students will evaluate the evidence for strengths and weaknesses by source types, sufficient evidence that is valid and reliable, and any alternative interpretations of the evidence.
- **KSA4:** Students will use reasoning (oral or written) to connect appropriate evidence to the claim making logical connections such as every scale of body function is composed of a system of interacting components, organs are composed of interacting tissues, each tissue is made up of specialized cells, and these interactions at the cellular and tissue levels enable the organs to carry out specific functions, and the body system of specialized organs interact with each other and their subsystem to carry out the functions necessary for life.

Standard

Topic: SC.6.6 Structure and Function and Information Processing

Standard Code: SC.6.6.2 Gather, analyze, and communicate evidence of the relationship between structure and in living things.

Students will investigate to show that living things are made of cells, develop models to explain cell functions, and argue that the body is a system of interacting cell groups. They will also explain how sensory receptors send messages to the brain for behavior or memory.

Indicator

Indicator Code: SC.6.6.2.d

Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or stored as memories. Assessment does not include mechanisms for the transmission of this information.

NGSS Comparison: MS-PS3-5

Other Indicators in this Standard

SC.6.6.2.a, SC.6.6.2.b, SC.6.6.2.c

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Obtaining, Evaluating, and Communicating Information: • Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural systems.

Disciplinary Core Idea (DCI)

LS1.D: **Information Processing**

- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena
- List of Phet Sims
  - https://phet.colorado.edu/

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.6.2.d Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or stored as memories.	
Obtaining information	
a	Students gather and synthesize information from at least two sources (e.g., text, media, visual displays, data) about a phenomenon that includes the relationship between sensory receptors and the storage and usage of sensory information by organisms. Students gather information about:

	i. Different types of sensory receptors and the types of inputs to which they respond (e.g., electromagnetic, mechanical, chemical stimuli).
	ii. Sensory information transmission along nerve cells from receptors to the brain.
	iii. Sensory information processing by the brain as:
	1. Memories (i.e., stored information).
	2. Immediate behavioral responses (i.e., immediate use).
b	Students gather sufficient information to provide evidence that illustrates the causal relationships between information received by sensory receptors and behavior, both immediate and over longer time scales (e.g., a loud noise processed via auditory receptors may cause an animal to startle immediately or may be encoded as a memory, which can later be used to help the animal react appropriately in similar situations).
Evaluating information	
a	Students evaluate the information based on:
	i. The credibility, accuracy, and possible bias of each publication and the methods used to generate and collect the evidence.
	ii. The ability of the information to provide evidence that supports or does not support the idea that sensory receptors send signals to the brain, resulting in immediate behavioral changes or stored memories.
	iii. Whether the information is sufficient to allow prediction of the response of an organism to different stimuli based on cause and effect relationships between the responses of sensory receptors and behavioral responses.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Obtaining, Evaluating, and Communicating Information

K-2	3-5	6-8	9-12
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.	Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.	Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.	Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.

Crosscutting Concepts (CCCs): Cause and Effect

K-2	3-5	6-8	9-12
In grades K-2, students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.	In grades 3-5, students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.	In grades 6-8, students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	In grades 9-12, students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Disciplinary Core Ideas (DCIs): LS1.D: Information Processing

K-2	3-5	6-8	9-12
LS1.D Animals sense and communicate information and respond to inputs with behaviors that help them grow and survive.	**LS1.D** Different sense receptors are specialized for particular kinds of information; Animals use their perceptions and memories to guide their actions.	**LS1.D** Each sense receptor responds to different inputs, transmitting them as signals that travel along nerve cells to the brain; The signals are then processed in the brain, resulting in immediate behavior or memories.	**LS1.D - N/A**

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.
- LA.6.RP.6 Analyze a literary text to answer and develop inferential and evaluative questions to enhance the comprehension of self and others, quoting or paraphrasing specific evidence from the text.
- LA.6.RI.2 Explain how a key individual, event, or idea or concept is introduced and developed, drawing on specific supporting details in an informational text.
- LA.6.RI.3 Explain how an author establishes and conveys a perspective or purpose in an informational text.
- LA.6.RI.4 Analyze how a particular sentence, paragraph, chapter, or section fits into the overall structure of a text and contributes to the development of the ideas.
- LA.6.RI.5 Compare and contrast one author's presentation of information with that of another.
- LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.

Mathematics Connections:

- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.
- SS 6.4.1.b Analyze the impact of historical events in the world using symbols, maps, documents, and artifacts.
- S 6.4.2.a Identify evidence from multiple perspectives and sources to better understand the complexities of world history
- SS 6.4.4 Interpret and evaluate sources for historical context.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.6 Cells and Systems)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- Sensory receptors, stimulus, message, brain, immediate behavior, reflex, memory, information, synthesize, gather, response, neuron, central nervous system, environment, behavior, storage, memory formation, nervous system

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA1:** Students will gather and synthesize information from at least two sources such as text, media, visual displays, or data about a phenomenon that includes the relationship between sensory receptors and the storage and usage of sensory information by organisms.
- **KSA2:** Students will gather information about different types of sensory receptors and the types of inputs to which they respond, sensory information transmission along nerve cells from receptors to the brain, and sensory information processing by the brain as memories and immediate behavioral responses.
- **KSA3:** Students will gather sufficient information to provide evidence to prove the cause-and-effect relationship between information received in the sensory receptor and the behavior that follows.
- **KSA4:** Student will evaluate the information for credibility, accuracy, and possible bias of each publication and the methods of evidence collection within.
- **KSA5:** Students will evaluate the information that provides evidence that supports or refutes the idea that sensory receptors send signals to the brain, resulting in immediate behavioral changes or stored memories.
- **KSA6:** Students will evaluate the information for sufficient information to be able to predict the response of an organism to different stimuli based on cause-and-effect relationships between the responses of sensory receptors and behavioral responses.

Standard

Topic: SC.6.9 Growth, Development, and Reproduction of Organisms

Standard Code: SC.6.9.3 Gather, analyze, and communicate evidence of the inheritance and variation of traits.

Students will argue how adaptations affect reproductive success, explain how environmental and genetic factors influence growth, and model why asexual reproduction produces identical offspring while sexual reproduction leads to genetic variation.

Indicator

Indicator Code: SC.6.9.3.a

Construct an argument based on evidence for how plant and animal adaptations affect the probability of successful reproduction. 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.

NGSS Comparison: MS-LS1-4 (modified)

Other Indicators in this Standard

SC.6.9.3.b, SC.6.9.3.c

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Engaging in Argument from Evidence: • Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.	**Cause and Effect:** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Disciplinary Core Idea (DCI)

LS1.B: Growth and Development of Organisms

- Animals engage in characteristic behaviors that increase the odds of reproduction.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Jumping spiders engage in what seems like a choreographed dance.
- Flowers come in many different, bright colors.
- The Kamehameha Butterfly in Hawaii spends its life on mamaki plants.

- The narrow-lipped hammer orchid looks and smells just like a female thynnid wasp.
- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.9.3.A Construct an argument based on evidence for how plant and animal adaptations affect the probability of successful reproduction.		
1	Supported claims	
	a	Students make a claim to support a given explanation of a phenomenon. In their claim, students include the idea that characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
2	Identifying scientific evidence	
	a	Students identify the given evidence that supports the claim (e.g., evidence from data and scientific literature), including:
		i. Characteristic animal behaviors that increase the probability of reproduction.
		ii. Specialized plant and animal structures that increase the probability of reproduction.
		iii. Cause-and-effect relationships between:
		1. Specialized plant structures and the probability of successful reproduction of plants that have those structures.
		2. Animal behaviors and the probability of successful reproduction of animals that exhibit those behaviors.
		3. Plant reproduction and the animal behaviors related to plant reproduction.
3	Evaluating and critiquing the evidence	
	a	Students evaluate the evidence and identify the strengths and weaknesses of the evidence used to support the claim, including:
		i. Validity and reliability of sources.
		ii. Sufficiency — including relevance, validity, and reliability — of the evidence to make and defend the claim.
		iii. Alternative interpretations of the evidence and why the evidence supports the student's claim, as opposed to any other claims.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the appropriate evidence to the claim, using oral or written arguments. Students describe* the following chain of reasoning in their argumentation:
		i. Many characteristic animal behaviors affect the likelihood of successful reproduction.
		ii. Many specialized plant structures affect the likelihood of successful reproduction.
		iii. Sometimes, animal behavior plays a role in the likelihood of successful reproduction in plants.
		iv. Because successful reproduction has several causes and contributing factors, the cause-and-effect relationships between any of these characteristics, separately or together, and reproductive likelihood can be accurately reflected only in terms of probability.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Engaging in Argument from Evidence

K-2	3-5	6-8	9-12
Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).	Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s)	Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).	Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

Crosscutting Concepts (CCCs): Cause and Effect

K-2	3-5	6-8	9-12
In grades K-2, students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.	In grades 3-5, students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.	In grades 6-8, students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	In grades 9-12, students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Disciplinary Core Ideas (DCIs): LS1.B: Growth and Development of Organisms

K-2	3-5	6-8	9-12
LS1.B Parents and offspring often engage in behaviors that help the offspring survive.	**LS1.B** Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles	**LS1.B** Animals engage in behaviors that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors.	**LS1.B** Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.6.RI.7 Compare and contrast regional, national, and/or multicultural perspectives within and across informational texts.
- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.

Mathematics Connections:

- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.
- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.1 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.D.1 Probability: Students will interpret and apply concepts of probability.

Social Studies Connections:

- SS 6.1.1.c Communicate the various ways governmental decisions have impacted people, places, and history.
- SS 6.2.1 Investigate how economic decisions affect the well-being of individuals and society.
- SS 6.2.3 Explain the interdependence of producers and consumers.
- SS 6.3.1 Identify where (spatial) and why people, places, and environments are organized on the Earth's surface.
- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.
- SS 6.3.4 Interpret and summarize patterns of culture around the world.
- SS 6.4.1 Analyze patterns of continuity and change over time in world history.
- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.6 Cells and Systems)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- Adaptation, reproduction, successful, probability, germination, pollination, insect pollinators, flower nectar, fertilization, genetic variation, evolution

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- KSA 1: Students identify evidence of specialized plant and animal structures or characteristic animal behaviors that increase the probability of reproduction.
- KSA 2: Students identify evidence of how animal behaviors affect the probability of successful reproduction in plants that depend on animals for reproduction.
- KSA 3: Students use evidence to show the structural and behavioral adaptations of plants and animals increase the likelihood of successful reproduction.
- KSA 4: Students evaluate and critique evidence to determine how the evidence supports claims about the role of adaptations in reproductive success.
- KSA 5: Students analyze alternative interpretations and make claims to connect evidence and support an explanation
- KSA 6: Students construct explanations supported by multiple sources of evidence consistent with scientific ideas, principles, and theories to explain how the adaptations of plants and animals affect the likelihood of successful reproduction.
-

Standard

Topic: SC.6.9 Growth, Development, and Reproduction of Organisms
Standard Code: SC.6.9.3 Gather, analyze, and communicate evidence of the inheritance and variation of traits.

Students will argue how adaptations affect reproductive success, explain how environmental and genetic factors influence growth, and model why asexual reproduction produces identical offspring while sexual reproduction leads to genetic variation.

Indicator

Indicator Code: SC.6.9.3.b

Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. Examples of local environmental conditions could include availability of food, light, space, and water. Examples of 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. Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.

NGSS Comparison: MS-LS1-5

Other Indicators in this Standard

SC.6.9.3.a, SC.6.9.3.c

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Constructing Explanations and Designing Solutions:	**Cause and Effect:**

• Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.	• Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Disciplinary Core Idea (DCI)

LS1.B: Growth and Development of Organisms

- Genetic factors as well as local conditions affect the growth of the adult plant.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena
- Children growth rates in a family
- Where saltwort plants are found and why
- Bison size grazing ground available
- Barn swallows nesting sites/ population
- The number/size/breed of cattle in a pasture
- Zebra Mussel invasion influences growth of other organisms
- Some crops grow better (more yield/larger/faster) in certain soil types/conditions (crop rotation)
- How the number/size of offspring influences growth
- Growth rates/size/species of fish in a small pond vs. large pond

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.9.3.b		**Construct a scientific explanation** based on evidence for how environmental and genetic factors influence the growth of organisms.
1		Articulating the explanation of phenomena
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including the idea that both environmental and genetic factors influence the growth of organisms.
	b	Students use evidence and reasoning to construct a scientific explanation for the given phenomenon.
2		Evidence
	a	Students identify and describe* evidence (e.g., from students' own investigations, observations, reading material, archived data) necessary for constructing the explanation, including:
		i. Environmental factors (e.g., availability of light, space, water; size of habitat) and that they can influence growth.
		ii. Genetic factors (e.g., specific breeds of plants and animals and their typical sizes) and that they can influence growth.
		iii. Changes in the growth of organisms as specific environmental and genetic factors change.
	b	Students use multiple valid and reliable sources of evidence to construct the explanation.
3		Reasoning

	a	Students use reasoning, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to connect the evidence and support an explanation for a phenomenon involving genetic and environmental influences on organism growth. Students describe* their chain of reasoning that includes:
		i. Organism growth is influenced by multiple environmental (e.g., drought, changes in food availability) and genetic (e.g., specific breed) factors.
		ii. Because both environmental and genetic factors can influence organisms simultaneously, organism growth is the result of environmental and genetic factors working together (e.g., water availability influences how tall dwarf fruit trees will grow).
		iii. Because organism growth can have several genetic and environmental causes, the contributions of specific causes or factors to organism growth can be described only using probability (e.g., not every fish in a large pond grows to the same size).

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Constructing Explanations and Designing Solutions

K-2	3-5	6-8	9-12
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence based accounts of natural phenomena and designing solutions.	Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.	Constructing explanations and designing solutions in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

Crosscutting Concepts (CCCs): Cause and Effect

K-2	3-5	6-8	9-12
In grades K-2, students learn that events have causes that generate observable	In grades 3-5, students routinely identify and test causal relationships and use these	In grades 6-8, students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation.	In grades 9-12, students understand that empirical evidence is required to differentiate between cause and correlation and to make

patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.	relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.	They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Disciplinary Core Ideas (DCIs): LS1.B: Growth and Development of Organisms

K-2	3-5	6-8	9-12
LS1.B Parents and offspring often engage in behaviors that help the offspring survive.	**LS1.B** Reproduction is essential to every kind of organism. Organisms have unique and diverse life cycles	**LS1.B** Animals engage in behaviors that increase the odds of reproduction. An organism's growth is affected by both genetic and environmental factors.	**LS1.B** Growth and division of cells in organisms occurs by mitosis and differentiation for specific cell types.

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.6.RI.7 Compare and contrast regional, national, and/or multicultural perspectives within and across informational texts.
- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.

Mathematics Connections:

- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.
- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.1 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.D.1 Probability: Students will interpret and apply concepts of probability.

Social Studies Connections:

- SS 6.1.1.c Communicate the various ways governmental decisions have impacted people, places, and history.
- SS 6.2.1 Investigate how economic decisions affect the well-being of individuals and society.
- SS 6.2.3 Explain the interdependence of producers and consumers.
- SS 6.3.1 Identify where (spatial) and why people, places, and environments are organized on the Earth's surface.

- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.
- SS 6.3.4 Interpret and summarize patterns of culture around the world.
- SS 6.4.1 Analyze patterns of continuity and change over time in world history.
- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.6 Cells and Systems)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- Inheritance, trait, genetic variation, environmental factors, genetic factors, allele, genotype, phenotype, dominant trait, recessive trait, heredity, natural selection, evolution, mutation, adaptation, fitness, population, diversity

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- KSA 1: Students will identify and describe evidence from their own investigations, observations, reading material, archived data, or other sources that show how environmental factors which may include the availability of light, space, water, or size of habitat influence growth.
- KSA 2: Students will identify and describe valid and reliable evidence from multiple sources that show how genetic factors such as specific breeds of plants and animals and their typical sizes influence growth.
- KSA 3: Students will describe their chain of reasoning to include how organism growth is the result of environmental and genetic factors working together (e.g., water availability influences how tall dwarf fruit trees will grow).
- KSA 4: Students will reason with evidence organism growth can have several genetic and environmental causes to organism growth which can be described only using probability (e.g., not every fish in a large pond grows to the same size).
- KSA 5: Students will articulate a claim or determine the reliability of claims about the effects of environmental and genetic factors on organism growth, recognizing that multiple factors can contribute to observed outcomes.

Standard

Topic: SC.6.9 Growth, Development, and Reproduction of Organisms
Standard Code: SC.6.9.3 Gather, analyze, and communicate evidence of the inheritance and variation of traits.

Students will argue how adaptations affect reproductive success, explain how environmental and genetic factors influence growth, and model why asexual reproduction produces identical offspring while sexual reproduction leads to genetic variation.

Indicator

Indicator Code: SC.6.9.3.c

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. 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. Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.

NGSS Comparison: MS-LS3-2

Other Indicators in this Standard

SC.6.9.3.a, SC.6.9.3.b

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Developing and Using Models: • Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural systems.

Disciplinary Core Idea (DCI)

LS3.A: Inheritance of Traits:

- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.

LS3.B: Variation of Traits:

- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena
- List of Phet Sims
  - https://phet.colorado.edu/
- All members of the desert grassland whiptail species are female.
- In a family with four children, two of the children have blonde hair and two of the children have red hair while both parents have red hair.
- A coral colony is made up of genetically identical individuals.

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.9.3.C 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.	
1	Components of the model

	a	Students develop a model (e.g., Punnett squares, diagrams, simulations) for a given phenomenon involving the differences in genetic variation that arise from sexual and asexual reproduction. In the model, students identify and describe* the relevant components, including:
		i. Chromosome pairs, including genetic variants, in asexual reproduction:
		1. Parents.
		2. Offspring.
		ii. Chromosome pairs, including genetic variants, in sexual reproduction:
		1. Parents.
		2. Offspring.
2	Relationships	
	a	In their model, students describe* the relationships between components, including:
		i. During reproduction (both sexual and asexual), parents transfer genetic information in the form of genes to their offspring.
		ii. Under normal conditions, offspring have the same number of chromosomes, and therefore genes, as their parents.
		iii. During asexual reproduction, a single parent's chromosomes (one set) are the source of genetic material in the offspring.
		iv. During sexual reproduction, two parents (two sets of chromosomes) contribute genetic material to the offspring.
3	Connections	
	a	Students use the model to describe* a causal account for why sexual and asexual reproduction result in different amounts of genetic variation in offspring relative to their parents, including that:
		i. In asexual reproduction:
		1. Offspring have a single source of genetic information, and their chromosomes are complete copies of each single parent pair of chromosomes.
		2. Offspring chromosomes are identical to parent chromosomes.
		ii. In sexual reproduction:
		1. Offspring have two sources of genetic information (i.e., two sets of chromosomes) that contribute to each final pair of chromosomes in the offspring.
		2. Because both parents are likely to contribute different genetic information, offspring chromosomes reflect a combination of genetic material from two sources and therefore contain new combinations of genes (genetic variation) that make offspring chromosomes distinct from those of either parent.
	b	Students use cause-and-effect relationships found in the model between the type of reproduction and the resulting genetic variation to predict that more genetic variation occurs in organisms that reproduce sexually compared to organisms that reproduce asexually.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Developing and Using Models

K-2	3-5	6-8	9-12

Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

Crosscutting Concepts (CCCs): Cause and Effect

K-2	3-5	6-8	9-12
In grades K-2, students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.	In grades 3-5, students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.	In grades 6-8, students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	In grades 9-12, students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Disciplinary Core Ideas (DCIs): LS3.A: Inheritance of Traits: LS3.B: Variation of Traits

K-2	3-5	6-8	9-12
LS3.A and LS3.B Young organisms are very much, but not exactly, like their parents and also resemble other organisms of the same kind.	**LS3.A and LS3.B** Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.	**LS3.A** Genes chiefly regulate a specific protein, which affect an individual's traits. **LS3.B** In sexual reproduction, each parent contributes half of the genes acquired by the offspring resulting in variation between parent and offspring. Genetic information can be altered	**LS3.A** DNA carries instructions for forming species' characteristics. Each cell in an organism has the same genetic content, but genes expressed by cells can differ. **LS3.B** The variation and distribution of traits in a population depend on genetic and

		because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism.	environmental factors. Genetic variation can result from mutations caused by environmental factors or errors in DNA replication, or from chromosomes swapping sections during meiosis.

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.6.RI.7 Compare and contrast regional, national, and/or multicultural perspectives within and across informational texts.
- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.

Mathematics Connections:

- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.
- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.1 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.D.1 Probability: Students will interpret and apply concepts of probability.

Social Studies Connections:

- SS 6.1.1.c Communicate the various ways governmental decisions have impacted people, places, and history.
- SS 6.2.1 Investigate how economic decisions affect the well-being of individuals and society.
- SS 6.2.3 Explain the interdependence of producers and consumers.
- SS 6.3.1 Identify where (spatial) and why people, places, and environments are organized on the Earth's surface.
- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.
- SS 6.3.4 Interpret and summarize patterns of culture around the world.
- SS 6.4.1 Analyze patterns of continuity and change over time in world history.
- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.6 Cells and Systems)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- Adaptation, factors, trait, variation, reproduction, gamete, parent, model, offspring, DNA, chromosome, mitosis, meiosis, mutation, asexual reproduction

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA 1:** Students create a basic model that identifies key components (parents, offspring, chromosomes) in both sexual and asexual reproduction
- **KSA 2:** Students annotate their model to describe how a single parent in asexual reproduction versus two parents in sexual reproduction transfer genetic material
- **KSA 3:** Students use their model to explain that asexual reproduction yields identical offspring while sexual reproduction produces genetic variation.
- **KSA 4:** Students refine their model based on evidence to show how offspring chromosomes reflect a combination of genetic material from two sources and therefore contain new combinations of genes that make offspring chromosomes distinct from those of either parent.
- **KSA 5:** Students will use cause-and-effect relationships found in the model to predict that more genetic variation occurs in organisms that reproduce sexually compared to organisms that reproduce asexually.

Standard

Topic: SC.6.12 Weather and Climate

Standard Code: SC.6.12.4 Gather, analyze, and communicate evidence of factors and interactions that affect weather and climate.

Students will collect data to show how air mass interactions cause weather changes, develop models to describe how unequal heating and Earth's rotation drive atmospheric and oceanic circulation patterns that determine regional climates, and ask questions to clarify evidence of factors causing the rise in global temperatures, emphasizing the impact of human activities. They will also analyze and interpret data on weather and climate to forecast future catastrophic events and develop technologies to mitigate their effects.

Indicator

Indicator Code: SC.6.12.4.a

Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. 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). Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.

NGSS Comparison: MS-ESS2-5

Other Indicators in this Standard

SC.6.12.4.b, SC.6.12.4.c, SC.6.12.4.d

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Planning and Carrying Out Investigations: • Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Disciplinary Core Idea (DCI)

ESS2.C: The Roles of Water in Earth's Surface Processes:

- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.

ESS2.D: Weather and Climate:

- Because these patterns are so complex, weather can only be predicted probabilistically.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Tornado Alley
- Tornado Alley is moving

- 2022 has been unusually windy
- Unusual weather events
- Predicting weather is not 100% accurate
- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena
- List of Phet Sims
  - https://phet.colorado.edu/

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.12.4.a		**Collect data** to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.
1		Identifying the phenomenon under investigation
	a	From the given investigation plan, students describe* the phenomenon under investigation, which includes the relationships between air mass interactions and weather conditions.
	b	Students identify the purpose of the investigation, which includes providing evidence to answer questions about how motions and complex interactions of air masses result in changes in weather conditions [note: expectations of students regarding mechanisms are limited to relationships between patterns of activity of air masses and changes in weather].
2		Identifying the evidence to address the purpose of the investigation
	a	From a given investigation plan, students describe* the data to be collected and the evidence to be derived from the data that would indicate relationships between air mass movement and changes in weather, including:
		i. Patterns in weather conditions in a specific area (e.g., temperature, air pressure, humidity, wind speed) over time.
		ii. The relationship between the distribution and movement of air masses and landforms, ocean temperatures, and currents.
		iii. The relationship between observed, large-scale weather patterns and the location or movement of air masses, including patterns that develop between air masses (e.g., cold fronts may be characterized by thunderstorms).
	b	Students describe* how the evidence to be collected will be relevant to determining the relationship between patterns of activity of air masses and changes in weather conditions.
	c	Students describe* that because weather patterns are so complex and have multiple causes, weather can be predicted only probabilistically.
3		Planning the investigation
	a	Students describe* the tools and methods used in the investigation, including how they are relevant to the purpose of the investigation.
4		Collecting the data
	a	According to the provided investigation plan, students make observations and record data, either firsthand and/or from professional weather monitoring services.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Planning and Carrying Out Investigations

K-2	3-5	6-8	9-12
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.	Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K– 2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.	Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.	Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

Crosscutting Concepts (CCCs): Cause and Effect

K-2	3-5	6-8	9-12
In grades K-2, students learn that events have causes that generate observable patterns. They design simple tests to gather evidence to support or refute their own ideas about causes.	In grades 3-5, students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.	In grades 6-8, students classify relationships as causal or correlational, and recognize that correlation does not necessarily imply causation. They use cause and effect relationships to predict phenomena in natural or designed systems. They also understand that phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.	In grades 9-12, students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Disciplinary Core Ideas (DCIs): ESS2.C: The Roles of Water in Earth's Surface Processes: ESS2.D: Weather and Climate

K-2	3-5	6-8	9-12
ESS2.C Water is found in many types of places and in different forms on Earth. **ESS2.D** Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time.	**ESS2.C** Most of Earth's water is in the ocean and much of the Earth's fresh water is in glaciers or underground. **ESS2.D** Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.	**ESS2.C** Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features. **ESS2.D** Complex interactions determine local weather patterns and influence climate, including the role of the ocean.	**ESS2.C** The planet's dynamics are greatly influenced by water's unique chemical and physical properties. **ESS2.D** The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors.

Related Cross-Curricular Standards: Current Grade Level

ELA Connections:

- LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.6.RI.7 Compare and contrast regional, national, and/or multicultural perspectives within and across informational texts.
- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.

Mathematics Connections:

- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.
- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.1 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.D.1 Probability: Students will interpret and apply concepts of probability.

Social Studies Connections:

- SS 6.1.1.c Communicate the various ways governmental decisions have impacted people, places, and history.
- SS 6.2.1 Investigate how economic decisions affect the well-being of individuals and society.
- SS 6.3.1 Identify where (spatial) and why people, places, and environments are organized on the Earth's surface.
- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.
- SS 6.4.1 Analyze patterns of continuity and change over time in world history.
- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.3 Weather Climate and Water Cycle)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- density, temperature, high pressure, low pressure, humidity, precipitation, wind speed, wind direction, air mass, cold/warm front, thermometer, barometer, anemometer, relative humidity, interactions, weather conditions, regions

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA 1:** Students describe the purpose of their investigation: provide evidence of the relationships between patterns of activity of air masses and changes in weather.
- **KSA 2:** Students identify evidence to be collected that will address the purpose of the investigation to include patterns in weather conditions in a specific area (e.g., temperature, air pressure, humidity, wind speed) over time.
- **KSA 3:** Students identify evidence to be collected that will show the relationship between the distribution and movement of air masses and landforms, ocean temperatures, and currents.
- **KSA 4**: Students identify evidence to be collected that will show the relationship between observed, large-scale weather patterns and the movement of air masses, including the cause-and-effect relationship of how the flow of air from high-pressure to low-pressure regions leads to observable changes in weather conditions.
- **KSA 5:** Students describe how the evidence will be relevant to determining that weather can only be predicted probabilistically because weather patterns are so complex and have multiple causes.
- **KSA 6:** Students select tools and methods to collect data, such as measurements of temperature, pressure, and wind speed because they are relevant to the purpose of the investigation.
- **KSA 7:** Students follow a provided investigation plan, make observations, and record and organize data, either firsthand and/or from professional weather monitoring services to document patterns in weather over time that result from the movement of air masses.

Standard

Topic: SC.6.12 Weather and Climate

Standard Code: SC.6.12.4 Gather, analyze, and communicate evidence of factors and interactions that affect weather and climate.

Students will collect data to show how air mass interactions cause weather changes, develop models to describe how unequal heating and Earth's rotation drive atmospheric and oceanic circulation patterns that determine regional climates, and ask questions to clarify evidence of factors causing the rise in global temperatures, emphasizing the impact of human activities. They will also analyze and interpret data on weather and climate to forecast future catastrophic events and develop technologies to mitigate their effects.

Indicator

Indicator Code: SC.6.12.4.b

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. 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. Assessment does not include the dynamics of the Coriolis effect.

NGSS Comparison: MS-ESS2-6

Other Indicators in this Standard

SC.6.12.4.a, SC.6.12.4.c, SC.6.12.4.d

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Develop and Using Models: • Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	**Systems and System Models:** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

Disciplinary Core Idea (DCI)

ESS2.C: The Roles of Water in Earth's Surface Processes:

- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.

ESS2.D: Weather and Climate:

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Dust Devils
- Rain Shadows
- Climate temperature and precipitation data ranges
- Lake effect snow
- Whirlpools
- Ocean garbage patch
- Deep ocean conveyor belt
- Doldrums near the equator
- Jet Streams
- Seabreeze/land breeze
- Local vs Global winds
- Global distribution of ice
- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb

- NGSS List of Phenomena
    - https://www.ngssphenomena.com/searchable-phenomena
- List of Phet Sims
    - https://phet.colorado.edu/

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.12.4.b 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.		
1	Components of the model	
	a	To make sense of a phenomenon, students develop a model in which they identify the relevant components of the system, with inputs and outputs, including:
		i. The rotating Earth.
		ii. The atmosphere.
		iii. The ocean, including the relative rate of thermal energy transfer of water compared to land or air.
		iv. Continents and the distribution of landforms on the surface of Earth.
		v. Global distribution of ice.
		vi. Distribution of living things.
		vii. Energy.
		1. Radiation from the sun as an input.
		2. Thermal energy that exists in the atmosphere, water, land, and ice (as represented by temperature).
2	Relationships	
	a	In the model, students identify and describe* the relationships between components of the system, including:
		i. Differences in the distribution of solar energy and temperature changes, including:
		1. Higher latitudes receive less solar energy per unit of area than do lower latitudes, resulting in temperature differences based on latitude.
		2. Smaller temperature changes tend to occur in oceans than on land in the same amount of time.
		3. In general, areas at higher elevations have lower average temperatures than do areas at lower elevations.
		4. Features on the Earth's surface, such as the amount of solar energy reflected back into the atmosphere or the absorption of solar energy by living things, affect the amount of solar energy transferred into heat energy.
		ii. Motion of ocean waters and air masses (matter):
		1. Fluid matter (i.e., air, water) flows from areas of higher density to areas of lower density (due to temperature or salinity). The density of a fluid can vary for several different reasons (e.g., changes in salinity and temperature of water can each cause changes in density). Differences in salinity and temperature can, therefore, cause fluids to move vertically and, as a result of vertical movement, also horizontally because of density differences.
		iii. Factors affecting the motion of wind and currents:
		1. The Earth's rotation causes oceanic and atmospheric flows to curve when viewed from the rotating surface of Earth (Coriolis force).
		2. The geographical distribution of land limits where ocean currents can flow.
		3. Landforms affect atmospheric flows (e.g., mountains deflect wind and/or force it to higher elevation).
		iv. Thermal energy transfer:
		1. Thermal energy moves from areas of high temperature to areas of lower temperature either through the movement of matter, via radiation, or via conduction of heat from warmer objects to cooler objects.

		2. Absorbing or releasing thermal energy produces a more rapid change in temperature on land compared to in water.
		3. Absorbing or releasing thermal energy produces a more rapid change in temperature in the atmosphere compared to either on land or in water so the atmosphere is warmed or cooled by being in contact with land or the ocean.
3	Connections	
	a	Students use the model to describe*:
		i. The general latitudinal pattern in climate (higher average annual temperatures near the equator and lower average annual temperatures at higher latitudes) caused by more direct light (greater energy per unit of area) at the equator (more solar energy) and less direct light at the poles (less solar energy).
		ii. The general latitudinal pattern of drier and wetter climates caused by the shift in the amount of air moisture during precipitation from rising moisture-rich air and the sinking of dry air.
		iii. The pattern of differing climates in continental areas as compared to the oceans. Because water can absorb more solar energy for every degree change in temperature compared to land, there is a greater and more rapid temperature change on land than in the ocean. At the centers of landmasses, this leads to conditions typical of continental climate patterns.
		iv. The pattern that climates near large water bodies, such as marine coasts, have comparatively smaller changes in temperature relative to the center of the landmass. Land near the oceans can exchange thermal energy through the air, resulting in smaller changes in temperature. At the edges of landmasses, this leads to marine climates.
		v. The pattern that climates at higher altitudes have lower temperatures than climates at lower altitudes. Because of the direct relationship between temperature and pressure, given the same amount of thermal energy, air at lower pressures (higher altitudes) will have lower temperatures than air at higher pressures (lower altitudes).
		vi. Regional patterns of climate (e.g., temperature or moisture) related to a specific pattern of water or air circulation, including the role of the following in contributing to the climate pattern:
		1. Air or water moving from areas of high temperature, density, and/or salinity to areas of low temperature, density, and/or salinity.
		2. The Earth's rotation, which affects atmospheric and oceanic circulation.
		3. The transfer of thermal energy with the movement of matter.
		4. The presence of landforms (e.g., the rain shadow effect).
	b	Students use the model to describe* the role of each of its components in producing a given regional climate.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Develop and Using Models

K-2	3-5	6-8	9-12

Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

Crosscutting Concepts (CCCs): Systems and System Models

K-2	3-5	6-8	9-12
In grades K-2, students understand objects and organisms can be described in terms of their parts; and systems in the natural and designed world have parts that work together.	In grades 3-5, students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.	In grades 6-8, students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. They can also learn that models are limited in that they only represent certain aspects of the system under study	In grades 9-12, students can investigate or analyze a system by defining its boundaries and initial conditions, as well as its inputs and outputs. They can use models (e.g., physical, mathematical, computer models) to simulate the flow of energy, matter, and interactions within and between systems at different scales. They can also use models and simulations to predict the behavior of a system, and recognize that these predictions have limited precision and reliability due to the assumptions and approximations inherent in the models. They can also design systems to do specific tasks.

Disciplinary Core Ideas (DCIs): ESS2.C: The Roles of Water in Earth's Surface Processes: ESS2.D: Weather and Climate

K-2	3-5	6-8	9-12

ESS2.C Water is found in many types of places and in different forms on Earth. **ESS2.D** Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region and time. People record weather patterns over time.	**ESS2.C** Most of Earth's water is in the ocean and much of the Earth's fresh water is in glaciers or underground. **ESS2.D** Climate describes patterns of typical weather conditions over different scales and variations. Historical weather patterns can be analyzed.	**ESS2.C** Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features. **ESS2.D** Complex interactions determine local weather patterns and influence climate, including the role of the ocean.	**ESS2.C** The planet's dynamics are greatly influenced by water's unique chemical and physical properties. **ESS2.D** The role of radiation from the sun and its interactions with the atmosphere, ocean, and land are the foundation for the global climate system. Global climate models are used to predict future changes, including changes influenced by human behavior and natural factors.

Related Cross-Curricular Standards: Current Grade Level

LA Connections:

- LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.6.RI.7 Compare and contrast regional, national, and/or multicultural perspectives within and across informational texts.
- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.

Mathematics Connections:

- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.
- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.1 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.D.1 Probability: Students will interpret and apply concepts of probability.

Social Studies Connections:

- SS 6.1.1.c Communicate the various ways governmental decisions have impacted people, places, and history.
- SS 6.2.1 Investigate how economic decisions affect the well-being of individuals and society.
- SS 6.3.1 Identify where (spatial) and why people, places, and environments are organized on the Earth's surface.
- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.
- SS 6.4.1 Analyze patterns of continuity and change over time in world history.
- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.3 Weather Climate and Water Cycle)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- weather, climate, temperature, density, current, region, equator, North Pole, South Pole, latitude, altitude, convection, Earth systems (atmosphere, hydrosphere, geosphere, biosphere), global, atmospheric circulation, oceanic circulation, warm front, cold front, stationary front

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA 1:** Students build a simple model that identifies the key parts of Earth's system—such as the rotating Earth, atmosphere, oceans, continents, and solar energy—and shows that unequal heating drives energy flow.
- **KSA 2:** Students label their model to explain how differences in solar energy at various latitudes, altitudes, and land areas create temperature differences across Earth.
- **KSA 3:** Students adjust their model to show how Earth's rotation changes the path of air and water masses and how landforms limit these flows.
- **KSA 4:** Students use their model to explain how solar energy, heat transfer, and geographic features work together to create different regional climate patterns by showing how the system's parts interact.
- **KSA 5:** Students present a complete model that combines unequal heating, Earth's rotation, and geographic features to predict regional climates and explain why weather patterns are only predictable within certain ranges.

Standard

Topic: SC.6.12 Weather and Climate
Standard Code: SC.6.12.4 Gather, analyze, and communicate evidence of factors and interactions that affect weather and climate.

Students will collect data to show how air mass interactions cause weather changes, develop models to describe how unequal heating and Earth's rotation drive atmospheric and oceanic circulation patterns that determine regional climates, and ask questions to clarify evidence of factors causing the rise in global temperatures, emphasizing the impact of human activities. They will also analyze and interpret data on weather and climate to forecast future catastrophic events and develop technologies to mitigate their effects.

Indicator

Indicator Code: SC.6.12.4.c

Ask questions to clarify evidence of the factors that have caused the change in global temperatures over thousands of years. 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 role that human activities play in causing the rise in global temperatures.

NGSS Comparison: MS-ESS3-5

Other Indicators in this Standard

SC.6.12.4.a, SC.6.12.4.b, SC.6.12.4.d

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Asking Questions and Defining Problems: • Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables and clarifying arguments and models.	**Stability and Change:** • Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

Disciplinary Core Idea (DCI)

ESS3.D: Global Climate Change:

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena
- List of Phet Sims
  - https://phet.colorado.edu/
- Although Mercury is the planet closest to the sun, Venus is the hottest planet in our solar system.
- On Mercury, the temperature extremes range from -279°F at night to 801°F during the day, while on Earth the temperature extremes range from -129°F to 136°F.

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.12.4.c	**Ask questions** to clarify evidence of the factors that have caused the change in global temperatures over thousands of years.	
1	Addressing phenomena of the natural world	
	a	Students examine a given claim and the given supporting evidence as a basis for formulating questions. Students ask questions that would identify and clarify the evidence, including:
		i. The relevant ways in which natural processes and/or human activities may have affected the patterns of change in global temperatures over the past century.

		ii. The influence of natural processes and/or human activities on a gradual or sudden change in global temperatures in natural systems (e.g., glaciers and arctic ice, and plant and animal seasonal movements and life cycle activities).
		iii. The influence of natural processes and/or human activities on changes in the concentration of carbon dioxide and other greenhouse gases in the atmosphere over the past century.
2	Identifying the scientific nature of the question	
	a	Students' questions can be answered by examining evidence for:
		i. Patterns in data that connect natural processes and human activities to changes in global temperatures over the past century.
		ii. Patterns in data that connect the changes in natural processes and/or human activities related to greenhouse gas production to changes in the concentrations of carbon dioxide and other greenhouse gases in the atmosphere.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Asking Questions and Defining Problems

K-2	3-5	6-8	9-12
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables and clarifying arguments and models.	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

Crosscutting Concepts (CCCs): Stability and Change

K-2	3-5	6-8	9-12
In grades K-2, students observe some things stay the same while other things	In grades 3-5, students measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some	In grades 6-8, students explain stability and change in natural or designed systems by examining changes over time, and considering forces at different scales,	In grades 9-12, students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify

change, and things may change slowly or rapidly.	systems appear stable, but over long periods of time they will eventually change.	including the atomic scale. Students learn changes in one part of a system might cause large changes in another part, systems in dynamic equilibrium are stable due to a balance of feedback mechanisms, and stability might be disturbed by either sudden events or gradual changes that accumulate over time.	and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Disciplinary Core Ideas (DCIs): ESS3.D: Global Climate Change

K-2	3-5	6-8	9-12
ESS3.D - N/A	**ESS3.D - N/A**	**ESS3.D** Human activities affect global warming. Decisions to reduce the impact of global warming depend on understanding climate science, engineering capabilities, and social dynamics.	**ESS3.D** Global climate models used to predict changes continue to be improved, although discoveries about the global climate system are ongoing and continually needed.

Related Cross-Curricular Standards: Current Grade Level

LA Connections:

- LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.6.RI.7 Compare and contrast regional, national, and/or multicultural perspectives within and across informational texts.
- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.

Mathematics Connections:

- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.
- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.1 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.D.1 Probability: Students will interpret and apply concepts of probability.

Social Studies Connections:

- SS 6.1.1.c Communicate the various ways governmental decisions have impacted people, places, and history.
- SS 6.2.1 Investigate how economic decisions affect the well-being of individuals and society.
- SS 6.3.1 Identify where (spatial) and why people, places, and environments are organized on the Earth’s surface.
- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.
- SS 6.4.1 Analyze patterns of continuity and change over time in world history.

- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.3 Weather Climate and Water Cycle)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- Weather, climate, airmass, front, cold front, warm front, stationary front, occluded front, atmospheric circulation, oceanic circulation, unequal heating, earth's rotation, Coriolis effect, regional climate, global warming, greenhouse effect, climate change, mitigation, adaptation, forecasting

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA 1**: Students identify a claim and supporting evidence about global temperature change and ask clarifying questions about how both human activities and natural processes may have influenced these changes.
- **KSA 2:** Students examine graphs, maps, and tables showing stable global temperature shifts between glacial and interglacial periods over thousands of years and greenhouse gas levels and ask specific questions to connect these data patterns with factors that have driven climate change.
- **KSA 3**: Students formulate questions that probe the relationships between natural processes (e.g., changes in solar radiation, volcanic activity) and human activities (e.g., fossil fuel combustion, cement production) in influencing global temperature changes.
- **KSA 4:** Students refine their questions to clarify how evidence on greenhouse gas concentrations and temperature patterns reveals both gradual and sudden changes in global climate.
- **KSA 5:** Students combine data from different sources to ask and support questions that explain how human actions and natural processes affect global temperatures, showing they understand how these factors cause climate change.

Standard

Topic: SC.6.12 Weather and Climate

Standard Code: SC.6.12.4 Gather, analyze, and communicate evidence of factors and interactions that affect weather and climate.

Students will collect data to show how air mass interactions cause weather changes, develop models to describe how unequal heating and Earth's rotation drive atmospheric and oceanic circulation patterns that determine regional climates, and ask questions to clarify evidence of factors causing the rise in global temperatures, emphasizing the impact of human activities. They will also analyze and interpret data on weather and climate to forecast future catastrophic events and develop technologies to mitigate their effects.

Indicator

Indicator Code: SC.6.12.4.d

Analyze and interpret data on weather and climate to forecast future catastrophic events and inform the development of technologies to mitigate their effect. Emphasis is on how some natural hazards, such as severe weather, are preceded by phenomena that allow for reliable predictions, but others occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).

NGSS Comparison: MS-ESS3-2 (modified)

Other Indicators in this Standard

SC.6.12.4.a, SC.6.12.4.b, SC.6.12.4.c

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Analyzing and Interpreting Data: • Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.	**Patterns:** • Graphs, charts, and images can be used to identify patterns in data. ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time.

Disciplinary Core Idea (DCI)

ESS3.B: Natural Hazards:

- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

- Link to List of Phenomena that are links to videos and lessons:
  - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
  - https://www.ngssphenomena.com/searchable-phenomena
- List of Phet Sims
  - https://phet.colorado.edu/
- Meteorology (local news stations)

- NASA links
    - www.nasa.gov

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.12.4.D	**Analyze and interpret** data on weather and climate to forecast future catastrophic events and inform the development of technologies to mitigate their effect.	
1	Organizing data	
	a	Students organize given data that represent the type of natural hazard event and features associated with that type of event, including the location, magnitude, frequency, and any associated precursor event or geologic forces.
	b	Students organize data in a way that facilitates analysis and interpretation.
	c	Students describe* what each dataset represents.
2	Identifying relationships	
	a	Students analyze data to identify and describe* patterns in the datasets, including:
		i. The location of natural hazard events relative to geographic and/or geologic features.
		ii. Frequency of natural hazard events.
		iii. Severity of natural hazard events.
		iv. Types of damage caused by natural hazard events.
		v. Location or timing of features and phenomena (e.g., aftershocks, flash floods) associated with natural hazard events.
	b	Students describe* similarities and differences among identified patterns.
3	Interpreting data	
	a	Students use the analyzed data to describe*:
		i. Areas that are susceptible to the natural hazard events, including areas designated as at the greatest and least risk for severe events.
		ii. How frequently areas, including areas experiencing the highest and lowest frequency of events, are at risk.
		iii. What type of damage each area is at risk of during a given natural hazard event.
		iv. What features, if any, occur before a given natural hazard event that can be used to predict the occurrence of the natural hazard event and when and where they can be observed.
	b	Using patterns in the data, students make a forecast for the potential of a natural hazard event to affect an area in the future, including information on frequency and/or probability of event occurrence; how severe the event is likely to be; where the event is most likely to cause the most damage; and what events, if any, are likely to precede the event.
	c	Students give at least three examples of the technologies that engineers have developed to mitigate the effects of natural hazards (e.g., the design of buildings and bridges to resist earthquakes, warning sirens for tsunamis, storm shelters for tornados, levees along rivers to prevent flooding).

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Analyzing and Interpreting Data

K-2	3-5	6-8	9-12
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.	Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations.	Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

Crosscutting Concepts (CCCs): Patterns

K-2	3-5	6-8	9-12
In grades K-2, children recognize that patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.	In grades 3-5, students identify similarities and differences in order to sort and classify natural objects and designed products. They identify patterns related to time, including simple rates of change and cycles, and to use these patterns to make predictions.	In grades 6-8, students recognize that macroscopic patterns are related to the nature of microscopic and atomic-level structure. They identify patterns in rates of change and other numerical relationships that provide information about natural and human designed systems. They use patterns to identify cause and effect relationships and use graphs and charts to identify patterns in data.	In grades 9-12, students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus, requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.

Disciplinary Core Ideas (DCIs): ESS3.B: Natural Hazards

K-2	3-5	6-8	9-12
ESS3.B In a region, some kinds of severe weather are more likely than others. Forecasts allow communities to prepare for severe weather.	**ESS3.B** A variety of hazards result from natural processes; humans cannot eliminate hazards but can reduce their impacts.	**ESS3.B** Mapping the history of natural hazards in a region and understanding related geological forces.	**ESS3.B** Natural hazards and other geological events have shaped the course of human history at local, regional, and global scales.

Related Cross-Curricular Standards: Current Grade Level

LA Connections:

- LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.6.RI.7 Compare and contrast regional, national, and/or multicultural perspectives within and across informational texts.
- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.

Mathematics Connections:

- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.
- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.1 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.D.1 Probability: Students will interpret and apply concepts of probability.

Social Studies Connections:

- SS 6.1.1.c Communicate the various ways governmental decisions have impacted people, places, and history.
- SS 6.2.1 Investigate how economic decisions affect the well-being of individuals and society.
- SS 6.3.1 Identify where (spatial) and why people, places, and environments are organized on the Earth's surface.
- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.
- SS 6.4.1 Analyze patterns of continuity and change over time in world history.
- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.3 Weather Climate and Water Cycle)
    - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- Atmospheric circulation, oceanic circulation, air mass, technological solutions, climate change, adaptation, mitigation, global warming, Coriolis effect, earth's rotation, greenhouse effect

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA 1:** Students organize provided data sets—including location, magnitude, frequency, and precursor events of natural hazards—and explain what each dataset shows.
- **KSA 2:** Students analyze the data to find and describe patterns in where natural hazards occur and how often they happen.
- **KSA 3:** Students compare and contrast these patterns to explain why some regions face higher natural hazard risks than others.
- **KSA 4:** Students use the data to predict future natural hazard events by identifying warning signs and assessing their likelihood, timing, and severity.
- **KSA 5:** Students evaluate different technologies—such as monitoring systems, strong building designs, and warning tools—and explain how these solutions connect to data patterns.
- **KSA 6:** Students bring their analysis together to create a forecast showing the probability, impact, and regional differences of future natural hazards, and suggest ways technology can reduce these risks.

Standard

Topic: SC.6.13 Earth's Systems

Standard Code: SC.6.13.5 Gather, analyze, and communicate evidence of the flow of energy and cycling of matter associated with Earth's materials and processes.

Students develop, use, and revise models to understand and predict phenomena and design systems. They study how energy transfer drives the cycling of matter, focusing on the continuous cycling of water among land, ocean, and atmosphere. Sunlight and gravity propel these global water movements and changes.

Indicator

Indicator Code: SC.6.13.5.a

Develop a model to describe how the water cycle is driven by the sun's energy and the force of gravity. 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. A quantitative understanding of the latent heat of vaporization and fusion is not assessed.

NGSS Comparison: MS-ESS2-4

Other Indicators in this Standard

None

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Developing and Using Models: • Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	**Energy and Matter:** • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter.

Disciplinary Core Idea (DCI)

ESS2.C: The Roles of Water in Earth's Surface Processes:

- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
- Global movements of water and its changes in form are propelled by sunlight and gravity.

Possible Science and/or Engineering Phenomena to Support 3D Instruction

A basketball loses its bounce when it is left out in the cold.

- Food coloring moves differently in hot water than cold water.
- Chocolate chips get soft if you hold them in your hand for a few minutes.
- Nebraska flooding 2019
- snow cover maps on March 9 and 14th, 2019 NOAA
- Yellowstone flooding 2022

- snow cover maps for May 2022
- Link to List of Phenomena that are links to videos and lessons:
    - https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.bhm2egkxmsmb
- NGSS List of Phenomena
    - https://www.ngssphenomena.com/searchable-phenomena
- List of Phet Sims
    - https://phet.colorado.edu/

Evidence Statements

What does it look like to demonstrate proficiency on this indicator?

6.13.5.a Develop a model to describe how the water cycle is driven by the sun's energy and the force of gravity.		
1	Components of the model	
	a	To make sense of a phenomenon, students develop a model in which they identify the relevant components:
		i. Water (liquid, solid, and in the atmosphere).
		ii. Energy in the form of sunlight.
		iii. Gravity.
		iv. Atmosphere.
		v. Landforms.
		vi. Plants and other living things.
2	Relationships	
	a	In their model, students describe* the relevant relationships between components, including:
		i. Energy transfer from the sun warms water on Earth, which can evaporate into the atmosphere.
		ii. Water vapor in the atmosphere forms clouds, which can cool and condense to produce precipitation that falls to the surface of Earth.
		iii. Gravity causes water on land to move downhill (e.g., rivers and glaciers) and much of it eventually flows into oceans.
		iv. Some liquid and solid water remains on land in the form of bodies of water and ice sheets.
		v. Some water remains in the tissues of plants and other living organisms, and this water is released when the tissues decompose.
3	Connections	
	a	Students use the model to account for both energy from light and the force of gravity driving water cycling between oceans, the atmosphere, and land, including that:
		i. Energy from the sun drives the movement of water from the Earth (e.g., oceans, landforms, plants) into the atmosphere through transpiration and evaporation.
		ii. Water vapor in the atmosphere can cool and condense to form rain or crystallize to form snow or ice, which returns to Earth when pulled down by gravity.
		iii. Some rain falls back into the ocean, and some rain falls on land. Water that falls on land can:
		1. Be pulled down by gravity to form surface waters such as rivers, which join together and generally flow back into the ocean.
		2. Evaporate back into the atmosphere.
		3. Be taken up by plants, which release it through transpiration and also eventually through decomposition.
		4. Be taken up by animals, which release it through respiration and also eventually through decomposition.
		5. Freeze (crystallize) and/or collect in frozen form, in some cases forming glaciers or ice sheets.
		6. Be stored on land in bodies of water or below ground in aquifers.

	b	Students use the model to describe* that the transfer of energy between water and its environment drives the phase changes that drive water cycling through evaporation, transpiration, condensation, crystallization, and precipitation.
	c	Students use the model to describe* how gravity interacts with water in different phases and locations to drive water cycling between the Earth's surface and the atmosphere.

Critical Background Knowledge

Grade Band Progressions:

Science and Engineering Practices (SEPs): Developing and Using Models

K-2	3-5	6-8	9-12
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions	Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.	Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

Crosscutting Concepts (CCCs): Energy and Matter

K-2	3-5	6-8	9-12
In grades K-2, students observe objects may break into smaller pieces, be put together into larger pieces, or change shapes.	In grades 3-5, students learn matter is made of particles and energy can be transferred in various ways and between objects. Students observe the conservation of matter by tracking matter flows and cycles before and after processes and recognizing the total weight of substances does not change.	In grades 6-8, students learn matter is conserved because atoms are conserved in physical and chemical processes. They also learn within a natural or designed system; the transfer of energy drives the motion and/or cycling of matter. Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). The transfer of energy can be tracked as energy flows through a designed or natural system.	In grades 9-12, students learn that the total amount of energy and matter in closed systems is conserved. They can describe changes of energy and matter in a system in terms of energy and matter flows into, out of, and within that system. They also learn that energy cannot be created or destroyed. It only moves between one place and another place, between objects and/or fields, or between systems. Energy drives the cycling of matter within and between systems. In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved.

Disciplinary Core Ideas (DCIs): ESS2.C: The Roles of Water in Earth's Surface Processes

K-2	3-5	6-8	9-12
ESS2.C Water is found in many types of places and in different forms on Earth.	**ESS2.C** Most of Earth's water is in the ocean and much of the Earth's fresh water is in glaciers or underground.	**ESS2.C** Water cycles among land, ocean, and atmosphere, and is propelled by sunlight and gravity. Density variations of sea water drive interconnected ocean currents. Water movement causes weathering and erosion, changing landscape features.	**ESS2.C** The planet's dynamics are greatly influenced by water's unique chemical and physical properties.

Related Cross-Curricular Standards: Current Grade Level

LA Connections:

- LA.6.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.6.RI.7 Compare and contrast regional, national, and/or multicultural perspectives within and across informational texts.
- LA.6.W.4 Write arguments that explain a perspective with supporting reasons and evidence.
- LA.6.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.6.W.6 Gather and use credible evidence from trustworthy sources and assess its relevance in answering a research question.
- LA.6.SL.2 Present claims and findings, sequencing ideas logically and using relevant descriptions, facts, and details to clarify themes or central ideas.

Mathematics Connections:

- 6.R.1 Ratios and Rates: Students will understand the concept of ratios and unit rates, use language to describe the relationship between two quantities, and use ratios and unit rates to solve authentic situations.
- 6.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 6.D.1 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.
- 6.D.1 Probability: Students will interpret and apply concepts of probability.

Social Studies Connections:

- SS 6.1.1.c Communicate the various ways governmental decisions have impacted people, places, and history.
- SS 6.2.1 Investigate how economic decisions affect the well-being of individuals and society.
- SS 6.3.1 Identify where (spatial) and why people, places, and environments are organized on the Earth's surface.
- SS 6.3.3 Identify how the natural environment is changed by natural and human forces, and how humans adapt to their surroundings.
- SS 6.4.1 Analyze patterns of continuity and change over time in world history.
- SS 6.4.5 Apply the inquiry process to construct and answer historical questions.

Connection to other grade level indicators

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.3 Weather Climate and Water Cycle)
  - https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

Words to support student discourse related to the Disciplinary Core Ideas (DCIs):

- precipitation, transpiration, evaporation, condensation, crystallization, runoff, temperature, cycle, Earth's systems (atmosphere, hydrosphere, geosphere, biosphere), energy, gravity, density

Assessment Considerations

Formative Assessment:

- https://www.education.ne.gov/assessment/nscas-science/

Stackable, Instructionally Embedded, Portable Science (SIPS) Assessments:

- https://sipsassessments.org/

Knowledge, Skills, and Abilities:

- **KSA 1:** Students list the key parts of the water cycle—water (liquid, solid, vapor), sunlight, and gravity—and explain each part's role in moving water
- **KSA 2:** Students explain, using simple diagrams, how sunlight warms water to cause evaporation and how gravity pulls water back as precipitation.
- **KSA 3: S**tudents build a basic model—either conceptual or physical—that shows water moving through evaporation, condensation, and precipitation, and clearly label how sunlight and gravity drive these changes.
- **KSA 4:** Students add landforms, the atmosphere, and living organisms to their models and explain how these elements work with sunlight and gravity to affect water movement.
- K**SA 5:** Students compare their model to real-world observations and adjust it to better show how sunlight and gravity control water cycling.
- **KSA 6:** Students present a complete model that shows how sunlight and gravity drive water's phase changes and movement among land, ocean, and atmosphere, supporting their model with clear evidence and reasoning.