Grade 7 Teacher's Guide to the Nebraska College and Career Ready Standards for Science 2024

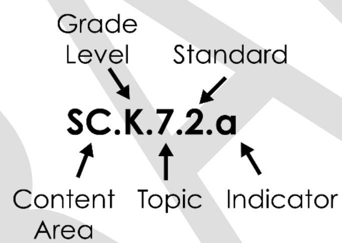
Last Revised 2/13/25

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, a crosscutting concept (underline), 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
I. Asking Questions and Defining Problems II. Developing and Using Models II. Planning and Carrying Out Investigations V. Analyzing and Interpreting Data V. Using Mathematics and Computational Thinking /I. Constructing Explanations and Designing Solutions II. Engaging in Argument from Evidence II. 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

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.

<table>
<tr><th>Science and Engineering Practice (SEP)</th><th>Crosscutting Concept (CCC)</th></tr>
<tr><td>[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.</td><td>[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.</td></tr>
<tr><th colspan="2">Disciplinary Core Idea (DCI)</th></tr>
<tr><td colspan="2">([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.</td></tr>
<tr><th colspan="2">Possible Science and/or Engineering Phenomena to Support 3D Instruction</th></tr>
<tr><td colspan="2">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.</td></tr>
</table>

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.

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 7 Teacher's Guide to the Nebraska CCR-Science Standards

The grade 7 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 does thermal energy affect particles?
Students will be able to provide molecular level descriptions that explain states of matter and changes between states.

Why do different pure substances have different physical and chemical properties and how do those properties determine how substances are used?
Students are expected to understand what occurs at the atomic molecular scales.

What happens when new materials are formed?
Students are expected to provide molecular level descriptions to explain that chemical reactions involve regrouping of atoms to form new substances and that atoms rearrange during chemical reactions.

How do organisms obtain and use energy?
Students are expected to use conceptual and physical models to explain the transfer of energy and cycling of matter as they construct explanations for the role of photosynthesis in cycling matter in ecosystems.

How does matter and energy move through an ecosystem?
Students are expected to construct explanations for the cycling of matter in organisms and the interaction of organisms to obtain matter and energy from an ecosystem to survive and grow.

How do organisms interact with other organisms in the physical environment to obtain matter and energy?
Students are expected to understand that organisms and populations of organisms are dependent on their environmental interactions both with other organisms and with non-living factors.

How do people figure out that Earth and life on Earth have changed over time?
Students are expected to examine geoscience data in order to understand the processes and events in Earth's history.

How do the materials in and on Earth's crust change over time?
Students are expected to understand how Earth's geosystems operate by modeling the flow of energy and the cycling of matter within and among different systems.

How do human activities affect Earth's systems?
Students are expected to understand the ways that human activities impact Earth's other systems

Standard
Topic Code: SC.7.3 Structure and Properties of Matter **Standard Code: SC.7.3.1 Gather, analyze, and communicate evidence of the structure, properties, and interactions of matter.**

Students will develop models to describe the atomic composition of simple molecules and understand that synthetic materials come from natural resources and impact society. They will also model changes in particle motion, temperature, and state of a substance when thermal energy is added or removed.

Indicator

Indicator Code: SC.7.3.1.a

Develop models to describe the atomic composition of simple molecules. Emphasis is on developing models of molecules that vary in complexity. Include the basic structure of an atom [structure of nucleus with protons/neutrons and electron cloud]. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms. Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.

NGSS Comparison: MS-PS1-1 (modified)

Other Indicators in this Standard

SC.7.5.2.b, SC.7.5.2.c

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 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.	**Scale, Proportion, and Quantity:** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Disciplinary Core Idea (DCI)

PS1.A: Structure and Properties of Matter:

- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

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

- https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.qiv3piaj6iq6
- Pencil lead (graphite), diamond, and charcoal are all made of carbon.
- Sugar (sucrose), rubbing alcohol (isopropyl alcohol), and nail polish remover (acetone) are made of carbon, hydrogen, and oxygen in them but they are not the same.
- Synthetic insulin and natural insulin molecules both have the same proportion of Carbon, Hydrogen, Nitrogen, Oxygen, and Sulfur

Evidence Statements

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

7.3.1.a		**Develop models to describe the atomic composition of simple molecules.**
1	Components of the model	
	a	Students develop models of atomic composition of simple molecules and extended structures that vary in complexity. In the models, students identify the relevant components, including:
		i. Individual atoms.
		ii. Molecules.
		iii. Extended structures with repeating subunits.
		iv. Substances (e.g., solids, liquids, and gases at the macro level).
2	Relationships	
	a	In the model, students describe* relationships between components, including:
		i. Individual atoms, from two to thousands, combine to form molecules, which can be made up of the same type or different types of atom.
		ii. Some molecules can connect to each other.
		iii. In some molecules, the same atoms of different elements repeat; in other molecules, the same atom of a single element repeats.
3	Connections	
	a	Students use models to describe* that:
		i. Pure substances are made up of a bulk quantity of individual atoms or molecules. Each pure substance is made up of one of the following:
		1. Individual atoms of the same type that are connected to form extended structures.
		2. Individual atoms of different types that repeat to form extended structures (e.g., sodium chloride).
		3. Individual atoms that are not attracted to each other (e.g., helium).
		4. Molecules of different types of atoms that are not attracted to each other (e.g., carbon dioxide).
		5. Molecules of different types of atoms that are attracted to each other to form extended structures (e.g., sugar, nylon).
		6. Molecules of the same type of atom that are not attracted to each other (e.g., oxygen).
		ii. Students use the models to describe* how the behavior of bulk substances depends on their structures at atomic and molecular levels, which are too small to see.

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): 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): [PS1.A](): Structure and Properties of Matter

K-2	3-5	6-8	9-12
PS1.A Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects can be built up from smaller parts.	**PS1.A** Matter exists as particles that are too small to see, and so matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials.	**PS1.A** The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.	**PS1.A** The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.

- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.1 Chemical Reactions and Matter)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Atom, element, molecule, chemical bond, covalent bond, ionic bond, compound, molecular formula, structural formula, Lewis structure, valence electrons, bonding pair, lone pair, electronegativity, polar covalent bond, nonpolar covalent bond, hydrogen bond, intermolecular forces, model, complexity

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:** Understand how atoms of different elements combine to form molecules.
  - **KSA2:** Identify different types of atoms in simple and complex molecules.
  - **KSA3:** Develop models of molecules varying in complexity (e.g., ammonia, methanol, sodium chloride, diamonds).
  - **KSA4:** Use drawings, 3D ball-and-stick structures, or computer representations to depict molecular structures.
  - **KSA5:** Describe molecular compositions using models.
  - **KSA6:** Compare different molecules based on their atomic compositions without detailed electron configuration or bonding energy discussions.

Standard

Topic: SC.7.3 Structure and Properties of Matter
Standard Code: SC.7.3.1 Gather, analyze, and communicate evidence of the structure, properties, and interactions of matter.

Students will develop models to describe the atomic composition of simple molecules and understand that synthetic materials come from natural resources and impact society. They will also model changes in particle motion, temperature, and state of a substance when thermal energy is added or removed.

Indicator

Indicator Code: SC.7.3.1.b

Gather and make sense of information to describe how natural materials may undergo chemical reactions to create new synthetic materials and have an impact on society. Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels. Examples include fossil fuels turning into plastics, new medication, and alternative fuels. Assessment is limited to qualitative information.

NGSS Comparison: MS-PS1-3

Other Indicators in this Standard

SC.7.5.2.a, SC.7.5.2.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 and progresses to evaluating the merit and validity of ideas and methods.	**Structure and Function:** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. ***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. **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)
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
• https://www.ngssphenomena.com/searchable-phenomena • https://phet.colorado.edu/ • https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.qiv3piaj6iq6 • Salt and sugar look and feel similar; however, they do not taste similar. • Washing a cut with water does not hurt as much as washing a cut with hydrogen peroxide. • Two filled balloons, one floats and the other sinks.

Evidence Statements

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

7.3.1.b Gather and make sense of information to describe how natural materials may undergo chemical reactions to create new synthetic materials and have an impact on society.		
1	Obtaining information	
	a	Students obtain information from published, grade-level appropriate material from at least two sources (e.g., text, media, visual displays, data) about:
		i. Synthetic materials and the natural resources from which they are derived.
		ii. Chemical processes used to create synthetic materials from natural resources (e.g., burning of limestone for the production of concrete).
		iii. The societal need for the synthetic material (e.g., the need for concrete as a building material).
2	Evaluating information	
	a	Students determine and describe* whether the gathered information is relevant for determining:
		i. That synthetic materials, via chemical reactions, come from natural resources.
		ii. The effects of the production and use of synthetic resources on society.
	b	Students determine the credibility, accuracy, and possible bias of each source of information, including the ideas included and methods described.
	c	Students synthesize information that is presented in various modes (e.g., graphs, diagrams, photographs, text, mathematical, verbal) to describe*:
		i. How synthetic materials are formed, including the natural resources and chemical processes used.
		ii. The properties of the synthetic material(s) that make it different from the natural resource(s) from which it was derived.
		iii. How those physical and chemical properties contribute to the function of the synthetic material.
		iv. How the synthetic material satisfies a societal need or desire through the properties of its structure and function.
		v. The effects of making and using synthetic materials on natural resources and society.

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): 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): 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 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.	**ETS1.A** Possible solutions to a problem are limited by available materials and 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	**ETS1.A** 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.	**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 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.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.1 Chemical Reactions and Matter)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Chemical reaction, natural materials, synthetic materials, raw materials, chemical process, reactant, product, catalyst, chemical bond, composition, natural resource, transformation, polymerization, fermentation, extraction, bioplastic, composite material, renewable resource, non-renewable resource, sustainability

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:** Understand the concept of chemical reactions transforming natural materials into synthetic materials.
- **KSA2:** Identify natural resources that undergo chemical processes to create new synthetic materials.
- **KSA3:** Gather information on how natural materials undergo chemical reactions to produce synthetic materials.
- **KSA4:** Interpret qualitative information about the transformation process.
- **KSA5:** Describe how chemical reactions of natural resources lead to the creation of new synthetic materials, such as medicines, foods, or alternative fuels.
- **KSA6:** Explain the qualitative aspects of these transformations, focusing on the process and outcomes rather than quantitative details.

Standard

Topic: SC.7.3 Structure and Properties of Matter

Standard Code: SC.7.3.1 Gather, analyze, and communicate evidence of the structure, properties, and interactions of matter.

Students will develop models to describe the atomic composition of simple molecules and understand that synthetic materials come from natural resources and impact society. They will also model changes in particle motion, temperature, and state of a substance when thermal energy is added or removed.

Indicator

Indicator Code: SC.7.3.1.c

Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. **Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.**

NGSS Comparison: MS-PS1-3

Other Indicators in this Standard

SC.7.5.2.a, SC.7.5.2.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 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 or designed systems.

Disciplinary Core Idea (DCI)

PS1.A: Structure and Properties of Matter

- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.

- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.

PS3.A: Definitions of Energy

- The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.
- The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.

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

- https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.qiv3piaj6iq6
- Balloons that deflate when going outside in the winter.
- Pop bottles that explode when frozen.
- Water bottles that "spit" when opened or shrink in the fridge.
- Steam engine
- Chocolate melting in your hands
- Popping popcorn
- Container of liquid in the car in summer

Evidence Statements

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

7.3.1.c Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.		
1	Components of the model	
	a	To make sense of a given phenomenon, students develop a model in which they identify the relevant components, including:
		i. Particles, including their motion.
		ii. The system within which the particles are contained.
		iii. The average kinetic energy of particles in the system.
		iv. Thermal energy of the system.
		v. Temperature of the system.
		vi. A pure substance in one of the states of matter (e.g., solid, liquid, gas at the macro scale).
2	Relationships	
	a	In the model, students describe* relationships between components, including:
		i. The relationships between:
		1. The motion of molecules in a system and the kinetic energy of the particles in the system.
		2. The average kinetic energy of the particles and the temperature of the system.
		3. The transfer of thermal energy from one system to another and:

		A. A change in kinetic energy of the particles in that new system, or
		B. A change in state of matter of the pure substance.
		4. The state of matter of the pure substance (gas, liquid, solid) and the particle motion (freely moving and not in contact with other particles, freely moving and in loose contact with other particles, vibrating in fixed positions relative to other particles).
3	Connections	
	a	Students use their model to provide a causal account of the relationship between the addition or removal of thermal energy from a substance and the change in the average kinetic energy of the particles in the substance.
	b	Students use their model to provide a causal account of the relationship between:
		i. The temperature of the system.
		ii. Motions of molecules in the gaseous phase.
		iii. The collisions of those molecules with other materials, which exerts a force called pressure.
	c	Students use their model to provide a causal account of what happens when thermal energy is transferred into a system, including that:
		i. An increase in kinetic energy of the particles can cause:
		1. An increase in the temperature of the system as the motion of the particles relative to each other increases, or
		2. A substance to change state from a solid to a liquid or from a liquid to a gas.
		ii. The motion of molecules in a gaseous state increases, causing the moving molecules in the gas to have greater kinetic energy, thereby colliding with molecules in surrounding materials with greater force (i.e., the pressure of the system increases).
	d	Students use their model to provide a causal account of what happens when thermal energy is transferred from a substance, including that:
		i. Decreased kinetic energy of the particles can cause:
		1. A decrease in the temperature of the system as the motion of the particles relative to each other decreases, or
		2. A substance to change state from a gas to a liquid or from a liquid to a solid.
		ii. The pressure that a gas exerts decreases because the kinetic energy of the gas molecules decreases, and the slower molecules exert less force in collisions with other molecules in surrounding materials.
	e	Students use their model to provide a causal account for the relationship between changes in pressure of a system and changes of the states of materials in the system.
		i. With a decrease in pressure, a smaller addition of thermal energy is required for particles of a liquid to change to gas because particles in the gaseous state are colliding with the surface of the liquid less frequently and exerting less force on the particles in the liquid, thereby allowing the particles in the liquid to break away and move into the gaseous state with the addition of less energy.
		ii. With an increase in pressure, a greater addition of thermal energy is required for particles of a liquid to change to gas because particles in the gaseous state are colliding with the surface of the liquid more frequently and exerting greater force on the particles in the liquid, thereby limiting the movement of particles from the liquid to gaseous state.

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): PS1.A: Structure and Properties of Matter: PS3.A: Definitions of Energy

K-2	3-5	6-8	9-12
PS1.A Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects	**PS1.A** Matter exists as particles that are too small to see, and so matter is always conserved even if it seems to disappear. Measurements of a variety of observable	**PS1.A** The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter.	**PS1.A** The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A

can be built up from smaller parts. **PS3.A - N/A**	properties can be used to identify particular materials. **PS3.A & 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 & 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.	stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart. **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).

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.1 Chemical Reactions and Matter)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Particle motion, temperature, thermal energy, kinetic energy, state of matter, solid, liquid, gas, phase change, melting, freezing, boiling, vaporization, condensation, sublimation, evaporation, deposition, phase diagram, heat transfer, thermal expansion, latent heat

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:** Understand how adding or removing thermal energy affects particle motion, temperature, and state changes in solids, liquids, and gases.
- **KSA2:** Develop qualitative models illustrating changes in particle motion and state transitions when thermal energy is added or removed.
- **KSA3:** Predict and explain qualitatively how thermal energy alters particle kinetic energy and leads to changes in state, using developed models to support understanding.

Standard

Topic: SC.7.5 Chemical Reactions

Standard Code: SC.7.5.2 Gather, analyze, and communicate evidence of chemical reactions.

Students will analyze data to identify chemical reactions, model atom conservation and mass in reactions, and design devices that release or absorb thermal energy through chemical processes. They will also combine the best features of different designs into improved solutions.

Indicator

Indicator Code: SC.7.5.2.a

Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride. Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.

NGSS Comparison: MS-PS1-2

Other Indicators in this Standard

SC.7.5.2.b, SC.7.5.2.c, SC.7.5.2.d

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 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ***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.	**Patterns:** • Macroscopic patterns are related to the nature of microscopic and atomic-level structure.

Disciplinary Core Idea (DCI)

PS1.A: Structure and Properties of Matter:

- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

PS1.B: Chemical Reactions:

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants

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

- https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.qiv3piaj6iq6
- Burning steel wool
- Elephant Toothpaste
- Diet Coke and Mentos
- Slime
- Penny and Ammonia
- Burning sugar
- Alka Seltzer Film Canister Rocket

Evidence Statements

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

7.5.2.a Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.		
1	Organizing data	
	a	Students organize given data about the characteristic physical and chemical properties (e.g., density, melting point, boiling point, solubility, flammability, odor) of pure substances before and after they interact.
	b	Students organize the given data in a way that facilitates analysis and interpretation.
	Identifying relationships	

2	a	Students analyze the data to identify patterns (i.e., similarities and differences), including the changes in physical and chemical properties of each substance before and after the interaction (e.g., before the interaction, a substance burns, while after the interaction, the resulting substance does not burn).
3	Interpreting data	
	a	Students use the analyzed data to determine whether a chemical reaction has occurred.
	b	Students support their interpretation of the data by describing* that the change in properties of substances is related to the rearrangement of atoms in the reactants and products in a chemical reaction (e.g., when a reaction has occurred, atoms from the substances present before the interaction must have been rearranged into new configurations, resulting in the properties of new substances).

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): PS1.A: Structure and Properties of Matter: PS1.B: Chemical Reactions

K-2	3-5	6-8	9-12
PS1.A Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects can be built up from smaller parts. **PS1.B** Heating and cooling substances cause changes that are sometimes reversible and sometimes not.	**PS1.A** Matter exists as particles that are too small to see, and so matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials. **PS1.B** Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same	**PS1.A** The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter. **PS1.B** Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.	**PS1.A** The sub-atomic structural model and interactions between electric charges at the atomic scale can be used to explain the structure and interactions of matter, including chemical reactions and nuclear processes. Repeating patterns of the periodic table reflect patterns of outer electrons. A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy to take the molecule apart. **PS1.B** Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.1 Chemical Reactions and Matter)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Chemical reaction, reactant, product, chemical bond, physical change, chemical change, chemical reaction, precipitate, endothermic reaction, exothermic reaction, Law of Conservation of Mass, activation energy, catalyst, chemical equation, reactivity, molecular structure, bond energy, yield, synthesis reaction, decomposition reaction

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:** Understand how chemical reactions alter substance properties like density, melting point, boiling point, solubility, flammability, and odor.
  - **KSA2:** Analyze changes in substance properties before and after interactions to assess if a chemical reaction has occurred.
  - **KSA3:** Interpret property changes to determine the occurrence of a chemical reaction, using specified properties as indicators.

Standard

Topic: SC.7.5 Chemical Reactions

Standard Code: SC.7.5.2 Gather, analyze, and communicate evidence of chemical reactions.

Students will analyze data to identify chemical reactions, model atom conservation and mass in reactions, and design devices that release or absorb thermal energy through chemical processes. They will also combine the best features of different designs into improved solutions.

Indicator

Indicator Code: SC.7.5.2.b

Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms that represent atoms. Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.

NGSS Comparison: MS-PS1-5

Other Indicators in this Standard

SC.7.5.2.a, SC.7.5.2.c, SC.7.5.2.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 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ***Connections to the nature of science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Laws are regularities or mathematical descriptions of natural phenomena.	**Energy and Matter:** • Matter is conserved because atoms are conserved in physical and chemical processes.

Disciplinary Core Idea (DCI)

PS1.B: Chemical Reactions:

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- The total number of each type of atom is conserved, and thus the mass does not change.

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

- https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.qiv3piaj6iq6
- When baking soda is poured into vinegar, the solution begins to fizz and the substance weighs less than the baking soda and vinegar weighed initially.
- When 50 mL of water is mixed with 50 mL of rubbing alcohol, the total volume decreases, but the total mass stays the same.
- A piece of steel wool weighs more after it rusts than before it was rusty.

Evidence Statements

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

7.5.2.b Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.		
1	Components of the model	
	a	To make sense of a given phenomenon, students develop a model in which they identify the relevant components for a given chemical reaction, including:
		i. The types and number of molecules that make up the reactants.
		ii. The types and number of molecules that make up the products.
	Relationships	

2	a	In the model, students describe* relationships between the components, including:
		i. Each molecule in each of the reactants is made up of the same type(s) and number of atoms.
		ii. When a chemical reaction occurs, the atoms that make up the molecules of reactants rearrange and form new molecules (i.e., products).
		iii. The number and types of atoms that make up the products are equal to the number and types of atoms that make up the reactants.
		iv. Each type of atom has a specific mass, which is the same for all atoms of that type.
3	Connections	
	a	Students use the model to describe* that the atoms that make up the reactants rearrange and come together in different arrangements to form the products of a reaction.
	b	Students use the model to provide a causal account that mass is conserved during chemical reactions because the number and types of atoms that are in the reactants equal the number and types of atoms that are in the products, and all atoms of the same type have the same mass regardless of the molecule in which they are found.

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	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	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	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

larger pieces, or change shapes.	recognizing the total weight of substances does not change.	energy can be tracked as energy flows through a designed or natural system.	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): PS1.B: Chemical Reactions

K-2	3-5	6-8	9-12
PS1.B Heating and cooling substances cause changes that are sometimes reversible and sometimes not.	**PS1.B** Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same	**PS1.B** Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy.	**PS1.B** Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in energy as determined by properties of elements involved.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.1 Chemical Reactions and Matter)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Chemical reaction, reactant, product, Law of Conservation of Mass, atom, element, molecule, chemical bond, physical model, digital model, conservation, mass, atomic number, nucleus, proton, neutron, electron, subscript, coefficient, reaction stoichiometry

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:** Understand that in chemical reactions, the total number of atoms remains unchanged, demonstrating the law of conservation of matter.
- **KSA2:** Explain that atoms are rearranged but not created or destroyed during reactions, ensuring mass conservation.
- **KSA3:** Create physical or digital models showing how atoms are conserved in quantity during chemical reactions.
- **KSA4:** Use models or drawings to depict atom rearrangement without changing the total count.
- **KSA5:** Describe with models how the conservation of atoms ensures mass is conserved in reactions.
- **KSA6:** Provide explanations of the conservation of matter, focusing on atom rearrangement for mass conservation.

Standard

Topic: SC.7.5 Chemical Reactions
Standard Code: SC.7.5.2 Gather, analyze, and communicate evidence of chemical reactions.

Students will analyze data to identify chemical reactions, model atom conservation and mass in reactions, and design devices that release or absorb thermal energy through chemical processes. They will also combine the best features of different designs into improved solutions.

Indicator

Indicator Code: SC.7.5.2.c

Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride. Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.

NGSS Comparison: MS-PS1-6

Other Indicators in this Standard

SC.7.5.2.a, SC.7.5.2.b, SC.7.5.2.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 knowledge, principles, and theories.	**Energy and Matter:** • The transfer of energy can be tracked as energy flows through a designed or natural system.

Disciplinary Core Idea (DCI)

PS1.B: **Chemical Reactions:**

- Some chemical reactions release energy, others store energy.

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.

ETS1.C: **Optimizing the Design Solution:**

- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.

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

- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.vhgqzv6j83tx https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- 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?

7.5.2.c Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.		
1	Using scientific knowledge to generate design solutions	
	a	Given a problem to solve that requires either heating or cooling, students design and construct a solution (i.e., a device). In their designs, students:
		i. Identify the components within the system related to the design solution, including:
		1. The components within the system to or from which energy will be transferred to solve the problem.
		2. The chemical reaction(s) and the substances that will be used to either release or absorb thermal energy via the device.

		ii. Describe* how the transfer of thermal energy between the device and other components within the system will be tracked and used to solve the given problem.
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students describe* the given criteria, including:
		i. Features of the given problem that are to be solved by the device.
		ii. The absorption or release of thermal energy by the device via a chemical reaction.
	b	Students describe* the given constraints, which may include:
		i. Amount and cost of materials.
		ii. Safety.
		iii. Amount of time during which the device must function.
3	Evaluating potential solutions	
	a	Students test the solution for its ability to solve the problem via the release or absorption of thermal energy to or from the system.
	b	Students use the results of their tests to systematically determine how well the design solution meets the criteria and constraints, and which characteristics of the design solution performed the best.
4	Modifying the design solution	
	a	Students modify the design of the device based on the results of iterative testing, and improve the design relative to 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 evidencebased 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): PS1.B Chemical Reactions: ETS1.B Developing Possible Solutions: ETS1.C Optimizing the Design Solution

K-2	3-5	6-8	9-12
PS1.B Heating and cooling substances cause changes that are sometimes reversible and sometimes not. **ETS1.B** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. **ETS1.C** Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	**PS1.B** Chemical reactions that occur when substances are mixed can be identified by the emergence of substances with different properties; the total mass remains the same. **ETS1.B** Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared	**PS1.B** Reacting substances rearrange to form different molecules, but the number of atoms is conserved. Some reactions release energy and others absorb energy. **ETS1.B** 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. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Models of all kinds are important for testing solutions.	**PS1.B** Chemical processes are understood in terms of collisions of molecules, rearrangement of atoms, and changes in **ETS1.B** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.

Because there is always more than one possible solution to a problem, it is useful to compare and test designs.	ideas can lead to improved designs. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **ETS1.C** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	**ETS1.C** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. **ETS1.C** Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Connection to other grade level indicators

ELA Connections:

- .LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.1 Chemical Reactions and 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):

Design, thermal energy, chemical process, device, release of thermal energy, Absorbtion of thermal energy, controlling, transfer of energy, modification, type of substance, concentration, reactant, product, prototype, criteria, constraints

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:** Understand how certain chemical reactions release or absorb thermal energy.
- **KSA2:** Identify examples like dissolving ammonium chloride or calcium chloride.
- **KSA3:** Design and construct a device using chemical processes to release or absorb thermal energy.
- **KSA4:** Control energy transfer by adjusting substance type and concentration.
- **KSA5:** Test the device to adjust factors such as substance amount, time, and temperature.
- **KSA6:** Modify the device based on testing to enhance thermal energy release or absorption.

Standard

Topic: SC.7.5 Chemical Reactions

Standard Code: SC.7.5.2 Gather, analyze, and communicate evidence of chemical reactions.

Students will analyze data to identify chemical reactions, model atom conservation and mass in reactions, and design devices that release or absorb thermal energy through chemical processes. They will also combine the best features of different designs into improved solutions.

Indicator

Indicator Code: SC.7.5.2.d

Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. An example could include determining which chemicals make the best hot or cold pack.

NGSS Comparison: MS-ETS1-3

Other Indicators in this Standard

SC.7.5.2.a, SC.7.5.2.b, SC.7.5.2.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 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.	

Disciplinary Core Idea (DCI)

ETS1.B: Developing Possible Solutions:

- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.

ETS1.C: Optimizing the Design Solution

- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design.

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

- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.vhgqzv6j83tx https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- The water pipes at your cabin keep freezing during the winter.
- The reservoir is losing water to evaporation.
- My sidewalk keeps freezing and becomes slippery.
- Popsicles keep melting before the party during the summer.

Evidence Statements

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

7.5.2.d Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		
1	Organizing data	
	a	Students organize given data (e.g., via tables, charts, or graphs) from tests intended to determine the effectiveness of three or more alternative solutions to a problem.
2	Identifying relationships	
	a	Students use appropriate analysis techniques (e.g., qualitative or quantitative analysis; basic statistical techniques of data and error analysis) to analyze the data and identify relationships within the datasets, including relationships between the design solutions and the given criteria and constraints.
3	Interpreting data	
	a	Students use the analyzed data to identify evidence of similarities and differences in features of the solutions.

	b	Based on the analyzed data, students make a claim for which characteristics of each design best meet the given criteria and constraints.
	c	Students use the analyzed data to identify the best features in each design that can be compiled into a new (improved) redesigned solution.

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.

Disciplinary Core Ideas (DCIs): ETS1.B: Developing Possible Solutions: ETS1.C: Optimizing the Design Solution

K-2	3-5	6-8	9-12
ETS1.B Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. **ETS1.C** Because there is always more than one possible solution to a problem, it is useful to compare and test designs. Because there is always more than one possible solution to a	**ETS1.B** Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.	**ETS1.B** 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. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Models of all kinds are important for testing solutions.	**ETS1.B** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.

problem, it is useful to compare and test designs.	Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **ETS1.C** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.	**ETS1.C** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	**ETS1.C** Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Connection to other grade level indicators

ELA Connections:

- .LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.1 Chemical Reactions and 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):

- Analyze, data, tests, design solutions, similarities, differences, identify, best characteristics, combine, new solution, criteria, success, evaluation, performance, effectiveness, optimize, feedback, improvement

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:** Understand the process of analyzing data from tests to evaluate multiple design solutions.
- **KSA2:** Identify key criteria for success in design solutions.
- **KSA3:** Analyze data from tests to identify similarities and differences among several design solutions.
- **KSA4:** Evaluate the effectiveness of each design solution based on established criteria.
- **KSA5:** Determine the best characteristics of each design solution that can be combined into a new, improved solution.
- **KSA6:** Propose and justify modifications or combinations of design features to enhance overall success criteria.

Standard

Topic: SC.7.7 Interdependent Relationships in Ecosystems
Standard Code: SC.7.7.3 Gather, analyze, and communicate evidence of interdependent relationships in ecosystems.

Students will explain patterns of interactions among organisms in different ecosystems, evaluate design solutions for maintaining biodiversity, and use a systematic process to assess how well these solutions meet criteria and constraints. They will also design methods to monitor and increase positive human impact on the environment.

Indicator

Indicator Code: SC.7.7.3.a
Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

NGSS Comparison: MS-LS2-2

Other Indicators in this Standard

SC.7.7.3.b, SC.7.7.3.c, SC.7.7.3.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.	**Patterns:** • Patterns can be used to identify cause and effect relationships.

Disciplinary Core Idea (DCI)

LS2.A: **Interdependent Relationships in Ecosystems:**

- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.

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

- Trophic cascades
- Coral bleaching
- Pest control in organic farming
- Reintroduction of mountain lions in Nebraska
- Invasive species
- Reintroduction of Big Horn sheep in Nebraska
- https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.btifh1chdrtz

Evidence Statements

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

7.7.3.a	**Construct an explanation** that predicts patterns of interactions among organisms across multiple ecosystems.	
1	Articulating the explanation of phenomena	
	a	Students articulate a statement that relates the given phenomenon to a scientific idea, including that similar patterns of interactions occur between organisms and their environment, regardless of the ecosystem or the species involved.
	b	Students use evidence and reasoning to construct an explanation for the given phenomenon.
2	Evidence	
	a	Students identify and describe* the evidence (e.g., from students' own investigations, observations, reading material, archived data) necessary for constructing the explanation, including evidence that:
		i. Competitive relationships occur when organisms within an ecosystem compete for shared resources (e.g., data about the change in population of a given species when a competing species is introduced).
		ii. Predatory interactions occur between organisms within an ecosystem.
		iii. Mutually beneficial interactions occur between organisms within an ecosystem. Organisms involved in these mutually beneficial interactions can become so dependent upon one another that they cannot survive alone.
		iv. Resource availability, or lack thereof, can affect interactions between organisms (e.g., organisms in a resource-limited environment may have a competitive relationship, while those same organisms may not be in competition in a resource-rich environment).
		v. Competitive, predatory, and mutually beneficial interactions occur across multiple, different, ecosystems
	b	Students use multiple valid and reliable sources for the evidence.
3	Reasoning	
	a	Students identify and describe* quantitative or qualitative patterns of interactions among organisms that can be used to identify causal relationships within ecosystems, related to the given phenomenon.
	b	Students describe* that regardless of the ecosystem or species involved, the patterns of interactions (competitive, mutually beneficial, predator/prey) are similar.
	c	Students use reasoning to connect the evidence and support an explanation. In their reasoning, students use patterns in the evidence to predict common interactions among organisms in ecosystems as they relate to the phenomenon, (e.g., given specific organisms in a given environment with specified resource availability, which organisms in the system will exhibit competitive interactions). Students predict the following types of interactions:
		i. Predatory interactions.
		ii. Competitive interactions.
		iii. Mutually beneficial interactions.

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): 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): LS2.A: Interdependent Relationships in Ecosystems

K-2	3-5	6-8	9-12
LS2.A Plants depend on water and light to grow, and also depend on animals for pollination or	**LS2.A** The food of almost any animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the	**LS2.A** Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. Competitive,	**LS2.A** Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and

to move their seeds around.	animals that eat plants, while decomposers restore some materials back to the soil	predatory, and mutually beneficial interactions vary across ecosystems but the patterns are shared.	organism populations affects the abundance of species in any given ecosystem.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.5 Ecosystem Dynamics and Biodiversity)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Ecosystem, organism, interactions, predator, competition, symbiosis, mutualism, parasite, food chain, food web, producer, consumer, decomposer, trophic level, energy transfer, population, community, biotic factors, abiotic factors

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:** Understand how organisms interact in different ecosystems, including competition, predation, symbiosis, and mutualism.
- **KSA2:** Construct explanations predicting interaction patterns among organisms across various ecosystems.
- **KSA3:** Analyze environmental factors influencing these patterns.
- **KSA4:** Apply ecological knowledge to explain how interactions vary across ecosystems.
- **KSA5:** Predict ecosystem-wide impacts of environmental changes on organism interactions.

Standard

Topic: SC.7.7 Interdependent Relationships in Ecosystems

Standard Code: SC.7.7.3 Gather, analyze, and communicate evidence of interdependent relationships in ecosystems.

Students will explain patterns of interactions among organisms in different ecosystems, evaluate design solutions for maintaining biodiversity, and use a systematic process to assess how well these solutions meet criteria and constraints. They will also design methods to monitor and increase positive human impact on the environment.

Indicator

Indicator Code: SC.7.7.3.b

Develop and use a model to describe how <u>stable ecosystems maintain</u> biodiversity and ecosystem services.

NGSS Comparison: MS-LS2-5

Other Indicators in this Standard

SC.7.7.3.a, SC.7.7.3.c, SC.7.7.3.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.	**Stability and Change:** • Small changes in one part of a system might cause large changes in another part. ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • The use 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)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience:

- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.

LS4.D: Biodiversity and Humans

- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.

ETS1.B: Developing Possible Solutions

- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

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

- https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.btifh1chdrtz
- A closed ecosphere that contains algae, coral, and shrimp has survived for many years; however, after being placed in a dark room, all the organisms die.
- Water flow in the Everglades changed when pythons were introduced to the ecosystem.
- As urban sprawl increases along the coasts, there has been a large decline in the survival rate of sea turtle hatchlings.
- The rate of heat transferred to the ocean has doubled since 1993.

Evidence Statements

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

SC.7.7.3.b Develop and use a model to describe how stable ecosystems maintain biodiversity and ecosystem services.		
1	Component of the model	
	a	Students create a model (like a drawing or chart) that shows the important parts of a healthy ecosystem.
		I. **Living things:** a variety of plants and animals (biodiversity).
		II. **Non-living parts:** things like soil, water, sunlight, and climate.
		III. **Ecosystem services:** natural benefits such as clean water, pollination, and recycling of nutrients.
2	Identifying relationships	
	a	Students add details to their model to explain how the parts work together. They show that:
		I. Interactions among plants and animals (like eating, competing, and helping each other) help keep the ecosystem healthy.
		II. Sunlight and water move through the system, helping with processes like evaporation and rain.
		III. Even small changes, like the loss of one species, can cause big changes in the ecosystem.
3	Connections	
	a	Students use their model to explain how a healthy ecosystem supports natural benefits (like clean water and good soil) that people need.

	b	Students explain how human actions (like pollution or protecting nature) can affect these benefits, and they suggest ways technology or new ideas can help keep the ecosystem stable.
	c	Students review their model using evidence to ensure it clearly explains how ecosystems maintain biodiversity and provide ecosystem services.
	d	Students then propose improvements to their model that further illustrate the role of biodiversity and ecosystem services in keeping ecosystems stable and in supporting human society.
		I. Adding arrows or labels to show how different species interact (e.g., pollination, food chains) to maintain balance.
		II. Including a section that shows how natural processes provide clean air and water for communities.
		III. Suggesting changes to the model to show what might happen if a key species is lost, and how that loss could affect both the ecosystem and people

Critical Background Knowledge

Grade Band Progressions:

Visit for progressions https://www.nextgenscience.org/resources/ngss-appendices (Delete this statement)

Science and Engineering Practices (SEPs): Ev

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. • Distinguish between a model and the actual object, process, and/or events the model represents. • Compare models to identify common features and differences. • Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s).	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. • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.	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. • Evaluate limitations of a model for a proposed object or tool. • Develop or modify a model— based on evidence – to match what happens if a variable or component of a system is changed. • Use and/or develop a model of simple systems with uncertain and less predictable factors. • Develop and/or revise a model to show the	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. • Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move

• Develop a simple model based on evidence to represent a proposed object or tool.	• Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.	relationships among variables, including those that are not observable but predict observable phenomena. • Develop and/or use a model to predict and/or describe phenomena. ▯ Develop a model to describe unobservable mechanisms. • Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.	flexibly between model types based on merits and limitations. • Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

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 change, and things may change slowly or rapidly.	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 systems appear stable, but over long periods of time they will eventually change.	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, 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.	In grades 9-12, students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify 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): LS2.C: Ecosystem Dynamics, Functioning, and Resilience: LS4.D: Biodiversity and Humans: ETS1.B: Developing Possible Solutions

K-2	3-5	6-8	9-12
LS2.C - N/A **LS4.D** A range of different organisms lives in different places. **ETS1.B** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**LS2.C** When the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. **LS4.D** Populations of organisms live in a variety of habitats. Change in those habitats affects the organisms living there. **ETS1.B** Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Testing a solution involves investigating how well it performs under a range of likely conditions.	**LS2.C** Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. **LS4.D** Changes in biodiversity can influence humans' resources and ecosystem services they rely on. **ETS1.B** 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. A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Models of all kinds are important for testing solutions.	**LS2.C** If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem. **LS4.D** Biodiversity is increased by formation of new species and reduced by extinction. Humans depend on biodiversity but also have adverse impacts on it. Sustaining biodiversity is essential to supporting life on Earth. **ETS1.B** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.5 Ecosystem Dynamics and Biodiversity)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Ecosystem, biodiversity, species, population, community, ecosystem services, model, dynamic, interdependence, habitat, niche, food web, energy pyramid, producers, consumers, decomposers, adaptation, resilience, conservation

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:** Understand how ecosystems maintain biodiversity through interactions among species and habitats.
  - **KSA2:** Identify ecosystem services and their importance to human well-being.
  - **KSA3:** Develop a model illustrating how ecosystems support biodiversity and provide ecosystem services.

- **KSA4:** Include factors such as species interactions, habitat diversity, and resource availability in the model.
- **KSA5:** Explain using the model how ecosystems maintain biodiversity and provide ecosystem services.
- **KSA6:** Apply understanding to discuss the importance of biodiversity and ecosystem services for ecological stability and human society.

Standard

Topic: SC.7.7 Interdependent Relationships in Ecosystems
Standard Code: SC.7.7.3 Gather, analyze, and communicate evidence of interdependent relationships in ecosystems.

Students will explain patterns of interactions among organisms in different ecosystems, evaluate design solutions for maintaining biodiversity, and use a systematic process to assess how well these solutions meet criteria and constraints. They will also design methods to monitor and increase positive human impact on the environment.

Indicator

Indicator Code: SC.7.7.3.c

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

NGSS Comparison: MS-ETS1-2

Other Indicators in this Standard

SC.7.7.3.a, SC.7.7.3.b, SC.7.7.3.d

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Engaging in Argument from Evidence: • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	**Systems and System Models:** • 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.

Disciplinary Core Idea (DCI)
ETS1.B: Developing Possible Solutions: • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem

Possible Science and/or Engineering Phenomena to Support 3D Instruction
• A closed ecosphere that contains algae, coral, and shrimp has survived for many years; however, after being placed in a dark room, all the organisms die. • Water flow in the Everglades changed when pythons were introduced to the ecosystem. • As urban sprawl increases along the coasts, there has been a large decline in the survival rate of sea turtle hatchlings. • The rate of heat transferred to the ocean has doubled since 1993. • https://www.ngssphenomena.com/searchable-phenomena NGSS List of Phenomena • https://phet.colorado.edu/ List of Phet Sims • https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.btifh1chdrtz

Evidence Statements

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

7.7.3.c **Evaluate competing design solutions** using a systematic process to determine how well they meet the criteria and constraints of the problem.		
1	Identifying the given design solution and associated claims and evidence	
	a	Students identify the given supported design solution.
	b	Students identify scientific knowledge related to the problem and each proposed solution.
	c	Students identify how each solution would solve the problem.
2	Identifying additional evidence	
	a	Students identify and describe* additional evidence necessary for their evaluation, including:
		i. Knowledge of how similar problems have been solved in the past.
		ii. Evidence of possible societal and environmental impacts of each proposed solution.
	b	Students collaboratively define and describe* criteria and constraints for the evaluation of the design solution.
3	Evaluating and critiquing evidence	
	a	Students use a systematic method (e.g., a decision matrix) to identify the strengths and weaknesses of each solution. In their evaluation, students:
		i. Evaluate each solution against each criterion and constraint.
		ii. Compare solutions based on the results of their performance against the defined criteria and constraints.
	b	Students use the evidence and reasoning to make a claim about the relative effectiveness of each proposed solution based on the strengths and weaknesses of each.

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.

Disciplinary Core Ideas (DCIs): ETS1.B: Developing Possible Solutions

K-2	3-5	6-8	9-12
ETS1.B Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	**ETS1.B** Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. Testing a solution involves investigating how well it performs under a range of likely conditions.	**ETS1.B** 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. A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Models of all kinds are important for testing solutions.	**ETS1.B** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.5 Ecosystem Dynamics and Biodiversity)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Evaluation, design, systematic process, criteria, constraint, problem statement, analysis, judgment, effectiveness, efficiency, quality, scoring rubric, feedback, iterative process, optimize, consensus

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:** Understand the systematic process for evaluating competing design solutions.

- **KSA2:** Identify criteria and constraints that define the problem-solving context.
- **KSA3:** Evaluate competing design solutions against established criteria and constraints.
- **KSA4:** Compare the strengths and weaknesses of each solution based on the evaluation process.
- **KSA5:** Make informed decisions on which design solutions best meet the criteria and constraints.
- **KSA6:** Justify choices using evidence from the evaluation process, articulating the rationale behind the selection.

Standard

Topic: SC.7.7 Interdependent Relationships in Ecosystems
Standard Code: SC.7.7.3 Gather, analyze, and communicate evidence of interdependent relationships in ecosystems.

Students will explain patterns of interactions among organisms in different ecosystems, evaluate design solutions for maintaining biodiversity, and use a systematic process to assess how well these solutions meet criteria and constraints. They will also design methods to monitor and increase positive human impact on the environment.

Indicator

Indicator Code: SC.7.7.3.d

Apply scientific principles to **design a method for monitoring and increasing positive human impact** on the environment. Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that have positive impacts. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).

NGSS Comparison: MS-ESS3-3

Other Indicators in this Standard

SC.7.7.3.a, SC.7.7.3.b, SC.7.7.3.c

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Constructing Explanations and Designing Solutions: • Apply scientific principles to design an object, tool, process or system.	**Cause and Effect:** • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. ***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.C: Human Impacts on Earth Systems:

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

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

- The average American eats 12,129 hamburgers in a lifetime.
- Per capita, the people in the United States and Australia use more fossil fuels for energy than the people in China, India, Canada, or France.
- Copper is used in solar panels, smart phones, and other devices. As more applications for copper are found, consumption increases.
- By 2025, two-thirds of the world's population may be facing water shortages.
- https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.btifh1chdrtz

Evidence Statements

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

7.7.3.d Apply scientific principles to **design a method for monitoring and increasing positive human impact** on the environment.		
1	Using scientific knowledge to generate design solutions	
	a	Given a problem related to human impact on the environment, students use scientific information and principles to generate a design solution that:
		i. Addresses the results of the particular human activity.
		ii. Incorporates technologies that can be used to monitor and minimize negative effects that human activities have on the environment.
	b	Students identify relationships between the human activity and the negative environmental impact based on scientific principles, and distinguish between causal and correlational relationships to facilitate the design of the solution.
2	Describing* criteria and constraints, including quantification when appropriate	
	a	Students define and quantify, when appropriate, criteria and constraints for the solution, including:
		i. Individual or societal needs and desires.
		ii. Constraints imposed by economic conditions (e.g., costs of building and maintaining the solution).
3	Evaluating potential solutions	
	a	Students describe* how well the solution meets the criteria and constraints, including monitoring or minimizing a human impact based on the causal relationships between relevant scientific principles about the processes that occur in, as well as among, Earth systems and the human impact on the environment.
	b	Students identify limitations of the use of technologies employed by the solution.

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 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): **[ESS3.C](ESS3.C)**: **Human Impacts on Earth Systems**

K-2	3-5	6-8	9-12
ESS3.C Things people do can affect the environment but they can make choices to reduce their impacts.	**ESS3.C** Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments.	**ESS3.C** Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.	**ESS3.C** Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.5 Ecosystem Dynamics and Biodiversity)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Scientific principles, design, method, monitor, positive human impact, negative human impact, environment, ecological footprint, conservation, restoration, biodiversity, ecosystem services, impact assessment, data collection, analysis, mitigation, stakeholder, policy, collaboration

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:** Understand scientific principles related to human environmental impacts.
  - **KSA2:** Identify various types of environmental problems caused by human activities.
  - **KSA3:** Apply scientific principles to design a method for monitoring and increasing positive human impact on the environment.
  - **KSA4:** Assess the feasibility of solutions to environmental problems.
  - **KSA5:** Design solutions that aim to have positive impacts on the environment.
  - **KSA6:** Evaluate the effectiveness of designed solutions based on scientific principles and evidence.

Standard

Topic: SC.7.8 Matter and Energy in Organisms

Standard Code: SC.7.8.4 Gather, analyze, and communicate evidence of the flow of energy and cycling of matter in organisms and ecosystems.

Students will model how food transforms through chemical reactions in organisms, analyze data on resource availability's effects on ecosystems, and describe how matter and energy cycle among living and nonliving parts of ecosystems. They will also argue how changes to ecosystem components affect populations, backed by evidence.

Indicator

Indicator Code: SC.7.8.4.a

Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. Emphasis is on tracing movement of matter and flow of energy. Assessment does not include the biochemical mechanisms of photosynthesis.

NGSS Comparison: MS-LS1-6

Other Indicators in this Standard

SC.7.8.4.b, SC.7.8.4.c, SC.7.8.4.d, SC.7.8.4.e

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 knowledge, principles, and theories. ***Connections to the nature of science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical connections between evidence and explanations.	**Energy and Matter:** • Within a natural system, the transfer of energy drives the motion and/or cycling of matter.

Disciplinary Core Idea (DCI)

LS1.C: Organization for Matter and Energy Flow in Organisms:

- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.

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

- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.ct1oxch26g30n
  https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/

- Is there such a thing as too much sun for a plant? (how different types of plants needs different amounts of sun)
- Do plants need soil to grow?
- Sunflowers pointing towards the sun
- Phototropism
- Air plants (epiphytes)
- Year without a summer
- Carbon dioxide levels after deforestation
- Producers in the Ocean
- Different types of glass for growing house plants
- Deforestation
- Carboniferous CO_2 levels

Evidence Statements

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

7.8.4.a		**Construct a scientific explanation** based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out 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 photosynthesis results in the cycling of matter and energy into and out 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 to constructing the explanation, including that:
		i. Plants, algae, and photosynthetic microorganisms require energy (in the form of sunlight) and must take in carbon dioxide and water to survive.
		ii. Energy from sunlight is used to combine simple nonfood molecules (e.g., carbon dioxide and water) into food molecules (e.g., sugar) and oxygen, which can be used immediately or stored by the plant.
		iii. Animals take in food and oxygen to provide energy and materials for growth and survival.
		iv. Some animals eat plants, algae, and photosynthetic microorganisms, and some animals eat other animals, which have themselves eaten photosynthetic organisms.
	b	Students use multiple valid and reliable sources of evidence.
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 energy and matter cycling during photosynthesis. Students describe* a chain of reasoning for their explanation, including:
		i. Plants, algae, and photosynthetic microorganisms take in matter (in the form of carbon dioxide and water) and use energy from the sun to produce carbon-based organic molecules (food), which they can use immediately or store, and release oxygen into the environment through photosynthesis.
		ii. Plants use the food they have made for energy, growth, and other necessary functions (e.g., repair, seed production).
		iii. Animals depend on matter from plants for growth and survival, including:
		1. Eating photosynthetic organisms (or other organisms that have eaten photosynthetic organisms), thus acquiring the matter they contain, the production of which was driven by photosynthesis.
		2. Breathing in oxygen, which was released when plants used energy to rearrange carbon dioxide and water during photosynthesis.

i. Because animals acquire their food from photosynthetic organisms (or from other animals that have eaten those organisms) and their oxygen from the products of photosynthesis, all food and most of the oxygen animals use for life processes are the results of energy from the sun driving matter flows through the process of photosynthesis.

ii. The process of photosynthesis has an important role in energy and matter cycling within plants (i.e., the conversion of carbon dioxide and water into complex carbon-based molecules (sugars) and oxygen, the contribution of sugars to plant growth and internal processes) as well as from plants to other organisms.

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): LS1.C: Organization for Matter and Energy Flow in Organisms

K-2	3-5	6-8	9-12
LS1.C Animals obtain food they need from plants or other animals. Plants need water and light.	**LS1.C** Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter and obtain energy from sunlight, which is used to maintain conditions necessary for survival.	**LS1.C** Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy.	**LS1.C** The hydrocarbon backbones of sugars produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.4 Matter Cycling and Photosynthesis)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Photosynthesis, organism, energy, matter, transform, molecule, product, reactant, chemical reaction, energy transfer, convert, light energy, chemical energy

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:** Understand the role of photosynthesis in the cycling of matter and flow of energy within ecosystems.
- **KSA2:** Identify the movement of matter (carbon, oxygen, water) and flow of energy (light energy) through photosynthesis.
- **KSA3:** Construct a scientific explanation based on evidence for how photosynthesis contributes to the cycling of matter and energy flow in ecosystems.
- **KSA4:** Trace the pathways of matter and energy involved in photosynthesis.
- **KSA5:** Integrate knowledge of photosynthesis to explain its role in ecosystem dynamics, focusing on the cycling of matter and flow of energy.
- **KSA6:** Apply understanding to describe how photosynthesis supports life processes and influences ecosystem stability.

Standard

Topic: SC.7.8 Matter and Energy in Organisms

Standard Code: SC.7.8.4 Gather, analyze, and communicate evidence of the flow of energy and cycling of matter in organisms and ecosystems.

Students will model how food transforms through chemical reactions in organisms, analyze data on resource availability's effects on ecosystems, and describe how matter and energy cycle among living and nonliving parts of ecosystems. They will also argue how changes to ecosystem components affect populations, backed by evidence.

Indicator

Indicator Code: SC.7.8.4.b

Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as matter moves through an organism. Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released . Assessment does not include details of the chemical reactions for photosynthesis or respiration.

NGSS Comparison: MS-LS1-7

Other Indicators in this Standard

SC.7.8.4.a, SC.7.8.4.c, SC.7.8.4.d, SC.7.8.4.e

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:** • Matter is conserved because atoms are conserved in physical and chemical processes.

Disciplinary Core Idea (DCI)

LS1.C: Organization for Matter and Energy Flow in Organisms:

- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy.

PS3.D: Energy in Chemical Processes and Everyday Life:

- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.

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

- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.ct1oxch26g30
- https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- Lions eat antelope but lions eventually support the growth of grass.
- You are more likely see a deer while on hike than a cougar.
- In 1963, a scientist removed all starfish from an ecosystem, which reduced the original 15 species to 8
- When cougars were removed from Zion National Park, deer populations increased and biodiversity along the Virgin River decreased.

Evidence Statements

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

7.8.4.b **Develop a model** to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as matter moves through an organism.

1	Components of the model	
	a	To make sense of a phenomenon, students develop a model in which they identify the relevant components for describing* how food molecules are rearranged as matter moves through an organism, including:
		i. Molecules of food, which are complex carbon-containing molecules.
		ii. Oxygen.
		iii. Energy that is released or absorbed during chemical reactions between food and oxygen.
		iv. New types of molecules produced through chemical reactions involving food.
2	Relationships	
	a	In the model, students identify and describe* the relationships between components, including:
		i. During cellular respiration, molecules of food undergo chemical reactions with oxygen, releasing stored energy.
		ii. The atoms in food are rearranged through chemical reactions to form new molecules.
3	Connections	
	a	Students use the model to describe*:

		i. The number of each type of atom being the same before and after chemical reactions, indicating that the matter ingested as food is conserved as it moves through an organism to support growth.
		ii. That all matter (atoms) used by the organism for growth comes from the products of the chemical reactions involving the matter taken in by the organism.
		iii. Food molecules taken in by the organism are broken down and can then be rearranged to become the molecules that comprise the organism (e.g., the proteins and other molecules in a hamburger can be broken down and used to make a variety of tissues in humans).
		iv. As food molecules are rearranged, energy is released and can be used to support other processes within the organism.

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): LS1.C: Organization for Matter and Energy Flow in Organisms: PS3.D: Energy in Chemical Processes and Everyday Life

K-2	3-5	6-8	9-12
LS1.C Animals obtain food they need from plants or other animals. Plants need water and light. **PS3.D** Sunlight warms Earth's surface.	**LS1.C** Food provides animals with the materials and energy they need for body repair, growth, warmth, and motion. Plants acquire material for growth chiefly from air, water, and process matter and obtain energy from sunlight, which is used to maintain conditions necessary for survival. **PS3.D** Energy can be "produced," "used," or "released" by converting stored energy. Plants capture energy from sunlight, which can later be used as fuel or food.	**LS1.C** Plants use the energy from light to make sugars through photosynthesis. Within individual organisms, food is broken down through a series of chemical reactions that rearrange molecules and release energy. **PS3.D** Sunlight is captured by plants and used in a reaction to produce sugar molecules, which can be reversed by burning those molecules to release energy.	**LS1.C** The hydrocarbon backbones of sugars produced through photosynthesis are used to make amino acids and other molecules that can be assembled into proteins or DNA. Through cellular respiration, matter and energy flow through different organizational levels of an organism as elements are recombined to form different products and transfer energy. **PS3.D** Photosynthesis is the primary biological means of capturing radiation from the sun; energy cannot be destroyed, it can be converted to less useful forms.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.4 Matter Cycling and Photosynthesis)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Chemical reaction, cellular respiration, molecule, rearranged, transform, energy, reactants, products, energy transfer, carbon dioxide, glucose

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:** Understand the process of food rearrangement through chemical reactions within organisms.
- **KSA2:** Identify that molecules are broken down and synthesized to support growth or release energy.
- **KSA3:** Develop a model illustrating how food molecules are rearranged through chemical reactions in organisms.
- **KSA4:** Emphasize the transformation of molecules and the release of energy in the process.
- **KSA5:** Explain using the model how food molecules are utilized to support growth or release energy.
- **KSA6:** Apply understanding to describe how energy is transferred and utilized within organisms during metabolic processes.

Standard

Topic: SC.7.8 Matter and Energy in Organisms

Standard Code: SC.7.8.4 Gather, analyze, and communicate evidence of the flow of energy and cycling of matter in organisms and ecosystems.

Students will model how food transforms through chemical reactions in organisms, analyze data on resource availability's effects on ecosystems, and describe how matter and energy cycle among living and nonliving parts of ecosystems. They will also argue how changes to ecosystem components affect populations, backed by evidence.

Indicator

Indicator Code: SC.7.8.4.c

Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.

NGSS Comparison: MS-LS2-1

Other Indicators in this Standard

SC.7.8.4.a, SC.7.8.4.b, SC.7.8.4.d, SC.7.8.4.e

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.	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Disciplinary Core Idea (DCI)

LS2.A: Interdependent Relationships in Ecosystems:
- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.

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

- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.ct1oxch26g30
- https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- The average American eats 12,129 hamburgers in a lifetime.
- Per capita, the people in the United States and Australia use more fossil fuels for energy than the people in China, India, Canada, or France.
- Copper is used in solar panels, smart phones, and other devices. As more applications for copper are found, consumption increases.
- By 2025, two-thirds of the world's population may be facing water shortages.

Evidence Statements

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

7.8.4.c		**Analyze and interpret data** to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
1	Organizing data	
	a	Students organize the given data (e.g., using tables, graphs, and charts) to allow for analysis and interpretation of relationships between resource availability and organisms in an ecosystem, including:
		i. Populations (e.g., sizes, reproduction rates, growth information) of organisms as a function of resource availability.
		ii. Growth of individual organisms as a function of resource availability.
2	Identifying relationships	
	a	Students analyze the organized data to determine the relationships between the size of a population, the growth and survival of individual organisms, and resource availability.

	b	Students determine whether the relationships provide evidence of a causal link between these factors.
3	Interpreting data	
	a	Students analyze and interpret the organized data to make predictions based on evidence of causal relationships between resource availability, organisms, and organism populations. Students make relevant predictions, including:
		i. Changes in the amount and availability of a given resource (e.g., less food) may result in changes in the population of an organism (e.g., less food results in fewer organisms).
		ii. Changes in the amount or availability of a resource (e.g., more food) may result in changes in the growth of individual organisms (e.g., more food results in faster growth).
		iii. Resource availability drives competition among organisms, both within a population as well as between populations.
		iv. Resource availability may have effects on a population's rate of reproduction.

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): 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	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	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

	might not signify a cause and effect relationship.	relationships in systems can only be described using probability.	mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.

Disciplinary Core Ideas (DCIs): LS2.A: Interdependent Relationships in Ecosystems

K-2	3-5	6-8	9-12
LS2.A Plants depend on water and light to grow, and also depend on animals for pollination or to move their seeds around.	**LS2.A** The food of almost any animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants, while decomposers restore some materials back to the soil.	**LS2.A** Organisms and populations are dependent on their environmental interactions both with other living things and with nonliving factors, any of which can limit their growth. Competitive, predatory, and mutually beneficial interactions vary across ecosystems but the patterns are shared.	**LS2.A** Ecosystems have carrying capacities resulting from biotic and abiotic factors. The fundamental tension between resource availability and organism populations affects the abundance of species in any given ecosystem.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.4 Matter Cycling and Photosynthesis)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- limited resources, ecosystem, organisms, populations, survival, stability, instability

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:** Understand how resource availability affects organisms and populations in ecosystems.
- **KSA2:** Identify key resources and their roles in organism growth and population dynamics.
- **KSA3:** Analyze data to determine how resource availability influences individual organism growth and population numbers.
- **KSA4:** Interpret data to establish cause-and-effect relationships between resource availability and ecosystem dynamics.
- **KSA5: Use analyzed data to provide evidence for resource availability's effects on organisms and populations.**
- **KSA6:** Explain how variations in resource availability impact ecosystem stability and species interactions.

Standard

Topic: SC.7.8 Matter and Energy in Organisms

Standard Code: SC.7.8.4 Gather, analyze, and communicate evidence of the flow of energy and cycling of matter in organisms and ecosystems.

Students will model how food transforms through chemical reactions in organisms, analyze data on resource availability's effects on ecosystems, and describe how matter and energy cycle among living and nonliving parts of ecosystems. They will also argue how changes to ecosystem components affect populations, backed by evidence.

Indicator

Indicator Code: SC.7.8.4.d

Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system. Assessment does not include the use of chemical reactions to describe the processes.

NGSS Comparison: MS-LS2-3

Other Indicators in this Standard

SC.7.8.4.a, SC.7.8.4.b, SC.7.8.4.c, SC.7.8.4.e

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:** • The transfer of energy can be tracked as energy flows through a natural system. ***Connections to Engineering, Technology, and Applications of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.

Disciplinary Core Idea (DCI)

LS2.B: **Cycle of Matter and Energy Transfer in Ecosystems:**

- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.

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

- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.ct1oxch26g30 https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- Modern day whales have hip bones even though they don't have hind limbs.
- Ancient horses had short legs and toes.
- The Paraceratherium is an animal that became extinct over 23 million years ago. It has a skeletal structure that is very similar to the modern day white rhinoceros.

Evidence Statements

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

7.8.4.d	**Develop a model** to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.	
1	Components of the model	
	a	To make sense of a given phenomenon, students develop a model in which they identify the relevant components, including:
		i. Organisms that can be classified as producers, consumers, and/or decomposers.
		ii. Nonliving parts of an ecosystem (e.g., water, minerals, air) that can provide matter to living organisms or receive matter from living organisms.
		iii. Energy
	b	Students define the boundaries of the ecosystem under consideration in their model (e.g., pond, part of a forest, meadow; a whole forest, which contains a meadow, pond, and stream).
2	Relationships	
	a	In the model, students describe* relationships between components within the ecosystem, including:

		i. Energy transfer into and out of the system.
		ii. Energy transfer and matter cycling (cycling of atoms):
		1. Among producers, consumers, and decomposers (e.g., decomposers break down consumers and producers via chemical reactions and use the energy released from rearranging those molecules for growth and development).
		2. Between organisms and the nonliving parts of the system (e.g., producers use matter from the nonliving parts of the ecosystem and energy from the sun to produce food from nonfood materials).
3	Connections	
	a	Students use the model to describe* the cycling of matter and flow of energy among living and nonliving parts of the defined system, including:
		i. When organisms consume other organisms, there is a transfer of energy and a cycling of atoms that were originally captured from the nonliving parts of the ecosystem by producers.
		ii. The transfer of matter (atoms) and energy between living and nonliving parts of the ecosystem at every level within the system, which allows matter to cycle and energy to flow within and outside of the system.
	b	Students use the model to track energy transfer and matter cycling in the system based on consistent and measurable patterns, including:
		i. That the atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.
		ii. That matter and energy are conserved through transfers within and outside of the ecosystem.

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): LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

K-2	3-5	6-8	9-12
LS2.B content for K-2 is found in LS1.C AND ESS3.A **LS1.C** Animals obtain food they need from plants or other animals. Plants need water and light. **ESS3.A** Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.	**LS2.B** Matter cycles between the air and soil and among organisms as they live and die.	**LS2.B** The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Food webs model how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.	**LS2.B** Photosynthesis and cellular respiration provide most of the energy for life processes. Only a fraction of matter consumed at the lower level of a food web is transferred up, resulting in fewer organisms at higher levels. At each link in an ecosystem elements are combined in different ways and matter and energy are conserved. Photosynthesis and cellular respiration are key components of the global carbon cycle.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.5 Ecosystem Dynamics and Biodiversity)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- producers, consumers, decomposers, recycling of matter, food web, energy, environment

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:** Understand the concepts of matter cycling and energy flow in ecosystems.
  - **KSA2:** Recognize how matter is conserved and energy flows through living and nonliving components.
  - **KSA3:** Develop a model to illustrate the cycling of matter and flow of energy within an ecosystem.
  - **KSA4:** Define the boundaries of the system and show how matter and energy enter and leave the ecosystem.

- **KSA5:** Use the model to explain the conservation of matter and the flow of energy in ecosystems.
- **KSA6:** Describe how the model represents the interactions between living and nonliving parts of the ecosystem.

Standard

Topic: SC.7.8 Matter and Energy in Organisms

Standard Code: SC.7.8.4 Gather, analyze, and communicate evidence of the flow of energy and cycling of matter in organisms and ecosystems.

Students will model how food transforms through chemical reactions in organisms, analyze data on resource availability's effects on ecosystems, and describe how matter and energy cycle among living and nonliving parts of ecosystems. They will also argue how changes to ecosystem components affect populations, backed by evidence.

Indicator

Indicator Code: SC.7.8.4.e

Construct an argument supported by evidence that changes to physical or biological components of an ecosystem affect populations. Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.

NGSS Comparison: MS-LS2-4 (modified)

Other Indicators in this Standard

SC.7.8.4.a, SC.7.8.4.b, SC.7.8.4.c, SC.7.8.4.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 that supports or refutes claims for either explanations or solutions about the natural and designed world(s). ***Connections to the nature of science*** **Scientific Knowledge is Based on Empirical Evidence** • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	**Stability and Change:** • Small changes in one part of a system might cause large changes in another part.

Disciplinary Core Idea (DCI)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience:

- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.

Possible Science and/or Engineering Phenomena to Support 3D Instruction
• https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.ct1oxch26g30 https://www.ngssphenomena.com/searchable-phenomena • https://phet.colorado.edu/ • Kiwi bird population decline • Ash Borer • Asian Beetle • Sea Otter population decline • Ucayali River, Peru • Tuskless elephants • Zebra mussel • Carp Cowboys • Brown tree snake • Urban Sprawl • Lionfish • Coral Reefs • Overfishing • Colorado River • Wolves in Yellowstone National Park • Forest fires in Yellowstone National Park • Climate Change • Pollution • Invasive Species

Evidence Statements

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

7.8.4.e Construct an argument supported by evidence that changes to physical or biological components of an ecosystem affect populations.		
1	Supported claims	
	a	Students make a claim to be supported about a given explanation or model for a phenomenon. In their claim, students include the idea that changes to physical or biological components of an ecosystem can affect the populations living there.
2	Identifying scientific evidence	
	a	Students identify and describe* the given evidence (e.g., evidence from data, scientific literature) needed for supporting the claim, including evidence about:
		i. Changes in the physical or biological components of an ecosystem, including the magnitude of the changes (e.g., data about rainfall, fires, predator removal, species introduction).
		ii. Changes in the populations of an ecosystem, including the magnitude of the changes (e.g., changes in population size, types of species present, and relative prevalence of a species within the ecosystem).
		iii. Evidence of causal and correlational relationships between changes in the components of an ecosystem with the changes in populations.
	b	Students use multiple valid and reliable sources of evidence.
3	Evaluating and critiquing the evidence	
	a	Students evaluate the given evidence, identifying the necessary and sufficient evidence for supporting the claim.

	b	Students identify alternative interpretations of the evidence and describe* why the evidence supports the student's claim.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the appropriate evidence to the claim and construct an oral or written argument about the causal relationship between physical and biological components of an ecosystem and changes in organism populations, based on patterns in the evidence. In the argument, students describe* a chain of reasoning that includes:
		i. Specific changes in the physical or biological components of an ecosystem cause changes that can affect the survival and reproductive likelihood of organisms within that ecosystem (e.g., scarcity of food or the elimination of a predator will alter the survival and reproductive probability of some organisms).
		ii. Factors that affect the survival and reproduction of organisms can cause changes in the populations of those organisms.
		iii. Patterns in the evidence suggest that many different types of changes (e.g., changes in multiple types of physical and biological components) are correlated with changes in organism populations.
		iv. Several consistent correlational patterns, along with the understanding of specific causal relationships between changes in the components of an ecosystem and changes in the survival and reproduction of organisms, suggest that many changes in physical or biological components of ecosystems can cause changes in populations of organisms.
		v. Some small changes in physical or biological components of an ecosystem are associated with large changes in a population, suggesting that small changes in one component of an ecosystem can cause large changes in another component.

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): 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 change, and things may change slowly or rapidly.	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 systems appear stable, but over long periods of time they will eventually change.	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, 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.	In grades 9-12, students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify 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): LS2.C: Ecosystem Dynamics, Functioning, and Resilience

K-2	3-5	6-8	9-12
LS2.C - N/A	**LS2.C** When the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die.	**LS2.C** Ecosystem characteristics vary over time. Disruptions to any part of an ecosystem can lead to shifts in all of its populations. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	**LS2.C** If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.

- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.5 Ecosystem Dynamics and Biodiversity)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Ecosystem, physical components, biological components, population, inferences, empirical evidence, casual relationships, impact, ecological relationships, interdependence, data analysis, stewardship

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:** Understand how physical and biological changes affect populations within ecosystems.
  - **KSA2:** Identify patterns in data related to ecosystem changes and their impact on populations.
  - **KSA3:** Construct a well-supported argument using evidence to show how changes in physical or biological components affect populations.
  - **KSA4:** Recognize and interpret patterns in data to make justified inferences about population changes.
  - **KSA5:** Evaluate empirical evidence to support arguments about changes in ecosystems and their effects on populations.
  - **KSA6:** Justify claims with relevant data and explain how the evidence supports the relationship between ecosystem changes and population dynamics.

Standard

Topic: SC7.13 Earth's Systems

Standard Code: SC7.13.5 Gather, analyze, and communicate evidence of the flow of energy and cycling of matter associated with Earth's materials and processes.

Students will model Earth's material cycling and energy flow, explain resource distribution based on geological processes, and argue how population growth and resource consumption affect Earth's systems, supported by evidence.

Indicator

Indicator Code: SC.7.13.5.a

Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. Emphasis is on the processes of melting, crystallization, weathering, erosion, deposition, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials. Assessment does not include the identification and naming of minerals.

NGSS Comparison: MS-ESS2-1

Other Indicators in this Standard

SC.7.13.5.b, SC.7.13.5.c

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.	**Stability and Change:** • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.

Disciplinary Core Idea (DCI)

ESS2.A: Earth's Materials and Systems:

- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.

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

- https://www.ngssphenomena.com/searchable-phenomena
- https://phet.colorado.edu/
- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.cseih6w52mnd

Evidence Statements

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

7.13.5.a Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.		
1	Components of the model	
	a	To make sense of a given phenomenon, students develop a model in which they identify the relevant components, including:
		i. General types of Earth materials that can be found in different locations, including:
		1. Those located at the surface (exterior) and/or in the interior
		2. Those that exist(ed) before and/or after chemical and/or physical changes that occur during Earth processes (e.g., melting, sedimentation, weathering).
		ii. Energy from the sun.
		iii. Energy from the Earth's hot interior.
		iv. Relevant earth processes
		v. The temporal and spatial scales for the system.
2	Relationships	
	a	In the model, students describe* relationships between components, including:
		i. Different Earth processes (e.g., melting, sedimentation, crystallization) drive matter cycling (i.e., from one type of Earth material to another) through observable chemical and physical changes.
		ii. The movement of energy that originates from the Earth's hot interior and causes the cycling of matter through the Earth processes of melting, crystallization, and deformation.
		iii. Energy flows from the sun cause matter cycling via processes that produce weathering, erosion, and sedimentation (e.g., wind, rain).
		iv. The temporal and spatial scales over which the relevant Earth processes operate.
3	Connections	
	a	Students use the model to describe* (based on evidence for changes over time and processes at different scales) that energy from the Earth's interior and the sun drive Earth processes that together cause matter cycling through different forms of Earth materials.
	b	Students use the model to account for interactions between different Earth processes, including:
		i. The Earth's internal heat energy drives processes such as melting, crystallization, and deformation that change the atomic arrangement of elements in rocks and that move and push rock material to the Earth's surface where it is subject to surface processes like weathering and erosion.
		ii. Energy from the sun drives the movement of wind and water that causes the erosion, movement, and sedimentation of weathered Earth materials.
		iii. Given the right setting, any rock on Earth can be changed into a new type of rock by processes driven by the Earth's internal energy or by energy from the sun.
	c	Students describe* that these changes are consistently occurring but that landforms appear stable to humans because they are changing on time scales much longer than human lifetimes.

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): 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 change, and things may change slowly or rapidly.	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 systems appear stable, but over long periods of time they will eventually change.	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, 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.	In grades 9-12, students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify 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): ESS2.A: Earth's Materials and Systems

K-2	3-5	6-8	9-12
ESS2.A Wind and water change the shape of the land.	**ESS2.A** Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around	**ESS2.A** Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.	**ESS2.A** Feedback effects exist within and among Earth's systems.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.6 Earth's Resources and Human Impact)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- igneous, sedimentary, metamorphic, melting, crystallization, weathering, erosion, sedimentation, deposition, deformation, minerals, heat energy, atmosphere

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:** Understand the processes involved in the cycling of Earth's materials, including melting, crystallization, weathering, deformation, and sedimentation.
  - **KSA2:** Recognize how these processes contribute to the formation of minerals and rocks.
  - **KSA3:** Develop a model that illustrates the cycling of Earth's materials and the flow of energy driving this process.
  - **KSA4:** Show how processes like melting, crystallization, weathering, deformation, and sedimentation interact to form minerals and rocks.

- **KSA5:** Use the model to explain how the cycling of Earth's materials and energy flow contribute to rock and mineral formation.
- **KSA6:** Describe the role of each process in the context of Earth's material cycles.

Standard

Topic: SC7.13 Earth's Systems

Standard Code: SC7.13.5 Gather, analyze, and communicate evidence of the flow of energy and cycling of matter associated with Earth's materials and processes.

Students will model Earth's material cycling and energy flow, explain resource distribution based on geological processes, and argue how population growth and resource consumption affect Earth's systems, supported by evidence.

Indicator

Indicator Code: SC.7.13.5.b

Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).

NGSS Comparison: MS-ESS3-1

Other Indicators in this Standard

SC.7.13.5.a, SC.7.13.5.c

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.	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. • ***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.

Disciplinary Core Idea (DCI)

ESS3.A: **Natural Resources:**

- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

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

- https://phet.colorado.edu/
- https://www.ngssphenomena.com/searchable-phenomena
- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.cseih6w52mnd

Evidence Statements

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

1	Articulating the explanation of phenomena	
	a	Students articulate a statement relating a given phenomenon to scientific ideas, including that past and current geoscience processes have caused the uneven distribution of the Earth's resources, including:
		i. That the uneven distributions of the Earth's mineral, energy, and groundwater resources are the results of past and current geologic processes.
		ii. That resources are typically limited and nonrenewable due to factors such as the long amounts of time required for some resources to form or the environment in which resources were created forming once or only rarely in the Earth's history.
	b	Students use evidence and reasoning to construct a scientific explanation of the phenomenon.
2	Identifying the scientific evidence to construct the explanation	
	a	Students identify and describe* the evidence necessary for constructing the explanation, including:
		i. Type and distribution of an example of each type of Earth resource: mineral, energy, and groundwater.
		ii. Evidence for the past and current geologic processes (e.g., volcanic activity, sedimentary processes) that have resulted in the formation of each of the given resources.
		iii. The ways in which the extraction of each type of resource by humans changes how much and where more of that resource can be found.
	b	Students use multiple valid and reliable sources of evidence.
3	Reasoning	
	a	Students use reasoning to connect the evidence and support an explanation. Students describe* a chain of reasoning that includes:
		i. The Earth's resources are formed as a result of past and current geologic processes.
		ii. The environment or conditions that formed the resources are specific to certain areas and/or times on Earth, thus identifying why those resources are found only in those specific places/periods.
		iii. As resources as used, they are depleted from the sources until they can be replenished, mainly through geologic processes.
		iv. Because many resources continue to be formed in the same ways that they were in the past, and because the amount of time required to form most of these resources (e.g., minerals, fossil fuels) is much longer than timescales of human lifetimes, these resources are limited to current and near-future generations. Some resources (e.g., groundwater) can be replenished on human timescales and are limited based on distribution.
		v. The extraction and use of resources by humans decreases the amounts of these resources available in some locations and changes the overall distribution of these resources on Earth.

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 evidencebased 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 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): ESS3.A: Natural Resources

K-2	3-5	6-8	9-12
ESS3.A Living things need water, air, and resources from the land, and they live in places that have the things they	**ESS3.A** Energy and fuels humans use are derived from natural sources and their use affects the environment. Some	**ESS3.A** Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly	**ESS3.A** Resource availability has guided the development of human society and use of natural resources

need. Humans use natural resources for everything they do.	resources are renewable over time, others are not.	around the planet as a result of past geologic processes.	has associated costs, risks, and benefits.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.6 Earth's Resources and Human Impact)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- Deposition, distribution, energy source, geologic process, marine sediment, metal ore, mineral, petroleum, subduction zone, uplift, tectonic plate, weathering, biosphere, geoscience, hydrothermal, organic, fault, fold, renewable, non-renewable, aquifer, water table, reservoir

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:** Understand how geological processes create uneven distributions of Earth's mineral, energy, and groundwater resources.
- **KSA2:** Recognize these resources as limited, non-renewable, and affected by human activities.
- **KSA3:** Construct explanations using evidence to show how geological processes and human activities affect resource distribution.
- **KSA4:** Use evidence to explain how resource distribution is shaped by geoscience processes and human impact, and discuss the implications for resource sustainability.

Standard

Topic: SC7.13 Earth's Systems

Standard Code: SC7.13.5 Gather, analyze, and communicate evidence of the flow of energy and cycling of matter associated with Earth's materials and processes.

Students will model Earth's material cycling and energy flow, explain resource distribution based on geological processes, and argue how population growth and resource consumption affect Earth's systems, supported by evidence.

Indicator

Indicator Code: SC.7.13.5.c

Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.

NGSS Comparison: MS-ESS3-4

Other Indicators in this Standard

SC.7.13.5.a, SC.7.13.5.b

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). ***Connections to the nature of science*** **Science Addresses Questions About the Natural and Material World**	**Cause and Effect:** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World**

• Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.	• 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.

Disciplinary Core Idea (DCI)

ESS3.C: Human Impacts on Earth Systems

- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

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

- https://phet.colorado.edu/
- https://www.ngssphenomena.com/searchable-phenomena
- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.cseih6w52mnd

Evidence Statements

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

7.13.5.c Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.		
1	Supported claims	
	a	Students make a claim, to be supported by evidence, to support or refute an explanation or model for a given phenomenon. Students include the following idea in their claim: that increases in the size of the human population and per-capita consumption of natural resources affect Earth systems.
2	Identifying scientific evidence	
	a	Students identify evidence to support the claim from the given materials, including:
		i. Changes in the size of human population(s) in a given region or ecosystem over a given timespan.
		ii. Per-capita consumption of resources by humans in a given region or ecosystem over a given timespan.
		iii. Changes in Earth systems in a given region or ecosystem over a given timespan.
		iv. The ways engineered solutions have altered the effects of human activities on Earth's systems.
3	Evaluating and critiquing evidence	
	a	Students evaluate the evidence for its necessity and sufficiency for supporting the claim.
	b	Students determine whether the evidence is sufficient to determine causal relationships between consumption of natural resources and the impact on Earth systems.
	c	Students consider alternative interpretations of the evidence and describe* why the evidence supports the claim they are making, as opposed to any alternative claims.
4	Reasoning and synthesis	
	a	Students use reasoning to connect the evidence and evaluation to the claim. In their arguments, students describe* a chain of reasoning that includes:
		i. Increases in the size of the human population or in the per-capita consumption of a given population cause increases in the consumption of natural resources.
		ii. Natural resource consumption causes changes in Earth systems.
		iii. Because human population growth affects natural resource consumption and natural resource consumption has an effect on Earth systems, changes in human populations have a causal role in changing Earth systems.
		iv. Engineered solutions alter the effects of human populations on Earth systems by changing the rate of natural resource consumption or mitigating the effects of changes in Earth systems.

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): ESS3.C: Human Impacts on Earth Systems

K-2	3-5	6-8	9-12
ESS3.C Things people do can affect the environment but they can make choices to reduce their impacts.	**ESS3.C** Societal activities have had major effects on the land, ocean, atmosphere, and even outer space. Societal activities can also help protect Earth's resources and environments.	**ESS3.C** Human activities have altered the biosphere, sometimes damaging it, although changes to environments can have different impacts for different living things. Activities and technologies can be engineered to reduce people's impacts on Earth.	**ESS3.C** Sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources, including the development of technologies.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.6 Earth's Resources and Human Impact)
- https://www.openscied.org/curriculum/middle-school/standards-alignment/

Academic Language Development

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

- groundwater, fossil fuels, pollution, renewable, non-renewable, consumption, biomass, natural resources, per capita

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:** Understand how increases in human population and per-capita consumption of natural resources affect Earth's systems.
- **KSA2:** Identify key impacts such as resource depletion, environmental degradation, and changes in Earth's systems.
- **KSA3:** Construct a well-supported argument using evidence to demonstrate how rising human population and resource consumption impact Earth's systems.
- **KSA4:** Analyze and interpret data to support the argument.
- **KSA5:** Evaluate evidence to support claims about the effects of human population growth and resource consumption.
- **KSA6:** Explain how these factors contribute to changes in Earth's systems and the implications for environmental sustainability.

Standard

Topic: SC.7.14 History of Earth

Standard Code: SC.7.14.6 Gather, analyze, and communicate evidence to explain Earth's history.

Students will explain how geoscience processes have shaped Earth's surface over time and space, using evidence. They will analyze data on fossils, rocks, continental shapes, and seafloor structures to show evidence of past plate movements. Additionally, they will analyze natural hazard data to predict future events and develop technologies to reduce their impact.

Indicator

Indicator Code: SC.7.14.6.a

Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying times and spatial scales. Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.

NGSS Comparison: MS-ESS2-2

Other Indicators in this Standard

SC.7.14.6.b, SC.7.14.6.c

Concepts and Skills to Master

Foundation Boxes:

Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Constructing Explanations and Designing Solutions: • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and 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.	**Scale, Proportion and Quantity:** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Disciplinary Core Idea (DCI)

ESS2.A: Earth's Materials and Systems:

- The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.

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

- Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations

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

- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.xh1q6ya8om5o

- https://phet.colorado.edu/
- https://www.ngssphenomena.com/searchable-phenomena
- The Sandhills and the dunes at Boyer Chute form by similar processes but at different time and spatial scales

Evidence Statements

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

7.14.6.a Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.		
1	Articulating the explanation of phenomena	
	a	Students articulate a statement that relates a given phenomenon to a scientific idea, including that geoscience processes have changed the Earth's surface at varying time and spatial scales.
	b	Students use evidence and reasoning to construct an explanation for the given phenomenon, which involves changes at Earth's surface.
2	Evidence	
	a	Students identify and describe* the evidence necessary for constructing an explanation, including:
		i. The slow and large-scale motion of the Earth's plates and the results of that motion.
		ii. Surface weathering, erosion, movement, and the deposition of sediment ranging from large to microscopic scales (e.g., sediment consisting of boulders and microscopic grains of sand, raindrops dissolving microscopic amounts of minerals).
		iii. Rapid catastrophic events (e.g., earthquakes, volcanoes, meteor impacts).
	b	Students identify the corresponding timescales for each identified geoscience process.
	c	Students use multiple valid and reliable sources, which may include students' own investigations, evidence from data, and observations from conceptual models used to represent changes that occur on very large or small spatial and/or temporal scales (e.g., stream tables to illustrate erosion and deposition, maps and models to show the motion of tectonic plates).
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 how geoscience processes have changed the Earth's surface at a variety of temporal and spatial scales. Students describe* the following chain of reasoning for their explanation:
		i. The motion of the Earth's plates produces changes on a planetary scale over a range of time periods from millions to billions of years. Evidence for the motion of plates can explain large-scale features of the Earth's surface (e.g., mountains, distribution of continents) and how they change.
		ii. Surface processes such as erosion, movement, weathering, and the deposition of sediment can modify surface features, such as mountains, or create new features, such as canyons. These processes can occur at spatial scales ranging from large to microscopic over time periods ranging from years to hundreds of millions of years.
		iii. Catastrophic changes can modify or create surface features over a very short period of time compared to other geoscience processes, and the results of those catastrophic changes are subject to further changes over time by processes that act on longer time scales (e.g., erosion of a meteor crater).
		iv. A given surface feature is the result of a broad range of geoscience processes occurring at different temporal and spatial scales.
		v. Surface features will continue to change in the future as geoscience processes continue to occur.

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 evidencebased 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): 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): ESS2.A: Earth's Materials and Systems: ESS2.C: The Roles of Water in Earth's Surface Processes

K-2	3-5	6-8	9-12
ESS2.A Wind and water change the shape of the land.	**ESS2.A** Four major Earth systems interact. Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind,	**ESS2.A** Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as	**ESS2.A** Feedback effects exist within and among Earth's systems.

ESS2.C Water is found in many types of places and in different forms on Earth.	organisms, and gravity break rocks, soils, and sediments into smaller pieces and move them around. **ESS2.C** Most of Earth's water is in the ocean and much of the Earth's fresh water is in glaciers or underground.	primary energy sources. Plate tectonics is one result of these processes. **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.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.4 Plate Tectonics and Rock Cycling)
- https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

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

- earthquake, volcanic eruptions, wind, pressure, continent, erosion, weathering, mountain, plate tectonics, ocean, continental drift, subduction zone, divergent boundary, convergent boundary, transform boundary, hot spot, fault, geosphere, uplift

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:** Understand how different geoscience processes (e.g., plate tectonics, erosion, volcanic activity) alter Earth's surface over various time and spatial scales.
- **KSA2:** Recognize how both gradual processes and catastrophic events contribute to surface changes.
- **KSA3:** Construct explanations using evidence to describe how geoscience processes impact Earth's surface at different time scales (e.g., gradual vs. rapid changes) and spatial scales (e.g., large mountain ranges vs. landslides).
- **KSA4:** Analyze how both gradual and sudden events (e.g., earthquakes, volcanoes) influence surface changes.
- **KSA5:** Use evidence to explain the role of both gradual and catastrophic geoscience processes in shaping Earth's surface.
- **KSA6:** Describe how different processes operate at various time and spatial scales to produce observable changes.

Standard

Topic: SC.7.14 History of Earth

Standard Code: SC.7.14.6 Gather, analyze, and communicate evidence to explain Earth's history.

Students will explain how geoscience processes have shaped Earth's surface over time and space, using evidence. They will analyze data on fossils, rocks, continental shapes, and seafloor structures to show evidence of past plate movements. Additionally, they will analyze natural hazard data to predict future events and develop technologies to reduce their impact.

Indicator

Indicator Code: SC.7.14.6.b

Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions. Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches). Paleomagnetic anomalies in oceanic and continental crust are not assessed.

NGSS Comparison: MS-ESS2-3

Other Indicators in this Standard

SC.7.14.6.a, SC.7.14.6.c

Concepts and Skills to Master

Foundation Boxes:

Analyzing and Interpreting Data Science and Engineering Practice (SEP)	Crosscutting Concept (CCC)
Analyzing and Interpreting Data: • Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and ***Connections to the nature of science*** **Scientific Knowledge is Open to Revision in Light of New Evidence** • Science findings are frequently revised and/or reinterpreted based on new evidence.	**Patterns:** • Patterns in rates of change and other numerical relationships can provide information about natural systems.
Disciplinary Core Idea (DCI)	
ESS1.C: The History of Planet Earth: • Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** • Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.	
Possible Science and/or Engineering Phenomena to Support 3D Instruction	
• https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.xh1q6ya8om5o • https://phet.colorado.edu/ • https://www.ngssphenomena.com/searchable-phenomena	

Evidence Statements

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

7.14.6.b Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.		
1	Organizing data	
	a	Students organize given data that represent the distribution and ages of fossils and rocks, continental shapes, seafloor structures, and/or age of oceanic crust.
	b	Students describe* what each dataset represents.
	c	Students organize the given data in a way that facilitates analysis and interpretation.
2	Identifying relationships	
	a	Students analyze the data to identify relationships (including relationships that can be used to infer numerical rates of change, such as patterns of age of seafloor) in the datasets about Earth features.
	Interpreting data	

3	a	Students use the analyzed data to provide evidence for past plate motion. Students describe*:
		i. Regions of different continents that share similar fossils and similar rocks suggest that, in the geologic past, those sections of continent were once attached and have since separated.
		ii. The shapes of continents, which roughly fit together (like pieces in a jigsaw puzzle) suggest that those land masses were once joined and have since separated.
		iii. The separation of continents by the sequential formation of new seafloor at the center of the ocean is inferred by age patterns in oceanic crust that increase in age from the center of the ocean to the edges of the ocean.
		iv. The distribution of seafloor structures (e.g., volcanic ridges at the centers of oceans, trenches at the edges of continents) combined with the patterns of ages of rocks of the seafloor (youngest ages at the ridge, oldest ages at the trenches) supports the interpretation that new crust forms at the ridges and then moves away from the ridges as new crust continues to form and that the oldest crust is being destroyed at seafloor trenches.

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	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	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

	and cycles, and to use these patterns to make predictions.	relationships, and use graphs and charts to identify patterns in data.	representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.

Disciplinary Core Ideas (DCIs): ESS1.C: The History of Planet Earth: ESS2.B: Plate Tectonics and Large-Scale System Interactions

K-2	3-5	6-8	9-12
ESS1.C Some events on Earth occur very quickly; others can occur very slowly. **ESS2.B** Maps show where things are located. One can map the shapes and kinds of land and water in any area.	**ESS1.C** Certain features on Earth can be used to order events that have occurred in a landscape. **ESS2.B** Earth's physical features occur in patterns, as do earthquakes and volcanoes. Maps can be used to locate features and determine patterns in those events.	**ESS1.C** Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history. **ESS2.B** Plate tectonics is the unifying theory that explains movements of rocks at Earth's surface and geological history. Maps are used to display evidence of plate movement.	**ESS1.C** The rock record resulting from tectonic and other geoscience processes as well as objects from the solar system can provide evidence of Earth's early history and the relative ages of major geologic formations. **ESS2.B** Radioactive decay within Earth's interior contributes to thermal convection in the mantle.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.

- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (6.4 Plate Tectonics and Rock Cycling)
- https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

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

- plate tectonics, continental boundary, subduction, subduction zone, convergent plate boundary, divergent plate boundary, transform plate boundary, ocean trench, crustal plate movement, fracture zone, tectonic process, regional hotspot, mid-ocean ridges, magma, crustal plate, oceanic plate, earthquake

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:** Understand how the distribution of fossils, rocks, continental shapes, and seafloor structures provides evidence for past plate motions.
  - **KSA2:** Recognize the types of data (e.g., fossil distribution, rock formations) used to infer historical plate movements.
  - **KSA3:** Analyze and interpret data related to fossils, rocks, continental shapes, and seafloor structures to identify patterns indicative of past plate motions.
  - **KSA4:** Use evidence from various sources to support conclusions about historical plate movements.
  - **KSA5:** Provide evidence-based explanations for how data on fossils, rocks, continental shapes, and seafloor structures reveal past plate tectonic activities.
  - **KSA6:** Integrate information from multiple data types to build a coherent argument about historical plate motions.

Standard

Topic: SC.7.14 History of Earth

Standard Code: SC.7.14.6 Gather, analyze, and communicate evidence to explain Earth's history.

Students will explain how geoscience processes have shaped Earth's surface over time and space, using evidence. They will analyze data on fossils, rocks, continental shapes, and seafloor structures to show evidence of past plate movements. Additionally, they will analyze natural hazard data to predict future events and develop technologies to reduce their impact.

Indicator

Indicator Code: SC.7.14.6.c

Analyze and interpret data on geologic hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. Emphasis is on how some natural hazards, such as volcanic eruptions are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as 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 reservoirs to mitigate droughts).

NGSS Comparison: MS-ESS3-2

Other Indicators in this Standard

SC.7.14.6.a, SC.7.14.6.b

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 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

- https://docs.google.com/document/d/1iu0FmkNBDhDJLUgHgRWcGp72MmLPinMuQlTpjl3Gj6Y/edit#heading=h.xh1q6ya8om5o
- https://phet.colorado.edu/
- https://www.ngssphenomena.com/searchable-phenomena

Evidence Statements

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

7.14.6.c Analyze and interpret data on geologic hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.		
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.

Connection to other grade level indicators

ELA Connections:

- LA.7.RI.5 Compare and contrast how two or more authors provide conflicting information on the same topic, including where the texts disagree on matters of evidence or interpretation.
- LA.7.RI.6 Analyze the development of an argument and identify the type(s) of reasoning used to support the argument.
- LA.7.RI.8 Read and comprehend a wide range of informational texts of appropriate complexity for the 6-8 grade band proficiently, with scaffolding as needed at the high end of the range.
- LA.7.W.4 Write arguments that develop a perspective with supporting reasons and evidence, organized as appropriate to the task, purpose, and audience.
- LA.7.W.5 Write informative/explanatory pieces to examine a topic or text and clearly convey ideas and information.
- LA.7.W.6 Gather and use credible evidence from multiple trustworthy sources and assess its relevance in answering the research question.
- LA.7.SL.2 Present claims and findings, emphasizing key ideas in a focused, coherent manner with relevant descriptions, facts, details, and examples to clarify themes or central ideas.

Mathematics Connections:

- 7.A.2 Applications: Students will solve authentic problems with algebraic expressions, equations, and inequalities.
- 7.D.1 Data Collection and Statistical Methods: Students will formulate statistical investigative questions, collect data, and organize data.
- 7.D.2 Analyze Data and Interpret Results: Students will represent and analyze the data and interpret the results.

Social Studies Connections:

- SS 7.3.3 Determine how the natural environment is changed by natural and human forces and how humans adapt to their surroundings.
- SS 7.4.2 Use multiple perspectives to examine the historical, social, and cultural context of past and current events.
- SS 7.4.4 Analyze and interpret sources for perspective and historical context.
- SS 7.4.5 Apply the inquiry process to construct and answer historical questions.

Related Cross-Curricular Standards: Current Grade Level

Authentic Connections to Other Content Standards:

- Open Sci Ed (7.6 Earth's Resources and Human Impact)
- https://www.openscied.org/curriculum/middle-school/standards-alignment

Academic Language Development

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

- magnitude, constraints, criteria, prototype, iteration, geologic hazards, mitigation, stability, human-engineered

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:** Understand how different geologic hazards, such as volcanic eruptions and earthquakes, present varying challenges for prediction and forecasting.
- **KSA2:** Recognize the phenomena that precede some natural hazards and how these can aid in forecasting.
- **KSA3:** Analyze and interpret data related to geologic hazards to identify patterns and indicators that may forecast future events.
- **KSA4:** Use data to inform the development of technologies and strategies to mitigate the effects of geologic hazards.
- **KSA5:** Provide evidence-based forecasts for future geologic events using data on past occurrences and precursor phenomena.
- **KSA6:** Develop and propose technological solutions or strategies to mitigate the impacts of hazards based on data analysis and interpretation.