Stackable Instructionally-embedded Portable Science (SIPS) Assessments Project

Grade 8 Science
Unit 3 End of Unit Assessment Unpacking Tools
Understanding Earth History and the Origin of Species
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SIPS Grade 8 Unit 3 End of Unit Assessment Unpacking Tools

NGSS Performance Expectation: MS-LS3-1 Develop and use a model to describe why structural changes to genes (mutations) may result in harmful, beneficial, or neutral effects on structure and function of organisms. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [*Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.*]

	Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Foundations	**SEP: 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. Develop and use a model to describe phenomena.	**DCI: LS3.A: Inheritance of Traits** Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. **LS3.B: Variation of Traits** In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism.	**CCC: Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among their parts, therefore complex natural structures/systems can be analyzed to determine how they function.
Key Aspects	• Students can develop, use, and revise models to describe, test, and predict more abstract phenomena and design systems. • Evaluate limitations of the gene and protein structure model. • Develop or modify a model—based on evidence—to match what happens if a variable or component of a system is changed. • Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.	• Genes are a code for inherited traits and make up the chromosomes of cells. • Each chromosome pair contains two variants of many distinct genes chiefly controlling the production of specific proteins. • Traits are the observable expression of genes. • Proteins affect the traits of the individual. • Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. • Genes chiefly regulate a specific protein, which affects an individual's traits.	• The model shows a structural/functional change in an organism. • The shape and stability of structures of natural and designed objects are related to their function(s). • Students model complex and microscopic structures and systems. • Students visualize how functions depend on the shapes, composition, and relationships among their parts. • They analyze many complex natural and designed structures and systems to determine how they function.

	• 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.	• Individuals inherit traits, half from each parent, during sexual reproduction. • During sexual reproduction genetic information can change because of mutations, which may result in beneficial, negative, or no change to proteins in or traits of an organism.		
Prior Knowledge	• Students can build and revise simple models and can use 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 regularly occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • 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.	• Different organisms vary in how they look and function because they have different inherited information. • Cells contain inherited information in the nucleus. • The environment also affects the traits that an organism develops.	**Relationships to SEPs:** 2) Develop and Use Models to describe structural changes	• Students can build and revise simple models and can use 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 regularly occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • 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.

NGSS Performance Expectation: MS-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [*Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record*.]

	Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Foundations	**SEP:** 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. Analyze and interpret data to determine similarities and differences in findings.	**DCI: LS4.A: Evidence of Common Ancestry and Diversity** The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.	**CCC: Patterns** Graphs, charts, and images can be used to identify patterns in data. ***Connections to Nature 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.
Key Aspects	• Organize data to differentiate between similarities and differences between the data itself. • Organize data that shows fossil layers can be seen as a function of time. • Look for patterns in data, identify significant features, describe relationships, highlight trends, and identify anomalies. • A single data set can result in multiple different kinds of evidence. • Is not a solo act—engage with multiple practices when they analyze and interpret data. • Use a range of tools and processes (statistics, graphs, visuals, and other mathematical tools).	• Rock strata/sedimentary layers and fossil records. • Age of layers by position (Law of Superposition—but kids don't need to know this law). • Fossil layers can (but aren't always) be seen as a function of time. • Explore details of recreating the timeline of the history of life on Earth by using the fossil record and careful examination of existing characteristics of living things that imply descent with modification. • Natural selection can occur more quickly due to changes in conditions (environment, food, disease, etc.), which can lead to the extinction of a species, but can also (over several generations) lead to the emergence of a new species. • Not all organisms that have existed in the past are left behind in fossils that can be found. • Extinctions have occurred throughout the history of life and continue to occur. • Most species living today did not exist when life first began on Earth.	• Careful observations of similarities and differences for classification. • Patterns exist everywhere. • Noticing patterns is often a first step to organizing and asking scientific questions about why and how the patterns occur.

		• Fossils can be used to study the anatomical features of extinct species. • Scientists have found similarities and differences between existing and extinct species which infer biological relationships.		
Prior Knowledge	• Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings (3-5). • Use observations to describe patterns and/or relationships in the natural and designed world in order to answer scientific questions and solve problems (K-2). • Represent data in tables and/or various graphical displays to reveal patterns that indicate relationships (3-5). • Interpret data, such as tables and graphs (K-5).	• Some kinds of plants and animals that once lived on Earth are no longer found anywhere (3-LS4-1). • Fossils provide evidence about the types of organisms that lived long ago and about the nature of their environments (3-LS4-1). • Mass extinction.	**Relationships to SEPs** 4) Analyze and Interpret Data	• Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings (3-5). • Use observations to describe patterns and/or relationships in the natural and designed world in order to answer scientific questions and solve problems (K-2). • Represent data in tables and/or various graphical displays to reveal patterns that indicate relationships (3-5). • Interpret data, such as tables and graphs (K-5).

NGSS Performance Expectation: MS-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]

	Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Foundations	**SEP: 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. Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events.	**DCI: LS4.A: Evidence of Common Ancestry and Diversity** Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.	**CCC: Patterns** Patterns can be used to identify cause-and-effect relationships. **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.
Key Aspects	• Construct an explanation using models or representations. • Construct an explanation based on valid and reliable evidence obtained from 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. • Apply scientific ideas, principles, and/or use an explanation for real-world phenomena, examples, or events. • Apply scientific reasoning to show why data or evidence is adequate for the explanation or conclusion.	• The collection of fossils and their placement in chronological order is known as the fossil record. • The fossil record documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. • Anatomical differences and similarities between various organisms living today and between them and organisms in the fossil record enable evolutionary history to be reconstructed. • Comparison of the embryological development of different species reveals similarities not evident in fully grown organisms. • Scientists have found similarities and differences between existing and extinct species which infer biological relationships. • Patterns and anatomical similarities in the fossil record can be used to identify cause-and-effect relationships.	• Careful observations of similarities and differences for classification. • Patterns exist everywhere. • Noticing patterns is often a first step to organizing and asking scientific questions about why and how the patterns occur.
Prior Knowledge	• Construct an explanation of observed relationships.	• Some living organisms resemble organisms that once lived on Earth.	**Relationships to SEPs:** • Analyze data to find similarities and differences to reveal patterns that indicate relationships.

	● Use evidence to construct or support an explanation. ● Identify the evidence that supports particular points in an explanation.	● Fossils provide evidence about the types of organisms and environments that existed long ago. ● Some kinds of plants and animals that once lived on Earth are no longer found anywhere.	4) Analyze and Interpret Data	● Construct a chart showing patterns as evidence of evolutionary relationships.

NGSS Performance Expectation: MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]

	Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Foundations	**SEP: 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. Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena.	**DCI: LS4.B: Natural Selection** Natural selection leads to the predominance of certain traits in a population and the suppression of others.	**CCC: Cause and Effect** Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.
Key Aspects	• Construct an explanation using qualitative or quantitative relationships. • Construct an explanation based on valid and reliable evidence obtained from data that articulates the explanation for phenomena. • Apply scientific ideas, principles, and/or use an explanation for real-world phenomena, examples, or events. • Apply scientific reasoning to show why data or evidence is adequate for the explanation or conclusion.	• Natural selection allows for dominant traits to be seen more easily than recessive ones. • Individuals in a species have a genetic variation that can be passed to their offspring. • Variation of traits is a result of genetic variations occurring in the population. • Populations in an environment contain a variety of inheritable genetic traits. • Punnett squares can show the probability of organisms showing specific traits. • Technology has changed the way humans influence the inheritance of desired traits in organisms. • Genetic variations among individuals in a population give some individuals an advantage in surviving and reproducing in their environment. • Natural selection leads to the predominance of certain traits in a population and the suppression of others. • Natural selection may have more than one cause, and some cause-and-effect relationships within natural selection can only be described using probability.	• Gather information to show that a changing environment causes a change in the organisms that live there. • Identify patterns that show how undesirable traits are removed from a population over time. • Describe cause-and-effect relationships in a system using mathematical representations.

Prior Knowledge	● Construct an explanation of observed relationships. ● Use evidence to construct or support an explanation. ● Identify the evidence that supports particular points in an explanation.	● Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. ● Different organisms vary in how they look and function because they have different inherited information. ● The environment also affects the traits that an organism develops.	**Relationships to SEPs:** 6) Construct Explanations	● Students classify relationships as causal or correlational and recognize that correlation does not necessarily imply causation. ● Students use cause-and-effect relationships to explain phenomena in natural or designed systems. ● Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.

NGSS Performance Expectation: MS-LS4-6 Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [*Assessment Boundary: Assessment does not include Hardy Weinberg calculations*.]

	Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Foundations	**SEP: Using Mathematics and Computational Thinking** Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. Use mathematical representations to support scientific conclusions and design solutions.	**DCI: LS4.C: Adaptation** Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.	**CCC: Cause and Effect** Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.
Key Aspects	• Interpret data that compare survival/death rates of organisms. • Interpret data that show how undesirable traits are removed from a population over time. • Use data to support a conclusion.	• Environmental conditions influence which organisms will survive and pass on their genes. • The success of an organism, in a changing environment, is affected by the inheritance of characteristics that may give a reproductive advantage. • Variations exist in all populations. • Characteristics of species change over time through adaptations by natural selection in response to changes in the environment. • Traits that better support survival and reproduction become more common. • Traits that do not support survival and reproduction become less common. • Some traits in a population may have more than one environmental cause.	• Gather information to show that a changing environment causes a change in the organisms that live there. • Identify patterns that show how undesirable traits are removed from a population over time. • Describe cause and effect relationships in a system using mathematical representations.
Prior Knowledge	• Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems (3-5). • Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena (7).	• For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all (3).	**Relationships to SEPs** 4) Analyze and Interpret Data • Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems (3-5). • Construct an explanation that includes qualitative or quantitative relationships

	● Represent data in tables and/or various graphical displays to reveal patterns that indicate relationships (3-5).		between variables that predict phenomena (7). ● Represent data in tables and/or various graphical displays to reveal patterns that indicate relationships (3-5).

NGSS Performance Expectation: MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geological time scale is used to organize Earth's 4.6 billion-year-old history. [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [*Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them*.]

	Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Crosscutting Concepts (CCC)
Foundations	**SEP: 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. 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.	**DCI: The History of Planet Earth** The geological time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.	**CCC: 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.
Key Aspects	• Construct an explanation using models or representations. • Construct an explanation based on valid and reliable evidence obtained from 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. • Apply scientific ideas, principles, and/or use an explanation for real-world phenomena, examples, or events. • Apply scientific reasoning to show why data or evidence is adequate for the explanation or conclusion.	• Several lines of evidence indicate that Earth is about 4.6 billion years old. • Geological time is organized to help communicate about Earth's history. • Rock strata and the fossil record can be used as evidence to organize the relative occurrence of major historical events in Earth's history. • Major historic events in Earth's history are evident in specific changes to rock strata and fossil records. • Fossils provide scientists with a record of the history of life on Earth. • Fossils provide important evidence of how life and environmental conditions have changed. • Older rock layers lie beneath younger rock layers - unless they have been disturbed.	• Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. • The observed function of natural and designed systems may change with scale. • Proportional relationships among different types of quantities provide information about the magnitude of properties and processes. • Phenomena that can be observed at one scale may not be observable at another scale. • Students describe that different representations illustrate different characteristics of objects in the Earth's history, including differences in scale.

		• Rock strata can be used to construct a model of Earth's history. • Fossil records can provide relative dates based on when organisms appeared or disappeared. • Theories and laws that describe the natural world operate today as they did in the past and will continue to do so. • Major events can be used to indicate periods of time that occurred before a given event from periods that occurred after it.		
Prior Knowledge	• Construct an explanation of observed relationships. • Use evidence to construct or support an explanation. • Identify the evidence that supports particular points in an explanation.	• Local, regional, and global patterns of rock formations reveal changes over time due to Earth forces, such as earthquakes (3-5). • The presence and location of certain fossil types indicate the order in which rock layers were formed (3-5). • Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe (K-2).	**Relationships to SEPs** 6) Construct explanations	• Construct an explanation of observed relationships. • Use evidence to construct or support an explanation. • Identify the evidence that supports particular points in an explanation.