



Stackable Instructionally- embedded Portable Science (SIPS) Assessments Project

Grade 8 Science Unit 3 End of Unit Assessment Design Patterns Understanding Earth History and the Origin of Species August 2023

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SIPS Grade 8 Unit 3 End of Unit Assessment Design Patterns (MS-ESS1-4, MS-LS4-1, MS-LS4-2, MS-LS4-4, MS-LS4-6, MS-LS3-1)

Grade 8 SIPS Design Pattern for MS-ESS1-4

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	<p>In this task, students:</p> <ul style="list-style-type: none"> • understand that geologic time can be interpreted from rock strata and provides a way to organize Earth’s history. • understand that the analysis of rock strata and the fossil record provides only relative dates and not an absolute scale. • construct scientific explanations based on valid and reliable evidence obtained from sources. <p>The crosscutting concept of applying scale, proportion, and quantity with respect to time, space, and energy observed at various scales using models is the organizing concept for these DCIs.</p>
Performance Expectation	<p>MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic 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.]</p>
Knowledge, Skills, & Abilities (KSAs)	<p>KSA1: Analyze rock strata and fossils to determine the relative age of the rock or fossils.</p> <p>KSA2: Analyze rock strata and fossils to reconstruct aspects of Earth’s history and interpret ancient environments.</p> <p>KSA3: Analyze rock formations and the fossils they contain to establish relative ages of major events in Earth’s history.</p> <p>KSA4: 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.</p> <p>KSA5: Construct an explanation using geological events, environmental conditions, and fossil evidence to describe units of geological time.</p> <p>KSA6: Construct an explanation using evidence, patterns, and reasoning that geologic principles/processes that occur today also occurred in the past.</p>

	<p>KSA7: Gather evidence from different data sources to help form an explanation.</p> <p>KSA8: Construct a scientific explanation based on rock strata 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.</p> <p>KSA9: Develop and/or use a model to describe the sequence of major events in Earth’s history on the geologic time scale.</p>
<p>Student Demonstration of Learning</p>	<ul style="list-style-type: none"> ● Applies rules that can be applied to rock strata and fossils to determine relative age. ● Identifies and describes how fossils and rock strata can be used to reconstruct aspects of Earth’s history and interpret ancient environments. ● Uses reasoning to connect the evidence and support an explanation for how fossils and rock strata can be used collectively to establish a geological time scale. ● Articulates how the geological time scale is broken into smaller units to establish relationships between geological events, environmental conditions, and fossil evidence. ● Applies the principle of geological processes occurring today that have been occurring since Earth formed to help explain major events in Earth’s history. ● Identifies and describes the evidence used to explain major events in Earth’s history. ● Uses the geologic time scale to organize Earth’s 4.6 billion-year-old history.
<p>Work Product</p>	<ul style="list-style-type: none"> ● Produce or analyze a chart, graph, or timeline. ● Create a model. ● Interpret a diagram. ● Making a claim using evidence. ● Construct an argument. ● Apply evidence. ● Identify evidence. ● Organize data into tables/charts/graphs. ● Constructed response.
<p>Task Features</p>	<ul style="list-style-type: none"> ● The task focuses on performances for which students’ opportunity to learn has prepared them. ● The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. ● The task scenario is grounded in the phenomena and problems being addressed.

	<ul style="list-style-type: none"> ● The task prompts students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. ● The task provides ways for students to make connections of meaningful local, global, or universal relevance. ● The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. ● The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, students who are English learners, or those who are working below or above grade level. ● All prompts within a task are fair and equitable and include a range of presentation and response modes. ● The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. ● The task requires students to use reasoning and integrate multiple dimensions (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. ● All tasks elicit core ideas as defined in the PE. ● The task uses information that is scientifically accurate. ● The task elicits core ideas as defined in the PE. ● The task uses active voice and present tense. ● The task is written at or below grade level.
<p>Variable Features - Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus</p>	<ul style="list-style-type: none"> ● The function of models, charts, or diagrams can be varied for different purposes. ● The complexity of the information provided. ● Number, type, and complexity of models, tables, graphs, and/or data sets. ● Use or purpose of the model. ● Types or sources of evidence. ● Domain-specific vocabulary and definitions. ● Format of ‘real-world’ phenomenon under investigation: image, data, text, combination. ● Phenomenon addressed in the scenario, including but not limited to: <ul style="list-style-type: none"> ○ Rock strata <ul style="list-style-type: none"> ▪ Rock layers may contain information about the environment when the rock formed, such as relative age when compared to other layers. ○ Patterns of layering

	<ul style="list-style-type: none"> ▪ Interpret cross-sections using fossils, faults, and other evidence. ▪ Compare the age and history of rock layers at different locations using widespread and recognizable events, such as volcanic eruptions. ▪ Disruption of layers from major geologic events (e.g., volcanic eruptions, asteroid impacts, earthquakes, tsunamis, etc.) ○ The fossil record <ul style="list-style-type: none"> ▪ Correlate fossil evidence in similar rock layers at different locations to describe changes through geologic time. ▪ Mass extinctions of organisms have occurred and are evident in the geologic record. ● Examples of Earth’s major events could include the Ice Age or the earliest fossils of <i>Homo sapiens</i>, the formation of Earth, and the earliest evidence of life. ● Other examples can include the formation of mountain chains and ocean basins, the evolution or extinction of specific living organisms, or significant volcanic eruptions.
Assessment Boundaries	<ul style="list-style-type: none"> ● Students will not be asked to recall the names of specific periods or epochs and events within them. ● Students are not expected to recall the names of specific index fossils. ● Students are not expected to recall details about specific geological events. ● Students are not expected to develop counterarguments based on evidence. ● Emphasis should be on analyses of rock strata providing only relative dates, not an absolute scale.
Technical Terms	<ul style="list-style-type: none"> ● Rock strata, ocean basin, mountain chains, glaciations, asteroid impacts, extinctions, geologic time scale, Ice Age, fossils,

Grade 8 SIPS Design Pattern for MS-LS4-1

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	<p>In this task, students:</p> <ul style="list-style-type: none"> understand that the fossil record is a collection of fossils and their placement in chronological order. understand that the fossil record documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. analyze and interpret data to determine similarities and differences. <p>The crosscutting concept of identifying patterns in data using graphs, charts, and images is the organizing concept for these DCIs.</p>
Performance Expectation	<p>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.]</p>
Knowledge, Skills, & Abilities (KSAs)	<p>KSA1: Students can identify patterns between sedimentary rock layers and the relative age of rock layers using a data representation.</p> <p>KSA2: Students use graphs, charts, and images to identify patterns within the fossil record (e.g., observed patterns in the fossil record as evidence for when mass extinctions occurred).</p> <p>KSA3: Students identify patterns of changes in the level of complexity of anatomical structures in organisms in the fossil record, as a function of time.</p> <p>KSA4: Students can identify data to find patterns in rock layers to determine the relative age of fossils and/or time periods when a given fossil organism is present.</p> <p>KSA5: Students can identify evidence for the long-term increase in the diversity and complexity of organisms on Earth.</p> <p>KSA6: Students can identify evidence for a change of life forms throughout the history of life on Earth (e.g., observed patterns in the fossil record as evidence for when organisms emerged, evolved, or went extinct).</p> <p>KSA7: Student identifies or uses a data representation (e.g., chart, table, or graph) about the fossil record to provide evidence to support a claim.</p>
Student Demonstration of Learning	<ul style="list-style-type: none"> Analyzes and interprets data to determine evidence for the long-term increase in the diversity and complexity of organisms on Earth.

	<ul style="list-style-type: none"> ● Analyzes and interprets data to find patterns in rock layers to determine the age of fossils. ● Analyzes and interprets data within the fossil record to determine similarities and differences in findings. ● Identifies patterns from given data about fossils found within various rock layers. ● Makes logical and conceptual connections between evidence in the fossil record and explanations about the existence, diversity, extinction, and change in many life forms throughout the history of life on Earth. ● Identifies patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth.
Work Product	<ul style="list-style-type: none"> ● Create or complete a model. ● Constructed response. ● Interpret a diagram. ● Making a claim using evidence. ● Construct an argument. ● Apply evidence. ● Identify evidence. ● Organize research or data into tables/charts/graphs. ● Utilize graphic organizers.
Task Features	<ul style="list-style-type: none"> ● The task focuses on performances for which students’ opportunity to learn has prepared them. ● The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. ● The task scenario is grounded in the phenomena and problems being addressed. ● The task prompts students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. ● The task provides ways for students to make connections of meaningful local, global, or universal relevance. ● The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. ● The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, students who are English learners, or those who are working below or above grade level. ● All prompts within a task are fair and equitable and include a range of presentation and response modes.

	<ul style="list-style-type: none"> ● The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. ● The task requires students to use reasoning and integrate multiple dimensions (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. ● All tasks elicit core ideas as defined in the PE. ● The task uses information that is scientifically accurate. ● The task elicits core ideas as defined in the PE. ● The task uses active voice and present tense. ● The task is written at or below grade level.
<p>Variable Features - Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus</p>	<ul style="list-style-type: none"> ● Complexity of provided information. ● Complexity of scientific concept(s) to be modeled. ● Domain-specific vocabulary and definitions. ● Phenomenon addressed in the scenario, including but not limited to: <ul style="list-style-type: none"> ○ The geographic distribution of species. ○ Changes in the size and function of anatomical structures over time. ○ Evidence of mass extinctions. ○ Evidence for the emergence and extinction of species. ○ Evidence for the increasing diversity and complexity of organisms. ○ Use of vertical location in strata to determine relative ages of different fossils. ● Format of "real-world" phenomenon under investigation: image, data, text, combination. ● Number and types of relationships and patterns in the data. ● Complexity and amount of data represented by graphs, charts, and/or images. ● Sentence starters. ● Number and types of life forms. ● Geologic period. ● Patterns to be used as evidence of existence, extinction, diversity, and/or change in life forms in the fossil record.
<p>Assessment Boundaries</p>	<ul style="list-style-type: none"> ● Assessment does not include the names of individual species or geological eras in the fossil record. ● Assessment does not include the use of other objects in the solar system, such as lunar rocks, asteroids, and meteorites as information about Earth’s early formation and early history.

	<ul style="list-style-type: none">• Students are not expected to recall the ongoing branches that produce multiple lines of descent that can be inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms.
Technical Terms	<ul style="list-style-type: none">• Fossils, anatomical similarities and differences, diversity, extinction, fossil record, sedimentary layers, evolution, relative age

Grade 8 SIPS Design Pattern for MS-LS4-2

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	<p>In this task, students:</p> <ul style="list-style-type: none"> understand that anatomical similarities and differences between various organisms living today and the fossil record enable the reconstruction of evolutionary history. understand that these similarities and differences can provide information to make inferences of lines of evolutionary descent. construct explanations about real-world phenomena. <p>The crosscutting concept of applying patterns to identify cause-and-effect relationships is the organizing concept for these DCIs.</p>
Performance Expectation	<p>MS-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]</p>
Knowledge, Skills, & Abilities (KSAs)	<p>KSA1: Identify or describe anatomical similarities and differences among modern organisms.</p> <p>KSA2: Identify or describe similarities and differences between modern organisms and fossil organisms.</p> <p>KSA3: Apply scientific ideas to construct explanations for evolutionary relationships between modern and fossil organisms.</p> <p>KSA4: Construct an explanation related to how an organism or organisms evolve based on similarities and differences between modern organisms and fossil organisms.</p> <p>KSA5: Construct an explanation for the anatomical differences between modern organisms.</p> <p>KSA6: Apply the patterns in gross anatomical structures among modern organisms and between modern organisms and fossil organisms to construct explanations of evolutionary relationships between modern organisms and fossil organisms.</p> <p>KSA7: Identify or describe evidence of similarities and differences in anatomical patterns that support a conclusion about evolutionary relationships.</p>
Student Demonstration of Learning	<ul style="list-style-type: none"> Accurately describes (or identifies) similarities and differences among modern organisms. Accurately describes (or identifies) similarities and differences between modern organisms and fossil organisms. Constructs an appropriate explanation related to how an organism or organisms evolve based on similarities and differences between modern organisms and fossil organisms based on the provided data.

	<ul style="list-style-type: none"> ● Supports a claim that organisms are more likely to be closely related if they share a pattern of similar anatomical features due to the cause-and-effect relationship between genetic makeup and anatomy. ● Supports an explanation with relevant and accurate evidence related to similarities and differences, and the evolutionary relationships among modern organisms and between fossil organisms and modern organisms. ● Supports an explanation with relevant and accurate evidence for evolutionary relationships evidenced by similarities or differences in the gross appearance of anatomical structures.
Work Product	<ul style="list-style-type: none"> ● Constructed response. ● Selected response. ● Making a claim using evidence. ● Construct an argument. ● Apply evidence. ● Identify evidence.
Task Features	<ul style="list-style-type: none"> ● The task focuses on performances for which students' opportunity to learn has prepared them. ● The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. ● The task scenario is grounded in the phenomena and problems being addressed. ● The task prompts students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. ● The task provides ways for students to make connections of meaningful local, global, or universal relevance. ● The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. ● The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, students who are English learners, or those who are working below or above grade level. ● All prompts within a task are fair and equitable and include a range of presentation and response modes. ● The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. ● The task requires students to use reasoning and integrate multiple dimensions (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. ● All tasks elicit core ideas as defined in the PE.

	<ul style="list-style-type: none"> ● The task uses information that is scientifically accurate. ● The task elicits core ideas as defined in the PE. ● The task uses active voice and present tense. ● The task is written at or below grade level.
Variable Features - Aspects of an assessment task that can be varied to shift complexity or focus	<ul style="list-style-type: none"> ● Complexity of provided information. ● Complexity of scientific concept(s) to be modeled. ● Domain-specific vocabulary and definitions. ● Phenomenon addressed in the scenario, including but not limited to: <ul style="list-style-type: none"> ○ Comparison of homologous, analogous, or vestigial structures. ○ Adaptations for aquatic or terrestrial life. ○ Trends in complexity over geologic time. ○ Comparison of extant vs. extinct fossils. ○ Interpolating gaps in the fossil record. ● Format of "real-world" phenomenon under investigation: image, data, text, combination. ● Number and type of organism(s). ● Degree and type of similarities and differences of organisms. ● Representation of data. ● Degree and complexity of data. ● Number and types of relationships and patterns in the data. ● Sentence starters. ● Number and types of life forms. ● Geologic period. ● Patterns to be used as evidence of similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. ● Type and number of anatomical similarities and differences among modern organisms and between modern organisms and fossil organisms.
Assessment Boundaries	<ul style="list-style-type: none"> ● Students are not expected to recall the ongoing branches that produce multiple lines of descent that can be inferred by comparing DNA sequences, amino acid sequences, and anatomical and embryological evidence of different organisms. ● Assessment does not include the use of other objects in the solar system, such as lunar rocks, asteroids, and meteorites as information about Earth's early formation and early history.
Technical Terms	<ul style="list-style-type: none"> ● Fossils, anatomical similarities and differences, evolutionary descent, fossil record, modern organisms, fossilized organisms, extinct organisms, evolutionary relationships

Grade 8 SIPS Design Pattern for MS-LS4-4

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	<p>In this task, students:</p> <ul style="list-style-type: none"> • demonstrate an understanding that natural selection leads to the predominance of certain traits in a population and the suppression of others. • construct explanations that include relationships between variables that describe phenomena. <p>The crosscutting concept of identifying that phenomena may have more than one cause and some cause-and-effect relationships in systems can only be described using probability as the organizing concept for the disciplinary core ideas.</p>
Performance Expectation	<p>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.]</p>
Knowledge, Skills, & Abilities (KSAs)	<p>KSA1: Identify data that provides information about how changes in genetic traits relate to a population's probability of surviving.</p> <p>KSA2: Construct an explanation using evidence between traits and the cause-and-effect relationships between those traits that affect the probability of survival and reproduction of a given organism in a specific environment.</p> <p>KSA3: Describe how the increasing frequency of one variation over other variations is evidence for how the variation is more advantageous for a specific environmental change using data.</p> <p>KSA4: Use reasoning to explain how changes in genetic traits in a population relate to a species' probability of surviving in a specific environment.</p> <p>KSA5: Explain how an environmental change resulted in different frequencies of traits using data on changing frequencies of multiple variations of a trait within a given population.</p> <p>KSA6: Construct an explanation of how natural selection leads to the predominance of certain traits in a population and the suppression of others.</p>
Student Demonstration of Learning	<ul style="list-style-type: none"> • Correctly identifies or interprets data that relates changes in genetic traits to the population's probability of surviving. • Accurately describes how genetic traits have changed over time. • Accurately describes how a given genetic trait can increase a population's chance of surviving.

	<ul style="list-style-type: none"> ● Accurately explains how changes in genetic traits in a population relate to a species' probability of surviving in a specific environment. ● Describes how cause-and-effect relationships can be used to explain why some individuals survive and reproduce in a specific environment. ● Constructs explanations that describe how genetic variations increase some individuals' probability of surviving and reproducing. ● Predicts a likely change in frequency of the phenotypes in a population given data representing changing phenotypes within a given population in response to environmental change. ● Analyzes numerical data sets that represent a proportional relationship between some change in the environment and corresponding changes in genetic variation over time.
<p>Work Product</p>	<ul style="list-style-type: none"> ● Produce or analyze a chart, graph, or timeline. ● Create a model. ● Interpret a diagram. ● Make a claim using evidence. ● Construct an argument. ● Apply evidence. ● Identify evidence. ● Organize data into tables/charts/graphs. ● Make predictions. ● Constructed response. ● Summarize numerical data sets.
<p>Task Features</p>	<ul style="list-style-type: none"> ● The task focuses on performances for which students' opportunity to learn has prepared them. ● The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. ● The task scenario is grounded in the phenomena and problems being addressed. ● The task prompts students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. ● The task provides ways for students to make connections of meaningful local, global, or universal relevance. ● The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. ● The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, students who are English learners, or those who are working below or above grade level.

	<ul style="list-style-type: none"> ● All prompts within a task are fair and equitable and include a range of presentation and response modes. ● The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. ● The task requires students to use reasoning and integrate multiple dimensions (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. ● All tasks elicit core ideas as defined in the PE. ● The task uses information that is scientifically accurate. ● The task elicits core ideas as defined in the PE. ● The task uses active voice and present tense. ● The task is written at or below grade level.
<p>Variable Features - Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus</p>	<ul style="list-style-type: none"> ● Complexity of provided information. ● Complexity of scientific concept(s) to be modeled. ● Domain-specific vocabulary and definitions. ● Phenomenon addressed in the scenario, including but not limited to: <ul style="list-style-type: none"> ○ Environmental changes over time. ○ Changes in available resources. ○ Disease outbreak. ○ Introduction/removal of a species. ○ Changes from increased gene flow with other populations. ○ Effects of habitat change due to human activity. ○ Changes in phenotypic frequency over time between two populations. ● Format of "real-world" phenomenon under investigation: image, data, text, combination. ● Type of population(s) used. ● Range and complexity of data provided. ● Representation of data. ● Degree and complexity of data. ● Type and number of variations of a trait within a given population. ● Frequencies of variations of a trait within a given population in response to environmental change.
<p>Assessment Boundaries</p>	<ul style="list-style-type: none"> ● Assessment does not rely on an understanding of independence and conditional probability and the analysis of two-way tables. ● Assessment does not include computation of probabilities of compound events. ● Assessment does not include an understanding of how the crossover between chromosomes during meiosis results in increased genetic

	variation; genetic mutations; or how genetic and environmental factors can affect the expression of traits.
Technical Terms	<ul style="list-style-type: none">• Genetic variation, trait, environmental change, species, phenotypes, frequencies of traits, natural selection, survival, reproduction, probability, proportional relationships

Grade 8 SIPS Design Pattern for MS-LS4-6

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	<p>Students:</p> <ul style="list-style-type: none"> • demonstrate an understanding that adaptation by natural selection is a process by which species change over time in response to changes in environmental conditions. • demonstrate an understanding that traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. • demonstrate an understanding that the distribution of traits in a population changes. • use mathematical representations to support scientific conclusions related to measurable changes in selected traits in a population over time. <p>The crosscutting concept of identifying that phenomena may have more than one cause and some cause-and-effect relationships in systems can only be described using probability as the organizing concept for these DCIs.</p>
Performance Expectation	<p>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.]</p>
Knowledge, Skills, & Abilities (KSAs)	<p>KSA1: Use mathematical representations that display a measurable change in selected traits in a population over time to support scientific conclusions.</p> <p>KSA2: Use mathematical representations to support an explanation of how a specific change in an environmental condition has led to an observed change in traits in a population over time.</p> <p>KSA3: Use mathematical representations to describe cause and effect relationships with phenomena in relation to the distribution of traits in a population over time.</p> <p>KSA4: Analyze data and determine ratio relationships to provide evidence of why some inherited traits result in individuals that have a survival advantage in a specific environment over time or why other traits in a population are suppressed.</p> <p>KSA5: Analyze mathematical and/or graphic representations as evidence to support the explanations that through natural selection, traits that better support survival and reproduction are more common in a population than those traits that are less effective.</p>

	<p>KSA6: Construct an explanation of the causes of natural selection and the effect it has on the increase or decrease of specific traits in populations over time.</p>
<p>Student Demonstration of Learning</p>	<ul style="list-style-type: none"> ● Gathers information to show that traits that do not support survival based on the environmental conditions will decrease in frequency within a given population over time. ● Interprets graphs to identify patterns that show how traits that support successful survival and reproduction in the new environment become more common and those that do not become less common. ● Describes evidence that shows that environmental conditions act as selective pressures. ● Constructs an explanation to support (mathematical representations) natural selection caused organism structures to change over time because of the cause-and-effect relationships between organisms and their environment. ● Demonstrates how mathematical representations be used to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
<p>Work Product</p>	<ul style="list-style-type: none"> ● Produce or analyze a chart, graph or timeline. ● Create a model. ● Interpret a diagram. ● Make a claim using evidence. ● Construct an argument. ● Apply evidence. ● Identify evidence. ● Organize data into tables/charts/graphs. ● Makes predictions. ● Constructed response. ● Summarize numerical data sets.
<p>Task Features</p>	<ul style="list-style-type: none"> ● The task focuses on performances for which students' opportunity to learn has prepared them. ● The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. ● The task scenario is grounded in the phenomena and problems being addressed. ● The task prompts students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. ● The task provides ways for students to make connections of meaningful local, global, or universal relevance.

	<ul style="list-style-type: none"> ● The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. ● The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, students who are English learners, or those who are working below or above grade level. ● All prompts within a task are fair and equitable and include a range of presentation and response modes. ● The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. ● The task requires students to use reasoning and integrate multiple dimensions (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. ● All tasks elicit core ideas as defined in the PE. ● The task uses information that is scientifically accurate. ● The task elicits core ideas as defined in the PE. ● The task uses active voice and present tense. ● The task is written at or below grade level.
<p>Variable Features - Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus</p>	<ul style="list-style-type: none"> ● Complexity of provided information. ● Complexity of scientific concept(s) to be modeled. ● Domain-specific vocabulary and definitions. ● Phenomenon addressed in the scenario, including but not limited to: <ul style="list-style-type: none"> ○ Defense from predation. ○ Changes in food sources. ○ Response to disease or parasitism. ○ Effect of changes in environmental conditions on phenotype and allele frequency. ○ Changes in competition with other species for resources. ○ Changes in competition within a species for resources. ○ Variation in the population. ○ Differential reproductive success. ○ Heritable traits. ● Format of "real-world" phenomenon under investigation: image, data, text, combination. ● Use or purpose of mathematical representations. ● Mathematical and/or computational representations. ● Type of population(s) used. ● Range and complexity of data provided. ● Representation of data.

	<ul style="list-style-type: none"> • Degree and complexity of data. • Type and number of variations of a trait within a given population. • Frequencies of variations of a trait within a given population in response to environmental change.
Assessment Boundaries	<ul style="list-style-type: none"> • Assessment does not include Hardy Weinberg calculations. • Assessment does not include an understanding of how the crossover between chromosomes during meiosis results in increased genetic variation; genetic mutations; or how genetic and environmental factors can affect the expression of traits.
Technical Terms	<ul style="list-style-type: none"> • Genetic variation, trait, environmental conditions, species, phenotypes, inherited traits, natural selection, survival, reproduction, ratio relationships, suppressed, survival advantage, environmental factors

Grade 8 SIPS Design Pattern for MS-LS3-1

Element	Description
Knowledge and Practices (DCI, SEP, CCC)	<p>In this task, students:</p> <ul style="list-style-type: none"> • demonstrate an understanding that genes are located in the chromosomes of cells and each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. • demonstrate an understanding that changes (mutations) to genes can result in changes to proteins which can affect the structure and functions of the organism and thereby change traits. • demonstrate an understanding that genetic mutations can result in changes to the structure and function of proteins which may be beneficial, harmful, or neutral to the organism. • develop and use models to describe phenomena related to the inheritance and variation of traits. <p>The crosscutting concept of applying the structure and function of complex and microscopic structures and systems to describe how their function depends on the shapes, composition, and relationships among their parts is the organizing concept for these DCIs.</p>
Performance Expectation	<p>MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects on the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]</p>
Knowledge, Skills, & Abilities (KSAs)	<p>KSA1: Identify and make distinctions between chromosomes and genes and understand the connections between them.</p> <p>KSA2: Develop or complete a model to show how a mutation of genetic material could have a positive, negative, or neutral impact on the expression of traits in organisms.</p> <p>KSA3: Identifies a model that shows a mutation and/or the resulting proteins.</p> <p>KSA4: Use the model to categorize the effects of mutations as beneficial, harmful, or neutral changes to trait structure and function.</p> <p>KSA5: Develop a model (concept map) that accurately represents the expression of genes as traits.</p> <p>KSA6: Identify proteins as the link between gene structure to trait structure and function.</p> <p>KSA7: Use the model to explain what the effects of a mutation could be on the resulting protein and a trait of an organism.</p>

	<p>KSA8: Develop or complete a model showing a gene, a resulting protein, the protein’s function, and the resulting structural/functional change in an organism.</p>
<p>Student Demonstration of Learning</p>	<ul style="list-style-type: none"> ● Model accurately represents the relationship between protein structure and function. ● Model accurately represents the relationship between trait structure and function. ● Model accurately represents the relationship between genes, proteins, and traits. ● Model accurately represents the expression of genes as traits. ● Model accurately represents how observable organism traits result from the activity of proteins. ● Accurately categorizes the effects of mutations and describes why they are beneficial, harmful, or neutral changes to protein function. ● Accurately predicts how an example mutation of a protein affects the structure and function of a trait. ● Predicts if the mutation is helpful, harmful, or neutral.
<p>Work Product</p>	<ul style="list-style-type: none"> ● Develop or complete a model. ● Constructed response. ● Concept map. ● Prediction. ● Represent mechanisms, relationships, and connections.
<p>Task Features</p>	<ul style="list-style-type: none"> ● The task focuses on performances for which students’ opportunity to learn has prepared them. ● The task is based on the assessed KSA(s) and driven by a high-quality scenario that focuses on a phenomenon or design problem. ● The task scenario is grounded in the phenomena and problems being addressed. ● The task prompts students to make connections between observed phenomena or evidence and reasoning underlying the observation/evidence. ● The task provides ways for students to make connections of meaningful local, global, or universal relevance. ● The task scenario is sufficient, engaging, relevant, and accessible to a wide range of students. ● The task is accessible, appropriate, and cognitively demanding for all learners, including students with disabilities, students who are English learners, or those who are working below or above grade level. ● All prompts within a task are fair and equitable and include a range of presentation and response modes.

	<ul style="list-style-type: none"> ● The task requires students to use scientific reasoning and process skills to produce evidence that can be used by educators to make inferences about student learning. ● The task requires students to use reasoning and integrate multiple dimensions (i.e., SEP, DCI, CCC) to support sense-making about phenomena or problems. ● All tasks elicit core ideas as defined in the PE. ● The task uses information that is scientifically accurate. ● The task elicits core ideas as defined in the PE. ● The task uses active voice and present tense. ● The task is written at or below grade level.
<p>Variable Features - Aspects of an assessment task that <u>can be varied</u> to shift complexity or focus</p>	<ul style="list-style-type: none"> ● Complexity of provided information. ● Complexity of scientific concept(s) to be modeled. ● Domain-specific vocabulary and definitions. ● Phenomenon addressed in the scenario, including but not limited to: <ul style="list-style-type: none"> ○ Genes and proteins are the same thing. ○ Traits change due to the environment, which in turn changes genes. ○ The information in genes provides instructions for rearranging chromosomes into traits. ○ Mutations are always harmful to the functioning of an organism. ● Format of "real-world" phenomenon under investigation: image, data, text, combination. ● Complexity of genes, proteins, and trait expressions presented. ● Complexity of definitions for beneficial, harmful, or neutral changes to protein and trait structure and function. ● Complexity of scientific concept(s) to be modeled. ● Function of the model: <ul style="list-style-type: none"> ○ To explain a mechanism underlying a phenomenon. ○ To predict future outcomes. ○ To describe a phenomenon. ○ To generate data to inform how the world works. ● The degree to which components of the model are provided. ● The model may be provided for revision or one that is created from scratch. ● Representation of model. ● Use or purpose of the model. ● Type of model (e.g., physical/virtual).

Assessment Boundaries	<ul style="list-style-type: none"> ● Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations. ● Assessment does not include meiosis, mitosis, or the process of sexual reproduction. ● Models focus on the expression of genetic traits, rather than on the molecular-level mechanisms for protein synthesis or specific types of mutations.
Technical Terms	<ul style="list-style-type: none"> ● Genes, chromosomes, proteins, traits, mutation, protein function, genetic information, cell, nucleus, genetic material, protein synthesis, gene expression

References

- Achieve, Inc. (2009). *A framework to evaluate cognitive complexity in science assessments*. Retrieved from <https://www.achieve.org/cognitive-complexity-frameworks>
- Achieve, Inc. (2019). *Equity in three-dimensional science assessments*. Retrieved from [http://www.achieve.org/files/sites/default/files/equity_02142019%20\(3\).pdf](http://www.achieve.org/files/sites/default/files/equity_02142019%20(3).pdf)
- Achieve, Inc. (2018). Science task screener. Washington, DC: Author.
- Achieve, Inc. (2020). STEM Teaching Too #29. *Steps to designing three-dimensional assessments that connect to students' interests, experiences, and identities*. Retrieved from: <http://stemteachingtools.org/brief/29>
- Achieve, Inc. (2019). Task annotation project in Science: phenomena. Retrieved from <https://www.achieve.org/publications/science-task-annotations-phenomena>
- Achieve, Inc (2019). Task annotation project in Science: sense-making. Retrieved from <https://www.achieve.org/our-initiatives/equip/tools-subject/science/task-annotation-project-science>
- American Educational Research Association (AERA), the American Psychological Association (APA), and the National Council on Measurement in Education (NCME) Joint Committee on Standards for Educational and Psychological Testing. (2014). *Standards for educational and psychological testing*. Washington DC: AERA.
- California Assessment of Student Performance and Progress (CAASPP) System. California Science Test (CAST) Item Specifications Retrieved from : [CAST Item Specifications - California Assessment of Student Performance and Progress \(CAASPP\) System \(CA Dept of Education\)](#)
- Forte, E. (2013a). *Re-conceptualizing alignment in the evidence-centered design context*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.
- Forte, E. (2013b). *Evaluating alignment for assessments developed using evidence-centered design*. Paper presented at the Annual Meeting of the National Council on Measurement in Education, San Francisco, CA.
- Haertel, G., Haydel DeBarger, A., Cheng, B., Blackorby, J., Javitz, H., Ructtinger, L., Snow, E., Mislevy, R. J., Zhang, T., Murray, E., Gravel, J., Rose, D., Mitman Colker, A., & Hansen, E. G. (2010). Using Evidence-Centered Design and Universal Design for Learning to Design Science Assessment Tasks for Students with Disabilities (*Assessment for Students with Disabilities Technical Report 1*). Menlo Park, CA: SRI International.
- Harris, C., Krajcik, J., Pellegrino, J. W., & DeBarger, A. (2019). Designing knowledge-in-use assessments to promote deeper learning. *Educational Measurement: Issues and Practice*, Summer 2019, 38(2), 53-67.
- McElhane, K. W., Gane, B. D., Harris, C. J., Pellegrino, J. W., DiBello, L. V., & Krajcik, J. S. (2016, April). *Using learning performances to design three-dimensional assessments of science proficiency*. Paper presented at the NARST Annual International Conference, Baltimore, MD.
- Mislevy, R. J., Almond, R. G., and Lukas, J. F. (2003). *A brief introduction to evidence centered design*. Princeton, NJ: Educational Testing Service.
- Mislevy, R. J., & Haertel, G. (2006). Implications of evidence-centered design for educational assessment. *Educational Measurement: Issues and Practice*, 25, 6-20.
- National Governors Association Center for Best Practices, Council of Chief State School Officers Title: Common Core State Standards (insert specific content area if you are using only one) Publisher:

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- National Research Council. (2001). *Knowing what students know: The science and design of educational assessment*. Committee on the Foundations of Assessment. Pellegrino, J., Chudowsky, N., and Glaser, R., editors. Board on Testing and Assessment, Center for Education, Division of Behavioral and Social Sciences and Education. Washington DC: National Academy Press.
- National Research Council. (2012). *A framework for k-12 science education: practices, crosscutting concepts, and core ideas*. Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education, Washington, DC: The National Academies Press.
- National Research Council. (2014). *Developing Assessments for the Next generations of Science Standards*. Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education, Washington, DC: The National Academies Press.
- NGSS Lead States. (2013). Appendix D – “ALL Standards, ALL Students”: Making the Next Generation Science Standards Accessible to All Students. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.
- NGSS Lead States. (2013). Appendix E – Progressions Within the Next Generation Science Standards. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.
- NGSS Lead States. (2013). Appendix F – Science and Engineering Practices in the NGSS. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.
- NGSS Lead States. (2013). Appendix G – Crosscutting Concepts. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.
- NGSS Network. (2016). *NGSS example bundles*. Retrieved from <https://www.nextgenscience.org/resources/bundling-ngss>
- NGSS Lead States. (2013). *Next generation science standards: For states, by states*. Washington, DC: National Academies Press.
- Nichols, P. D., Kobrin, J. L., Lai, E., Koepfler, J. D. (2017). The role of theories of learning and cognition in assessment design and development. A. A. Rupp & J. P. Leighton (Eds.) *The Handbook of Cognition and Assessment: Frameworks, Methodologies, an Applications, First Edition*, pp. 41-74. New York: Wiley Blackwell.
- Norris, M., & Gong, B. (2014) *Thinking about claims for the next generation science standards*. Paper presented at the Annual Meeting of the National Council for Measurement in Education Conference, Toronto, Canada.