Delaware State System of Assessments

(DeSSA)

Science

Achievement Level Descriptors

2019

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Introduction

Achievement level descriptors (ALDs) describe a student's degree of success on an assessment (i.e., well below standard, below standard, on standard, beyond standard). The Delaware Department of Education (DDOE) created ALDs for science to assist with the standard-setting process for its Delaware System of Student Assessment (DeSSA) Science Assessment. ALDs can assist with score interpretation on student reports and assist teachers with understanding expectations for the progression of student learning and performance at each level of achievement during and after instruction. WestEd and DDOE developed ALDs with the assistance of grade-level teacher teams to enable valid inferences about student content area knowledge and skill in relation to the Next Generation Science Performance Expectations as measured by large-scale assessment. Next, the ALDs will be used and finalized at standard setting, incorporated into score reports, and made publicly available.

Development of Delaware Science ALDs

Process Overview

ALD development for the Delaware Next Generation Science Assessment (NGSA) began with a draft outline of descriptors for each Next Generation Science Standard (NGSS) Performance Expectation (PE) created by the state vendor, WestEd. This detailed work in preparation for the educator review was important because the coordination of language and expectations across the grade spans represented by the assessment is significant. The ALDs need to appropriately incorporate the three-dimensional expectations of the NGSS, as well as the progressions of the science and engineering practices, disciplinary core ideas, and crosscutting concepts as described in Appendices E, F, and G of the NGSS. In early March of 2019, DDOE approved ALD Drafts. DDOE invited fifth grade, eighth grade, and high school biology teachers to attend an ALD review, revision, and approval session held on April 1 and 2, 2019. The slides used to provide the initial training and guide the teachers through the tasks are included in the Appendix.

During the two-day event, teachers broke into grade-level groups and completed the following tasks:

- Evaluated draft range ALDs and provided recommendations for improving draft language within each grade's ALDs;
- Edited across grades for coherence of expectations; and
- Identified places for language consolidation.

Teacher Panel

Fifteen (15) teachers from across the state of Delaware attended the two-day event. Teachers were broken up into three grade-level groups, with five (5) teachers participating at each grade level—five (5), eight (8), and high school biology. Teacher participants were from all three counties of the state and reported at least two significant professional development opportunities regarding NGSS and/or large-scale science assessment. Table 1 illustrates panel and group composition(s).

Table 1: Panel Composition

Committee	N Count	% Female	% Male	% White	% African American	Other	% Experienced with SPED or EL population
Grade 5	5	100%	0%	60%	40%	0%	60%
Grade 8	5	60%	40%	60%	20%	20%	60%
HS Biology	5	80%	20%	80%	20%	0%	20%

Detailed Workshop Agenda

DDOE's vendor, WestEd, conducted the ALD panel workshop. The facilitator's agenda is below.

Delaware Achievement Level Descriptors Meeting

April 1–2, 2019

Facilitators' Agenda

Day One

Time	**Description**
8:30	Welcome (large group) • Welcome and introductions • Purpose of the meeting • Review agenda • Definition and purposes of ALDs
9:00	Background Information to Inform the Process—April (large group) • Delaware's assessment system • Next Generation Science Standards • Overview of structure of the ITA
9:30	Item Cluster Types and Review of Sample Items (large group, table group discussions) • IICs • RICs • Standalones Test Blueprint and Item Types Overview
10:00	Exercise 1, Part 1: Draft Description of a Proficient Student (large group room, table group work)
10:30	**Break**
10:45	Exercise 1, Part 2: Share and Discuss Proficient Student Descriptions (large group)
11:15	ALD Structure (large group)
11:30	Exercise 2: Discuss General Principles to Include in ALDs (large group, number off and regroup to multi-grade table groups) • Discuss in table groups • Share out to large group
12:00	**Lunch**
12:45	Progressions in the ALDs and ALD Review Process (large group)
1:15	Exercise 3, Part 1: Review of Draft Level 3 ALDs (small groups)
2:00	Exercise 3, Part 2: Review of Draft Level 3 ALDs Share-Out (large group)

2:30	**Break**
2:45	Exercise 4, Part 1: Review of Draft Level 2 ALDs (small groups)
3:15	Exercise 4, Part 2: Review of Draft Level 2 ALDs Share-Out (large group)
4:15	Closing Comments and Adjourn

Day Two

Time	**Description**
8:30	Welcome and Orientation to Day (large group)
8:45	Exercise 5, Part 1: Level 2 and Level 3 ALD Feedback and Recommendations (small groups) • Provide specific feedback on the ALD statements • Facilitator captures edit suggestions electronically
10:15	**Break**
10:30	Exercise 5, Part 2: Level 2 and Level 3 ALD Feedback and Recommendations (large group) • Discuss suggested edits for calibration and articulation
11:15	Exercise 6: Level 4 ALD Feedback and Recommendations (small groups) • Review and discuss draft Level 4 ALDs • Provide specific feedback on the ALD statements • Facilitator captures edit suggestions electronically
12:00	**Lunch**
12:45	Exercise 7: Level 1 ALD Feedback and Recommendations (small groups) • Review and discuss draft Level 1 ALDs • Provide specific feedback on the ALD statements • Facilitator captures edit suggestions electronically
2:30	**Break**
2:45	Exercise 8: Level 1 and Level 4 ALD Feedback and Recommendations (large group) • Discuss suggested edits for calibration and articulation • Review and discuss articulation across all grades and all levels (if needed) • Return to small groups for any additional conversations based on large group discussion (if needed)
4:15	Closing Comments and Adjourn

Policy Achievement Level Descriptors

Policy ALDs are important tools used to communicate a state's vision for what it means to "meet the standard" or "be proficient." To clarify this vision, a state explains its intended message regarding a student's achievement within each performance level. Policy ALDs should be consistent across grades, with the recognition that high school claims describe student readiness for college and/or career.

Grade 5 Policy ALDs

Grade 5 Level 1—Well Below Standard

Students performing at Level 1 can complete tasks, given specific instructions embedded in the task, to use some crosscutting concepts to define a familiar simple system and identify some cause and effect relationships and simple patterns that provide an opportunity for using scientific practices, such as using simple data, using information, communicating information, using models, or constructing simple explanations/arguments, and applying some foundational disciplinary core ideas to make sense of phenomena relating to the structure and properties of matter, ecosystems and Earth systems, and stars and the solar system.

Grade 5 Level 2—Below Standard

Students performing at Level 2 can complete tasks, when given specific instructions embedded in the task, to use crosscutting concepts to define a simple system and identify some cause and effect relationships and simple patterns that provide an opportunity for using scientific practices, such as using data, using information, communicating information, using models or constructing simple explanations/arguments, and applying foundational disciplinary core ideas to make sense of phenomena relating to the structure and properties of matter, ecosystems and Earth systems, and stars and the solar system.

Grade 5 Level 3—At Standard

Students performing at Level 3 can complete tasks that focus student attention toward using crosscutting concepts to define a system and identify cause and effect relationships and patterns that provide an opportunity for using scientific practices, such as analyzing data, gathering information, communicating information, developing models or constructing explanations/arguments, and applying foundational disciplinary core ideas to make sense of phenomena relating to the structure and properties of matter, ecosystems and Earth systems, and stars and the solar system.

Grade 5 Level 4—Beyond Standard

Students performing at Level 4 can consistently use crosscutting concepts to define novel systems and identify cause and effect relationships and patterns that provide an opportunity for using scientific practices, such as analyzing and evaluating data, gathering information from multiple sources, communicating information, developing models or constructing and evaluating explanations/arguments, and applying foundational disciplinary core ideas to make sense of phenomena relating to the structure and properties of matter, ecosystems and Earth systems, and stars and the solar system.

Grade 8 Policy ALDs

Grade 8 Level 1—Well Below Standard

Students performing at Level 1 can complete tasks, given specific instructions embedded in the task, to use some crosscutting concepts to define a familiar simple system and identify some cause and effect relationships and simple patterns that provide an opportunity for using scientific practices, such as using simple data, using models or constructing simple explanations/arguments, and applying some foundational disciplinary core ideas to make sense of phenomena relating to transformations of energy, weather and climate, and ecosystems.

Grade 8 Level 2—Below Standard

Students performing at Level 2 can complete tasks, when given specific instructions embedded in the task, to use crosscutting concepts to define a simple system and identify some cause and effect relationships and simple patterns that provide an opportunity for using scientific practices, such as using data, using models, or constructing simple explanations/arguments, and applying foundational disciplinary core ideas to make sense of phenomena relating to transformations of energy, weather and climate, and ecosystems.

Grade 8 Level 3—At Standard

Students performing at Level 3 can complete tasks that focus student attention toward using crosscutting concepts to define a system and identify cause and effect relationships and patterns that provide an opportunity for using scientific practices, such as analyzing data, developing models or constructing explanations/arguments, and applying foundational disciplinary core ideas to make sense of phenomena relating to transformations of energy, weather and climate, and ecosystems.

Grade 8 Level 4—Beyond Standard

Students performing at Level 4 can consistently use complex and multiple/varied sources of information to use crosscutting concepts to define novel systems and identify cause and effect relationships and patterns that provide an opportunity for using scientific practices, such as analyzing and evaluating data, developing models or constructing and evaluating explanations/arguments, and applying foundational disciplinary core ideas to make sense of phenomena relating to transformations of energy, weather and climate, and ecosystems.

HS Biology Policy ALDs

HS Biology Level 1—Well Below Standard

Students performing at Level 1 can complete tasks, given specific instructions embedded in the task, to use some crosscutting concepts to define a familiar simple system and identify some cause and effect relationships and simple patterns that provide an opportunity for using scientific practices, such as using simple data, using information, communicating information, using models or constructing simple explanations/arguments, and applying some foundational disciplinary core ideas to make sense of phenomena relating to the cellular foundation of life, matter and energy and interdependent relationships in ecosystems, and inheritance and variation of traits and natural selection and evolution.

HS Biology Level 2—Below Standard

Students performing at Level 2 can complete tasks, when given specific instructions embedded in the task, to use crosscutting concepts to define a simple system and identify some cause and effect relationships and simple patterns that provide an opportunity for using scientific practices, such as using data, using information, communicating information, using models or constructing simple explanations/arguments, and applying foundational disciplinary core ideas to make sense of phenomena relating to cellular foundation of life, matter and energy and interdependent relationships in ecosystems, and inheritance and variation of traits and natural selection and evolution.

HS Biology Level 3—At Standard

Students performing at Level 3 can complete tasks that focus student attention toward using crosscutting concepts to define a system and identify cause and effect relationships and patterns that provide an opportunity for using scientific practices, such as analyzing data, gathering information, communicating information, developing models or constructing explanations/arguments, and applying foundational disciplinary core ideas to make sense of phenomena relating to the cellular foundation of life, matter and energy and interdependent relationships in ecosystems, and inheritance and variation of traits and natural selection and evolution.

HS Biology Level 4—Beyond Standard

Students performing at Level 4 can consistently use crosscutting concepts to define novel systems and identify cause and effect relationships and patterns that provide an opportunity for using scientific practices, such as analyzing and evaluating data, gathering information from multiple sources, communicating information, developing and/or revising models or constructing, evaluating, and/or revising explanations/arguments, and applying foundational disciplinary core ideas to make sense of phenomena relating to the cellular foundation of life, matter and energy and interdependent relationships in ecosystems, and inheritance and variation of traits and natural selection and evolution.

Range Achievement Level Descriptors

For each standard and performance level on an assessment, Range ALDs should explain observable evidence of achievement, demonstrating how the skill changes and becomes more sophisticated across performance levels. Schneider, Huff, Egan, Gaines, and Ferrara (2013)[1] wrote that ALDs should reflect more complex knowledge, skills, and abilities (KSAs) as the performance levels increase (e.g., more complex KSAs should be expected for Advanced than for Proficient). This is consistent with what is termed a “learning progression” or “learning trajectory” in the research literature.

Learning trajectories are described in literature as theoretical underpinnings for curriculum development, instruction, and assessment of learning. The purpose of a learning trajectory is to inform researchers and educators about general developmental pathways of learning so they can set reasonable, achievable learning goals and provide appropriate guidance for instruction and assessment in a given content area.

In terms of learning progressions, the NGSS may be thought of as the learning goals for students at each grade level, and the Range ALDs may be considered developmental trajectories—evidentiary statements regarding students’ observable thinking and skills as they make their way to the learning goals. In the development of Range ALDs, the state defines the expected learning trajectory, which may be useful to teachers working to identify and support student progress.

[1] Schneider, M. C., Huff, K. L., Egan, K. L., Gaines, M. L., & Ferrara, S. (2013). Relationships among item cognitive complexity, contextual demands, and item difficulty: Implications for achievement-level descriptors. *Educational Assessment, 18*(2),p. 99–121.

Grade 5 NGSS Range ALDs by Performance Expectation

Structure and Properties of Matter

5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]	
ALD 1	Identify a simple model to show that matter is made of particles too small to be seen.
ALD 2	Use a model to describe that matter is made of particles too small to be seen.
ALD 3	Develop and use a model to describe that matter is made of particles too small to be seen.
ALD 4	Evaluate the limitations of a model and/or revise a model to describe that matter is made of particles too small to be seen.

5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.]	
ALD 1	Identify a quantity such as mass or volume to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
ALD 2	Measure quantities such as mass or volume to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
ALD 3	Graph quantities such as mass or volume to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.
ALD 4	Use evidence in graphs and tables to evaluate explanations that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

5-PS1-3. Make observations and measurements to identify materials based on their properties. [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]	
ALD 1	Identify a qualitative observation or measurement that can be used to identify materials based on their properties.
ALD 2	Describe observations and measurements that can be used to identify materials based on their properties.
ALD 3	Make observations and measurements that can be used to identify materials based on their properties.
ALD 4	Evaluate and/or revise an investigation to gather data that can be used to identify materials based on their properties.

5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.	
ALD 1	Identify the order of steps for a simple investigation to determine whether the mixing of two or more substances results in new substances.
ALD 2	Use data from an investigation to determine whether the mixing of two or more substances results in new substances.
ALD 3	Plan an investigation to determine whether the mixing of two or more substances results in new substances.
ALD 4	Evaluate and/or revise an investigation to determine whether the mixing of two or more substances results in new substances.

Ecosystems and Earth Systems

5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. [Clarification Statement: Examples of models could include diagrams, and flow charts.]	
ALD 1	Identify a simple model to show that energy in animals' food was once energy from the sun.
ALD 2	Use a model to describe that energy in animals' food was once energy from the Sun.
ALD 3	Develop and use a model to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the Sun.
ALD 4	Evaluate the limitations of a model and/or revise a model to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the Sun.

5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water. [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]	
ALD 1	Identify an observation to show that matter for plant growth comes chiefly from air and water.
ALD 2	Identify evidence to support an argument that matter for plant growth comes chiefly from air and water.
ALD 3	Use evidence to construct an argument or support a claim that matter for plant growth comes chiefly from air and water.
ALD 4	Use evidence to evaluate and/or revise an argument or claim that matter for plant growth comes chiefly from air and water.

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. [Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]	
ALD 1	Identify a simple model to show the movement of matter among plants, animals, decomposers, and/or the environment.
ALD 2	Use a model to describe the movement of matter among plants, animals, decomposers, and the environment.
ALD 3	Develop and use a model to describe the movement of matter among plants, animals, decomposers, and the environment.
ALD 4	Evaluate the limitations of a model and/or revise a model to describe the movement of matter among plants, animals, decomposers, and the environment.

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]	
ALD 1	Identify a simple model to show ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
ALD 2	Use a model to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
ALD 3	Develop and use a model to describe the ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
ALD 4	Evaluate the limitations of a model and/or revise a model to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]	
ALD 1	Identify a simple graph that shows the amounts and/or distribution of water on Earth.
ALD 2	Use simple graphs to describe the amounts and distribution of water on Earth.
ALD 3	Graph and use data to describe the relative amounts and distribution of water on Earth.
ALD 4	Use quantities in graphs and tables to evaluate descriptions of the relative amounts and distribution of water on Earth.

5-ESS3-1. **Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.**	
ALD 1	Identify information that describes a way an individual community can use a simple science principle to protect Earth's resources and environment.
ALD 2	Use given information to identify ways individual communities can use science to protect Earth's resources and environment.
ALD 3	Use information from multiple sources to describe ways individual communities can use science to protect Earth's resources and environment.
ALD 4	Obtain, combine, and/or evaluate information from multiple sources to explain ways individual communities can use science to protect Earth's resources and environment.

Stars and the Solar System

5-PS2-1. **Support an argument that the gravitational force exerted by Earth on objects is directed down**. [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]	
ALD 1	Identify an observation to show that the gravitational force exerted by Earth on objects is directed down.
ALD 2	Identify evidence to support an argument that the gravitational force exerted by Earth on objects is directed down.
ALD 3	Use evidence to construct an argument or support a claim that the gravitational force exerted by Earth on objects is directed down.
ALD 4	Use evidence to evaluate and/or revise an argument or claim about the relationship between the direction of gravitational force and the force exerted by Earth.

5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from the Earth. [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]	
ALD 1	Identify an observation to show that the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.
ALD 2	Identify evidence to support an argument that the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.
ALD 3	Use evidence to construct an argument or support a claim that differences in the apparent brightness of the Sun compared to other stars is due to their relative distances from the Earth.
ALD 4	Use evidence to evaluate and/or revise an argument or claim about the cause and effect relationship between the apparent brightness of the Sun and other stars and their relative distances from Earth.

5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [Assessment Boundary: Assessment does not include causes of seasons.]	
ALD 1	Identify data that shows simple patterns in the daily changes in length and direction of shadows, day and night, or the seasonal appearance of some stars in the night sky.
ALD 2	Use graphical displays of data to identify patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
ALD 3	Make and use graphical displays of data to describe patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.
ALD 4	Make and use evidence in graphical displays of data and use scientific reasoning to evaluate a description of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Engineering Design

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	
ALD 1	Identify a criterion for success or a constraint on a solution to a simple design problem.
ALD 2	Identify a criterion for success or a constraint on a solution to a simple design problem, taking into account materials, time, or cost.
ALD 3	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, and/or cost.
ALD 4	Evaluate criteria for success and/or constraints on materials, time, and/or cost for a simple design problem.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	
ALD 1	Identify one way a solution to a simple problem meets the criteria and/or constraints of the problem.
ALD 2	Describe how a solution to a problem meets the criteria and constraints of the problem.
ALD 3	Generate and compare multiple solutions to a problem to evaluate how well each meets the criteria and constraints of the problem.
ALD 4	Refine and/or evaluate multiple solutions to a problem, using the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	
ALD 1	Identify the order of steps for a simple fair test of a model or prototype.
ALD 2	Describe data that can be collected and variables that can be controlled in a fair test of a model or prototype.
ALD 3	Plan investigations to fairly test aspects of a model or prototype and identify an aspect that could be improved.
ALD 4	Evaluate and/or revise an investigation designed to fairly test a model or prototype and identify aspects that could be improved.

Grade 8 NGSS Range ALDs by Performance Expectation

Transformation of Energy

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]	
ALD 1	Identify simple data to show a relationship between kinetic energy and mass or speed of an object.
ALD 2	Use graphical displays of data (e.g., maps, charts, graphs, and/or tables) to describe qualitative relationships between speed, mass, and/or kinetic energy of an object.
ALD 3	Construct and interpret graphical displays of data to describe quantitative relationships between kinetic energy, the mass of an object, and the speed of an object.
ALD 4	Evaluate how well graphical data describe quantitative relationships between speed, mass, and kinetic energy.

MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]	
ALD 1	Identify a simple model to show how the arrangement of objects interacting at a distance is related to the potential energy stored in the system.
ALD 2	Use a model to describe how the arrangement of objects interacting at a distance changes the amount of potential energy stored in the system.
ALD 3	Develop and use a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
ALD 4	Evaluate and/or revise a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]	
ALD 1	Identify an observation to support a claim that when the kinetic energy of an object changes, the energy of the object changes.
ALD 2	Identify evidence to support an argument that when the kinetic energy of an object changes, energy is transferred to or from the object.
ALD 3	Use evidence to construct an argument to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
ALD 4	Use evidence to evaluate and/or revise an argument to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]	
ALD 1	Use a simple model for waves to identify a relationship between amplitude and wave energy.
ALD 2	Use a simple model of a mathematical representation of a wave to describe a qualitative relationship between amplitude and wave energy.
ALD 3	Use mathematical representations to describe a simple model of a wave that includes a quantitative relationship between amplitude and wave energy.
ALD 4	Use and revise a model that uses mathematical representations to describe the quantitative relationship between amplitude and wave energy.

MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]	
ALD 1	Identify a simple model to show how a wave property changes as it travels through a material.
ALD 2	Use a model to describe how waves are reflected, absorbed, or transmitted through various materials.
ALD 3	Develop and use a model to describe that waves are reflected, absorbed, or transmitted, through various materials.
ALD 4	Evaluate and/or revise a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Weather and Climate

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. (apply to weather and ecosystems unit) [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]	
ALD 1	Identify a scientific principle to design or test a device that either minimizes or maximizes thermal energy transfer.
ALD 2	Describe scientific principles and/or criteria to design a device that either minimizes or maximizes thermal energy transfer.
ALD 3	Apply scientific principles and criteria and/or constraints to design and/or test a device that either minimizes or maximizes thermal energy transfer.
ALD 4	Use scientific principles and criteria and/or constraints to evaluate and/or revise the design of a device that either minimizes or maximizes thermal energy transfer.

MS-PS3-4. Plan an investigation to determine the relations among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. (apply to weather and ecosystems unit) [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]	
ALD 1	Identify some of the variables for an investigation and the order for steps of an investigation plan to determine a relationship among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
ALD 2	Describe data to be collected and/or variables to be controlled in an investigation that can be used to determine relationships among energy transferred, type of matter, mass, and/or change in average kinetic energy of the particles as measured by the temperature of a sample.
ALD 3	Plan an investigation that can be used to determine relationships among energy transferred, type of matter, mass, and/or change in average kinetic energy of the particles as measured by the temperature of the sample.
ALD 4	Evaluate and revise an investigation to determine relationships among energy transferred, type of matter, mass, and change in average kinetic energy of the particles as measured by the temperature of the sample.

MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]	
ALD 1	Identify data to show changes in weather conditions as the result of moving air masses.
ALD 2	Identify data to provide evidence that moving air masses result in changes in weather conditions.
ALD 3	Describe the data that needs to be collected to provide evidence that the motions and interactions of air masses affect weather conditions.
ALD 4	Evaluate how well the data to be collected will provide evidence of the relationship between the motions and complex interactions of air masses and changes in weather conditions.

MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]	
ALD 1	Identify a simple model to show how unequal heating and the rotation of Earth affect atmospheric or oceanic circulation and/or regional climates.
ALD 2	Use a model to describe how unequal heating and the rotation of Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
ALD 3	Develop and use a model to describe how unequal heating and the rotation of Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
ALD 4	Evaluate and/or revise a model to describe how unequal heating and the rotation of Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

MS-ESS3-5. **Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.** [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]	
ALD 1	Identify questions that can be answered when studying factors that have caused the rise in global temperatures over the past century.
ALD 2	Identify questions to clarify evidence of a factor that has caused the rise in global temperatures over the past century.
ALD 3	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
ALD 4	Evaluate and/or revise questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

MS-ESS2-1. **Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.** [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]	
ALD 1	Identify a simple model to show the cycling of Earth's materials and/or the flow of energy that drives this process.
ALD 2	Use a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
ALD 3	Develop and use a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
ALD 4	Evaluate and/or revise a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

MS-ESS2-4. **Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.** [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]	
ALD 1	Identify a simple model to show the cycling of water through Earth's systems caused by the Sun.
ALD 2	Use a model to describe the cycling of water through Earth's systems driven by energy from the Sun and the force of gravity.
ALD 3	Develop and use a model to describe the cycling of water through Earth's systems driven by energy from the Sun and the force of gravity.
ALD 4	Evaluate and/or revise a model to describe the cycling of water through Earth's systems driven by energy from the Sun and the force of gravity.

MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (related to severe weather events) [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, 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 hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]	
ALD 1	Identify simple data on natural hazards that could be used to forecast future catastrophic events and/or inform the development of technologies to mitigate their effects.
ALD 2	Identify patterns in data on natural hazards to forecast future catastrophic events and/or inform the development of technologies to mitigate their effects.
ALD 3	Analyze and interpret patterns in data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
ALD 4	Evaluate how well data on natural hazards can support a forecast of future catastrophic events and inform the development of technologies to mitigate their effects.

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]	
ALD 1	Identify a scientific principle related to a method for monitoring or minimizing a human impact on the environment.
ALD 2	Describe scientific principles and/or criteria to design a method for monitoring and/or minimizing a human impact on the environment.
ALD 3	Apply scientific principles and criteria and/or constraints to design a method for monitoring and minimizing a human impact on the environment.
ALD 4	Use scientific principles and criteria and/or constraints to evaluate and/or revise a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]	
ALD 1	Identify evidence in simple graphs, diagrams, or text that supports a claim that increases in human population or per-capita consumption of natural resources impact Earth's systems.
ALD 2	Identify evidence that supports an argument for how increases in human population and/or per-capita consumption of natural resources impact Earth's systems.
ALD 3	Use evidence to construct and support an argument for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
ALD 4	Use evidence to evaluate and/or revise an argument for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Ecosystems

MS-LS1-6. 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. [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]	
ALD 1	Identify evidence that supports an explanation for the role of photosynthesis in the cycling of matter or flow of energy into and out of organisms.
ALD 2	Use evidence to support an explanation of the role of photosynthesis in the cycling of matter and/or flow of energy into and out of organisms.
ALD 3	Construct an explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
ALD 4	Evaluate and/or revise an explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. [Clarification Statement: 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.]	
ALD 1	Identify simple data that can be provided as evidence for the effects of resource availability on organisms or populations of organisms in an ecosystem.
ALD 2	Interpret qualitative data that provides evidence for the effects of resource availability on organisms and/or populations of organisms in an ecosystem.
ALD 3	Analyze and interpret quantitative data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
ALD 4	Evaluate quantitative data to determine how well the data provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]	
ALD 1	Identify evidence to support an explanation of a pattern of interactions among organisms within an ecosystem.
ALD 2	Use evidence to support an explanation that predicts patterns of interactions among organisms within or across multiple ecosystems.
ALD 3	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
ALD 4	Evaluate and/or revise an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: 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.]	
ALD 1	Identify an observation to support a claim that a change to a simple ecosystem affects a population.
ALD 2	Identify evidence in simple graphs, diagrams, or text that supports an argument about how a change to an ecosystem affects a population.
ALD 3	Construct an argument supported by empirical evidence that changes to physical and/or biological components of an ecosystem affect populations.
ALD 4	Evaluate and/or revise an argument based on empirical evidence that changes to physical or biological components of an ecosystem affect populations.

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.	
ALD 1	Identify a design solution for maintaining biodiversity or ecosystem services.
ALD 2	Compare two competing design solutions to determine how well they maintain biodiversity and/or ecosystem services.
ALD 3	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
ALD 4	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

MS-LS1-7. **Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.** [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]	
ALD 1	Identify a simple model to show how food is rearranged through chemical reactions forming new molecules that support growth or release energy as this matter moves through an organism.
ALD 2	Use a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
ALD 3	Develop and use a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
ALD 4	Evaluate and/or revise a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

MS-LS2-3. **Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** [Clarification Statement: 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 Boundary: Assessment does not include the use of chemical reactions to describe the processes.]	
ALD 1	Identify a simple model to show the cycling of matter or flow of energy among living and nonliving parts of an ecosystem.
ALD 2	Use a model to describe the cycling of matter and/or flow of energy among living and nonliving parts of an ecosystem.
ALD 3	Develop and use a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
ALD 4	Evaluate and/or revise a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Engineering Design

MS-ETS1-1. **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**	
ALD 1	Use data to identify a characteristic of a design solution that meets a criterion for success.
ALD 2	Identify data from tests to identify a similarity and/or a difference among several design solutions to identify the best characteristics of each.
ALD 3	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.
ALD 4	Evaluate data from tests of several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	
ALD 1	Identify a design solution that meets a criterion or constraint of a problem.
ALD 2	Compare two competing design solutions to determine how well they meet the criteria or constraints of the problem.
ALD 3	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
ALD 4	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. 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.	
ALD 1	Use data to identify a characteristic of a design solution that meets a criterion for success.
ALD 2	Identify data from tests to identify a similarity and/or a difference among several design solutions to identify the best characteristics of each.
ALD 3	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.
ALD 4	Evaluate data from tests of several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	
ALD 1	Identify a simple model that could be used to test a proposed object, tool, or process such that an optimal design can be achieved.
ALD 2	Use a model to generate data for testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
ALD 3	Develop and use a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
ALD 4	Evaluate and/or revise a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

High School Biology NGSS Range ALDs by Performance Expectation

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]	
ALD 1	Identify a simple model to show the release or absorption of energy from a chemical reaction.
ALD 2	Use a model to illustrate that the release or absorption of energy from a chemical reaction depends upon the changes in total bond energy.
ALD 3	Develop and use a model to explain that the release or absorption of energy from a chemical reaction depends upon the changes in total bond energy.
ALD 4	Evaluate and/or revise multiple types of models to predict or explain that the release or absorption of energy from a chemical reaction depends upon the changes in total bond energy.

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]	
ALD 1	Identify a simple mathematical representation to support a claim that atoms are conserved during a chemical reaction.
ALD 2	Use simple mathematical representations and basic algebraic thinking to support a claim that atoms, and therefore mass, are conserved during a chemical reaction.
ALD 3	Use mathematical representations and computational thinking to support a claim that atoms, and therefore mass, are conserved during a chemical reaction.
ALD 4	Use mathematical representations and computational thinking to evaluate and/or revise claims that atoms, and therefore mass, are conserved during a chemical reaction.

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.] [Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.]	
ALD 1	Identify a simple mathematical representation of the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
ALD 2	Use simple mathematics and basic algebraic thinking to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
ALD 3	Develop a basic algebraic and/or computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
ALD 4	Evaluate and/or revise a computational model to calculate or evaluate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]	
ALD 1	Identify evidence to support a description of how the structure of DNA determines the structure of proteins which carry out the essential functions of life.
ALD 2	Use evidence to support an explanation for how the structure of DNA determines the structure of proteins which carry out the essential functions of life.
ALD 3	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
ALD 4	Evaluate and/or revise an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]	
ALD 1	Identify a simple model to show the hierarchical organization of two interacting systems that provide specific functions within multicellular organisms.
ALD 2	Use a model to describe the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
ALD 3	Develop and use models to show relationships within and among the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
ALD 4	Evaluate and/or revise multiple types of models to show the relationships within and among the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]	
ALD 1	Identify the order of steps in an investigation to provide evidence that feedback mechanisms maintain homeostasis.
ALD 2	Describe the data in an investigation to be collected, the variables to be controlled, and/or the importance of multiple trials in a procedure to provide evidence that feedback mechanisms maintain homeostasis.
ALD 3	Design an investigation, including all data to be collected, variables to control or manipulate, tools, and procedures, to provide evidence that feedback mechanisms maintain homeostasis.
ALD 4	Evaluate and/or revise an investigation to provide evidence that feedback mechanisms maintain homeostasis.

HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. [Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]	
ALD 1	Identify a simple model to illustrate the role of cellular division (mitosis) in producing and maintaining complex organisms.
ALD 2	Use a model to illustrate the role of cellular division (mitosis) and/or differentiation in producing and maintaining complex organisms.
ALD 3	Develop and use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
ALD 4	Evaluate and/or revise multiple types of models to explain the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment does not include specific biochemical steps.]	
ALD 1	Identify a simple model to show how photosynthesis transforms light energy into stored chemical energy.
ALD 2	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
ALD 3	Develop and use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
ALD 4	Evaluate and/or revise multiple types of models to explain how photosynthesis transforms light energy into stored chemical energy.

HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]	
ALD 1	Identify evidence to support a description of how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
ALD 2	Use evidence to support an explanation for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
ALD 3	Construct an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
ALD 4	Evaluate and/or revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.]	
ALD 1	Identify a simple model to show that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed.
ALD 2	Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.
ALD 3	Develop and use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.
ALD 4	Evaluate and/or revise multiple types of models to explain that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.

HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]	
ALD 1	Identify a simple mathematical representation of a factor that affects carrying capacity of an ecosystem.
ALD 2	Use simple mathematical representations and basic algebraic thinking to support explanations of factors that affect carrying capacity of ecosystems at different scales.
ALD 3	Use mathematical and/or computational representations to support explanations of the factors that affect carrying capacity of ecosystems at different scales.
ALD 4	Use mathematical and computational representations to evaluate and revise explanations of factors that affect carrying capacity of ecosystems at different scales.

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.]	
ALD 1	Identify a simple mathematical representation to support a claim about a factor affecting populations in ecosystems.
ALD 2	Use a simple mathematical representation and basic algebraic thinking to support a claim about factors affecting biodiversity and populations in ecosystems.
ALD 3	Use mathematical representations and computational thinking to support explanations about factors affecting biodiversity and populations in ecosystems of different scales.
ALD 4	Use mathematical representations and computational thinking to evaluate and/or revise explanations of the factors affecting biodiversity and populations in ecosystems of different scales.

HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. [Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.] [Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.]	
ALD 1	Identify evidence to support a description of the cycling of matter and flow of energy in aerobic or anaerobic conditions.
ALD 2	Use evidence to support an explanation for the cycling of matter and flow of energy in aerobic or anaerobic conditions.
ALD 3	Construct an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
ALD 4	Evaluate and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.] [Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.]	
ALD 1	Identify a simple mathematical representation to support a claim for the cycling of matter or flow of energy in a simple ecosystem.
ALD 2	Use simple mathematical representations and basic algebraic thinking to support a claim for the cycling of matter and flow of energy among organisms in an ecosystem.
ALD 3	Use mathematical representations and computational thinking to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
ALD 4	Use mathematical representations and computational thinking to evaluate and/or revise claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. [Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]	
ALD 1	Identify a simple model that shows the role of photosynthesis or cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and/or geosphere.
ALD 2	Use a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
ALD 3	Develop and use a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
ALD 4	Evaluate and/or revise multiple types of models to explain the roles of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]	
ALD 1	Identify evidence to support a claim that changing conditions may result in a new ecosystem.
ALD 2	Compare evidence supporting claims that interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions or that changing conditions may result in a new ecosystem.
ALD 3	Evaluate evidence supporting claims that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
ALD 4	Evaluate reasoning supporting claims that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HSLS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]	
ALD 1	Identify a solution for reducing the impacts of human activities on the environment and biodiversity.
ALD 2	Design a solution for reducing the impacts of human activities on the environment and biodiversity.
ALD 3	Design and evaluate and/or refine a solution for reducing the impacts of human activities on the environment and biodiversity.
ALD 4	Evaluate and revise a solution, taking into consideration unanticipated effects, for reducing the impacts of human activities on the environment and biodiversity.

HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. [Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.]	
ALD 1	Identify evidence to support an argument about the role of group behavior on individual and/or species' chances to survive and reproduce.
ALD 2	Compare evidence to support arguments about the role of group behavior on individual and species' chances to survive and reproduce.
ALD 3	Evaluate the evidence used in arguments about the role of group behavior on individual and species' chances to survive and reproduce.
ALD 4	Evaluate the evidence used in arguments about the role of group behavior on individual and species' chances to survive and reproduce.

HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]	
ALD 1	Identify questions that can be investigated to clarify trends observed in the patterns of genetic inheritance between parents and offspring.
ALD 2	Identify questions that can help to identify relationships among DNA, chromosomes, and/or traits.
ALD 3	Select questions that can be investigated to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
ALD 4	Evaluate and/or revise questions that can be investigated to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]	
ALD 1	Identify evidence to support a claim that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, or (3) mutations caused by environmental factors.
ALD 2	Compare evidence supporting claims that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, or (3) mutations caused by environmental factors.
ALD 3	Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
ALD 4	Use evidence to compare and evaluate claims that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]	
ALD 1	Use a simple concept of statistics or probability to identify the variation or distribution of expressed traits in a population.
ALD 2	Apply simple concepts of statistics or probability to describe the variation or distribution of expressed traits in a population.
ALD 3	Apply concepts of statistics or probability to explain the variation and distribution of expressed traits in a population.
ALD 4	Apply concepts of statistics and probability to evaluate explanations of the variation and distribution of expressed traits in a population.

HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]	
ALD 1	Identify information to communicate that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
ALD 2	Use information from different sources to communicate that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
ALD 3	Obtain and evaluate data from multiple sources and formats to synthesize and communicate information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
ALD 4	Obtain and evaluate data from multiple sources and formats to synthesize and communicate information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

HS-LS4-2. **Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.** [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.]	
ALD 1	Identify evidence to support a description that biological diversity is influenced by (1) the potential for a species to increase in number, (2) the variation among individuals within a species, (3) competition for limited resources, and/or (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
ALD 2	Use evidence to support an explanation that biological diversity is influenced by (1) the potential for a species to increase in number, (2) the variation among individuals within a species, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
ALD 3	Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
ALD 4	Evaluate and/or revise an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

HS-LS4-3. **Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.** [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.]	
ALD 1	Use a simple concept of statistics or probability to identify that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
ALD 2	Apply simple concepts of statistics or probability to describe that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
ALD 3	Apply concepts of statistics or probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
ALD 4	Apply concepts of statistics and probability to evaluate explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]	
ALD 1	Identify evidence to support a description of how natural selection leads to changes in populations.
ALD 2	Use evidence to support an explanation of how natural selection leads to adaptation of populations.
ALD 3	Construct an explanation based on evidence of how natural selection leads to adaptation of populations.
ALD 4	Evaluate and/or revise an explanation based on evidence of how natural selection leads to adaptation of populations.

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]	
ALD 1	Identify evidence to support a claim that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, or (3) the extinction of other species.
ALD 2	Compare evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and/or (3) the extinction of other species.
ALD 3	Evaluate evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
ALD 4	Use evidence to compare and evaluate claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

HS-LS4-6. **Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.** [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]	
ALD 1	Identify components modeled by a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
ALD 2	Use a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
ALD 3	Use mathematics and computational thinking to design or evaluate a simulation that tests a solution to mitigate adverse impacts of human activity on biodiversity.
ALD 4	Use mathematical and computational thinking to evaluate and/or revise a simulation that tests a solution to mitigate adverse impacts of human activity on biodiversity.

HS-ESS2-6. **Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.** [Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]	
ALD 1	Identify components of a model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and/or biosphere.
ALD 2	Use a model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and/or biosphere.
ALD 3	Develop and use a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
ALD 4	Evaluate and/or revise a quantitative model that describes the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. [Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.]	
ALD 1	Identify evidence to support an argument of the simultaneous coevolution of Earth's systems and life on Earth.
ALD 2	Compare evidence to support arguments about the simultaneous coevolution of Earth's systems and life on Earth.
ALD 3	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
ALD 4	Use evidence to evaluate and/or revise arguments about the simultaneous coevolution of Earth's systems and life on Earth.

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	
ALD 1	Identify a qualitative criterion for a solution to a major global challenge.
ALD 2	Identify qualitative and/or quantitative criteria and/or constraints for a solution to a major global challenge that account for societal needs and wants.
ALD 3	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
ALD 4	Evaluate and/or revise criteria and constraints for a solution to a major global challenge that account for societal needs and wants.

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	
ALD 1	Identify a component of a complex real-world problem that can be solved through engineering.
ALD 2	Describe criteria for a solution to a complex real-world problem that can be solved through engineering.
ALD 3	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
ALD 4	Evaluate, prioritize, and/or revise criteria for a solution to a complex real-world problem that can be solved through engineering.

HS-ETS1-3. **Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.**	
ALD 1	Identify criteria and/or tradeoffs for a solution to a real-world problem, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, or environmental impacts.
ALD 2	Describe a solution to a real-world problem based on criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
ALD 3	Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
ALD 4	Evaluate and compare solutions to a complex real-world problem based on prioritized or new criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Appendix: Slides Used in the Session to Review, Revise, and Approve Achievement Level Descriptors

Phase II Next Generation Science Assessment System for Delaware Learners

Achievement Level Descriptor Meeting

April 1–2, 2019

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Agenda

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- **Welcome**
- **Introductions**
- **Purpose of this meeting**

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Welcome and Introductions

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Delaware Department of Education
- April McCrae
- Science Assessment Education Associate

Pearson
- Rachel Penticuff
- Sr. Project Manager

WestEd
- Meghan Bell
- Sr. Science Content Specialist
- Cinda Parton
- Sr. Assessment Manager
- Kevin King
- Project Director

Participants
- Current assignment and assessment involvement

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Purpose of Meeting

To review and provide feedback on draft Achievement Level Descriptors (ALDs)

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Agenda

Overview

- Definition and Purposes of Achievement Level Descriptors (ALDs)
- Background to Inform Process
  - Delaware Assessment System
  - NGSS
  - Test Design
- ALD Structure and Process

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What are Achievement Level Descriptors?

ALDs are:

- Descriptions of what students know and are able to do at each achievement level: Level 1, Level 2, Level 3, and Level 4
- Based on the grade-level performance expectations (NGSS, the adopted standards)

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Purposes of ALDs

The purposes are to:

- Provide the criteria for establishing achievement levels (or cut scores) for the tests at standard setting;
- Provide parents, teachers, and other stakeholders with a description of student performance; and
- Provide summaries in student score reports to help with the interpretation of test results.

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Background Information

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Delaware's Assessment System

Three Levels of Assessments:

1. Classroom Embedded Assessments
2. End-of-Unit (EoU) Assessments
3. Integrative Transfer Assessment (ITA)

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Integrative Transfer Assessment

Integrative Transfer Assessment (ITA)

- Summative test given at the end of the year
- Scores for this test will be reported to the district, state, and federal government
- Computer-based

Components of ITA

- Item Clusters
  - Integrative Item Cluster (IIC)
  - Regular Item Cluster (RIC)
- Standalone Items (SAI)

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Test Development Process

Development Timeline

- 2017–2018
  - Phase I Research and Cognitive Labs
- Fall 2017–Winter 2018
  - Initial Item Development
- Spring 2018
  - ITA Stand-Alone Field Test
- Spring 2019
  - First Operational Assessment
- Spring 2019
  - Achievement Level Descriptor Development
- Summer 2019
  - Standard Setting
- Fall 2019
  - First score reports based on new assessments
- Ongoing
  - ITA and End-of-Unit Development and Implementation

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Next Generation Science Standards (NGSS)

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NGSS

- **Performance Expectations (PEs)**
  - Assessable statement
  - Clarification statement
  - Assessment boundary
- **Foundation Boxes**
  - 8 Science and Engineering Practices (SEPs)
    - Q/P, MOD, INV, DATA, MCT, E/S, ARG, INFO
  - Disciplinary Core Ideas (DCIs)
    - Four Domains: PS, LS, ESS, ETS
  - 7 Crosscutting Concepts (CCCs)
    - PAT, C/E, SPQ, SYS, E/M, S/F, S/C
  - Connections
    - Nature of Science
    - Engineering, Technology, and Applications of Science
- **Appendices**

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NGSS

5-PS1-2 Matter and Its Interactions

Students who demonstrate understanding can:

5-PS1-2. **Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.** [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [*Assessment Boundary: Assessment does not include distinguishing mass and weight.*]

The performance expectation above was developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Measure and graph quantities such as weight to address scientific and engineering questions and problems.	**PS1.A: Structure and Properties of Matter** • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. **PS1.B: Chemical Reactions** • No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)	**Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. - - - - - - - - - - - - - - - - - - - ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes consistent patterns in natural systems.

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Structure of the ITA

- Item Clusters
  - Aligned to a PE bundle
    - Usually 2–3 PEs that work naturally together
    - May be within or across domains
  - Phenomena-Based
    - Observable events in the universe that can be predicted or explained using science knowledge
    - Some phenomena may only be observed indirectly or through models
    - Phenomena occur within contexts that provide the backdrop for clusters and items
  - Stimulus and Set of Items
    - Integrative Item Clusters (IICs)
    - Regular Item Clusters (RICs)
- Stand-Alone Items (SAIs)
  - Aligned to a single PE
    - Must assess at least 2 dimensions of the PE
  - May be one or two parts

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Item Cluster Types

Integrative Item Cluster (IIC)

- Stimuli and typically 6 items
- Stimuli and items build upon each other
- Aligned to 2–3 PEs (a PE bundle)
- Stimuli may include simulations
- Culminates with 4-point extended response (ER) item
- Items still function independently for measurement purposes
- Developed and field-tested as a complete set

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Review Sample IIC

- **Individually read through the stimuli and items for the IIC in your sample items booklet.**
- **Discuss in your grade-level table group:**
  - What do you understand about the assessment by reviewing the items?
  - What knowledge, skills, and abilities do the students need in order to answer the items correctly?
  - Which items will be easy for your students and which will be challenging?
  - What is the evidence of the three dimensions of the NGSS in the item cluster?

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Item Cluster Types

Regular Item Cluster (RIC)

- **Stimulus and 5 items**
- **Shorter, often single stimulus**
- **Aligned to 2–3 PEs (a PE bundle)**
- **May include 2-point constructed response (CR) item**
- **Developed with 8–10 items from which 5 are selected for operational use**
- **Items are interchangeable and not dependent on one another**
- **Field tested with different items on different forms**

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Review Sample RIC

- **Individually read through the stimuli and items for the RIC in your sample items booklet.**
- **Discuss in your grade-level table group:**
  - What do you understand about the assessment by reviewing the items?
  - What knowledge, skills, and abilities do the students need in order to answer the items correctly?
  - Which items will be easy for your students and which will be challenging?
  - What is the evidence of the three dimensions of the NGSS in the item cluster?

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Standalone Items

- **No external stimulus**
- **Information (data) needed by student to determine answer is contained within the item**
- **Aligned to two or three dimensions of a single PE**
- **Variety of item types, each worth 1 or 2 points**
- **Focuses on one aspect of a phenomenon (limited breadth and depth)**

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Review Sample Standalone Items

- **Individually read through the standalone items in your sample items booklet.**
- **Discuss in your grade-level table group:**
  - What do you understand about the assessment by reviewing the items?
  - What knowledge, skills, and abilities do the students need in order to answer the items correctly?
  - Which items will be easy for your students and which will be challenging?
  - What is the evidence of the dimensions of the NGSS in these items?

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Test Blueprint

ITA Operational Test Design

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Grade 5 Test Design – ITA

	IIC	RIC		SAIs	Matrix Field Test Slots
	IIC 1	RIC 1	RIC 2	Items	IIC or RIC + SAIs
Items	6	5	5	10	6 or 8

Grade 8 & HS Biology Test Design - ITA

	IIC	RIC			SAIs	Matrix Field Test Slots
	IIC 1	RIC 1	RIC 2	RIC 3	Items	IIC or RIC + SAIs
Items	6	5	5	5	14	6 or 8

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Item Types

- Multiple Choice (MC)
  - 1 point
  - 4 options
  - 1 correct answer
- Multiple Select (MS)
  - 1 point
  - Up to 5 options
  - 2 correct answers
- Technology Enhanced (TE)
  - 1–2 points
  - Graph
  - Gap Match (Drag and Drop)
  - Hot Spot
  - Match Table Grid

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Item Types

2- and 4-point items

- Two-Part Items
  - Composed of two 1-point items
  - Each part can be MC, MS, or TE
  - Each component is always 1 point
  - Partial credit depends on scoring rules
- Constructed Response (CR)
  - 2 points
  - May have one or two parts
  - Only used in RICs
  - Include rubric for scoring and partial credit
- Extended Response (ER)
  - 4 points
  - May have one to three parts
  - Only used in IICs as culminating item
  - Include rubric for scoring and partial credit

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Exercise 1

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Grade-Level Teams

Describe a "typical" proficient (Level 3) student:

- Consider the PEs at the grade level.
- Consider each of the dimensions—SEPs, DCIs, CCCs.
- Consider the expected performances and evidence produced by that student
- Create a poster to share with large group.

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Exercise 1

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Large Group

- Share your team's description of a "typical" proficient (Level 3) student.
- Discuss each poster.
- Discuss the vertical articulation across the grades.

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ALD Structure

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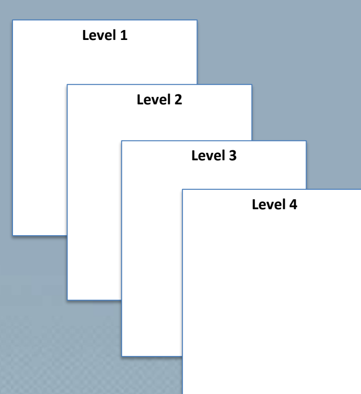
Complete Set of ALDs

For each grade: 5, 8, and biology



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ALD Structure

For each grade and for each achievement level:

- A summary paragraph
  - Students performing at Level 3 can . . .
- A list of statements that further clarify the skills and knowledge of a student performing at that level on the PE
  - Develop and use a model to . . .
  - Construct an explanation based on evidence for . . .
  - Analyze and interpret quantitative data for . . .

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Exercise 2

<u>Table groups</u>

Discuss the general principles that are important to include in the ALDs.

- Consider the information the ALDs should convey about student performance.
- Be ready to share main points with large group.

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Exercise 2

Large Group

- Share your team's description of the general principles of the ALDs.
- Discuss the vertical articulation across the grades.

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Progressions in the ALDs & ALD Review Process

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ALD Progression Within a Grade

Level 1	Level 2	Level 3	Level 4
Students performing at **Level 1** can, with significant support, use some crosscutting concepts to define a familiar simple system and identify some cause and effect relationships and simple patterns . . .	Students performing at **Level 2** can, with support, use crosscutting concepts to define a simple system and identify some cause and effect relationships and simple patterns . . .	Students performing at **Level 3** can, with minimal support, use crosscutting concepts to define a system and identify cause and effect relationships and patterns . . .	Students performing at **Level 4** can independently and consistently use crosscutting concepts to define novel systems and identify cause and effect relationships and patterns . . .

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ALD Progression: Across Grades

Grade	Level 3 Paragraphs
5	Students performing at **Level 3** can, with minimal support, use crosscutting concepts to define a system and identify cause and effect relationships and patterns . . .
8	Students performing at **Level 3** can, with minimal support, use crosscutting concepts to define a system and identify cause and effect relationships and patterns . . .
Biology	Students performing at **Level 3** can, with minimal support, use crosscutting concepts to define a system and identify cause and effect relationships and patterns . . .

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ALD Progression: Within and Across Grades

Grade	Level 1	Level 2	Level 3	Level 4
5	Identify a simple model to show . . . when provided with significant support.	Use a model to describe . . . when provided with some support.	Develop and use a model to describe . . .	Independently evaluate the limitations of or revise a model to describe . . .
8	Identify a simple model to show . . . when provided with significant support.	Use a model to describe . . . when provided with some support.	Develop and use a model to describe . . .	Independently evaluate and/or revise a model to describe . . .
Bio	Identify a simple model to show . . . when provided with significant support.	Use a model to describe . . . when provided with some support.	Develop and use a model to describe . . .	Independently evaluate and/or revise multiple types of models to describe . . .

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Progression of MS-PS3-1 across Grade 8

Level	Statements
1	Identify simple data to show a relationship between kinetic energy and mass or speed of an object when provided with significant support.
2	Use graphical displays of data (e.g., maps, charts, graphs, and/or tables) to describe qualitative relationships between speed, mass, and/or kinetic energy of an object when provided with some support.
3	Construct and interpret graphical displays of data to describe quantitative relationships between kinetic energy, the mass of an object, and the speed of an object.
4	Independently evaluate how well graphical data describe quantitative relationships between speed, mass, and kinetic energy.

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ALD Review Process

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Process

- Review and discuss ALDs for each level.
- Room facilitator captures feedback and recommendations electronically.

Guidelines

- ALDs must stay within grade, even for Level 4.
- ALDs must reflect evidence that can be gathered on the summative assessment.
- ALDs must be articulated horizontally within a grade and vertically across the grades.

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Exercise 3

Review Draft Level 3 ALDs

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Individually:

- Read the draft Level 3 ALDs.
- Note any patterns, appreciations, concerns, and questions.

In grade-level groups:

- Discuss general observations.
- Prepare consensus observations to share with large group.

In large group:

- Share general observations.
- Discuss commonalities and differences.

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Exercise 4

Review of Draft Level 2 ALDs

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Individually:

- **Read the draft Level 2 ALDs.**
- **Note any patterns, appreciations, concerns, and questions.**

In grade-level groups:

- **Discuss general observations.**
- **Prepare consensus observations to share with large group.**

In large group:

- **Share general observations.**
- **Discuss commonalities and differences.**

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Closing Comments and Adjourn

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ALD Feedback and Recommendations: Day 2

Welcome and Orientation to the Day

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Exercise 5

Level 2 and 3 ALDs Feedback and Recommendations

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In grade-level groups:

- Provide specific feedback on the ALD statements.
  - Recommendations and adjustments
- Facilitator captures edit suggestions electronically on documents.

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Exercise 5

Level 2 and 3 ALDs Feedback and Recommendations

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In large group:

- Share suggested edits for calibration and articulation.

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Exercise 6

Review and Recommendations for Draft Level 4 ALDs

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Individually:

- Read the draft Level 4 ALDs.
- Note any patterns, appreciations, concerns, and questions.

In grade-level groups:

- Discuss general observations.
- Prepare consensus observations to share with large group.
- Provide recommended edits/comments.

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Exercise 7

Review and Recommendations for Draft Level 1 ALDs

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Individually:

- Read the draft Level 1 ALDs.
- Note any patterns, appreciations, concerns, and questions.

In grade-level groups:

- Discuss general observations.
- Prepare consensus observations to share with large group.
- Provide recommended edits/comments.

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Exercise 8

Final Feedback and Recommendations

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In large group:

- Share suggested edits for Level 1 and Level 4 calibration and articulation.
- Review and discuss articulation across all grades and all levels.

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Wrap-Up &
Thank You!
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Closing comments
Adjourn

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