Oklahoma School Testing Program
Oklahoma Core Curriculum Tests

Test and Item Specifications
Science
Grade 5

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Test Specifications

***Important Note*:**

The material in the test and item specifications should not be used as a curriculum guide.

Purpose of the Grade 5 Science Assessment

The purpose of the Grade 5 Science test is to measure Oklahoma students' level of proficiency in the discipline of science. On this test, students are required to respond to clusters of items aligned to the assessable fifth-grade performance expectations (standards) identified in the 2014 Oklahoma Academic Standards for Science (OASS). A cluster is a set of three multiple-choice items linked with a common stimulus.

All Grade 5 Science test forms will assess a sampling of the performance expectations in each of the reporting categories below. The reporting categories represent the grouping of performance expectations by the three science content domains as laid out in the OASS with the exception of 5-PS2-1 and 5-PS3-1 (which are placed with Earth and Space Sciences and Life Sciences, respectively, to reflect the likely way they would be addressed in classroom instruction). Note that results for the Grade 5 Science test will be reported at the content domain level, not at the level of individual performance expectations.

Grade 5 Science Reporting Categories and Assessable Performance Expectations from the Oklahoma Academic Standards for Science*
Physical Sciences • 5-PS1-1 • 5-PS1-2 • 5-PS1-3 • 5-PS1-4
Life Sciences • 5-LS1-1 • 5-LS2-1 • 5-LS2-2 • 5-PS3-1
Earth and Space Sciences • 5-ESS1-1 • 5-ESS1-2 • 5-ESS2-1 • 5-ESS2-2 • 5-PS2-1

*Performance expectation 5-ESS3-1 is not listed in the reporting categories because it is not assessed at the state level.

Test Structure, Format, and Scoring

The Oklahoma Core Curriculum Test for Grade 5 Science consists of clusters of items. A cluster is a set of three multiple-choice items linked with a common stimulus.

- A cluster stimulus consists of the passages, graphs, models, figures, diagrams, data tables, etc. that students must read and examine to respond to the items in the cluster. The stimulus may be a combination of multiple stimulus elements (e.g., some text plus a diagram and a data table).
- Each multiple-choice item within the cluster is worth one point and is scored as correct or incorrect.
- Items within a cluster are arranged logically, typically with easier and/or less complex items first.

The table below shows the total number of items (in clusters) that students respond to and the total number of points allocated on a test form. Further explanation is provided in the paragraph below the table.

Total Number of Items and Point Values for Grade 5 Science Test			
Content Assessment	**Total Items**	**Total Operational Items and Points**	**Total Field-Test Items**
Grade 5 Science	51 items (17 clusters)	45 items (15 clusters) 45 points	6 items (2 clusters)

As shown in the table, the test form for Grade 5 Science contains both operational clusters and field-test clusters. The operational clusters contribute to the student's score; the raw score (number of points earned) is converted to a scaled score to report test results. The field-test clusters do not contribute to the student's score, but the results are used to evaluate new clusters for use in future operational forms. Clusters that have suitable statistics are used to construct operational tests in subsequent years.

Each cluster aligns to a single OASS performance expectation (consisting of a Science and Engineering Practice, Disciplinary Core Idea, and Crosscutting Concept). The clusters are also structured to assess a range of skills and knowledge applications within the performance expectation. In this way, the assessment will gather data measuring a breadth and depth of student ability within the performance expectations.

Test Alignment with the Oklahoma Academic Standards for Science

The following criteria are used to ensure alignment of the Grade 5 Science test with the performance expectations (standards) in the OASS:

1. **Range of Knowledge Correspondence**
   The Grade 5 Science test is constructed so that a minimum of 75–80% of the performance expectations in each reporting category have at least one corresponding cluster of items in the operational portion of the assessment.

2. **Categorical Concurrence**
   The Grade 5 Science test is constructed so that there are at least 12 score points measuring each reporting category. This number of points is based on the typical psychometric recommendations for a minimum of 10–12 score points needed to produce a reasonably reliable estimate of a student's mastery of the constructs measured.

3. **Depth of Knowledge Consistency**
   On the Grade 5 Science test, the items in the clusters require various Depth of Knowledge (DOK) levels. Because items in a cluster are structured to assess a range of skills and knowledge applications within a performance expectation, items at DOK levels 1, 2, and 3 are all included on the test.

Test Blueprint

The blueprint describes the content and structure of the operational test and defines the target number of test items by reporting category for the Grade 5 Science assessment.

Reporting Categories[1] (Oklahoma Academic Standards for Science)	Target Number of MC Items	Target Percentage of Total Items/ Score Points[2]	Target Number of Clusters[3]
Physical Sciences • 5-PS1-1 • 5-PS1-2 • 5-PS1-3 • 5-PS1-4	**12–15**	**27–33%**	**4–5**
Life Sciences • 5-LS1-1 • 5-LS2-1 • 5-LS2-2 • 5-PS3-1[a]	**12–15**	**27–33%**	**4–5**
Earth and Space Sciences • 5-ESS1-1 • 5-ESS1-2 • 5-ESS2-1 • 5-ESS2-2 • 5-PS2-1[a]	**15–18**	**33–40%**	**5–6**
Total Operational Test	**45**	**(45 total score points) 100%**	**15**

(Please note that this blueprint does not include items that will be field-tested.)

1 Reporting category names are taken from the three content domain names in the OASS.

a The physical science performance expectations 5-PS3-1 and 5-PS2-1 are being reported in Life Sciences and Earth and Space Sciences, respectively. Their placement in these reporting categories reflects the way that these performance expectations would typically be incorporated into units in classroom instruction.

2 A minimum of 12 points is required to report results for a reporting category for Grade 5 Science.

3 Performance expectations will be assessed using a cluster-based format: a set of three multiple-choice items linked with a common stimulus. Each cluster will align to a single performance expectation. The Grade 5 Science operational test will contain a total of 15 clusters.

Depth of Knowledge Assessed by Test Items

The Oklahoma Core Curriculum Test for Grade 5 Science will, as closely as possible, reflect the following Depth of Knowledge distribution of items within the clusters.

Grade 5 Science Test DOK Distribution	
Depth of Knowledge	**Percent of Total Test Points**
Level 1 – Recall and Reproduction	10–20%
Level 2 – Skills and Concepts	60–70%
Level 3 – Strategic Thinking	15–25%

Items within a cluster are structured to assess a range of skill and knowledge applications within a performance expectation. Some parts of the cluster may reflect more routine concepts and skills, and thus require only DOK Level 1 cognition. Other parts of the cluster will reflect more sophisticated use of knowledge and skills, as well as multi-dimensional thinking, and therefore will require DOK Level 2 and DOK Level 3 cognition.

DOK Level 1

Level 1—Recall and Reproduction—is defined as recalling information such as a fact, definition, term, or simple procedure, as well as performing a simple science process or procedure. At Level 1, students supply basic knowledge; plug in numbers to use a simple formula; make simple measurements; or perform a clearly defined, given series of steps. In simple/DOK 1 procedures, the step or steps to follow are already outlined and are very familiar to/routinely performed by students.

Some examples that represent, but do not constitute all, Level 1 performances are

- recognizing or showing the correct representation of a basic scientific concept or relationship in words, diagrams, or simple models.
- performing a routine procedure, such as measuring length.
- identifying basic tools or steps needed for a defined scientific investigation.
- reading data from a graph or stating a simple, obvious pattern from data.
- restating information from scientific text.

DOK Level 2

Level 2—Skills and Concepts—extends the mental processing beyond recalling or reproducing a response at DOK Level 1. The content knowledge and process involved are more complex than in Level 1. Level 2 items often require students to reason and make decisions as to how to approach the question or problem and to plan or consider a series of steps.

Some examples that represent, but do not constitute all, Level 2 performances are

- specifying and explaining the relationship between basic concepts, properties, or variables.
- developing and using a scientific model in basic conceptual interpretations.
- determining/planning a procedure for a scientific investigation according to specified criteria and then performing the investigation.

- asking clarifying questions about a phenomenon, a scientific investigation, or an engineering problem.
- classifying objects or data into logical categories.
- organizing, displaying, comparing, and interpreting data in different graphical forms.
- predicting the outcome of changes in a system, scientific investigations, or other events.

DOK Level 3

Level 3—Strategic Thinking—requires reasoning, planning, using evidence, and using a higher level of thinking than the previous two levels. The cognitive demands of Level 3 are complex and abstract. The complexity does not result only from the fact that there could be multiple answers, a possibility for both Levels 1 and 2, but because the multistep task requires more demanding reasoning. In most instances, requiring students to explain their thinking is at Level 3, while requiring a very simple explanation or a word or two should be at Level 2. An activity that has more than one possible answer and requires students to justify the response they give would most likely be at Level 3.

Some examples that represent, but do not constitute all, Level 3 performances are

- identifying rich research questions and designing investigations for a scientific or an engineering problem, typically with more than one dependent variable.
- developing a scientific model for a complex situation.
- interpreting and drawing conclusions from complex experimental data.
- justifying and providing evidence for explanations of phenomena.
- constructing a scientific argument with a claim, evidence, and scientific reasoning.
- evaluating the merits and limitations of models, investigative designs, scientific arguments, etc.
- using evidence to revise models, explanations, claims, etc.
- solving non-routine science and engineering problems.
- obtaining and combining information from multiple sources to explain or compare scientific issues.

Note that while the DOK levels are presented discretely, the cognitive demands of items really fall along a continuum. Many cognitive processes and their associated action verbs can be classified at different DOK levels depending on the complexity of what students are expected to do. Therefore, relying primarily on verbs to make a DOK assignment is not reliable. For example, the cognitive process of understanding can include clarifying, giving examples, classifying, summarizing, inferring, comparing, making a model, and explaining. The depth of knowledge at which such processes are carried out can vary, however, as shown in the chart.

<table>
<tr><th colspan="4">Example of Cognitive Process Across Various DOK Levels</th></tr>
<tr><td>Cognitive Process: Understanding</td><td>DOK 1
Solve a one-step problem
Represent simple relationships in words, pictures, or symbols</td><td>DOK 2
Specify and explain relationships (e.g., non-examples/ examples; cause-effect)
Make and record observations
Make basic inferences or logical predictions from data/ observations
Use models/diagrams to represent or explain concepts</td><td>DOK 3
Use concepts to solve non-routine problems
Explain, generalize, or connect ideas using supporting evidence
Make and justify claims
Explain thinking when more than one response is possible
Explain phenomena in terms of concepts</td></tr>
</table>

References:

- Webb Science Levels of Depth of Knowledge: http://www.newleaders.org/wp-content/uploads/All-content-areas-DOK-levels-32802.pdf
- Hess Cognitive Rigor Matrix, Science: http://static.pdesas.org/content/documents/M2-Activity_2_Handout.pdf

Universal Test Design Considerations

Universal design, as applied to assessments, is a concept that allows the widest possible range of students to participate in assessments and may even reduce the need for accommodations and alternative assessments by expanding access to the tests themselves. In the Oklahoma Core Curriculum Tests, modifications have been made to some items to simplify and clarify their instructions and to provide maximum readability, comprehensibility, and legibility. This includes such changes as reduction of language load in content areas other than Reading, increased font size, fewer items per page, and boxed items to assist visual focus. Specifically in the Science tests, the cluster-based design reduces the number of unique stimuli that students must process. The stimuli and items are constructed with clear wording and presentation, and they exclude extraneous information. Additionally, the vocabulary level for the Grade 5 Science test is two grade levels below, except for science content words.

Test Administration Details

Administration Mode

The Grade 5 Science test is administered in a paper/pencil testing format.
Scratch paper will not be provided, as scratch work may be done in the test booklet.
No reference sheets/resource materials or calculators may be used by students during the Grade 5 Science test.

Estimated Testing Time

The Grade 5 Science test is divided into two sessions. Districts may exercise flexibility in determining how to administer the sessions. When testing a session, test administrators may give students additional time if they need it, but the additional time is to be given as an extension of that specific testing session.

The following table provides estimates of the time required to administer the Grade 5 Science test by session. These time approximations are provided to facilitate planning administration logistics within schools and to ensure adequate testing time for all students. Actual testing times may vary from these approximations.

Grade 5 Science Estimated Testing Times	
Session	**Approximate Duration**
Directions	20 minutes
Test Session 1	50–60 minutes
Test Session 2	50–60 minutes
Total Testing Time	**120–140 minutes**

Item Specifications

***Important Note*:**

The material in the test and item specifications should not be used as a curriculum guide.

The item specifications provide guidelines and suggestions for the type of content to be included in item clusters, but they do not provide an exhaustive list of what can be included. The cluster stimulus attributes, model item descriptions, and sample item clusters are not intended to be completely definitive in nature or construction—the cluster stimuli and items may differ from one test form to another, as may their presentations.

All item clusters are expected to be of the highest quality and be tightly aligned to the OASS. All item clusters developed using these specifications are reviewed by Oklahoma educators and approved by the Oklahoma State Department of Education.

Introduction

The item specifications documentation is intended to provide guidance on the structure and content of the test material developed for the Oklahoma Core Curriculum Test (OCCT) for Grade 5 Science. The Grade 5 performance expectations of the Oklahoma Academic Standards for Science (OASS) will be assessed on the OCCT using a cluster-based format: a set of three multiple-choice items linked with a common stimulus.

Functionally, the item specifications documentation represents a bridge between the constructs in the OASS, the Oklahoma Science Framework, the test specifications, and the test blueprint for Grade 5 Science. The item specifications delineate core emphases, examples, and boundaries for item clusters written for each OASS performance expectation as well as expectations for the format and structure of the cluster stimuli and items. In this way, the item specifications help ensure that the item clusters appearing on the Grade 5 Science test consistently and accurately reflect the constructs in the OASS and validly measure students' proficiency in the performance expectations of the OASS.

The information utilized for the specifications for each Grade 5 OASS performance expectation draws extensively from the OASS and from the Oklahoma Science Framework, thus providing a strong link between instruction and assessment. The information in the item specifications is also informed by the tenets in *A Framework for K-12 Science Education*[1] and recognized best practices in assessment (*Standards for Educational and Psychological Testing*[2], *Code of Fair Testing Practices in Education*[3]).

The item specifications are intended to be used by multiple audiences: Oklahoma educators, Oklahoma State Department of Education staff, and testing vendors. The item specifications provide outlines and suggestions for the types of content and presentation that can be utilized in developing the item clusters for the Grade 5 Science test. As such, the item specifications provide all users with information to gauge the types of skills and understandings that students will be asked to demonstrate on the Grade 5 Science test. This information is useful to Oklahoma educators in planning instruction and conducting classroom formative and summative assessment. It is also useful to Oklahoma educators and State Department of Education staff in reviewing and approving item clusters for use on the Grade 5 Science test because it provides a clearly delineated description of the intent of each performance expectation and what item clusters aligned to each performance expectation should measure.

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1 National Research Council. (2011). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

2 American Educational Research Association, American Psychological Association, and National Council on Measurement in Education (2014). Standards for Educational and Psychological Testing. Washington, DC: American Educational Research Association.

3 *Code of Fair Testing Practices in Education* (2004). Washington, DC: Joint Committee on Testing Practices.

General Cluster Specifications

The Grade 5 performance expectations of the OASS will be assessed on the OCCT by using a cluster-based format: a set of three multiple-choice items linked with a common stimulus. The Grade 5 test consists only of clusters with multiple-choice items.

A cluster requires students to actively use the Science and Engineering Practice of the performance expectation while applying their knowledge of the Crosscutting Concept and drawing on their understanding of the Disciplinary Core Idea to explain a phenomenon or to solve a science/engineering problem.

- ***Cluster Stimulus***

A **cluster stimulus** consists of the passages, graphs, models, figures, diagrams, data tables, etc., that students must read and examine in order to respond to the items in the cluster. To meet the intent of the OASS, stimuli must represent a variety of topics and scenarios, many of them novel. An individual stimulus may be a combination of multiple stimulus elements (e.g., some text plus a diagram and a data table).

While the specific content and context requirements of a stimulus will vary depending on the performance expectation being assessed (and are outlined in the individual specification for each performance expectation), the following characteristics are necessary for all cluster stimuli:

1. Information in the stimulus is representative of the Science and Engineering Practice, Disciplinary Core Idea, and Crosscutting Concept for a specific performance expectation.

2. The stimulus presents an example of an event, a phenomenon, an observation, an investigation, or a problem that is engaging, realistic, meaningful, and appropriate for Oklahoma students in Grade 5.

3. The stimulus includes a "hook" or driving reason students would want to find out or know more about the example presented, which is aligned with the core emphasis of the performance expectation. When students are given information, data, or an experimental setup to evaluate, they should know the research question and/or purpose of the research when applicable. To avoid increases in reading load, hooks should be brief (1 or 2 sentences). Additionally, hooks should be integral to the item, not gratuitous.

4. The stimulus provides sufficient information (in the form of tables, graphs, text, diagrams, etc.) for the assessment of a specific performance expectation. In other words, the stimulus must supply sufficient information to allow students to engage in the Science and Engineering Practice of the performance expectation in conjunction with the Disciplinary Core Idea and Crosscutting Concept to respond to items.

5. The stimulus information must be necessary, but not conceptually sufficient, for the student response (i.e., students must also utilize their own knowledge of the constructs in the performance expectation to answer the items).

6. The information included within the stimulus must pertain to multiple items. Unique lead information that supports only one item will be placed in the introduction to that particular item. Extraneous information

should be eliminated from the cluster stimulus and from item lead information (i.e., only relevant, concise information is utilized in order to reduce information overload).

7. There is a balance of graphic and textual stimulus materials among the set of clusters for the test form. The pictorial and graphic representations in the stimulus are appropriate for the grade level and performance expectation being assessed. The stimulus (text and graphic elements) should fit on a single page whenever possible.

8. The placement of graphic and textual materials within the stimulus follows a logical flow of information. This is facilitated by the use of clear language, transitions, and pointers between text and graphics.

9. The stimulus avoids material or subject matter that might introduce bias or sensitivity issues:
    a. The material is balanced and culturally diverse.
    b. There is a balance of gender and active/passive roles by gender.
    c. The stimulus does not display unfair representations of gender, race, ethnicity, disability, culture, or religion; nor does the stimulus contain elements that are offensive to any such groups.
    d. The content of the stimulus avoids subject matter that might prompt emotional distress on the part of the students.

10. The content of the stimulus is developed and verified using valid and reliable scientific sources for contexts, examples, and data.

11. Permission to use stimuli from copyrighted material is obtained as necessary by the testing vendor.

12. The stimulus supports the development of 6–8 associated items. (While clusters will contain only three items on the operational test, additional items must be field-tested with the stimulus to ensure enough items are available to construct the operational clusters. Items are sometimes rejected after the field test if the performance data for the item do not meet psychometric requirements.)

13. Careful attention is given to the wording, length, and complexity of the stimulus:
    - word count of approximately 50–300 words
    - vocabulary level two grade levels below, except for science content words
    - use of footnotes to define unfamiliar science content words (exception: one-word parentheticals may be used)
    - focus on shorter sentence structure and less complex grammatical constructions
    - consideration of qualitative and quantitative readability measures to review text complexity

    Note: The exact vocabulary, word count, and complexity of each stimulus will be reviewed by Oklahoma educators and approved by the Oklahoma State Department of Education to achieve the most appropriate stimulus for each cluster based on the grade level and content being assessed.

➢ ***Cluster Items***

The items within each cluster must work together cohesively to provide a valid measure of the performance expectation being assessed. The following criteria should guide the development of items in each cluster:

1. The items are tied closely to their specific stimulus so that the impact of non-curricular knowledge and experience, while never wholly avoidable, is minimized.

2. The items cover the concepts, information, and evidence that are central to students' understanding of the specific cluster stimulus and are focused on the Science and Engineering Practice, Disciplinary Core Idea, and Crosscutting Concept of the performance expectation. Across an item set it must be clearly evident that students have used all three dimensions of the given performance expectation.

3. The items do not assess Science and Engineering Practices that are not part of the performance expectation that the cluster is aligned to.

4. The items within a cluster address different depths and breadths of understanding of the specific performance expectation. Items are to be written to a range of depths of knowledge, from basic representation and skill applications to strategic thinking and reasoning.

5. The model item stems described in the specifications for each performance expectation are utilized whenever possible. The model item stems represent general ways (and specific ways, in brackets) to assess the multiple dimensions of each performance expectation. The model item stems are not meant to be an exhaustive listing; rather, they represent a selection that can be used with an appropriate stimulus to craft well-aligned items. Other stems may be used in place of these model item stems, but they must capture multiple dimensions such that the finished cluster shows alignment to all three dimensions of the performance expectation.

6. Graphics and information for all cluster items are generally placed in the cluster stimulus, but items may have additional information or graphics when necessary. (Unique lead information supporting only one item will be placed in the introduction to that specific item.) Graphics must be clearly associated with their intended items.

7. Each item in the cluster is independent of the other items; that is, the answer to one item is not required to answer the other items.

8. To the greatest extent possible, no item or answer choice clues the correct answer to any other item.

9. Items in the cluster appear on a page facing the stimulus whenever possible to minimize page turning.

General Item Writing Mechanics

All items written during the development of the item clusters for the Grade 5 Science test will follow best practices in assessment pertaining to the structure and format of the items per item type. Consideration is also given to vocabulary word choices.

- ***Multiple-Choice Items***
  - Each multiple-choice item has a stem (formatted as a question or an incomplete statement) and four answer options, only one of which is correct.
  - All item stems clearly indicate what is expected in the item to help students focus on selecting a response. The stem presents a complete problem so that students know what to do before looking at the answer choices; students should not need to read all the answer choices before knowing what is expected.
  - All multiple-choice options—the correct response and the three distractors—are similar in length and syntax. Students should not be able to rule out an incorrect answer or identify a correct response solely because it looks or sounds different from the other answer choices. Distractors are created so that students reason their way to the correct answer rather than simply identify incorrect responses because of a distractor's obviously inappropriate nature. Distractors should always be plausible (but incorrect) in the context of the item stem.
  - Any art within individual items (e.g., additional lead art, graphic options) must be functional and necessary for the item.
  - Most item stems are positively worded and avoid the use of the word "not." If a negative is required, the preferred format is "All of the following . . . except."
  - The responses "Both of the above," "All of the above," "None of the above," and "Neither of the above" are not used as options.

- ***Item Vocabulary***
  - No single source is available to determine the reading level of various words. Therefore, the appropriateness and difficulty of a word is determined in various ways. Vocabulary is checked in the following: *EDL Core Vocabularies in Reading, Mathematics, Science, and Social Studies*; *Basic Reading Vocabularies*; the *Living Word*; or other reliable readability sources.
  - In addition, each vocabulary word must be approved by Oklahoma's Content Review Committee. The committee, composed of Oklahoma educators from across the state, reviews proposed vocabulary in item clusters for grade-level appropriateness.
  - Except for science content words, the Grade 5 Science test will have a vocabulary level two grade levels below.
  - Unfamiliar science words in stimuli are to be defined using footnotes. The exception to this is single-word definitions, which may be placed in parentheses [e.g., mean (average)].

Overview of Layout of Item Specifications by Performance Expectation

For each OASS performance expectation, the item specifications are organized in the following way:

Core Idea Category: Performance Expectation Code[1]

Performance Expectation Code and Text[2]

OASS Clarification Statement: [3]

OASS Assessment Boundary: [4]

Science & Engineering Practice: [5]	Disciplinary Core Idea:	Crosscutting Concept:

In Lay Terms: [6]

Cluster Clarifications: [7]

Cluster Stimulus Attributes: [8]

- *Typical stimulus elements:*
- *Possible contexts:*
- *Content and evidence to be included:*
- *Types of student responses that need to be supported:*

Allowable Item Types: [9]

Model Item Descriptions for Performance Expectation: [10]

Item Type	DOK	Model Stem	Response Characteristics*
MC			
MC			
MC			
MC			
MC			
MC			
MC			
MC			

***Response options can make use of <u>Student Misconceptions</u> (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:** [11]

Sample Cluster for Performance Expectation: [12]

[1] *Core idea category and code for each performance expectation from the OASS (e.g.,* ***Energy: 5-PS3-1****)*

[2] *Coding and text of the performance expectation from the OASS*

[3] *Clarification statement for the performance expectation from the OASS*

[4] *Assessment boundary for the performance expectation from the OASS*

[5] *Science & Engineering Practice, Disciplinary Core Idea, and Crosscutting Concept that underpin the performance expectation from the OASS*

[6] *Description of the basic meaning and intent of the performance expectation in easily understandable terms*

[7] *Additional details, clarifications, and content limits needing to be conveyed*

[8] *Specific information about the typical features of the stimuli for clusters aligned to this performance expectation*

[9] *Item types that may comprise the item clusters*

[10] *Descriptions of possible item stems/starters that could be included in clusters for this performance expectation; i.e., general statements (and/or specific statements, in brackets) of ways to assess each performance expectation are given*

[11] *Common student misconceptions related to the performance expectation, to be used when writing items*

[12] *Example of a cluster for this performance expectation (*will eventually be available for all clusters)*

Item Specifications by Performance Expectation

Matter and Its Interactions: 5-PS1-1

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5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.

OASS Clarification Statement:

Examples of evidence that could be utilized in building models include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.

OASS Assessment Boundary:

Assessment does not include atomic-scale mechanism of evaporation and condensation or defining the unseen particles.

Science & Engineering Practice:	**Disciplinary Core Idea:**	**Crosscutting Concept:**
Developing and Using Models • Develop a model to describe phenomena.	PS1.A: Structure and Properties of Matter • Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. • A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects.	Scale, Proportion, and Quantity • Natural objects exist from the very small to the immensely large.

In Lay Terms:

Students should be able to identify, select, and describe components and relationships for a model (i.e., develop a model) that can show matter is made of particles too small to be seen, based on macro observations that matter has weight and occupies space.

Cluster Clarifications:

- Focus needs to be on the idea that the phenomena/observations presented result from particles that cannot be seen, in order to develop a particle model.
- The word "represent" is acceptable vocabulary to use in asking about developing models.
- Relevant components that students need to include in the model are bulk/macroscopic matter, and particles.
- Interactions and relationships that students need to represent and describe in the model include (1) the composition of the bulk matter, as being made of the particles, and (2) the behavior of the particles that relate to the macro observations (e.g., expanding, dissolving) in order to account for what was observed.
- Focus is not on the actual phase changes, as in 5-PS1-2. Minimize use of phase-change vocabulary in describing any scenarios with phase change context.
- The difference between mass and weight will not be assessed.
- Whenever the term "grams" is used, the term "amount" is preferred instead of "weight." However, when clarity is needed, the term "weight" will be used.
- The amount of matter is correctly measured as mass. However, at this grade it is taught conceptually as weight. Mass as a measure of matter is addressed in middle school as students gain a fuller understanding of matter.
- When students develop a model, they are constructing a model from evidence/data, completing a model, or choosing the best model to illustrate a given phenomenon.

Cluster Stimulus Attributes:

Typical stimulus elements:

- descriptions or diagrams of observations or discrepant events
- data tables or graphs of amounts/weights, circumferences (measures)
- partial or incorrect diagrams (models) to improve or revise

Possible contexts:

- two balloons on scale (inflated and uninflated)
- inflating a balloon or basketball
- what fills balloon in vinegar-baking soda reaction
- wind effects (e.g., flag on flagpole)
- water cycle (e.g., cloud formation)
- evaporating salt water or sugar water
- how sugar/salt crystals form out of water
- condensation examples: dew, breath on a cold day, water on the outside of a glass, glasses fogging up
- syringes—amount/weight comparisons for various situations (but use this context sparingly; probably more difficult than other examples for Grade 5 students)

- *Content and evidence to be included:* data about change in size/shape/motion (through measurements, described changes, etc.)

- *Types of student responses that need to be supported:* identifying, selecting, and describing a particle model, including the components and relationships that need to be included to show that matter is made of particles too small to be seen; and/or improving (adding to) such models

Allowable Item Types:

- MC

Model Item Descriptions for 5-PS1-1:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	1 or 2 per complexity of event or observations	Choose the model that fits/represents the event or observations. [Which model shows what is happening to cause dew to form on the grass?]	Key must be a particle model. Distractors may include empty spaces, changing size of particles vs. space between particles, etc., drawing from misconceptions.
2	**MC**	2	Identify the evidence (data, observations) that supports the model being developed.	Distractors may include irrelevant data or observations.
3	**MC**	3	Describe *how* particular data or observations are evidence to support the model being developed. [How do the data help to support the model being developed?]	Distractors may include misinterpretation of the data or observations based on misconceptions and faulty reasoning.
4	**MC**	2 or 3 per amount of explanation/ justification required and complexity of models and judging between them	Compare models to identify (and explain) which model is more correct for the situation. [Which model best shows how small, unseen particles cause the flag motions?]	Distractors may include incorrect or irrelevant parts in the model, incorrect mechanisms, and/or unclear representations.
5	**MC**	1 or 2 per complexity	Describe what the model needs to show (in regard to the phenomenon and/or the particles causing it). [What should the model show as the cause of the observations?] [How should matter be shown in this model?]	Distractors may include features that are not supportive of the particle concept, misconceptions about particles, and/or misunderstanding of how to create a model.
6	**MC**	2 or 3 per complexity	Describe the link/relationship that needs to be shown between the parts of the model and the observations/events. [How should the model be drawn to explain the observations about the weights of the inflated and uninflated balloons?] [How can the relationship between the air cooling and the dew forming be shown in the model?]	Key should focus on how the model can connect micro and macro, using DCI knowledge. Distractors may include incorrect inferences about what the model should show or how it should apply/connect to the real situation.
7	**MC**	2 or 3 per amount of explanation/ justification required	Identify/describe a change to the model to better represent the phenomena (and/or explain why the change improves the model). [Which change would make the model of the salt-water mixture more correct?]	Distractors may include misconceptions that would misrepresent the phenomenon.

8	**MC**	2	Describe how to revise the model given additional evidence or data.	Distractors may include misinterpretation of additional data and/or misconceptions that would misrepresent the phenomenon.

***Response options can make use of <u>Student Misconceptions</u> (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://assessment.aaas.org/misconceptions:

- Air does not take up space; air is not matter.
- Solids are not made of atoms; especially not those without visible granularity.
- Matter exists only when there is perceptual evidence of its existence.
- Gases are not made of matter.
- Biological materials are not matter.

From http://amasci.com/miscon/opphys.html:

- Gases are not matter because most are invisible.
- Gases do not have mass.
- Particles possess the same properties as the materials they compose. For example, atoms of copper are "orange and shiny," gas molecules are transparent, and solid molecules are hard.

From http://beyondpenguins.ehe.osu.edu/issue/climate-change-and-the-polar-regions/climate-misconceptions-a-top-10-list:

- Air is weightless. Air has no color or odor and is in effect invisible and inconsequential.
- Gas makes things lighter.

From http://www.rsc.org/learn-chemistry/resource/download/res00002202/cmp00007478/pdf:

- When matter disappears, it no longer exists.

Matter and Its Interactions: 5-PS1-2

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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.

OASS Clarification Statement:
Examples of reactions or changes could include phase changes, dissolving, and mixing that forms new substances.

OASS Assessment Boundary:
Assessment does not include distinguishing mass and weight.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Using Mathematics and Computational Thinking • 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.

In Lay Terms:
Students should be able to choose/describe measurements and use graphs to show that the amount of matter does not change regardless of any change it undergoes. In any closed system, matter may change its form (heating, cooling, mixing, forming a new substance), but the amount stays constant. The amount of matter measured in SI units is used as a means to observe the conservation of matter.

Cluster Clarifications:

- In all cases, the unit grams will be used.
- Whenever the term “grams” is used, the term “amount” is preferred instead of “weight.” However, when clarity is needed, the term “weight” will be used.
- Weight is used as a means to observe conservation of matter because weight, not mass, is the term used in fifth grade. Students have not been introduced to the concept of mass or gravity’s effect on mass.
- The difference between mass and weight will not be assessed.
- The amount of matter is correctly measured as mass. However, at this grade it is taught conceptually as weight. Mass as a measure of matter is addressed in middle school as students gain a fuller understanding of matter.
- Although students are not to be assessed on the term “closed system,” examples of closed systems (jar covered with lid, etc.) should be a part of the stimulus.
- Students are not responsible for stating/identifying the law of conservation of mass; this performance expectation focuses on gathering/showing evidence of the *concept* only.
- The specific terminology of physical and chemical changes should be avoided.

Cluster Stimulus Attributes:
Typical stimulus elements:

- descriptions or diagrams of investigations (closed systems)
- diagrams of measuring tools
- data tables

Possible contexts:

- vinegar and baking soda reaction
- antacid in water
- melting ice, freezing water
- dissolving sugar, salt in water
- mixing solids or liquids
- comparing masses before and after a reaction (data table)—reactions can be from investigations that a student could do or those that a scientist could do (as long as it is interesting/engaging for Grade 5 students)
- balloon expand, contract (e.g., heated, cooled)

Content and evidence to be included: data provided (or gathered from pictures) to allow for graphing and analysis of conservation of matter

Types of student responses that need to be supported: choosing/reporting measurements and selecting graphical displays as evidence/predictions of conservation of matter

Allowable Item Types:

- MC

Model Item Descriptions for 5-PS1-2:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	1 or 2 per complexity	Interpret graphs or data related to amount of matter before or after a change. [What does the graph show about the amount of matter in the sample before and after the investigation?]	Distractors may include misconceptions about changes in amount of matter (gain, loss). Key conveys conservation of matter principles.
2	**MC**	2	Describe *how* the measurements or graph serve as evidence to support a statement/conclusion about conservation of matter.	Distractors may include misconceptions about changes in amount of matter (gain, loss).
3	**MC**	2	Choose the graph, table, or measurement picture that correctly predicts the expected data.	Distractors may include graphs or measurements that would show variation in weight or volume and predictions that do not reflect the conservation of matter.
4	**MC**	1 or 2 per complexity	Identify the graph that correctly displays the *given* investigation data. [Which graph shows the amounts of metal before and after the reaction?]	Distractors may include graphs that scramble data or incorrectly represent investigative data.
5	**MC**	1 or 2 per complexity	Describe how to use a measurement tool to collect specific data showing conservation of mass. [Which picture shows how to measure (X)?]	Distractors may include common student errors related to measurement tools and/or misconceptions about changes in amount of matter (gain, loss).
6	**MC**	2 or 3 per complexity	Describe how measurements/data will vary or remain the same for two phenomena (e.g., two different substances melted, water frozen and melted, two different amounts of the same substance changed). [Which statement describes how the weight of a melted ice cube will compare to its weight when it is frozen?]	Distractors may include options that do not accurately reflect the law of conservation of matter. Options should be as quantitative as possible, based on the measurement focus of the SEP and CCC.
7	**MC**	1 or 2 per complexity	Choose the measurements to make, or data or data displays needed, to demonstrate conservation of matter. [Which measurement would best show what happened to the amount of water when the water was frozen?]	Distractors may include measurements/data displays that do not match the data needed.

***Response options can make use of <u>Student Misconceptions</u> (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://assessment.aaas.org:

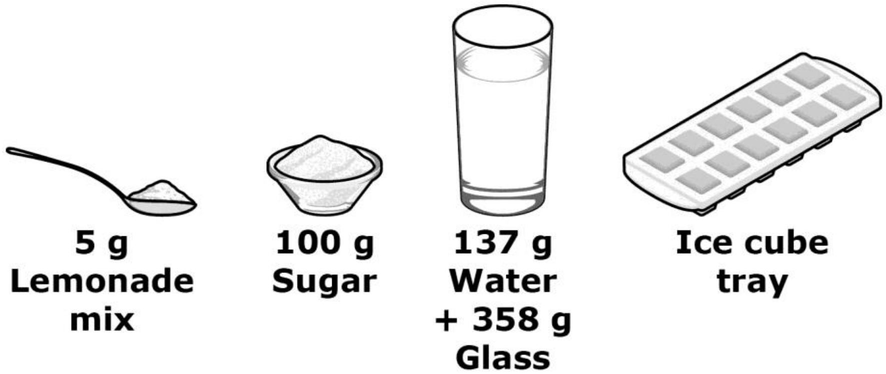
- In a closed system, total mass increases after a solid dissolves in a liquid.
- In a closed system, total mass decreases after a solid dissolves in a liquid.
- In a closed system, the total mass increases during a precipitation reaction.
- If a gas is produced during a chemical reaction that takes place in a closed system, the total mass decreases.
- When a liquid in a closed container is heated, the mass of the liquid increases as the liquid expands.
- Matter can disappear with repeated division, dissolving, evaporation, or chemical change.
- Mass is not conserved during processes in which gases take part.

From http://www.rsc.org/learn-chemistry/resource/download/res00002202/cmp00007478/pdf:

- When matter disappears, it no longer exists.

Sample Cluster for 5-PS1-2:

Two students investigated what happens when matter changes form. The materials the students used are shown in the pictures. The students used the amounts of lemonade mix, sugar, and water shown.



Then the students followed this procedure.

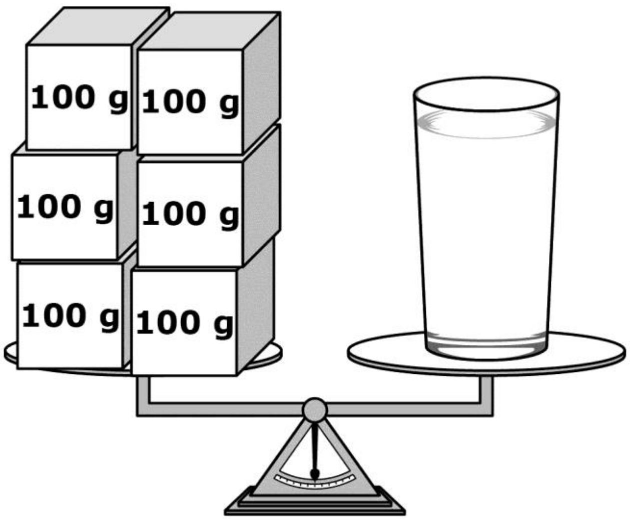
1. Make lemonade from the lemonade mix, sugar, and water.
2. Pour all of the lemonade into the ice cube tray. Put the same amount of lemonade into each spot in the tray. Leave no lemonade left over. Cover the tray and place it in the freezer overnight.
3. Remove the ice cube tray from the freezer the next day. See that the liquid lemonade has frozen into lemon ice. See that the cubes of lemon ice are taller than the sides of the tray.

(Items on the following pages)

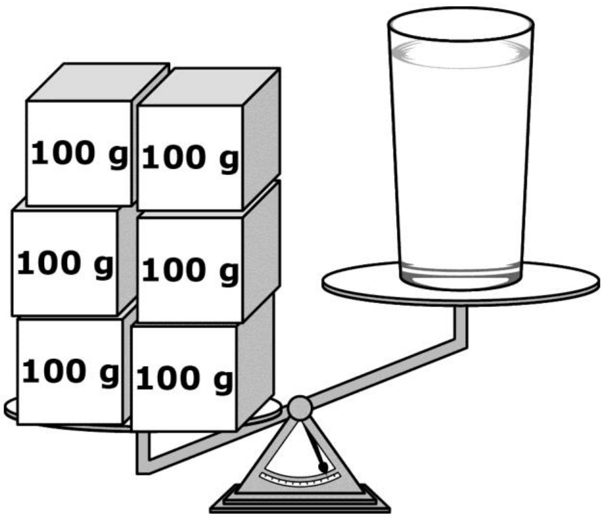
Item 1
Item type: MC
DOK 2
Key: A

The students measured each material before mixing them together. After they mixed the materials to make the lemonade they measured it using the balance.

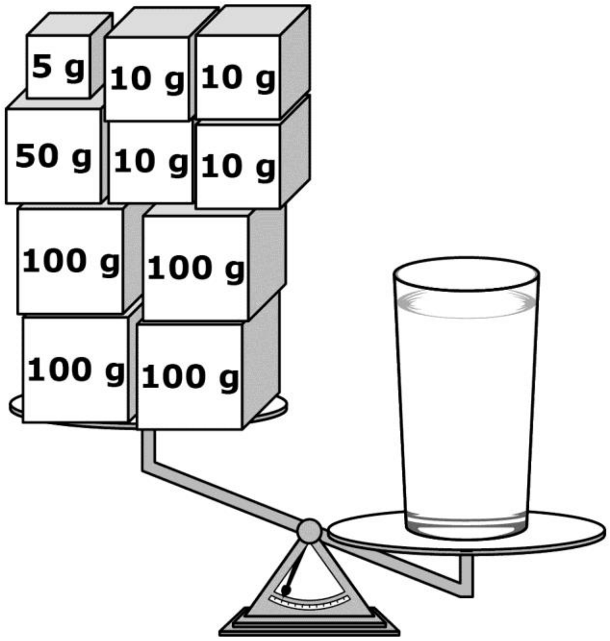
Which picture shows what the students should have observed after mixing?



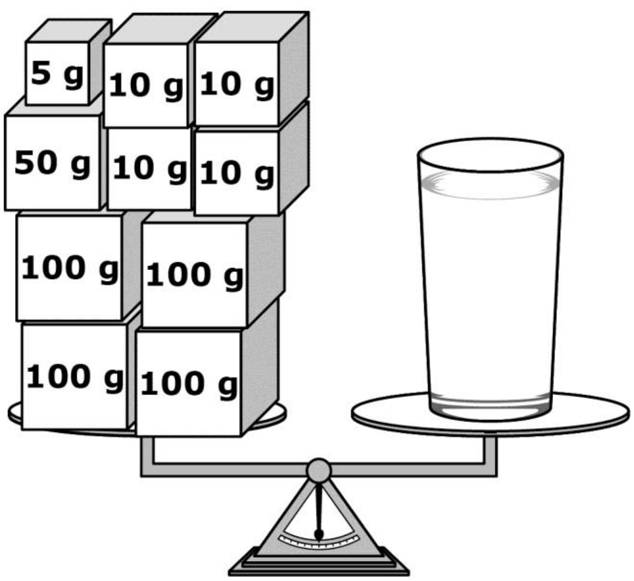
A.



B.


5 g
10 g
10 g
50 g
10 g
10 g
100 g
100 g
100 g
100 g

C.

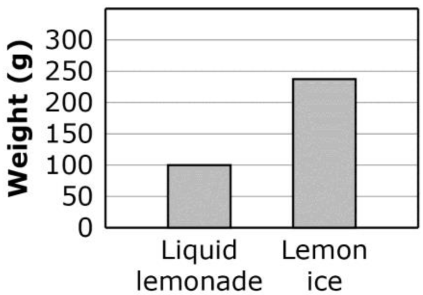

5 g
10 g
10 g
50 g
10 g
10 g
100 g
100 g
100 g
100 g

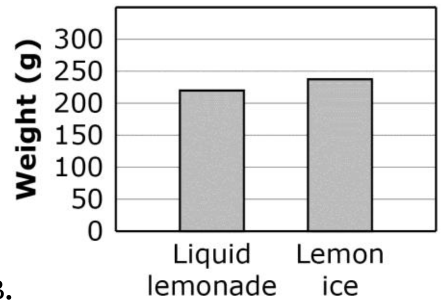
D.

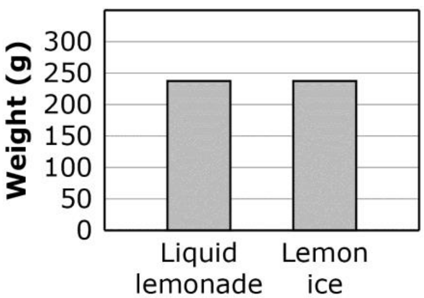
Item 2
Item type: MC
DOK 2
Key: C

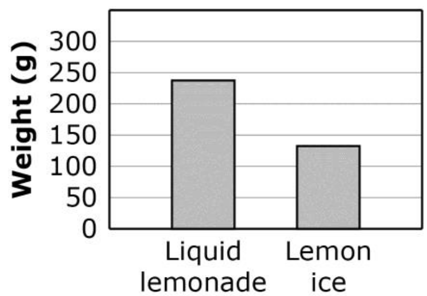
The students removed the lemon ice from the ice cube tray at the end of the investigation. Then they measured the total weight of all the lemon ice cubes.

Which graph shows the total weight of the liquid lemonade before it was poured into the tray and the total weight of the lemon ice removed from the tray?

A. 

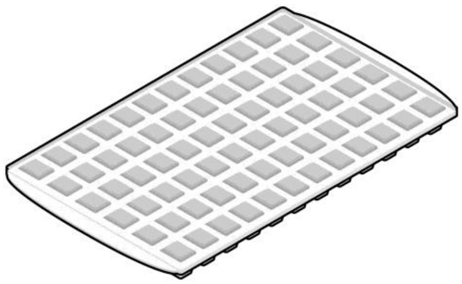
B. 

C. 

D. 

Item 3
Item type: MC
DOK 3
Key: D

The students decided to let the lemon ice melt after the investigation. Once the lemon ice melted, the students poured all the liquid into a different ice cube tray. The drawing below shows this new tray.



The students poured the same amount of lemonade into each spot in the tray. There was no lemonade left over. The students covered the tray and placed it in the freezer overnight. The students removed the tray from the freezer the next day.

Which statement is correct about the new lemon ice cubes?

A. Altogether, the new lemon ice weighed less than the lemon ice made the first time.
B. Each new lemon ice cube had the same weight as each lemon ice cube made the first time.
C. Each new lemon ice cube contained more matter than each lemon ice cube made the first time.
D. Altogether, the new lemon ice contained the same amount of matter as the lemon ice made the first time.

Matter and Its Interactions: 5-PS1-3

back to Item Specifications list

5-PS1-3. Make observations and measurements to identify materials based on their properties.

OASS 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.

OASS Assessment Boundary:
Assessment does not include density or distinguishing mass and weight.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Planning and Carrying Out Investigations • Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	PS1.A: Structure and Properties of Matter • Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)	Patterns • Objects can be classified into groups based on their similarities and differences.

In Lay Terms:
Students should be able to describe what to observe or measure to identify materials, since materials can be identified based on their unique properties.

Cluster Clarifications:

- Item clusters require observations and/or numeric data as the focus, as evidence that would be used in material identification.
- The amount of matter is correctly measured as mass. However, at this grade it is taught conceptually as weight. Mass as a measure of matter is addressed in middle school as students gain a fuller understanding of matter.
- Whenever the term “grams” is used, the term “amount” is preferred instead of “weight.” However, when clarity is needed the term “weight” will be used.

Cluster Stimulus Attributes:

Typical stimulus elements:

- lists/descriptions of materials to be identified or classified
- descriptions or diagrams of investigation setup
- (partial) data tables of properties

Possible contexts:

- heating different material rods to melt butter/wax on the end of the rods (goal is to identify materials or sort by conductivity, metal properties)
- different types of rocks or minerals to identify/classify
- studying/classifying baking soda and other powders—e.g., dissolving
- collection of metals to test with magnets
- collection of liquids to test

- insulators and conductors of heat or electricity (e.g., foam insulation, plastic, copper, steel, wood, etc.)
- light and dark materials as thermal conductors
- analyzing a set of characteristics (any measurements and properties in the clarification statement) to identify a material

Content and evidence to be included: descriptions of materials and/or setup for investigation, and/or some initial data and observations about properties

Types of student responses that need to be supported: identifying observations/measurements needed to identify a material; identifying methods and tools to gather data to identify materials; analyzing data to determine if the material can be identified

Allowable Item Types:
- MC

Model Item Descriptions for 5-PS1-3:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	1 or 2 per complexity of scenario	Describe what to measure to identify the substance. [Which property would help to identify the material as a metal?]	Distractors may include physical properties that would not help to classify or identify the substance.
2	**MC**	1	Identify the appropriate tool needed to measure a property.	Distractors may include inappropriate uses for tools and tools that do not measure a particular quantity.
3	**MC**	1	Identify the appropriate way to make observations that do not require measurement tools (e.g., reflectivity or shininess, metallic luster) but provide information about a property. [How can the students figure out which substance is hardest?]	Distractors may include measurements that require tools or those that will not provide information about the property (e.g., floating or sinking provides information about dissolving).
4	**MC**	2 or 3 per complexity	Evaluate whether, *or how/why*, a proposed set of observations/measurements will accomplish the purpose of an investigation to identify a material. [Which statement explains whether the data will help to figure out which materials can keep a liquid cold?]	Distractors may include justifications that are not supported by the data or responses that analyze the data incorrectly.
5	**MC**	3	Describe additional observations or measurements needed to distinguish materials. [Which additional observations would help to classify the materials as conductors?]	Distractors may include data that would not help to distinguish materials.
6	**MC**	1 or 2 per complexity	Select the appropriate numeric measure or qualitative description of properties for a substance being investigated. [Which table shows the properties that should be recorded for material (X) during the investigation?]	Distractors may include incorrect observations or common mistakes in reading measurements or results.

***Response options can make use of Student Misconceptions (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://assessment.aaas.org:

- If two substances share one characteristic property, they are the same substance.
- Color is not a characteristic property of a pure substance.
- Shape is a characteristic property of a substance.
- Mass/weight is a characteristic property of a substance.

Matter and Its Interactions: 5-PS1-4

back to Item Specifications list

5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

OASS Clarification Statement:

Examples of interactions forming new substances can include mixing baking soda and vinegar. Examples of interactions not forming new substances can include mixing baking soda and water.

OASS Assessment Boundary:

(none)

Science & Engineering Practice:	**Disciplinary Core Idea:**	**Crosscutting Concept:**
Planning and Carrying Out Investigations • Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.	PS1.B: Chemical Reactions • When two or more different substances are mixed, a new substance with different properties may be formed.	Cause and Effect • Cause and effect relationships are routinely identified, tested, and used to explain change.

In Lay Terms:

Students should be able to describe how to do an investigation to determine whether or not mixing particular substances results in new substances. Some substances only physically combine when mixed (no new substances formed), while others react (chemically) to form a new substance.

Cluster Clarifications:

- A complete understanding of physical and chemical changes and the differences between them is not expected at this grade. Avoid the terminology of physical and chemical change.
- The materials are to be mixed—not heated, etc.
- Emphasis must be on common observations/evidence *(or lack of evidence)* for new substances forming (e.g., heat given off/temperature change, color change, gas released/bubbles observed, formation of solid).
- Items should not be focused on steps of "the scientific method" but rather on whether the investigation supports answering the investigation question (whether a new substance was formed).
- Contexts should be groups of students, to reflect the collaboration called out in the Science and Engineering Practice.

Cluster Stimulus Attributes:
Typical stimulus elements:

- description of investigation question and materials
- diagram or description of investigation setup
- some observations/results (as pictures, data tables, etc.)

Possible contexts:

- mixing vinegar and baking soda (reaction) versus mixing water and baking soda
- dissolving salt or sugar in water
- other physical mixtures: iron filings and sand, salt and iron, corn starch and water, alloys of metals, salad dressing, mayonnaise, milk plus cream
- other reactions that occur upon mixing: antacid and water, baking soda and lemon juice, white glue plus borax, lemon juice plus milk

Content and evidence to be included: information about investigation materials, setup, steps, and/or data that can be used as evidence

Types of student responses that need to be supported: describing and/or analyzing investigation process

Allowable Item Types:

- MC

Model Item Descriptions for 5-PS1-4:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	1 or 2 per complexity	Identify the evidence from the investigation that supports the conclusion about whether a new substance formed, and explain.	Distractors may include the misconception that a new substance forms every time substances are mixed.
2	**MC**	2	Describe if/how the investigation was a fair test. [Which of the following helped make this investigation a fair test?]	Distractors may include factors that do not represent fairness in testing. Key may address enough data/trials and/or controlled investigation.
3	**MC**	2 or 3 per complexity	Describe *how* data collected will support determining if a new substance formed. [How will the temperature data help the students know if a new substance forms when (X) and (Y) are mixed?]	Distractors may include explanations that are not based on the provided data.
4	**MC**	1 or 2 per complexity	Identify the evidence from the investigation that supports the conclusion about the identity of a substance formed. [Which observation supports the conclusion that the material formed is (X)?]	Distractors may include evidence that is irrelevant or does not support the conclusion given.
5	**MC**	2 or 3 per complexity	Identify the data to collect in order to determine if new substances are formed when mixed. [Which observations will support that a new substance formed?]	Distractors may include misconceptions about mixing and reactions, properties that are associated with physical change, etc.
6	**MC**	3	Describe investigation procedure/steps needed to figure out if mixing two substances will form a new substance. [Which steps will best help the student figure out if a reaction between the two substances will produce a new substance?]	Distractors may include steps not needed for proper investigation or may omit necessary steps. Key may also include control of variables, proper type and amount of data, adequate number of trials, etc.
7	**MC**	2	Describe the purpose of the investigation, when given a description of the setup, steps, and data being collected. [Based on the setup and the data to be collected, what is the purpose of this investigation?]	Distractors may include purposes that are possible for some but not all of the materials and setup given. Key will be purpose to determine if a new substance formed when materials were mixed.
8	**MC**	2 or 3 per complexity of context and plan to evaluate	Evaluate if a given investigation plan will meet the purpose of the investigation. [Which of the following explains whether these steps will help the students find out if a new substance has formed?]	Distractors may include statements that indicate a misunderstanding of the purpose or plan described.

9	**MC**	2	Describe how to improve/revise the investigation plan. [Which change to the investigation will help the students be sure they are correctly identifying the substances formed?]	Distractors may include changes that do not improve the investigation or collect more/better data.

***Response options can make use of Student Misconceptions (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://assessment.aaas.org:

- A chemical reaction always happens when two liquids are combined together.
- A solid substance is always formed during a chemical reaction.
- A chemical reaction occurs when a substance dissolves.
- A chemical reaction occurs during a change of state.
- Chemical reactions involve only the production of gas.
- Chemical reactions involve liquids only.
- After a chemical reaction, the product is a mixture in which the old substances persist and is not a new substance.
- The reactants and products of a chemical reaction are different and independent of each other. There is no recognition of a change of one sample to the other.
- A chemical reaction always happens when two substances are combined together.
- Substances can change their characteristic properties but maintain their identity.
- The products of a chemical reaction are the same substances as the reactants but with different properties.

Motion and Stability: Forces and Interactions: 5-PS2-1
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5-PS2-1. Support an argument that the gravitational force exerted by the Earth is directed down.

OASS Clarification Statement:
"Down" is a local description of the direction that points toward the center of the spherical Earth. Earth causes objects to have a force on them that points toward the center of the Earth, "down." Support for arguments can be drawn from diagrams, evidence, and data that are provided.

OASS Assessment Boundary:
Mathematical representation of gravitational force is not assessed.

Science & Engineering Practice:	**Disciplinary Core Idea:**	**Crosscutting Concept:**
Engaging in Argument from Evidence • Support an argument with evidence, data, or a model.	PS2.B: Types of Interactions • The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	Cause and Effect • Cause and effect relationships are routinely identified, tested, and used to explain change.

In Lay Terms:
Students should be able to provide and explain data and evidence to support the claim/argument that the direction of Earth's gravitational force is "down," toward the center of Earth.

Cluster Clarifications:
- Vector diagrams that reflect the mathematical representation of gravity/force magnitude are above grade level, but arrows pointing in the direction of the force are acceptable.
- Both (1) rates of falling objects and (2) variation in strength of force based on distance and mass are beyond scope.
- Evidence should focus on the direction objects fall (straight down) and the repeatability of that observation in multiple places/circumstances.
- The term "claim" is acceptable vocabulary for stimuli and items.

Cluster Stimulus Attributes:
Typical stimulus elements:
- diagram or description of investigations or observations
- data tables
- models of gravitational force acting on objects

Possible contexts:
- planned investigation of objects falling (could be different reference points, heights, angles, etc.)
- natural observations of falling objects
- model to interpret (showing force of gravity/gravity acting)
- diagram of Earth and proposed paths of objects when dropped
- descriptions of motions of a variety of objects (some affected by gravity and some not, for comparisons)

Content and evidence to be included: stated investigative question or claim, plus data, observations, or models related to effects of gravity

Types of student responses that need to be supported: supplying and explaining evidence for given claim/argument; evaluating or revising claims using evidence

Allowable Item Types:

- MC

Model Item Descriptions for 5-PS2-1:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	3	Explain *how* the data support the claim about gravitational force. [How do the data from the investigation support the claim that gravity pulls objects toward the center of Earth?]	Key should supply the reasoning (scientific thinking) to link the evidence and claim—same, repeated observations of objects falling down in multiple locations/conditions, change in motion from stationary to falling indicates a force, etc. Distractors may include misconceptions about the motion of falling objects.
2	**MC**	2 or 3 per amount of explanation required and complexity of claim(s) to be evaluated	Evaluate a claim (or set of claims) about gravitational force to determine if it (or which one) is supported by evidence (and explain why).	Key should focus on claims with appropriate evidence and/or enough evidence to support the claim. Distractors may include misapplication of data, misunderstanding of what constitutes enough or appropriate evidence, and reasoning that conveys misconceptions.
3	**MC**	2 or 3 per complexity	Determine which additional data/observations would support the claim/argument about gravitational force. [Which observations would provide more evidence to support the claim that the force of gravity is directed down?]	Distractors may include data that do not provide support or that support misconceptions.
4	**MC**	2	Identify evidence that supports the claim that gravity is directed down/toward Earth's center. [What evidence would best support the claim that gravity pulls objects to the center of Earth?]	Distractors may include irrelevant data or observations.
5	**MC**	2 or 3 per complexity	Revise an incorrect claim about the force of gravity, based on provided evidence.	Distractors may include statements that don't appropriately interpret data, or that provide misconceptions as the new claim.

6	**MC**	1 or 2 per complexity of data provided	Identify the claim being investigated or that is supported by the observations/data/model. [Which claim about Earth's gravitational force is supported by the student's model?]	Distractors may include misconceptions or other concepts not supported by a gravity model, e.g., concepts associated with magnetism.

***Response options can make use of <u>Student Misconceptions</u> (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://www.lpi.usra.edu/education/pre_service_edu/GravityMisconceptions.shtml:

- Gravity is related to movement.
- Space shuttle astronauts are weightless because there is no gravity above Earth.

Energy: 5-PS3-1

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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.

OASS Clarification Statement:
Examples of models could include diagrams, and flow charts.

OASS Assessment Boundary:
Assessment does not include cellular mechanisms of digestive absorption.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Developing and Using Models • Use models to describe phenomena.	PS3.D: Energy in Chemical Processes and Everyday Life • The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). LS1.C: Organization of Matter and Energy Flow in Organisms • Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion.	Energy and Matter • Energy can be transferred in various ways and between objects.

In Lay Terms:
Students should be able to interpret models to describe/trace the source of the energy in animals' food and describe/trace how that energy is used in animals.

Cluster Clarifications:

- Common animals should be used: hawks, squirrels, snakes, mice, rats, grasshoppers, rabbits. For plants, herbaceous plants should be used.
- Complex food web relationships are beyond the scope of Grade 5.
- Relevant components in the models should include energy, the Sun, plants, and animals (and their bodily functions).
- Interactions and relationships that students need to describe and analyze in the model include (1) the relationship between plants and the energy they get from sunlight to make food, (2) the relationship between food and the energy and materials that animals require, (3) the relationship between animals and they food they eat (plants and/or other animals), and (4) the Sun as the ultimate source of energy for animals' use (transferred via a chain of events).
- Focus on matter and energy transfer, not populations/population size of organisms.
- Students are not expected to know/recall the terms "producer" and "consumer." If the terms help clarify the stimulus and items, they must be provided and defined.
- The word "represent" is acceptable vocabulary to use in asking questions about models.
- When students use a model, they are interacting with an already complete model.
- All ***necessary*** predator/prey relationships must be provided to students.

Cluster Stimulus Attributes:
Typical stimulus elements: models (can be pictures, diagrams, flow charts, food chains/webs)

Possible contexts:

- familiar ecosystems: grassland, forest, lake
- food chains and food webs
- energy and matter flow charts, including cyclic models

Content and evidence to be included: models to analyze or use as evidence of energy transfer and matter-energy relationship

Types of student responses that need to be supported: interpreting a provided model in order to describe how animals use the energy in food and how the energy in animals' food was once energy from the Sun and is transferred to animals through a chain of events that begins with plants producing food that is then eaten by animals

Allowable Item Types:

- MC

Model Item Descriptions for 5-PS3-1:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	1or 2 per complexity	Describe what the model shows (components). [Which organisms in the food web capture energy from the Sun?] [What is represented by the arrows in the food chain?]	Key should focus on more basic "reading" of the model parts. Distractors may include misinterpretations based on misconceptions.
2	**MC**	1 or 2 per complexity	Describe the role of various parts (organisms) in the model in terms of energy transfer/use. [What is the main role of the plants in the transfer of energy in this model?] [Based on the model, how do animals use the energy they receive from their food?]	Distractors may include other roles outside of energy/matter role, confuse roles with other organisms, etc.
3	**MC**	2 or 3 per complexity	Interpret relationships and sequence among parts of the model. [What is the relationship between plants and animals in terms of energy flow in this model?] [Which statement describes the energy flow among the organisms in the model?] [Based on the model, where does the energy in animals' food come from?]	Distractors may include incorrect interpretations, reversed sequences, and misconceptions.
4	**MC**	2	Explain the relationship between food (matter) and energy in the model.	Distractors may include misconceptions.

***Response options can make use of <u>Student Misconceptions</u> (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://assessment.aaas.org:

- Oxygen supplies energy for animals
- Food is a source of building materials, but not a source of energy.
- Food is what is needed to keep animals and plants alive or to grow, without reference to any more specific function of food.

From http://beyondpenguins.ehe.osu.edu/issue/tundra-life-in-the-polar-extremes/common-misconceptions-about-biomes-and-ecosystems:

- Organisms higher in a food web eat everything that is lower in the food web.
- Plants are dependent on humans.

From Molecules to Organisms: Structure and Processes: 5-LS1-1

back to Item Specifications list

5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.

OASS Clarification Statement:
Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.

OASS Assessment Boundary:
(none)

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Engaging in Argument from Evidence • Support an argument with evidence, data, or a model.	LS1.C: Organization for Matter and Energy Flow in Organisms • Plants acquire their material for growth chiefly from air and water.	Energy and Matter • Matter is transported into, out of, and within systems.

In Lay Terms:
Students should be able to provide and explain data and evidence to support the claim/argument that plants get the materials they need for growth from air and water.

Cluster Clarifications:

- Use Grade 5 processes and vocabulary (e.g., “plants capture the Sun’s energy,” and not “chloroplasts are used in photosynthesis”).
- Evidence should focus on plant growth over time, media for growing plants, negligible change in weight of soil while plants grow, inability of plants to grow without air or water, and ability of water and air to be transported (CCC).
- The term “claim” is acceptable vocabulary for stimuli and items.

Cluster Stimulus Attributes:
Typical stimulus elements:

- diagram or description of investigations or observations
- data tables
- models of plant inputs/functioning

Possible contexts:

- growing seeds in different media
- model/diagram of inputs for plant growth
- hydroponics
- duckweed, bladderwort (free floating plants) in ponds, bodies of water
- plants growing in air (e.g., orchid, ball moss, epiphytes)
- plants growing with and without a material (e.g., fresh air), and data or graphs on growth rates
- weighing of soil and plant over time as plant grows

Content and evidence to be included: stated investigative question or claim, plus data, observations, or models related to materials for plant growth
Types of student responses that need to be supported: supplying and explaining evidence for given argument/claim; evaluating or revising claims using evidence
Allowable Item Types:

- MC

Model Item Descriptions for 5-LS1-1:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	3	Explain *how* data support the claim about where plants get the materials they need for growth. [How do the data support the claim that water is needed for plant growth?] [How do the weight measurements support the claim that plants are <u>not</u> using soil as material for growth?]	Key should supply the reasoning (scientific thinking) to link the evidence and claim. Distractors may include incorrect interpretation of data, use of wrong data, and/or explanations with misconceptions.
2	**MC**	2 or 3 per amount of explanation required and complexity of claim(s) to be evaluated	Evaluate a claim (or set of claims) about materials needed for plant growth to determine if it (or which one) is supported by evidence, (and explain why). [Which claim about the source of materials for plant growth is supported by the data, and why?]	Key should focus on appropriate evidence and/or enough evidence to support the claim. Distractors may include misapplication of data, misunderstanding of what constitutes enough or appropriate evidence, and other claims or reasoning based on misconceptions.
3	**MC**	2 or 3 per complexity	Determine which additional data/observations would support the claim/argument about where plants get materials they need for growth. [What other data would support the claim that plants obtain nutrients from the air?]	Distractors may include data that do not provide support for the claim or that support misconceptions.
4	**MC**	2	Identify evidence that supports the claim about where plants get material for growth (air, water). [Which graph gives evidence that plants use materials from air for growth?]	Distractors may include irrelevant data or observations.
5	**MC**	2 or 3 per complexity	Revise an incorrect claim about the materials plants use for growth, based on provided evidence.	Distractors may include statements that don't appropriately interpret data, or that provide misconceptions as the new claim.
6	**MC**	1 or 2 per complexity of data provided	Identify the claim being investigated or that is supported by the observations/data/model. [Which claim about where plants get the materials they need for growth is supported by the student's model?]	Distractors may include concepts not supported by the plant input/growth model, e.g., misconceptions about materials and growth.

***Response options can make use of Student Misconceptions (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://beyondpenguins.ehe.osu.edu/issue/polar-plants/common-misconceptions-about-plants:

- Plants get their energy from the soil through roots.
- Plants are dependent on humans.

From http://beyondpenguins.ehe.osu.edu/issue/tundra-life-in-the-polar-extremes/common-misconceptions-about-biomes-and-ecosystems:

- Sunlight helps plants grow by keeping them warm.

From http://assessment.aaas.org:

- Water is food for plants.
- Liquids cannot be food.

Ecosystems: Interactions, Energy, and Dynamics: 5-LS2-1

back to Item Specifications list

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

OASS 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.

OASS Assessment Boundary:
Assessment does not include molecular explanations.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Developing and Using Models • Develop a model to describe phenomena.	LS2.A: Interdependent Relationships in Ecosystems • The food of almost any kind of animal can be traced back to plants. • Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. • Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plant parts and animals) and therefore operate as "decomposers." • Decomposition eventually restores (recycles) some materials back to the soil. • Organisms can survive only in environments in which their particular needs are met. • A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. • Newly introduced species can damage the balance of an ecosystem. LS2.B: Cycles of Matter and Energy Transfer in Ecosystems • Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. • Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment.	Systems and System Models • A system can be described in terms of its components and their interactions.

In Lay Terms:
Students should be able to identify, select, and describe components and relationships for a model (i.e., develop a model) that can show/trace the movement of matter among plants, animals, decomposers, and the environment.

Cluster Clarifications:

- Develop food webs, not food chains, for this performance expectation.
- Ecosystems should not be limited to those shown in model stems and may include common ecosystems outside of Oklahoma.
- Models can include other diagrams and flow charts.
- Relevant components that students need to include in the model are matter, plants, animals, decomposers (fungi, bacteria), and the environment.

- Interactions and relationships that students need to represent and describe in the model include (1) the feeding relationships and resulting matter movement between organisms (e.g., animals eating other animals, animals eating plants, decomposers consuming dead plants and animals), (2) the exchange of matter between organisms and the environment (e.g., obtain air, water; release waste; decomposer cycling of matter back to soil), and (3) the way that interactions and matter cycling help species meet their needs.
- More comprehensive coverage of performance expectation will utilize models that show movement of matter not only between organisms but also between organisms and environment.
- Organisms in the models should include plants, animals, and decomposers.
- While the term "decomposer" is expected per the DCI, students are not expected to know/recall the terms "producer" and "consumer." If the terms help clarify the stimulus and items, they must be provided and defined.
- Specific nutrient cycles (e.g., water cycle, nitrogen cycle, carbon cycle) should not be used.
- When students develop a model, they are constructing a model from evidence/data, completing a model, or choosing the best model to illustrate a given phenomenon.
- All ***necessary*** predator/prey relationships must be provided to students.

Cluster Stimulus Attributes:
Typical stimulus elements:
- descriptions, pictures, or diagrams of ecosystems and organism interactions
- partial or incorrect models (e.g., food webs, diagrams)

Possible contexts
- examples of transfer of matter not only between organisms but also between organisms and environment (e.g., forest with decomposition)
- local invasive species (e.g., fire ants, zebra mussels, kudzu, starlings)—how it impacts matter flow, food web
- event that disrupts populations and affects matter flow, food web (e.g., flood, drought, disease)
- descriptions or drawings to indicate who eats whom for a food web

Content and evidence to be included: information/data about relationships and movement of matter

Types of student responses that need to be supported: identifying, selecting, and describing components and relationships for a model, and/or improving models, in order to describe the movement of matter in an ecosystem (among living things, and between living things and the environment)

Allowable Item Types:
- MC

Model Item Descriptions for 5-LS2-1:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	1 or 2 per complexity	Identify components that should be included in, added to, or are missing from the model being developed. [Which organisms should be added to the model to show how matter will be recycled in the ecosystem?]	Distractors may include components not appropriate for the system described, drawing from misconceptions.
2	**MC**	2 or 3 per amount of explanation/ justification required	Identify/describe a change to a partial/incomplete model to better represent the phenomena, (and/or explain why the change improves the model). [Which change would make the flow chart more correctly show how matter moves through the ecosystem?] [Which change to the model is the best way to show how introduced species are affecting the ecosystem?]	Distractors may include misconceptions that would misrepresent the phenomenon.
3	**MC**	1 or 2 per complexity	Describe/interpret what the model being developed needs to show (regarding components and roles of components). [What role should plants have in the model, and why?] [What connections should the model have to show how matter moves in the system?]	Key may focus on purpose, representation, components, or roles. Distractors may include features that are not supportive of matter cycling, misconceptions about movement of matter, and/or misunderstanding of how to create a model.
4	**MC**	2 or 3 depending on complexity of model and information	Describe what the model being developed needs to show about the movement of matter (relationships, cause/effect, sequence) in real systems. [How should the model show what happens to make matter available to plants for growth?] [Which statement describes the movement of matter that needs to be shown in the grassland ecosystem?]	Key should focus on connecting the model representation to real systems and evaluating cause-effect, sequence, etc. Distractors may include incorrect inferences about what the model should show or how it should apply/connect to the real situation.
5	**MC**	2 or 3 per amount of explanation/ justification required and complexity of models and judging between them	Compare models to identify (and explain) which best shows movement of matter in a healthy ecosystem. [Which of the models best shows how matter moves through the ecosystem?]	Distractors may include models that omit certain groups, do not address both organisms and the environment, or are otherwise less complete. Note focus is on best representation among choices vs. right/wrong representation (which is more the focus of model stem #2).

6	**MC**	2 or 3 per complexity of evidence and type of response	Identify or describe the information/reasoning that supports the model or a part of the model being developed. [Which information supports the direction the arrows should be pointed in the food web?] [Why should the model show the bacteria connected to the rest of the organisms in the food web?]	Distractors may include irrelevant information and/or incorrect reasoning.

***Response options can make use of Student Misconceptions (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://beyondpenguins.ehe.osu.edu/issue/tundra-life-in-the-polar-extremes/common-misconceptions-about-biomes-and-ecosystems:

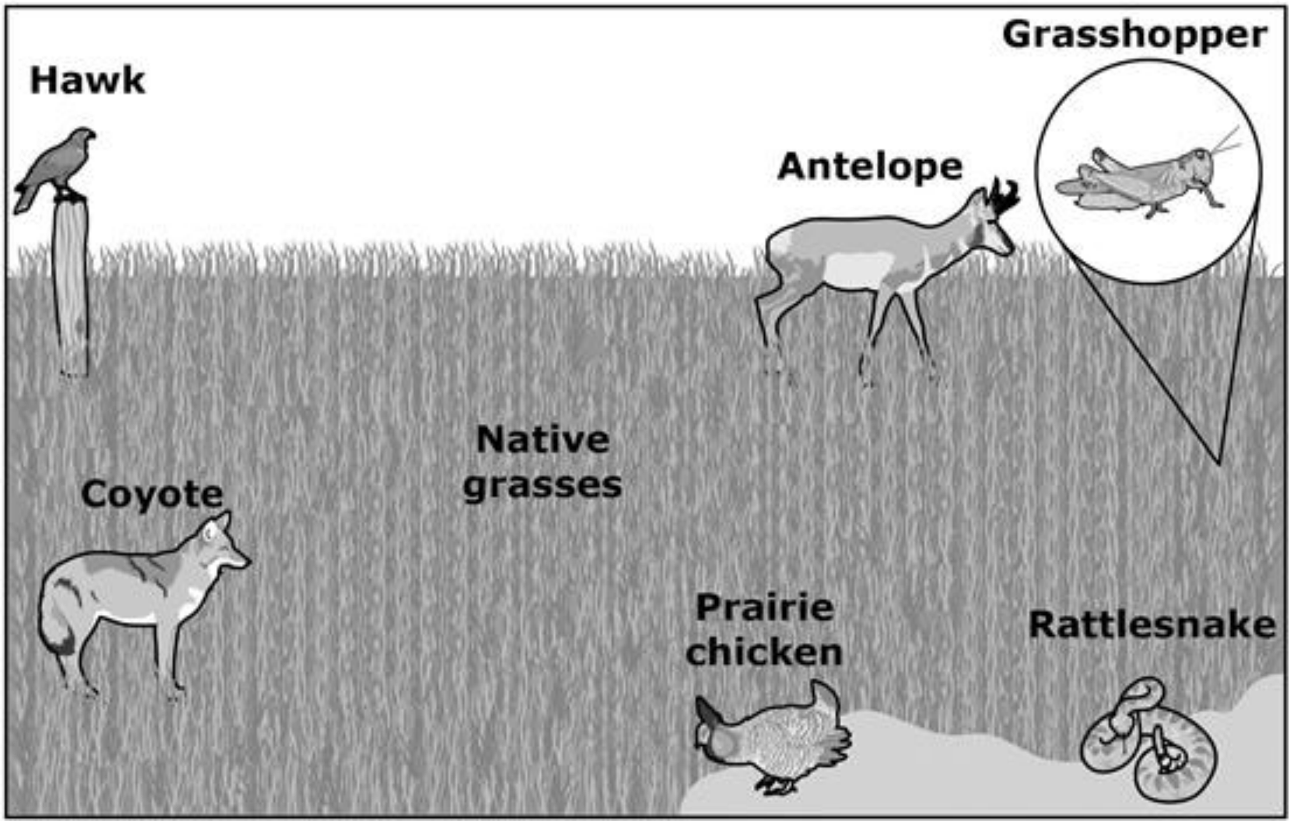
- All animals in an ecosystem get along with each other.
- Not all animals in an ecosystem get eaten.
- Plants are dependent on humans.
- Plants cannot defend themselves.
- Organisms higher in a food web eat everything that is lower in the food web.
- Decomposers release some energy that is cycled back to plants.

From http://beyondpenguins.ehe.osu.edu/issue/polar-plants/common-misconceptions-about-plants:

- Plants get their energy from the soil through roots.

Sample Cluster for 5-LS2-1:

The drawing shows some plants and animals that live in the Black Kettle National Grassland in southwestern Oklahoma.



Some students wanted to make a model to show how matter moves through this grassland. The students had learned that the movement of matter allows plants and animals in the grassland to get nutrients or food. If the plants and animals do not get the nutrients or food they need, they cannot survive.

By making the model, the students could predict how well plants and animals would survive if events such as fire or drought happened in the ecosystem.

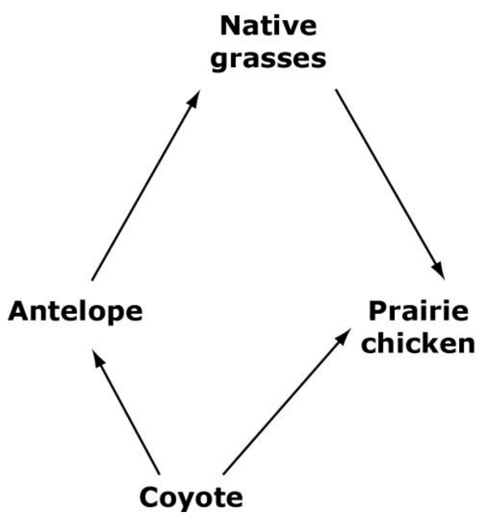
(Items on the following pages)

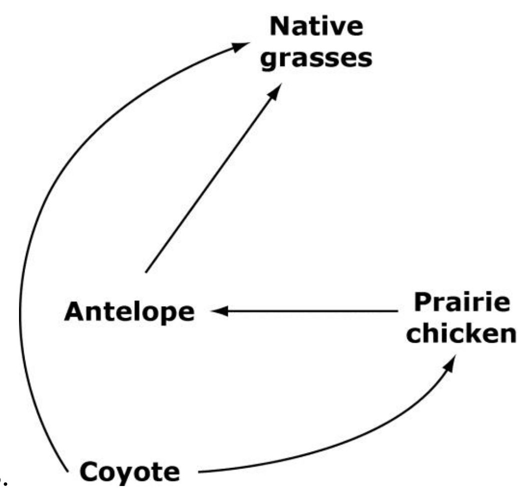
Item 1
Item type: MC
DOK 2
Key: C

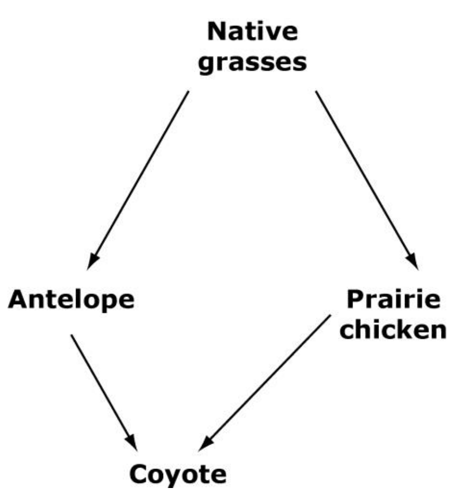
The students also learned about what some of the organisms eat.

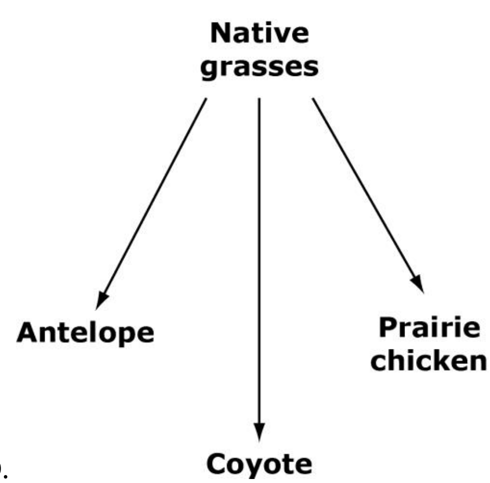
- Prairie chickens eat native grasses and coyotes eat prairie chickens.
- Native grasses are eaten by antelope and antelope are eaten by coyotes.

Which model shows how matter moves among these four grassland organisms?

A.


B.


C.


D.


Item 2
Item type: MC
DOK 1
Key: D

What can the students add to their model to show that matter also moves between organisms and the environment?

A. rock, because it is a common part of soil
B. clouds, because they add water to ecosystems
C. wind, because it moves air and dust around the grassland
D. decomposers, because they break down dead plants and animals

Item 3
Item type: MC
DOK 2
Key: A

Which set of events should the students' model also include to show how matter moves in the ecosystem?

A. plants take up air and water to make food → animals eat plants → animals breathe out air
B. plants release food as waste → animals break down wastes from plants → animals breathe out air
C. animals take in air and water to make food → other animals eat these animals → animals release waste
D. animals release waste into air → animals breathe in water in air → water is taken up by animals to make food

Ecosystems: Interactions, Energy, and Dynamics: 5-LS2-2
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5-LS2-2. Use models to explain factors that upset the stability of local ecosystems.

OASS Clarification Statement:
Factors that upset an ecosystem's stability include: invasive species, drought, human development, and removal of predators. Models could include simulations, and representations, etc.

OASS Assessment Boundary:
Assessment does not include molecular explanations.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Developing and Using Models • Use models to describe phenomena.	LS2.A: Interdependent Relationships in Ecosystems • Organisms can survive only in environments in which their particular needs are met. • A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. • Newly introduced species can damage the balance of an ecosystem.	Systems and System Models • A system can be described in terms of its components and their interactions.

In Lay Terms:
Ecosystems have many parts that exist together in a balance; when any part changes it can influence other parts of the ecosystem positively or negatively. Students should be able to interpret models to explain how various factors/changes may affect the stability of an ecosystem.

Cluster Clarifications:
- Models should show ecosystems and parts (biotic/living and abiotic/non-living); relevant components of the models may include plants, animals, decomposers, and parts of the environment (e.g., soil, rock, air, water, Sun/sunlight), etc.
- The stability of the ecosystem can be addressed in terms of changes in number/type of species, species survival, competition for resources, population numbers, etc.
- A cluster should address a single factor/change (not multiple effects simultaneously).
- The word "represent" is acceptable vocabulary to use in asking questions about models.
- When students use a model, they are interacting with an already complete model.

Cluster Stimulus Attributes:
Typical stimulus elements:
- models (e.g., pictorial diagrams of numbers and kinds of organisms, food webs, etc.)

Possible contexts:
- local natural events (drought, fire, flood)
- food webs that highlight predator/prey relationships
- human development effects
- conversion of natural land to farmland
- other human activities that impact ecosystems (e.g., use of resources, industrial practices, pollution)
- invasive species
- removal or introduction of predators

Content and evidence to be included: models with information about a factor or single change affecting the ecosystem

Types of student responses that need to be supported: interpreting a provided model in order to describe and explain how a particular factor influences ecosystem stability (species survival, population numbers, species balance, etc.)

Allowable Item Types:
- MC

Model Item Descriptions for 5-LS2-2:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	2 or 3 per complexity	Predict an outcome/change (i.e., effect on stability) using the model and the understanding of organisms' needs (e.g., drought–plants, flood–habitat). [How would an early freeze most likely affect the organisms in the ecosystem?] [According to the model, how would plowing the grassland affect the ability of the ecosystem to make the Sun's energy available to organisms in the area?]	Distractors may include misconceptions or incorrectly interpret the model.
2	**MC**	2 or 3 per complexity	Use the model to describe/explain the relationships/dependence of various parts of ecosystems on each other. [Which statement explains how the relationship between coyotes and white-tailed deer helps the ecosystem?]	Distractors may include misconceptions or other incorrect associations between parts of the model.
3	**MC**	1 or 2 per complexity	Describe what the model shows (components/parts). [According to the food web, which organisms depend on insects as their only source of food?]	Distractors may include incorrect parts or incorrect interpretations of the model.

***Response options can make use of <u>Student Misconceptions</u> (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://beyondpenguins.ehe.osu.edu/issue/tundra-life-in-the-polar-extremes/common-misconceptions-about-biomes-and-ecosystems:

- All animals in an ecosystem get along with each other.
- Organisms higher in a food web eat everything that is lower in the food web.
- Decomposers release some energy that is cycled back to plants.
- Not all animals in an ecosystem get eaten.
- Plants are dependent on humans.
- Plants cannot defend themselves.

From http://beyondpenguins.ehe.osu.edu/issue/polar-plants/common-misconceptions-about-plants:

- Plants get their energy from the soil through roots.
- Plants need things provided by people (water, nutrients, light).

From http://www.fewresources.org/ecological-footprints--human-impact-factors.html:

- Earth is too large for humans to have too much of an impact, either positive or negative.

Earth's Place in the Universe: 5-ESS1-1

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5-ESS1-1. Support an argument that identifies differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.

OASS Clarification Statement:
(none)

OASS Assessment Boundary:
Assessment is limited to relative distances, not sizes, of stars. Assessment does not include factors that affect apparent brightness such as stellar masses, age, stage.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Engaging in Argument from Evidence • Support an argument with evidence, data, or a model.	ESS1.A: The Universe and Its Stars • The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.	Scale, Proportion, and Quantity • Distances exist from the very small to the immensely large.

In Lay Terms:
Students should be able to provide and explain data and evidence to support the claim/argument that the Sun appears brighter than other stars because it is much closer to Earth. The Sun is an average star in terms of its brightness, and it is only because it is much closer than other stars that it appears brighter.

Cluster Clarifications:

- Students are not responsible for names of stars. Clusters/items may include data about specific stars to compare but preference is to label the stars X, Y, Z rather than use actual names.
- The data provided should be qualitative in nature, not quantitative. Quantitative magnitudes/measures of brightness should not be used.
- The actual brightness of stars and objects (only in qualitative measures) may also be provided to help students with interpretation of the relationship of distance and apparent brightness (e.g., flashlights of equal brightness appear dimmer as they are moved farther away, a bright flashlight looks dim far away and a dim flashlight looks bright if moved close, etc.).
- The term "claim" is acceptable vocabulary for stimuli and items.
- The stimulus may mention or discuss the size appearance of the sun, but assessing that the sun appears larger due to its relative distance from Earth is outside of the assessment boundary.

Cluster Stimulus Attributes:
Typical stimulus elements:

- diagram or description of investigations or observations
- models
- data tables (i.e., qualitative data about brightness, size; qualitative data about distance)

Possible contexts:

- investigations with flashlights/light sources (at different distances)
- diagrammatic models (to represent distance and/or brightness)
- data tables on distances and other characteristics of stars and Sun
- constellation scenario (from different locations)

Content and evidence to be included: stated investigative question or claim, plus data, observations, or models related to the apparent brightness of the Sun and other stars

Types of student responses that need to be supported: supplying and explaining evidence for given claim/argument; evaluating or revising claims using evidence

Allowable Item Types:

- MC

Model Item Descriptions for 5-ESS1-1:

#	**Item Type**	**DOK**	**Model Stem (Items ask students to…)**	**Response Characteristics***
1	**MC**	3	Explain *how* the data support the claim about difference in apparent brightness of the Sun and other stars. [How do the data support the claim that the Sun appears brighter than Alpha Centauri?]	Key should supply the reasoning (scientific thinking) to link the evidence and claim—Sun is closest in distance but average in other factors, so apparent brightness must be caused by distance. Distractors may include misconceptions and statements that misinterpret or misapply the data.
2	**MC**	2 or 3 per amount of explanation required and complexity of claim(s) to be evaluated	Evaluate a claim (or set of claims) about difference in apparent brightness of the Sun and other stars to determine if it (or which one) is supported by evidence, (and explain why). [Which claim correctly states the reason for the difference in how bright the four stars appear to be?]	Key should focus on appropriate evidence and/or enough evidence to support the claim. Distractors may include misapplication of data, misunderstanding of what constitutes enough or appropriate evidence, and other claims or reasoning based on misconceptions.

3	**MC**	2 or 3 per complexity	Determine which additional data/observations would support the claim/argument about difference in apparent brightness of the Sun and other stars. [What other data would help support the claim about the difference in the brightness of the stars as viewed from Earth?]	Distractors may include data that do not provide support (e.g., implications about stars orbiting planets, qualities of light, etc.) or that support misconceptions.
4	**MC**	2	Identify evidence that supports the claim about difference in apparent brightness of the Sun and other stars.	Distractors may include irrelevant data or observations.
5	**MC**	2 or 3 per complexity	Revise an incorrect claim about difference in apparent brightness of the Sun and other stars, based on provided evidence.	Distractors may include statements that don't appropriately interpret data or that provide misconceptions as the new claim.
6	**MC**	1 or 2 per complexity of data provided	Identify the claim being investigated or that is supported by the observations/data/model. [Based on the data, which claim should the student make about what causes the Sun to appear brighter than the other stars?]	Distractors may include statements based on misconceptions or misinterpreting the data/information provided.

***Response options can make use of <u>Student Misconceptions</u> (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://www.scienceboom.com/wp-content/uploads/pages/101_misconceptions.pdf:
- In a constellation, all of the stars are near each other.

From http://www.scc.losrios.edu/pag/observatory/44-common-misconceptions-astronomy/#24:
- All stars are ours: Stars shine by reflected light from the Sun.

From http://newyorkscienceteacher.com/sci/pages/miscon/astr.php:
- All the stars are the same distance from Earth.
- All stars are the same size.

Earth's Place in the Universe: 5-ESS1-2

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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.

OASS 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.

OASS Assessment Boundary:
Assessment does not include causes of seasons.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Analyzing and Interpreting Data • Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.	ESS1.B: Earth and the Solar System • The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.	Patterns • Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena.

In Lay Terms:
Students should be able to graphically represent data (about movement of shadows; night and day; and nightly, monthly, and seasonal movements of the Sun, stars, and moon) to show and describe the pattern for the particular celestial phenomenon.

Cluster Clarifications:

- Graphical displays may include bar graphs, pictographs, pie charts, and new data tables.
- For moon phases, students do not need to know the names of the phases—the emphasis is on the pattern.
- Focus on phenomena accessible to students living in Oklahoma (e.g., stars/constellations of the Northern Hemisphere). Note that seasonal constellations are those that are only visible above the horizon in the night sky for a portion of the year; seasonal constellations include, but are not limited to, Orion, Bootes, Hydra, Aquila, and Lyra.

Cluster Stimulus Attributes:

Typical stimulus elements:

- data tables
- diagrams of relative locations of celestial objects
- descriptions or diagrams of student observations

Possible contexts:
(related to shadows; night and day; daily/nightly, monthly, and seasonal movement of the Sun, stars, moon)

- classroom/student models of moon phases (could observe eight phases)
- investigations of relationship between time of day and shadow length
- student data collection of moon phases, day length, visibility of constellations
- diagrams of Sun location through a window at the same time of day throughout a year

Content and evidence to be included: data that can be transformed into a graphical display

Types of student responses that need to be supported: identifying or describing correct graphical displays for data; interpolating data; describing and/or predicting patterns

Allowable Item Types:
- MC

Model Item Descriptions for 5-ESS1-2:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	2	Select the graph that correctly displays the given data (about changes in shadows, daylight, phases of the moon, visibility of stars, etc.). [Which graph shows how the length of the flagpole shadow changes during the day?] [Which pie graph correctly shows the seasonal differences in day/night length?]	Options should utilize bar graphs for lengths of shadows, daylight length, percent of moon appearing, hours stars are visible, etc. Options should utilize circle/pie graph for seasonal differences in day/night, or other phenomena that may be represented as parts of a whole. Distractors may include common student graphing errors, such as inverted (flipped) axes, incorrect numbering, incorrect intervals, or incorrect sorting of data.
2	**MC**	1	Describe the trend/pattern in the given data, table, or graph. [Which statement best describes the length of shadows on a playground after lunchtime?] [Which statement describes the lighted area of the moon in the two weeks following a full moon?]	Distractors may include reversed trends, trends for other phenomena, inconsistent changes, etc.
3	**MC**	2	Interpolate or extrapolate trends/patterns to predict a missing value within data set, next value in sequence, etc. [Which table shows the missing sunrise data?] [What should the date of the next full moon be?] [Which picture shows how long the shadow will be at noon?]	Distractors may include quantities or trends already given in the table/graph, or the inverse of expected pattern.

4	**MC**	3	Use the data pattern to describe/predict the locations or movement of the Sun, moon, stars at a particular point within or after the time frame shown. [Based on the data pattern, how does the Sun move in the sky between noon and 3 p.m.?]	Distractors may include relative locations for other times of day, such as dawn, dusk, noon; include circumpolar stars as reference points.
5	**MC**	2 or 3 per complexity of event	Choose the correct graphical display for another similar celestial event (e.g., pattern of appearance of constellations that are in different locations relative to Earth; length of shadows in summer vs. winter; etc.)	This item model allows for assessment of all three dimensions in one item. Distractors may include patterns that repeat or invert the pattern seen in the first scenario or that show no change.

***Response options can make use of Student Misconceptions (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From Operation Physics, www.amasci.com/miscon/opphys.html:

- Stars and constellations appear in the same place every night.
- The moon can only be seen during the night.
- The phases of the moon are caused by the shadow of Earth on the moon.
- The phases of the moon are caused by the moon moving into the Sun's shadow.

From http://assessment.aaas.org:

- The equator has more daylight hours and the North Pole has the fewest.
- The orientation of Earth's axis of rotation with respect to a point in space changes throughout the year.
- The orientation of Earth's axis of rotation in respect to the Sun does not change throughout the year.
- Students interpret graphs as literal pictures of a phenomenon rather than a symbolic representation.
- Students have difficulty selecting appropriate scale for graphs.
- Students have difficulty interpreting axis tick marks between skipped numbers as "½."
- Students may assign different scales to different parts of an axis.
- Students may require use of the same numbering scheme for *x*- and *y*-axis.

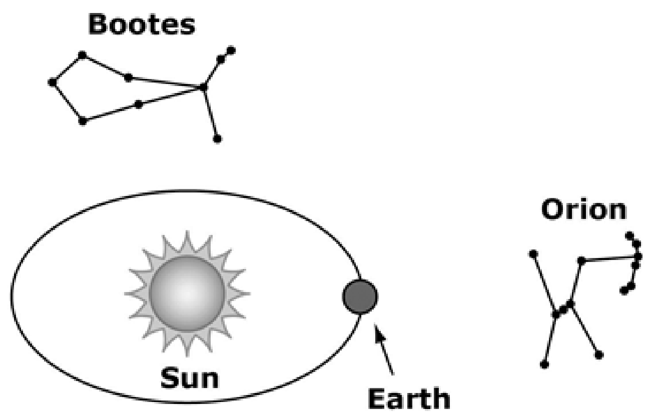
Sample Cluster for 5-ESS1-2:

A student in Oklahoma studying the night sky wondered why different stars are seen at different times of the year. The student decided to study two constellations.[1] One of the constellations was Orion, and the other constellation was Bootes. The student found two pieces of information about the constellations. First, the student found the number of hours Orion is visible each night. The student recorded the data for different months in a table. Next, the student found a picture to show where Earth is in its path around the Sun in December. The student copied the picture and also marked where the constellations, Orion and Bootes, are in December.

The student's table and picture are shown.

When Can Orion Be Seen?

Month	Hours Orion Can Be Seen at Night in Oklahoma
February	7.2
April	3.4
June	0.0
August	1.3
October	6.4
December	11.2



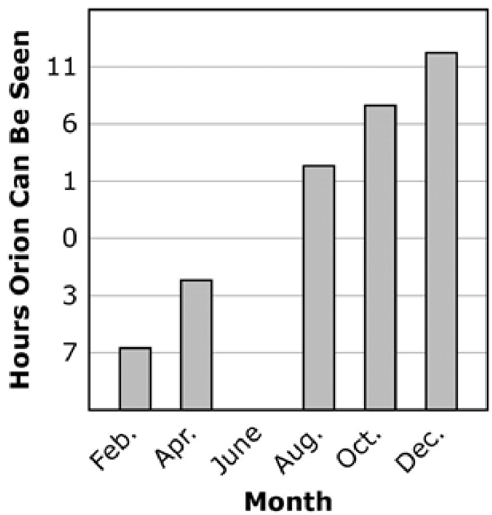
[1]**constellation:** a group of stars

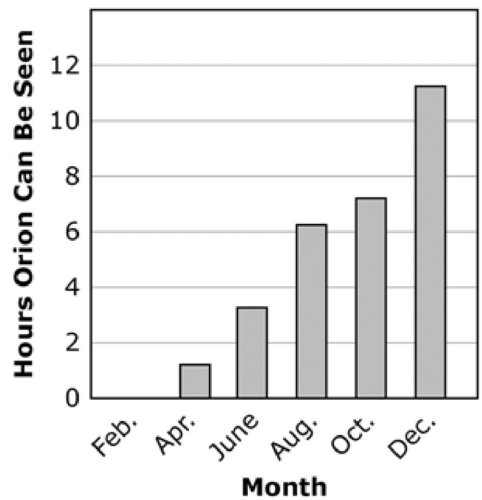
(Items on the following pages)

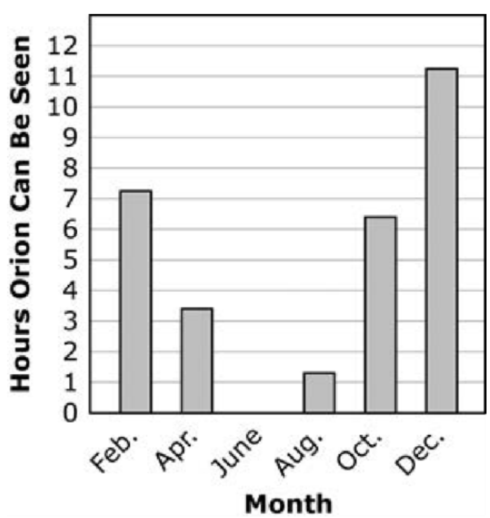
Item 1
Item Type: MC
DOK 2
Key: C

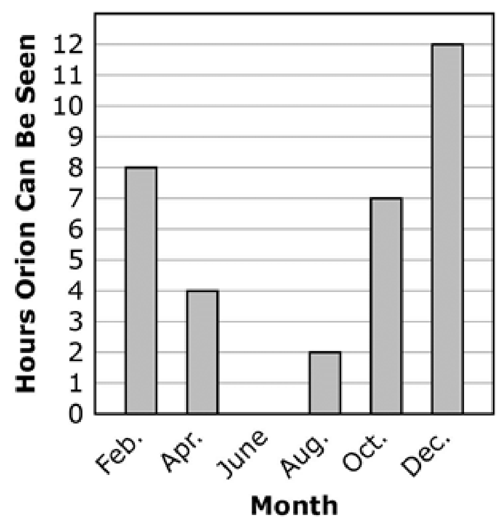
During the year, the number of hours Orion can be seen in Oklahoma changes.

Which graph correctly shows the changes?

A.


B.


C.


D.


Item 2
Item Type: MC
DOK 2
Key: B

Some months are missing from the student's data table.

Which of these tables shows the number of hours Orion will likely be seen in September and November in Oklahoma?

A.

Month	Hours Orion Can Be Seen at Night
September	1.25
November	6.25

B.

Month	Hours Orion Can Be Seen at Night
September	3.8
November	9.8

C.

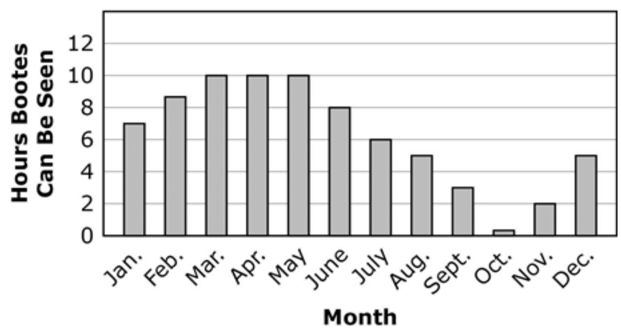
Month	Hours Orion Can Be Seen at Night
September	0.8
November	5.3

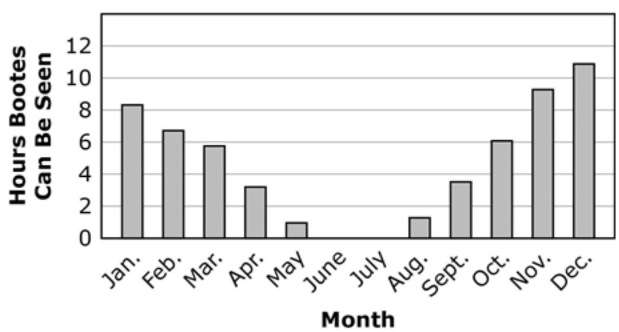
D.

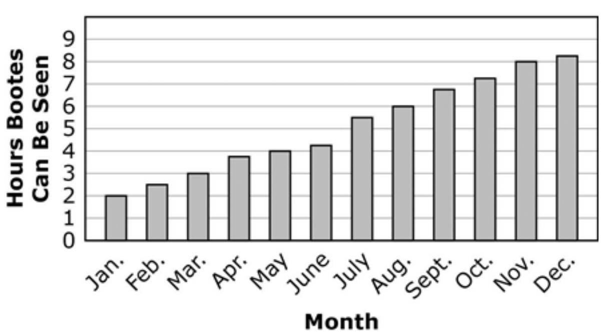
Month	Hours Orion Can Be Seen at Night
September	7.25
November	3.25

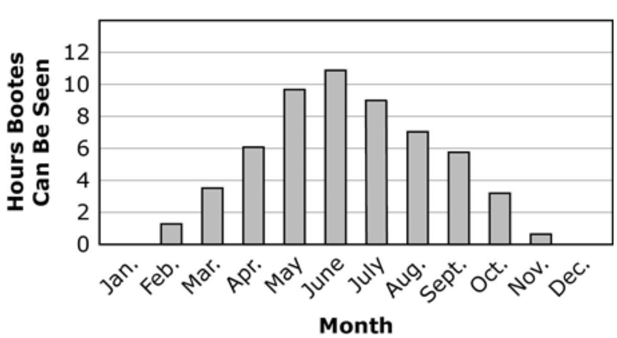
Item 3
Item Type: MC
DOK 3
Key: A

Which graph shows the number of hours Bootes will most likely be seen in the Oklahoma night sky during the year?

A. 

B. 

C. 

D. 

Earth's Systems: 5-ESS2-1

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5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

OASS 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.

OASS Assessment Boundary:
Assessment is limited to the interactions of two systems at a time in an item.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Developing and Using Models • Develop a model using an example to describe phenomena.	ESS2.A: Earth Materials and Systems • Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. • The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. • Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather.	Systems and System Models • A system can be described in terms of its components and their interactions.

In Lay Terms:
Students should be able to identify, select, and describe components and relationships for a model (i.e., develop a model) that can describe the ways Earth systems interact, based on given examples.

Cluster Clarifications:

- The components of each Earth system are as follows:
  - Geosphere – solid rock, molten rock, soil, sediment (sand, silt, clay), continents, mountains, ocean floor
  - Hydrosphere – water in the form of rivers, lakes, glaciers, oceans, ponds, streams, and all ice on Earth
  - Atmosphere – air, wind, oxygen
  - Biosphere – all living things (e.g., plants and animals including humans)
- Individual MC items in the cluster are limited to the interactions of two systems at a time.
- Use sensitivity when discussing specific weather events as examples. In general avoid tornadoes.
- The types of models to be developed could be diagrams, 3-D models, flow charts, etc.
- Relevant components that students need to include in the model are the parts of the specific Earth systems in question (e.g., rock, soil, mountains in geosphere; water, ice, precipitation in hydrosphere).
- Interactions and relationships that students need to represent and describe in the model are the interdependence and/or cause-effect relationships of the particular example (e.g., temperature change in atmosphere causes formation or melting of ice – hydrosphere).
- The word "represent" is acceptable vocabulary to use in asking about developing models.
- When students develop a model, they are constructing a model from evidence/data, completing a model, or choosing the best model to illustrate a given phenomenon.

Cluster Stimulus Attributes:
Typical stimulus elements:

- description/example of one system interacting with one or more other systems
- descriptions of cause and effect involving Earth systems
- partial or incorrect models (models could be maps, diagrams)

Possible contexts:
[Note: May need to include several examples to get at models of one system's interactions with one system, then another. But context/scenario presented should feel cohesive and logical.]

- terrarium, aquarium interactions
- impacts of ocean, other water bodies—on climate, on landforms, on ecosystems and unique life forms
- impacts of landforms/surface features on atmosphere/weather patterns (including winds, release of heat to atmosphere, rain shadows, etc.)
- impact of soil on biosphere (including providing shelter for animals and insects, providing a rich environment for plant roots to reside, etc.)
- water cycle (i.e., water continuously moves through and interacts with the geosphere, atmosphere, and biosphere via the water cycle)
- weathering/erosion of rocks, soils, sediments by other systems (i.e., by wind, precipitation, rivers, ocean, ice, living organisms)
- plant and animal oxygen/carbon dioxide exchange via atmosphere

Content and evidence to be included: example(s) of interacting Earth systems, with adequate information/detail

Types of student responses that need to be supported: identifying, selecting, and describing components and relationships for a model, and/or improving models, in order to describe Earth systems and the processes within them interact and influence each other in a specific example/phenomenon

Allowable Item Types:

- MC

Model Item Descriptions for 5-ESS2-1:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	1 or 2 per complexity	Choose the model that shows the interaction occurring between two systems. [Which model shows the interaction that was described between the hydrosphere and the geosphere?]	Distractors may include misconceptions, or model types that are common for other purposes.
2	**MC**	2 or 3 per complexity of evidence and type of response	Use evidence from the example to explain why the model being developed appropriately/correctly represents a particular system interaction. *or* Identify or describe the information/reasoning that supports the representation in the model or a part of the model in a given way. [Why should the model show rivers, rainfall, and ocean waves interacting with Earth's surface?]	Distractors may include misconceptions, misinterpretation of the example and interactions, or misunderstanding of how to represent components in a model.
3	**MC**	2 or 3 per amount of explanation/ justification required and complexity of models and judging between them	Compare models to identify and explain which model is most correct for the example. [Which model best shows how the hydrosphere is responsible for changes in the surface of the planet?]	Distractors may include models and/or explanations based on misconceptions or misunderstanding of how to represent components and interactions in a model.
4	**MC**	2 or 3 per amount of explanation/ justification required	Explain how to modify a model and/or why these changes will improve the model. [How could the model be changed to show how water is needed for cloud formation?] [Which materials would make the model better represent the geosphere, and why?]	Distractors may include changes that are based on misconceptions or lack of understanding of how to represent parts and interactions in a model.
5	**MC**	1 or 2 per complexity	Identify or describe what the model being developed needs to show in terms of components/parts and roles of the parts. [What should be used to represent sediment in the model?] [What parts need to be included in the model to show how the hydrosphere and geosphere interact (on each side of the mountain)?]	Options could be text descriptions or graphic options. Distractors may include incorrect parts and roles, drawing from misconceptions.

6	**MC**	2 or 3 per complexity	Describe the relationship or interaction that needs to be shown in the model being developed. [How can the parts of the model be arranged to show one way the atmosphere and hydrosphere interact?]	Options could be text descriptions or graphic options. Distractors may include incorrect representations, mechanisms, and cause/effect, drawing from misconceptions.
7	**MC**	3	Describe how to revise a model to show a specific interaction of systems. [What should be added to the model to show the ways that soil supports living things?]	

***Response options can make use of <u>Student Misconceptions</u> (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://assessment.aaas.org:

- The land does not transfer energy to the air.
- The temperature of air is not affected by the surface of the earth beneath it.
- The surface of the earth does not warm the air above it.
- The amount of energy sunlight can transfer to a given place on the surface of the earth is not affected by clouds blocking the sun.
- The air around the earth is mainly warmed by energy transferred directly from sunlight, not by energy transferred from the surface of the earth.
- The air around the earth is mainly warmed by heat from deep inside the earth.
- Water evaporates into the air only when the air is very warm.
- When water evaporates, tiny droplets of water, not water vapor, are formed.
- Cooler air can hold more water vapor than warmer air.
- Liquid water does not evaporate and become part of the air.
- Rain falls from a cloud when the pool of water in the cloud becomes too large, so the cloud can no longer hold the water inside.
- The main cause of rain falling from clouds is wind blowing on the cloud and making the water in the cloud spill out.
- New clouds cannot form. Clouds are just pushed from place to place.
- Wind and water cannot wear away the solid rock of a mountain.
- Landforms can change in size, but not by the motion of wind and water.
- Clouds are like vessels that hold water.
- Landforms look similar today as they did many millions of years ago. For example, a river on earth today hasn't changed over time.

From http://hub.mspnet.org/media/data/MiTEP_List_of_Common_Geoscience_Misconceptions.pdf?media_000000007297.pdfh:

- The atmosphere, hydrosphere, lithosphere, and biosphere do not cause changes in one another; these systems operate independently on Earth.
- Events that occur on a continent do not affect oceans or the atmosphere.

From https://serc.carleton.edu/NAGTWorkshops/intro/misconception_list.html:

- Groundwater and spring waters are pure, naturally filtered water systems. Filtering is emphasized in some texts and common literature, as well as Madison Avenue advertising.
- There is no real connection between groundwater and surface water systems.

Earth's Systems: 5-ESS2-2
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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.

OASS Clarification Statement:
(none)

OASS Assessment Boundary:
Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.

Science & Engineering Practice:	Disciplinary Core Idea:	Crosscutting Concept:
Using Mathematics and Computational Thinking • Describe and graph quantities such as area and volume to address scientific questions.	ESS2.C: The Roles of Water in Earth's Surface Processes • Nearly all of Earth's available water is in the ocean. • Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.	Scale, Proportion, and Quantity • Natural objects exist form the very small to the immensely large

In Lay Terms:
Students should be able to identify appropriate graphs about water distribution and describe that nearly all of Earth's water is in the ocean, and most fresh water is found in glaciers or underground.

Cluster Clarifications:
- Stick to the water types listed in assessment boundary. It is also acceptable to include streams and wetlands (per DCI). Do not include atmospheric data.
- Data about distribution and amounts may be relative (general comparisons) or absolute (comparing specific data).
- Graphs will most commonly be circle graphs and bar graphs.

Cluster Stimulus Attributes:
Typical stimulus elements:
- maps
- diagrams of water distribution with key/legend
- diagrams with data
- data tables (note only partial sets of data should be provided, in order to allow for assessment of the DCI, based on understanding of relative amounts)

Possible contexts:
- flat map of globe with shading of water vs. land, liquid vs. frozen water, salt water vs. fresh water, etc.
- surface maps with keys
- data tables (historic or current) about water distribution or amounts
- research scenarios in which data is being collected to help inform a question about water usage, water preservation measures, etc. (note the question/problem is the hook; not assessable in itself)

Content and evidence to be included: data for graphing and analysis of distributions (note only partial sets of data should be provided, in order to allow for assessment of the DCI, based on understanding of relative amounts)

Types of student responses that need to be supported: selecting graphs of water amounts and distribution; describing water distribution; describing and/or predicting additional or related data

Allowable Item Types:

- MC

Model Item Descriptions for 5-ESS2-2:

#	Item Type	DOK	Model Stem (Items ask students to…)	Response Characteristics*
1	**MC**	1 or 2 per data complexity	Select the graph that matches the data provided about water amounts/percentages. [Which graph shows the percentages of fresh and salt water on Earth?]	Distractors may include graphs that incorrectly transform data, use incorrect data, flip axes, show data in wrong order/pattern, etc.
2	**MC**	1 or 2 depending on whether answer requires reading or inferring	Describe what the data or graphs show about the amount, percentage, or distribution of water. [How much more water is found in glaciers than in the polar ice caps?] [Which statement compares the amounts of water in rivers and glaciers?] [What does the graph show about the distribution of fresh water across Earth?]	Key and options may focus on more basic "reading" of the data, on comparisons, or on trends/relationships. Distractors may include trends not represented in data or other (incorrect) values from the table or graph.
3	**MC**	2	Choose alternate representations/graphs for the given data and/or additional or comparison data. [What other method of presenting the data would show the percentages of fresh and salt water on Earth?]	Distractors may include inappropriate types of graphs/charts, inappropriate scales, or displays that make data interpretation more difficult.
4	**MC**	1 or 2 per complexity of data and trend	Identify missing data values (based on knowledge of water types, amounts, and distribution). [What percentage of water is expected to be found in rivers and lakes?]	This item model allows for assessment of the DCI in addition to SEP (and likely CCC). Distractors may include incorrect amounts and locations based on misconceptions.
5	**MC**	2	Predict what a graph for a related but different water distribution question would look like (based on the information from the given data set).	This item model allows for assessment of the DCI in addition to SEP (and likely CCC). Distractors may include patterns that repeat or invert the pattern seen in the first data set, show no change, or convey other misconceptions.

6	**MC**	2	Describe the type of graph or data needed to support a given claim about the distribution of water on Earth.	Distractors may include misconceptions and/or incorrect variables, incorrect data displays, etc.

***Response options can make use of <u>Student Misconceptions</u> (examples of scientifically incorrect assumptions) related to this performance expectation; references to misconceptions are listed in the links below:**

From http://serc.carleton.edu/NAGTWorkshops/intro/misconception_list.html:

- Rivers flow south—sometimes modified to rivers in Northern Hemisphere flow south, while those in Southern Hemisphere flow north.
- There is no real connection between groundwater and surface water systems.
- Lakes and rivers contain more fresh water than groundwater systems do.

From http://beyondpenguins.ehe.osu.edu/issue/polar-oceans/common-misconceptions-about-oceans:

- Oceans are shaped like a bowl.
- Oceans are deepest in the middle.
- The bottom of the ocean is a big, sandy desert.
- Table salt + water = seawater.
- Oceans have the same salinity everywhere.
- Earth's oceans are separate and not connected.
- The oceans' resources are limitless.
- Icebergs are made of salt water.