# AMENDED AND RESTATED MEMORANDUM OF UNDERSTANDING
# FOR SCIENCE ITEM SHARING

This Amended and Restated Memorandum of Understanding (the "**MOU**") amends and restates the initial Memorandum of Understanding for Science Item Sharing between the Parties first signed on November 22, 2017, became effective on December 8, 2017 (in accordance with its terms) and is scheduled to expire on June 30, 2022 (the "Original MOU"). As such, this MOU sets out the key terms and conditions under which the Parties propose to contribute to and share in the use of an item bank comprised of science assessment items that have not been publicly released (the "**Science Item Bank**") for another Term (as such term is defined in Section 8 below). The term "**Party**" or "**Parties**" shall include the Initial Parties (as such term is defined in Section 1(a) below) as well as any subsequent State or entity that becomes a party to this MOU.

**1. Parties**

**(a) Initial Parties:** The Initial Parties to this MOU shall consist of the following: Connecticut State Board of Education ("CSBE"), Hawaii Department of Education ("HIDOE"), Idaho State Department of Education ("SDE"), Montana Office of Public Instruction ("OPI"), Oregon Department of Education ("ODE"), Rhode Island Department of Education ("RIDE"), Utah State Board of Education ("USBE"), Vermont Agency of Education ("VTAOE"), West Virginia Department of Education ("WVDE"), Wyoming Department of Education ("WDE"), and Cambium Assessment, Inc ("CAI"). CSBE, HIDOE, SDE, OPI, ODE, RIDE, USBE, VTAOE, WVDE, WDE and CAI may be referred to individually as an "Initial Party" and collectively as the "Initial Parties". The designated representative and contact information for each Initial Party are set forth in Schedule C to this MOU.

**(b) Subsequent Parties:** Any State or entity seeking to become a party to this MOU shall require the consent of all Parties at that time.

**2. Purpose:** The purpose of this MOU is to establish and maintain a Science Item Bank in order to increase the quantity of science assessment items and item clusters available to each Party in a cost-efficient manner. The Parties shall share "Licensed Materials" (defined below), for use in securely administered operational state assessments.

**3. Definitions:** Unless and except to the extent otherwise defined in the relevant provisions of this MOU, all capitalized terms shall have the meanings assigned to them below (whether in singular or plural forms of the terms defined):

**(a) "Contributing Party"** means a Party that contributes its own Licensed Materials to the Science Item Bank.

**(b) "Governance Committee"** means the committee consisting of one representative from each Party that is responsible for the implementation and the operation of the Science Item Bank and the process for sharing Licensed Materials.

(c) **"Intellectual Property Rights"** means the rights, titles, and interests, including but not limited to licenses, copyrights, patents, trade secret, trademark, utility design, or other proprietary rights in the Licensed Materials.

(d) **"Licensed Materials"** means copyrighted or other proprietary materials consisting of such items or clusters developed, owned and/or licensed by the Parties, including the agreed-upon metadata associated with such items or clusters.

(e) **"Licensee Party"** means a Party that uses Licensed Materials provided to the Science Item Bank by a Contributing Party.

(f) **"State Party"** means any Party that is an agency or department of a state or territory of the United States.

**4. Scope of License:**

(a) **License to State Parties:** Subject to the terms and conditions set forth herein, each Contributing Party, including CAI, grants to each State Party a limited, non-exclusive, non-transferrable, royalty-free license to use and reproduce the Licensed Materials contributed by such Contributing Party in securely administered operational state assessments that are administered by the Licensee Party or its designated third-party test administration contractor to students in such Party's state or territory. Notwithstanding anything in this MOU to the contrary, each Licensee Party expressly acknowledges that its license to the Licensed Materials contributed by the other Parties shall be solely for the term set forth in the MOU or, in the case of the Licensed Materials of CAI, for the period specified in such Licensee Party's State Assessment Contract with CAI as provided in subsection (b) below, and will in no event be perpetual. CAI has no right to use any of the Licensed Materials (other than its own) except as directed by the Contributing or Licensee Party.

(b) **License by CAI:** Although CAI has contributed and will continue to contribute items to the Science Item Bank from time to time, the Parties acknowledge and agree that CAI's role as a Contributing Party herein is unique and solely pursuant to and in accordance with the terms and conditions of its separate agreement for assessment services with each of the State Parties (each, a "State Assessment Contract"). Accordingly, CAI's obligation to contribute its Licensed Materials to the Science Item Bank and make them available to a State Party is separate and specific to such State Party, and CAI shall have no obligation or liability to any other Party in connection therewith. Similarly, and for the avoidance of doubt, the following terms shall apply, notwithstanding anything to the contrary contained in this MOU: (i) the terms and conditions of this MOU relating to each Party's contribution of items to the Science Item Bank shall apply to CAI's provision of its Licensed Materials to a State Party hereunder only if and to the extent they expressly reference and include CAI, and to the extent any such term or condition conflicts or is otherwise inconsistent with the terms and conditions contained in CAI's State Assessment Contract with such State Party, the terms and conditions contained in the State Assessment Contract shall prevail; (ii) in the event CAI's obligation to provide its Licensed Materials to a State Party under a State Assessment

Contract ceases for whatever reason, including but not limited to the expiration or termination thereof, CAI's grant of a license for the use of its Licensed Materials to such State Party hereunder shall correspondingly cease and may be renewed only upon the completion of a new and separate contract between CAI and the State Party; and (iii) in the event a State subsequently becomes a Party to this MOU but does not have a State Assessment Contract in effect with CAI, such State Party shall have no right to receive or use the Licensed Materials of CAI until such time as a separate and appropriate contract has been concluded between the two Parties.

**(c) Intellectual Property Rights:**

(i) Each Contributing Party warrants and represents that it has all of the necessary Intellectual Property Rights in the Licensed Materials that are and will be deposited into the Science Item Bank and that such Intellectual Property Rights include the right to license or sublicense the use of such Licensed Materials to the Parties to, and in accordance with the terms of, this MOU and/or, in the case of CAI, the terms and conditions of its State Assessment Contract with each State Party.

(ii) Notwithstanding the licenses or sublicenses granted by each Contributing Party to the other Parties under Section 4(a) of this MOU, each Contributing Party retains, subject to the terms and conditions of this MOU, all of its Intellectual Property Rights in the Licensed Materials that each such Contributing Party contributes to the Science Item Bank and no Party shall have or acquire any other Intellectual Property Right in the Licensed Materials contributed by the Contributing Party.

(iii) In addition, except for CAI, no Party shall, either with respect to its own Licensed Material or with respect to another Contributing Party's Licensed Material, (A) do anything to infringe upon, harm or take any action contrary to, or that would diminish or contest the validity of, any Intellectual Property Rights in the Licensed Materials; (B) remove or alter any copyright or other Intellectual Property notices that appear on or in any portion of the Licensed Materials; (C) sublicense, release publicly, modify, transfer, assign, provide or otherwise make the Licensed Materials available to any other third party, nor create derivative works based on the Licensed Materials or otherwise commercially exploit the Licensed Materials; or (D) otherwise use the Licensed Materials in any manner or any purpose other than those expressly provided for under this MOU. Each Contributing Party reserves all rights in its own Licensed Material not expressly granted or restricted in this MOU. For purposes of clarification, a Contributing Party's restriction on its right to sublicense, release publication, modify, or otherwise create derivative works based on, its own Licensed Material under Subsection (C) of this Section 4(c)(iii), shall automatically terminate upon release or withdrawal made in accordance with Section 5(a)(iii) below.

(iv) Notwithstanding Section 4(c)(iii), a Contributing Party may provide its own Licensed Materials (which is held in the Science Item Bank) to a third party upon the written consent of each and every other Party to this MOU. CAI may, in any event, provide its own Licensed Materials to a third party without regard to the foregoing consent requirement or any other restriction set forth in this MOU.

(v) Each State Party shall cause its employees, contractors and any other personnel having access to the Licensed Materials to comply with the terms of Section 4(c)(iii).

**5. Contributions of State Parties:**

**(a) Contributions of Science Items or Item Clusters**

(i) **Base and Proportional Contribution by States:** Within eighteen (18) months of acceptance to join the MOU, each (new) State Party shall make a base contribution and a proportional contribution of secure, high quality science items and item clusters to the Science Item Bank in accordance with the formula and other criteria to be determined by the Governance Committee; a proposed initial formula and set of criteria are set out in Schedule A hereto. The State Parties may also agree to contribute additional science items or item clusters for use in state practice tests. The Initial State Parties to this MOU have made a base contribution and a proportional contribution of secure items to the Science Item Bank and are no longer subject to the terms of this Section 5(a)(i).

(ii) **Periodic Contribution by States:** To maintain the Science Item Bank after the initial base and proportional contribution, each State Party shall make a periodic contribution of secure, high quality science items and item clusters to the Science Item Bank in accordance with the formula and other criteria set forth by the Governance Committee; a proposed formula and set of criteria are set out in Schedule A hereto.

(iii) **Conditional Release or Withdrawal:** Once a State Party contributes an item or item cluster to the Science Item Bank, it cannot withdraw or release such item or cluster during that school year and must notify the other Parties by June 30 of each year if it intends to withdraw or release the item or cluster. The Contributing State Party agrees to wait two (2) full school years before releasing such items or clusters for publication or use on its Practice Tests. Each State Party shall contribute a new item or item cluster that is operationally ready for use to the Science Item Bank before it will be permitted to withdraw or release an existing item or cluster.

(iv) **Item and Item Cluster Specifications; Third Party Materials:** Each contributed item or item cluster must meet the item specification requirements that are established and agreed upon by the Governance Committee as set out in Schedule B hereto before it can be included in the Science Item Bank and counted towards the Contributing State Party's item and item cluster contribution obligations. Similarly, to the extent any Licensed Materials contain the copyrighted materials of any third party, the Contributing State Party shall confirm that its license (or otherwise procure a separate license) for such third-party materials allows for the use thereof by the other Parties as contemplated herein before the items containing such third-party materials can be included in the Science Item Bank and counted towards the Contributing State Party's item and item cluster contribution obligations.

(v) **Related Materials:** In addition to the actual assessment items or item clusters, each Contributing Party shall provide the agreed-upon metadata associated with such contributed items or clusters.

**(b) Science Item Bank Hosting:** CAI shall host the Science Item Bank for no charge, provided that at least one of the State Parties has a State Assessment Contract in effect with CAI that provides for CAI to serve as the primary contractor for assessment services in such State. Either CAI or the Governance Committee may terminate such hosting arrangement upon ninety (90) days prior written notice to the other Party.

**(c) Access to the Science Item Bank:** No State Party will be allowed access to the Science Item Bank or use of the Licensed Materials unless it:

(i) has made its full initial contribution (Base and Proportional Contribution) and required periodic contribution of science items or item clusters to such Item Bank or the Governance Committee determines that such Party is making progress towards its full contribution; and

(ii) remains in good standing under this MOU as determined by the Governance Committee.

6. **Governance Committee:** The implementation and the operation of the Science Item sharing shall be the responsibility of the Governance Committee. All matters requiring a decision shall be determined by simple majority vote except those matters specified in this MOU that require unanimous approval. Matters requiring unanimous approval shall include (but not be limited to) (i) adding a party to the MOU, (ii) amending the MOU (including any schedule thereto, with the exception of Schedule C), (iii) adopting or revising the item contribution formula and related criteria applicable to Parties, (iv) any proposed expenditure that would require one or more states to contribute additional funding, and (v) the selection of the Science Item Bank hosting party (other than CAI).

7. **Confidentiality:** Each Party shall treat its own Licensed Materials and the Licensed Material of another Contributing Party as confidential information. Each Party shall hold such confidential information in confidence, using at least the same care and protection as it treats its own assessment items that have not been publicly released, but in no event less than reasonable care. Each Party shall notify all the other Parties immediately in writing of any unauthorized use or distribution of the Licensed Materials of which such Party becomes aware and shall take all steps necessary to ensure that such unauthorized use or distribution is terminated.

8. **Term:** This MOU shall commence on July 1, 2022, and shall remain in effect until June 30, 2027 (the "Term"). A Party may elect to withdraw from the MOU during the Term upon ninety (90) days prior written notice to the other Parties, provided that (1) its contributed items shall remain in the Science Item Bank (subject to Section 5(a)(iii) above) until the expiration or termination of the MOU, and (ii) its use of the other Parties' items has to cease by the end of the 90-day period.

9. **Security Standards:** Each Party shall comply with the security procedures and measures put in place by CAI, including:

   **(a)** Following all security measures embedded in CAI's existing system, subject to change, upon notification from CAI; and

   **(b)** Maintaining the security of the online environment and test items through the use of the CAI Secure Brower.

10. **DISCLAIMER OF WARRANTIES: EXCEPT FOR THE WARRANTY MADE IN SECTION 4(c)(i) ABOVE, THE LICENSED MATERIALS CONTRIBUTED BY EACH PARTY ARE PROVIDED "AS IS" AND WITHOUT ANY OTHER WARRANTY OF ANY KIND, AND EACH CONTRIBUTING PARTY EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. FURTHERMORE, NO CONTRIBUTING PARTY WARRANTS OR MAKES ANY REPRESENTATIONS REGARDING THE USE OR THE RESULTS OF THE USE OF THE LICENSED MATERIALS IT HAS CONTRIBUTED IN TERMS OF THEIR CORRECTNESS, EFFECTIVENESS OR OTHERWISE. NO ORAL OR WRITTEN INFORMATION OR ADVICE GIVEN BY ANY PARTY OR PARTY REPRESENTATIVE SHALL CREATE A WARRANTY OR IN ANY WAY INCREASE THE SCOPE OF ANY WARRANTY.**

11. **LIMITATION OF LIABILITY: NO PARTY SHALL BE LIABLE TO ANY OTHER PARTY FOR ANY SPECIAL, EXEMPLARY, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THIS MOU, ANY LICENSED MATERIALS OR THE USE OR INABILITY TO USE ANY OF THE LICENSED MATERIALS, EVEN IF SUCH PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR THEY ARE FORESEEABLE.**

12. **General:**

   **(a)** **No Assignment or Sublicensing:** No Party will be permitted to assign this MOU and any such assignment shall be null and void.

   **(b)** **Force Majeure:** No Party shall be held liable to any other Party for failure of performance where such failure is caused by supervening conditions beyond that Party's reasonable control, including acts of God, civil disturbance, strikes or labor disputes.

   **(c)** **Invalidity**: If any provision of this MOU is invalid or unenforceable under any applicable statute or rule of law, this MOU shall be enforced to the maximum extent possible to effectuate the original express intent of the Parties.

   **(d)** **Relationship of the Parties**: The Parties hereto are independent contractors, and no agency, employment, partnership, fiduciary, or joint venture relationship is intended or created by this MOU. No Party (nor any agent or employee of that Party) is the representative of any other Party for any purpose and no Party has the power or authority as agent, employee, or in any other capacity to represent, act for, bind, or otherwise create or assume any obligation on behalf of any other Party for any purpose whatsoever. No Party, including but not limited to any contractor of a Party, will be deemed as a third-party beneficiary to this MOU or any provision herein.

(e) **Entire Agreement:** Except as otherwise expressly provided herein, this MOU constitutes the entire agreement between the Parties with respect to its subject matter, and supersedes all prior discussions, understandings, arrangements, proposals, and negotiations with respect to same.

(f) **No Modification:** Nothing in this MOU modifies or alters the terms of any existing contract or future contract between a State Party and CAI.

(g) **Amendment**: No amendment or modification to this MOU will be valid or binding upon the Parties unless it is made in writing and signed by all Parties.

(h) **No Waiver:** The failure of any Party to enforce at any time the provisions of this MOU in one instance will not constitute a waiver by any other Party of that or any other provision, nor shall it be deemed a future waiver of such provision, nor in any way affect the ability of any other Party to enforce each and every such provision thereafter. No waiver, consent, modification, or change in terms of this MOU will bind any Party unless made in writing and signed by all Parties.

(i) **Counterparts:** This MOU will be executed in counterparts with the same force and effect as if each of the Parties had executed the same instrument. Each copy of this MOU so executed constitutes an original.

(j) **Sovereign Immunity**: All governmental entities that are Parties to this MOU expressly reserve all sovereign immunity provided by the law of their respective jurisdictions and specifically retain all immunities and defenses available to them as sovereigns. Designations of venue, choice of law, enforcement actions, and similar provisions shall not be construed as a waiver of sovereign immunity. The Parties agree that any ambiguity in this MOU shall not be strictly construed, either against or for either Party, except that any ambiguity as to sovereign immunity shall be construed in favor of sovereign immunity.

The Parties have caused this MOU to be executed by their authorized representatives on the dates written below:

For the **Connecticut State Board of Education:**

______________________________ 06/08/2022
Charlene Russell-Tucker — Date
Commissioner of Education

For the **Hawaii State Department of Education:**

______________________________ JUN 2 4 2022
**Keith T. Hayashi** — **Date**
**Interim Superintendent**

For the **Idaho State Department of Education:**

Sherri A. Ybarra  06/09/2022

Name: Sherri A. Ybarra  Date

Title: Superintendent of Public Instruction

For the **Montana Office of Public Instruction:**

DocuSigned by:
Elsie Arntzen
29C400292A4D43E...  6/22/2022

Name: Elsie Arntzen  Date

Title: MT State Superintendent

For the **Oregon Department of Education:**

Karen L. Hull  December 06, 2022

Name: Karen L Hull  Date

Title: Procurement & Contract Specialist

For the **Rhode Island Department of Education:**

for Angélica Infante-Green  6/3/22

Commissioner of Education  Date

For the **Utah State Office of Education:**

Scott Jones Digitally signed by Scott Jones Date: 2022.06.23 08:02:07 -06'00'  June 23, 2022

Name: Scott Jones  Date

Title: Deputy Superintendent of Operations

For the **Vermont Agency of Education:**

Name:  Date

Title:

For the **West Virginia Department of Education:**

W. Clayton Burch
Superintendent of Schools

8/3/22
Date

For the **Wyoming Department of Education:**

Deputy Superintend

10 / 10 / 2022

Name:

Title:

WYOMING ATTORNEY
GENERAL'S OFFICE
SEP 30 2022
#223926
Brie M. Richardson
APPROVED AS TO FORM

For **Cambium Assessment, Inc:**

Christopher Lowe
Senior Director, Contracts

01/23/2023
Date

**MEMORANDUM OF UNDERSTANDING FOR SCIENCE ITEM SHARING COLLABORATIVE**

**SCHEDULE A – ITEM SHARING FORMULA**

**Base Contribution and Proportional Contribution:** Each State will make a Base Contribution and a Proportional Contribution of secure items as their Initial Contribution as a condition to join as a Party to this MOU. All Initial Parties have met the Initial contribution requirements as outlined in the original Memorandum of Understanding executed in 2017-2018. A new State or entity must make the Initial Contribution within 18 months of becoming a Party to the MOU.

- Base contribution of 15 standalone items and 15 cluster items will be equal for each Party.
- Proportional Contribution for additional items will be based on tested student population.
- Through the Governance Committee, the Parties may agree to develop additional non-secure items or to establish additional criteria for assignments across grades, content strands, item difficulty and other measures to ensure the Science Item Bank will support tests that meet blueprints and meet State Program needs.

The following tables illustrate the initial base and proportional contributions ("Initial Contribution") by state.

**Total Initial Contribution:**

| State | Tested Students per Grade | Standalone Items | Cluster Items |
|---|---|---|---|
| Connecticut | 40,000 | 21 | 21 |
| Hawaii | 15,000 | 17 | 17 |
| Idaho | 22,000 | 18 | 18 |
| Montana | 12,000 | 17 | 17 |
| Oregon | 45,000 | 22 | 22 |
| Rhode Island/Vermont | 17,000 | 18 | 18 |
| Utah | 45,000 | 22 | 22 |
| West Virginia | 20,000 | 18 | 18 |
| Wyoming | 7,500 | 16 | 16 |

**Base and Proportional Initial Contributions:**

| State | Base Contribution | | Proportional Contribution | |
|---|---|---|---|---|
| | Standalone Items | Cluster Items | Standalone Items | Cluster Items |
| Connecticut | 15 | 15 | 6 | 6 |
| Hawaii | 15 | 15 | 2 | 2 |
| Idaho | 15 | 15 | 3 | 3 |
| Montana | 15 | 15 | 2 | 2 |
| Oregon | 15 | 15 | 7 | 7 |
| Rhode Island/Vermont | 15 | 15 | 3 | 3 |

| | | | | |
|---|---|---|---|---|
| Utah | 15 | 15 | 7 | 7 |
| West Virginia | 15 | 15 | 3 | 3 |
| Wyoming | 15 | 15 | 1 | 1 |

**Periodic Contribution:** Each State will make a Periodic Contribution of secure items as an obligation of their participation in the agreement. The Periodic Contribution shall be made by all Parties and is intended to continue to maintain and enhance the Science Item Bank. The Periodic Contribution commences at the completion of the Initial contribution period for any new Party, meaning that after a joining state successfully completes their Initial contribution the terms of the Periodic Contribution commence. The Governance Committee may allow a Party that has not made its full periodic contribution with access to the Science Item Bank if the Governance Committee determines that such Party is making progress towards its full contribution.

- Periodic Contribution is defined by the Governance Committee to mean occurring once every two years.
- The Periodic Contribution will be based on states' initial contribution (base and proportional contribution) and is established as fifty percent (50%) of a Party's initial contribution made once every two years **or** twenty-five percent (25%) of the state's initial contribution made each year.
- Through the Governance Committee, the Parties may agree to develop additional non-secure items or to establish additional criteria for contribution to meet the maintenance needs of the Science Item Bank or State program needs.

The following tables illustrate the periodic contribution by State.

| **State** | **Initial Contribution** | | **Biannual Proportional Contribution*** | |
|---|---|---|---|---|
| | **Standalone Items** | **Cluster Items** | **Standalone Items** | **Cluster Items** |
| Connecticut | 21 | 21 | 11 | 11 |
| Hawaii | 17 | 17 | 9 | 9 |
| Idaho | 18 | 18 | 9 | 9 |
| Montana | 17 | 17 | 9 | 9 |
| Oregon | 22 | 22 | 11 | 11 |
| Rhode Island | 18* | 18* | 4 | 5 |
| Vermont | | | 5 | 4 |
| Utah | 0* | 27 | 0* | 11 |
| West Virginia | 18 | 18 | 9 | 9 |
| Wyoming | 16 | 16 | 8 | 8 |

*The contribution may be in equivalent numbers of one item type (standalone vs. clusters) if state development plan does not include both types.

**Initial Contribution made under MSSA contract with Rhode Island and Vermont as co-owners of the items.

# Science Standards Cluster/Item Specifications
# Specification Front Matter

*Specification development is complete for Grades 3-8 and High School. We have included a sample of specifications from across grade-bands and provided the link to the current set of specifications for each grade band.*

## Introduction

This document presents *cluster specifications* for use with the Next Generation Science Standards (NGSS). These standards are based on the Framework for K-12 Science Education. The present document is not intended to replace the standards, but rather to present guidelines for the development of items and item clusters used to measure those standards.

The remainder of this section provides a very brief introduction to the standards and the framework, an overview of the design and intent of the item clusters, and a description of the cluster specifications that follow. The bulk of the document is composed of cluster specifications, organized by grade and standard.

### Background on the framework and standards

The Framework for K-12 Science Education are organized around three core dimensions of scientific understanding. The standards are derived from these same dimensions:

- Disciplinary Core Ideas: The fundamental ideas that are necessary for understanding a given science discipline. The core ideas all have broad importance within or across science or engineering disciplines, provide a key tool for understanding or investigating complex ideas and solving problems, relate to societal or personal concerns, and can be taught over multiple grade levels at progressive levels of depth and complexity.
- Science and Engineering Practices: The practices are what students DO to make sense of phenomena. They are both a set of skills and a set of knowledge to be internalized. The SEPs reflect the major practices that scientists and engineers use to investigate the world and design and build systems.
- Cross-Cutting Concepts: These are concepts that hold true across the natural and engineered world. Students can use them to make connections across seemingly disparate disciplines or situations, connect new learning to prior experiences, and more deeply engage with material across the other dimensions. The NGSS requires that students explicitly use their understanding of the CCCs to make sense of phenomena or solve problems.
- There is substantial overlap between and among the three dimensions. For example, the cross-cutting concepts are echoed in many of the disciplinary core ideas. The core ideas are often closely intertwined with the practices. This overlap reflects the nature of science itself. For example, we

often come to understand and communicate causal relationships by employing models to make sense of observations. Even within a dimension, overlap exists. Quantifying characteristics of phenomena is important in developing an understanding of them, so employing computational and mathematical thinking in the construction and use of models is a very common scientific practice, and one of the cross-cutting concepts suggests that scientists often infer causality by observing patterns. In short, the dimensions are not orthogonal.

The framework envisions effective science education as occurring at the intersection of these interwoven dimensions: students learn science by doing science—applying the practices through the lens of the cross-cutting concepts to investigate phenomena that relate to the content of the disciplinary core ideas.

### Item clusters

Each item cluster is designed to engage the examinee in a grade-appropriate, meaningful scientific activity aligned to a specific standard.

Each cluster begins with a phenomenon, an observable fact or design problem that engages student interest and can be explained, modeled, investigated, or designed using the knowledge and skill described by the standard in question.

What it means to be observable varies across practices. For example, a phenomenon for a performance expectation exercising the a*nalyze data* practice may be observable through regularities in a data set, while standards related to the *development and use of models* might be something that can be watched, seen, felt, smelled, or heard.

What it means to be observable also varies across grade levels. For example, elementary-level phenomena are very concrete and directly observable. At the high school level, an observation of the natural world may be more abstract--for example, "observing" changes in the chemical composition of cells through the observation of macroscopic results of those changes on organism physiology, or through the measurement of system- or organ-level indications.

Content limits refine the intent of the performance expectations and provide limits on what may be asked of items in the cluster to structure the student activity. The content limits also reflect the disciplinary core ideas learning progressions that are present in the K-12 Framework for Science Education.

The task or goal should be explicitly stated in the stimulus or the first item in the cluster: statements such as "In the questions that follow, you will develop a model that will allow you to identify moons of Jupiter," or "In the questions below, you will complete a model to describe the processes that lead to the steam coming out of the teapot."

Whereas item clusters have been described elsewhere as "scaffolded," they are better described as providing structure to the task. For example, some clusters begin with students summarizing data to discover patterns that may have explanatory value. Depending on the grade level and nature of the standard, items may provide complete table shells or labeled graphs to be drawn or may require the student to choose what to tabulate or graph. Subsequent items may ask the student to note patterns in the tabulated or graphed data and draw on domain content knowledge to posit explanations for the patterns.

These guidelines for clusters do not appear separately in the specifications. Rather, they apply to all clusters.

### Structure of the cluster specifications

The item cluster specifications are designed to guide the work of item writers and the review of item clusters by stakeholders.

Each item cluster has the following elements:

- The text of the performance expectations, including the practice, core idea, and cross-cutting concept.
- Content limits, which refine the intent of the performance expectations and provide limits of what may be asked of examinees. For example, they may identify the specific formulae that students are expected to know or not know.
- Vocabulary, which identifies the relevant technical words that students are expected to know, and related words that they are explicitly not expected to know. Of course, the latter category should not be considered exhaustive, since the boundaries of relevance are ambiguous, and the list is limited by the imagination of the writers.
- Sample phenomena, which provide some examples of the sort of phenomena that would support effective item clusters related to the standard in question. In general, these should be guideposts, and item writers should seek comparable phenomena, rather than drawing on those within the documents. Novelty is valued when applying scientific practices.
- Task demands comprise the heart of the specifications. These statements identify the types of items and activities that item writers should use, and each item written should be clearly linked to one or more of the demands. The verbs in the demands (e.g., *select, identify, illustrate, describe*) provide guidance on the types of interactions that item writers might employ to elicit the student response. We avoid explicitly identifying interaction types or item formats to accommodate future innovations and to avoid discouraging imaginative work by the item writers.

For each cluster we present, the printed documentation includes the cluster, the task demands represented by each item, and its linkage to the practice and cross-cutting concept identified in the performance expectation.

### Access to Science Standards Cluster/Item Specifications:

Grades 3-5: https://cambiumast.seismic.com/app#/contentmanager/detail/ef2f4c29-96bb-4d27-babc-8d0c0fa31513/75d2224a-ea97-43b7-8e58-2df5bee85af3/info/tile/title

Middle School: https://cambiumast.seismic.com/app#/contentmanager/detail/ef2f4c29-96bb-4d27-babc-8d0c0fa31513/edf528ef-72c4-4fa9-b068-bddb8a271152/info/tile/title

High School: https://cambiumast.seismic.com/app#/contentmanager/detail/ef2f4c29-96bb-4d27-babc-8d0c0fa31513/3de51dee-0761-4957-aee9-a6e103962701/info/tile/title

Science Standards Cluster/Item Specifications

Sample Specifications

Cover Page

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-PS2-1<br>Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.</td></tr>
<tr><td>Dimensions</td><td>Planning and Carrying Out Investigations<br>• Plan and 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.</td><td>PS2.A: Forces and Motion<br>• Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object’s speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.)<br><br>PS2.B: Types of Interactions<br>• Objects in contact exert forces on each other.</td><td>Cause and Effect<br>• Cause and effect relationships are routinely identified.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements<br>• Examples could include an unbalanced force on one side of a ball can make it start moving, and balanced forces pushing on a box from both sides will not produce any motion at all.<br><br>Content Limits<br>• Assessment is limited to gravity being addressed as a force that pulls objects down.<br>• Assessment is limited to one variable at a time: number, size, or direction of forces.<br>• Assessment does include normal force, but not by name or magnitude.<br>• Assessment does not include quantitative force size, only qualitative and relative.</td></tr>
<tr><td>Science Vocabulary Students are Expected to Know</td><td colspan="3">Force, balanced, unbalanced, strength, direction, motion, speed, gravity, net, sum, weight (physical).</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Velocity, acceleration, mass, friction, vector, quantitative, relative, scale, weight (mass • gravity), Newtons, normal force.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Example Phenomena for 3-PS2-1:<br>• Kids of the same size and strength play a game of tug of war. When the same number of kids are on each side, a ribbon tied to the rope does not move. When more kids are on one side, the rope moves in that direction.<br>• A ball rests on the ground, unmoving. When it is gently kicked, it moves slowly in the direction it was kicked. When it is kicked harder, it moves more quickly in the direction it was kicked.<br>• A box is sitting in the center of a table. Strings attached to the left and right sides of the box hang over the sides of the table. Identical weights can be attached to the end of these strings.</td></tr>
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| | • A flat track with posts and rubber bands on either ends of the track. The student can pull a car back different distances to gather data. |
| This Performance Expectation and associated Evidence Statements support the following Task Demands. | |
| Task Demands | |
| 1. Assemble, complete, or identify, from a collection including distractors, the essential components of an investigation that studies balanced and unbalanced forces on an object at rest and/or in motion. | |
| 2. Identify the variables in the investigation that are held constant and which are changing, and define important factors in the design including number of trials, methods, and techniques. | |
| 3. Identify the observations that should be collected in an investigation of an object’s motion to determine the forces on the object and the causes of those forces. | |
| 4. Observe, collect, and record data from observations of the forces acting on an object at rest and/or in motion after forces of different strengths and/or directions are applied, including both balanced and unbalanced forces. ***(SEP/DCI/CCC)** | |
| 5. Identify from a list, including distractors, the effects of forces on an object’s motion and the cause of those forces. | |
| 6. Make predictions about the effects of changes in the motion of an object given specific forces. Predictions can be made by manipulating components of the investigation, completing illustrations, or selecting from lists with distractors. | |

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-LS1-1<br>Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models<br>• Develop models to describe phenomenon.</td><td>LS1.B: Growth and Development of Organisms<br>• Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.</td><td>Patterns<br>• Patterns of change can be used to make predictions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements<br>• Changes organisms go through during their lifetime form a pattern.<br><br>Content Limits<br>• Assessment of plant life cycles is limited to those of flowering plants.<br>• Assessment does not include details of human reproduction.<br>• <u>Students do not need to know:</u> the alternation of generations life cycle, the human reproductive system, mitosis and meiosis.</td></tr>
<tr><td>Science Vocabulary Students Are Expected to Know</td><td colspan="3">Adult, growth, life cycle, parent, pollen, offspring, structure, feature, trait, birth, death, young, caterpillar, root, stem, leaf/leaves, seed, flower, petal, tadpole, frog.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Organism, breed, diverse, transfer, development, germination, reproductive system, organ, cell, tissue, egg, fertilize, genetic, unicellular, multicellular, specialized cell, sperm, cell differentiation, cell division, variation, juvenile, metamorphosis, chrysalis, pupa, spores, pistil, stamen, ovary, anther, filament, sepal, receptacle, ovule, stigma, style.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-LS1-1:<br>• A young moth builds a soft case around it called a cocoon and a young butterfly builds a hard case called a chrysalis.<br>• A young ladybug looks very different from an adult ladybug.<br>• Plants and animals both form eggs.<br>• A pea planted in the ground grows into a new pea plant.</td></tr>
<tr><td colspan="4">This Performance Expectation and associated Evidence Statements support the following Task Demands.</td></tr>
<tr><td colspan="4">Task Demands</td></tr>
<tr><td colspan="4">1. Select the components needed to model the phenomenon. Components might include stages of life cycles such as birth, growth, reproduction, and death.</td></tr>
<tr><td colspan="4">2. Assemble or complete an illustration or flow chart that is capable of representing the patterns in life cycles of different types of organisms.</td></tr>
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| 3. | Manipulate the components of a model to demonstrate the changes, properties, processes and/or events that act to result in a phenomenon. |
| 4. | Make predictions about the effects of changes in life cycles on organisms. Predictions can be made by manipulating model components, completing illustrations, or selecting from a list with distractors. |
| 5. | Given models or diagrams of life cycles, identify relevant components such as birth, growth, reproduction, and death, and how the life cycles are different in each scenario. |
| 6. | Identify missing components, relationships, or other limitations of the model of a life cycle. |
| 7. | Describe, select, or identify the relationships among components of a model that describe the patterns of life cycles among different organisms. |

<table>
<tr><td>Performance Expectation</td><td colspan="3">3-ESS2-1<br>Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.</td></tr>
<tr><td>Dimensions</td><td>Analyzing and Interpreting Data<br>• Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships.</td><td>ESS2.D: Weather and Climate<br>• Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next.</td><td>Patterns<br>• Patterns of change can be used to make predictions.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements<br>• Examples of data could include average temperature, precipitation, and wind direction.<br><br>Content Limits<br>• Assessment of graphical displays is limited to pictographs and bar graphs.<br>• Assessment does not include climate change.<br>• <u>Students do not need to know:</u> probabilities or how to calculate them, fronts and pressure systems, the movements of weather systems.</td></tr>
<tr><td>Science Vocabulary Students Are Expected to Know</td><td colspan="3">Season, weather, temperature, precipitation, rain, snow, wind, sunlight, patterns, average.</td></tr>
<tr><td>Science Vocabulary Students Are Not Expected to Know</td><td colspan="3">Climate change, probability, anthropogenic change, latitude, longitude.</td></tr>
<tr><td colspan="4" align="center">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for 3-ESS2-1:<br>• Vienna, Austria, records more sunny days in the summer than in the winter. Data: Average sunshine hours by month for the city, given as a table or graph.<br>• People in Florida can often go outside without jackets during the winter. Data: Months and Temperatures for Florida, given as table or graph.<br>• Visitors to the desert in Death Valley, California, were surprised to be rained on. Data: Months and Precipitation Averages for the region given as table or graph.<br>• Flags in California’s San Joaquin Valley are seen blowing to the SE for most of the year, but are seen blowing to the NW in winter months. Data: Monthly average wind direction (and maybe speed) for the region, given as a table or graphic with wind direction arrows.</td></tr>
</table>

| This Performance Expectation and associated Evidence Statements support the following Task Demands. |
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| Task Demands |
| 1. Organize and/or arrange (e.g., using illustrations and/or labels), or summarize data to highlight trends, patterns, or correlations in weather patterns.*** (SEP/DCI/CCC)** |
| 2. Generate/construct graphs, tables, or assemblages of illustrations and/or labels of data that document patterns, trends, or correlations in weather patterns. This may include sorting out distractors.*** (SEP/DCI/CCC)** |
| 3. Use relationships and patterns identified in the data to predict weather. |
| 4. Identify patterns or evidence in the data that support conclusions about weather. ** |

*denotes those task demands which are deemed appropriate for use in stand-alone item development.

**TD4 can be used for stand-alone item development if paired with TD2.

<table>
<tr><td>Performance Expectation</td><td colspan="3">MS-PS1-1<br>Develop models to describe the atomic composition of simple molecules and extended structures.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models<br>• Develop and/or use a model to predict and/or describe phenomena.</td><td>PS1.A: Structure and Properties of Matter<br>• Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.<br>• Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).</td><td>Scale, Proportion, and Quantity<br>• Time, space, and energy phenomena can be observed at various scales, using models to study systems that are too large or too small.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements<br>• Emphasis is on identifying elements vs. compounds and their basic units of atoms and molecules.<br>• Emphasis is on developing models of molecules that vary in complexity.<br>• Examples of simple molecules could include ammonia, methanol, methane, water, carbon dioxide, etc.<br>• Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.<br><br>Content Limits<br>• Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.<br>• Modelling should be limited to molecules that have only one type of bond, no combination of bonds; the structure of the molecule is easy to model; single bonded molecules.<br>• Examples of extended structures could include sodium chloride or diamonds.<br>• Students are not expected to memorize the atomic characteristics of any element.<br>• <u>Students do not need to know</u>: valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, a complete description of all individual atoms in a complex molecule or extended structure, memorization of atoms found in different molecule, VSEPR or geometric arrangements, the difference between single, double, and triple bonding, periodic table patterns and how it affects bonding, oxidation numbers, polyatomic ions.</td></tr>
<tr><td>Science Vocabulary Students are Expected to Know</td><td colspan="3">Atoms, molecules, element, compound, mixtures, homogenous, heterogeneous, pure substances, solution, solvent, solute.</td></tr>
<tr><td>Science Vocabulary</td><td colspan="3">Valence electrons, subatomic particles such as protons, electrons, neutrons, neutrinos etc., ions, positive or negative charges, covalent bond, ionic bond.</td></tr>
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| Students are Not Expected to Know | |
| Phenomena | |
| Context/ Phenomena | Some example phenomena for MS-PS1-1:<br>• Submarines can stay underwater for months using sea water as a source of oxygen for air. Special machines run electricity through large amounts of sea water, generating oxygen from the water.<br>• Water and hydrogen peroxide are both made up of hydrogen and oxygen. When water is poured on a chunk of $CaCO_3$, there is no reaction. When hydrogen peroxide is poured on a chunk of $CaCO_3$, it fizzes.<br>• Graphite is an extremely soft substance and diamonds are the hardest substance known. Both are made completely of carbon atoms in different arrangements.<br>• Oxygen ($O_2$) is a gas we breathe to stay alive. Ozone ($O_3$), also made only of oxygen atoms, is unhealthy to breathe. |
| This Performance Expectation and associated Evidence Statements support the following Task Demands. | |
| Task Demands | |
| 1. Identify or assemble from a collection of potential model components, including distractors, components of a model that describes the structures of atoms, molecules, or extended molecules and/or how they interact, or explains how atoms of the same/different element(s) are arranged in repeated patterns in extended structures. | |
| 2. Describe, select, and/or identify the relationships among components of a model that describes the structures of atoms, molecules, or extended molecules and/or how they interact, or explains how atoms of the same/different element(s) are arranged in repeated patterns in extended structures. | |
| 3. Assemble, illustrate, describe, and/or complete a model or manipulate components of a model to describe the structure of an atom, molecule, or extended molecule and/or how they interact, or to explain or predict how atoms of the same/different element(s) are arranged in repeated patterns in extended structures. | |

<table>
<tr><td>Performance Expectation</td><td colspan="3">MS-LS1-1<br>Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.</td></tr>
<tr><td>Dimensions</td><td>Planning and Carrying Out Investigations<br>• Conduct an investigation to produce data to serve as the basis for evidence that meets the goals of an investigation.</td><td>LS1.A: Structure and Function<br>• All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).</td><td>Scale, Proportion, and Quantity<br>• Phenomena that can be observed at one scale may not be observable at another scale.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements<br>• Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many varying cells.<br><br>Content Limits<br>• <u>Students do not need to know</u>:<br>o The structures or functions of specific organelles or different proteins<br>o Systems of specialized cells<br>o The mechanisms by which cells are alive<br>o Specifics of DNA and proteins or of cell growth and division<br>o Endosymbiotic theory<br>o Histological procedures.</td></tr>
<tr><td>Science Vocabulary Students are Expected to Know</td><td colspan="3">Multicellular, unicellular, cells, tissues, organ, system, organism hierarchy, bacteria, colonies, yeast, prokaryote, eukaryote, magnify, microscope, DNA, nucleus, cell wall, cell membrane, algae, chloroplast(s), chromosomes, cork.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Differentiation, mitosis, meiosis, genetics, cellular respiration, energy transfer, RNA, protozoa, amoeba, histology, Protista, archaea, nucleoid, plasmid, diatoms, cyanobacteria.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for MS-LS1-1:<br>• Plant leaves and roots have tiny box-like structures that can be seen under a microscope.<br>• Small creatures can be seen swimming in samples of pond water viewed through a microscope.<br>• Different parts of a frog’s body (muscles, skin, tongue, etc.) are observed under a microscope, and are seen to be composed of cells.<br>• One-celled organisms (bacteria, protists) perform the eight necessary functions of life, but nothing smaller has been seen to do this.<br>• Swabs from the human cheek are observed under a microscope. Small cells can be seen.</td></tr>
</table>

| This Performance Expectation and associated Evidence Statements support the following Task Demands. |
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| Task Demands |
| 1. Identify from a list, including distractors, the materials/tools needed for an investigation to find the smallest unit of life (cell). |
| 2. Identify the outcome data that should be collected in an investigation of the smallest unit of living things. |
| 3. Evaluate the sufficiency and limitations of data collected to explain that the smallest unit of living things is the cell. |
| 4. Make and/or record observations about whether the sample contains cells or not. ***(SEP/DCI/CCC)** |
| 5. Interpret and/or communicate data from the investigation to determine if a specimen is alive or not. |
| 6. Construct a statement to describe the overall trend suggested by the observed data. |

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">MS-ESS1-1<br>Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and the seasons.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models<br>• Develop and use a model to describe phenomena.</td><td>ESS1.A The Universe and Its Stars<br>• Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.<br><br>ESS1.B Earth and the Solar System<br>• This model of the solar system can explain eclipses of the sun and the moon. Earth’s spin axis is fixed in direction over the short term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth over the year.</td><td>Patterns<br>• Patterns can be used to identify cause and effect relationships.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statement<br>• Examples of models can be physical, graphical, or conceptual.<br><br>Content Limits<br>• <u>Students do not need to know</u> Earth’s exact tilt; perigee and apogee; sidereal and synodic periods; umbra and penumbra (the term “shadow” should be used); times of moonrise and moonset; precession; exact dates of equinoxes and solstices (but knowledge of the months in which they occur is reasonable to assess).</td></tr>
<tr><td>Science Vocabulary Students are Expected to Know</td><td colspan="3">Sun, Earth, moon, shadow, orbit, axis, planet, satellite, full moon, new moon, half moon.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Perigee, apogee, sidereal period, sidereal month, synodic period, synodic month, umbra, penumbra, precession, equinox, solstice, ecliptic, waxing, waning, gibbous, first quarter moon, last quarter moon.</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for MS-ESS1-1:<br>• When observed from Earth over the course of a month, the appearance of the moon changes.<br>• A full moon occurs in every calendar month. However, an eclipse of the moon does not occur in every calendar month.<br>• A new moon occurs in every calendar month. However, a total eclipse of the sun is a rare event.</td></tr>
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| | • In the northern hemisphere, July is a summer month. In the southern hemisphere, July is a winter month. |
| This Performance Expectation and associated Evidence Statements support the following Task Demands. | |
| Task Demands | |
| 1. Select or identify from a collection of potential model components, including distractors, components needed for a model that can explain lunar phases, eclipses of the sun, eclipses of the moon, *or* seasons on Earth. Components might include the sun, moon, Earth, solar energy, the moon's orbital trace, Earth's orbital trace, the angle of the moon's orbital trace, the angle of Earth's orbital trace, Earth's axis, or the tilt of Earth's axis. | |
| 2. Assemble or complete, from a collection of potential model components, an illustration or flow chart that is capable of representing the causes of lunar phases, eclipses of the sun, eclipses of the moon, *or* seasons on Earth. This <u>does not</u> include labeling a simple diagram of the Earth-sun-moon system. | |
| 3. Describe, select, or identify the relationships among components of a model that can explain lunar phases, eclipses of the sun, eclipses of the moon, *or* seasons on Earth. Components might include the sun, moon, Earth, solar energy, the moon's orbital trace, Earth's orbital trace, the angle of the moon's orbital trace, the angle of Earth's orbital trace, Earth's axis, or the tilt of Earth's axis. | |
| 4. Manipulate the components of a model to demonstrate how the relationships among the sun, the moon, Earth, and solar energy change to result in lunar phases, eclipses of the sun, eclipses of the moon, *or* seasons on Earth. *** (SEP/DCI/CCC)** | |
| 5. Make predictions about the effects of changes in the relationships among the sun, the moon, Earth, and solar energy as they relate to lunar phases, eclipses of the sun, eclipses of the moon, *or* seasons on Earth. Predictions can be made by manipulating model components, completing illustrations, or selecting from lists with distractors. *** (SEP/DCI/CCC)** | |
| 6. Identify missing components, relationships, or other limitations of a model that can explain lunar phases, eclipses of the sun, eclipses of the moon, *or* seasons on Earth. | |

*denotes those task demands which are deemed appropriate for use in stand-alone item development

<table>
<tr><td>Performance Expectation</td><td colspan="3">HS-PS1-1<br>Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</td></tr>
<tr><td>Dimensions</td><td>Developing and Using Models<br>• Use a model to predict the relationships between systems or between components of a system.</td><td>PS1.A: Structure and Properties of Matter<br>• Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.<br>• The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.</td><td>Patterns<br>• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements<br>• Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.<br><br>Content Limits<br>• Assessment is limited to main group elements.<br>• Assessment does not include quantitative understanding of ionization energy beyond relative trends.<br>• <u>Students do not need to know:</u> Properties of individual elements, names of groups, anomalous electron configurations (Chromium and Copper)</td></tr>
<tr><td>Science Vocabulary Students are Expected to Know</td><td colspan="3">Proton, electron, neutron, valence shell, filled shell, ion, cation, anion, solid, liquid, gas, metal, nonmetal, metalloid, group, period, family, atom, molecule, matter, elements, states of matter, pure substance, physical property, chemical property, atomic number, atomic symbol, atomic weight, chemical formula, ionic bond, covalent bond, s, p, d, f orbitals, electron configuration, core electrons, nucleus, single, double, triple bond(s), molar mass, atomic radius, melting point, boiling point, electronegativity,</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Oxidation state, diatomic, polyatomic ions, empirical formulas, molecular formulas, quantum, photon, Heisenberg Uncertainty Principle, Hund’s Rule, Pauli Exclusion Principle</td></tr>
<tr><td colspan="4" align="center">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for HS-PS1-1:<br>• Potassium chloride (KCl) tastes similar to table salt (sodium chloride (NaCl)).<br>• Balloons are filled with helium gas instead of hydrogen gas.<br>• Scientists work with silicate substrates in chambers filled with Argon instead of air.<br>• Diamond, graphene, and fullerene are different molecules/materials that are only made of carbon.</td></tr>
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| This Performance Expectation and associated Evidence Statements support the following Task Demands. |
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| Task Demands |
| 1. Select or identify from a collection of periodic table components (periods, groups, etc.), including distractors, the components needed to model the phenomenon. |
| 2. Make predictions about the properties of elements based on the number of valence electrons. Predictions can be made by completing illustrations or selecting from lists with distractors. |
| 3. Identify missing components, relationships, or other limitations of the model. (Hydrogen similar to Alkali metals, one valence electron, and Halogens, missing only one valence electron). |
| 4. Describe, select, or identify the relationships among components of the periodic table that describe the properties of valence electrons, or explains the properties of elements. |

<table>
<tr><td>Performance Expectation</td><td colspan="3">HS-LS1-1<br>Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.</td></tr>
<tr><td>Dimensions</td><td>Constructing Explanations and Designing Solutions<br>• Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</td><td>LS1.A: Structure and Function<br>• Systems of specialized cells within organisms help them perform the essential functions of life.<br>• All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.</td><td>Structure and Function<br>• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and the connections of these components in order to solve problems.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Content Limits<br>• Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.</td></tr>
<tr><td>Science Vocabulary Students are Expected to Know</td><td colspan="3">Cell, nucleus, chromosome, gene, genetic, molecule, protein, DNA, nucleated cell, structure, function, transcription, double helix, adenine, guanine, cytosine, thymine, deoxyribose, phosphate, hydrogen bond, RNA, nucleotide, base.</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">Body tissue, organs, body systems, amino acid, primary, secondary, tertiary protein structure, translation, mRNA, tRNA, ribosome.</td></tr>
<tr><td colspan="4" align="center">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Sample phenomena for HS-LS1-1:<br>• Sweat glands cool the body by releasing sweat onto the skin's surface. A protein transports salt to help carry the water to the skin's surface. In some individuals, the salt is not reabsorbed and is left on the skin.<br>• When a blood vessel is cut, several proteins act to form a blood clot. This blood clot helps to stop the loss of blood from the body. In some individuals, when a blood vessel is cut, a blood clot does not form.<br>• During cell division, a copy of DNA in the cell is made. Sometimes mistakes are made in the DNA copy that are corrected by specific proteins. In some cells, when those mistakes in the DNA are not corrected, uncontrolled cellular division results.<br>• After a person eats, sugars from food are absorbed from the bloodstream into the body's cells. Insulin—a polypeptide hormone—allows those cells to absorb glucose from the bloodstream. In some individuals, sugars are not absorbed into the body's cells and are left in the bloodstream.</td></tr>
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| This Performance Expectation and associated Evidence Statements support the following Task Demands. |
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| Task Demands |
| 1. Describe the cause and effect relationship between a DNA sequence and the structure/function of a protein. This may include indicating the directions of causality in a model or completing a cause and effect chain. |
| 2. Describe, identify, or select evidence that supports or contradicts a claim about the role of DNA in causing the phenomenon. The evidence may be obtained from valid source(s) or might be generated by students using a simulation. |
| 3. Given an appropriate explanation for a phenomenon, predict the effects of subsequent changes to a DNA sequence in protein structure and function. Predictions may be selected from a collection of possibilities, including distractors, or they might be illustrated or described in writing. |
| 4. Use evidence to construct an explanation of how protein structure and subsequent function depend on a DNA sequence. |
| 5. Identify and justify additional pieces of evidence that would help distinguish between competing hypotheses. |

<table>
<tr><td>Performance Expectation</td><td colspan="3">HS-ESS1-1<br>Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun’s core to release energy that eventually reaches Earth in the form of radiation.</td></tr>
<tr><td>Dimensions</td><td>Developing and using models<br>• Develop a model based on evidence to illustrate the relationships between systems or between components of a system.</td><td>ESS1.A: The Universe and Its Stars<br>• The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years.<br><br>PS3.D: Energy in Chemical Processes and Everyday Life<br>• Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary)</td><td>Scale, Proportion, and Quantity<br>• The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.</td></tr>
<tr><td>Clarifications and Content Limits</td><td colspan="3">Clarification Statements<br>• Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun’s core to reach Earth.<br>• Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun’s radiation varies due to sudden solar flares (“space weather”), the 11-year sunspot cycle, and non-cyclic variations over centuries.<br><br>Content Limits<br>• Assessment does not include details of the atomic and sub-atomic processes involved with the sun’s nuclear fusion.</td></tr>
<tr><td>Science Vocabulary Students are Expected to Know</td><td colspan="3">sunspot cycle, solar maximum, solar minimum, sunspots, solar flares, UV radiation, IR radiation, convection, nuclear fusion, core, atmosphere, aurora, solar storm, northern lights</td></tr>
<tr><td>Science Vocabulary Students are Not Expected to Know</td><td colspan="3">photosphere, chromosphere, corona, luminosity, coronal mass ejections</td></tr>
<tr><td colspan="4">Phenomena</td></tr>
<tr><td>Context/ Phenomena</td><td colspan="3">Some example phenomena for HS-ESS1-1:<br>• The habitable zone in our solar system currently contains both Earth and Mars. In the future it will contain a different set of planets.<br>• The sun's current surface temperature is about 5,800 K. In 5 billion years, the sun's surface temperature will cool to 3,500 K.<br>• The sun is 40% brighter, 6% larger than 5% hotter than it was 5 billion years ago.<br>• The Earth’s atmosphere will contain more water vapor and the oceans will contain less water in a few billion years.</td></tr>
</table>

| This Performance Expectation and associated Evidence Statements support the following Task Demands. |
| --- |
| Task Demands |
| 1. Organize and/or arrange (e.g., using illustrations and/or labels), summarize or make inferences about data to highlight trends, patterns, or correlations. |
| 2. Identify patterns or evidence in the data that supports inferences about the lifespan of the sun or the transfer of energy from the sun to the earth. |
| 3. Select or identify from a collection of potential model components, including distractors, the components needed for a model that illustrates the lifespan of the sun or the transfer of energy from the sun to the earth. |
| 4. Construct or complete a model capable of illustrating the lifespan of the sun or the transfer of energy from the sun to the earth. |
| 5. Manipulate the components of a model to demonstrate the changes, properties, processes, and/or events that relevant to the lifespan of the sun or the transfer of energy from the sun to the earth. |
| 6. Identify missing components, relationships, or other limitations of the model. |
| 7. Make predictions about the effects of changes in the sun or in the transfer of energy from the sun to the earth. Predictions can be made by manipulating model components, completing illustrations, or selecting from lists with distractors. |

**MEMORANDUM OF UNDERSTANDING FOR SCIENCE ITEM SHARING**

**SCHEDULE C – CONTACT INFORMATION**

The parties agree all notices related to this MOU shall be provided in writing to the designated contacts below. The Parties further agree they will notify all Parties to this MOU in writing of any change to such contact information promptly.

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