Rhode Island and Vermont Multi-State Science Assessment

2018–2019

Volume 3: Setting Achievement Standards

Rhode Island Department of Education

VERMONT AGENCY OF EDUCATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1. Executive Summary

In 2013, the Rhode Island Department of Education (RIDE) and Vermont Agency of Education (VT AOE) adopted the Next Generation Science Standards (NGSS). The new standards employ a three-dimensional conceptualization of science understanding, including science and engineering practices, crosscutting concepts, and disciplinary core ideas. With the adoption of the NGSS standards in science, and the development of new statewide assessments to measure achievement of those standards, the Rhode Island Department of Education and the Vermont Agency of Education convened a standard-setting workshop to recommend a system of achievement standards to determine whether students have met the learning goals defined by the NGSS.

Under contract to RIDE and VT AOE, the American Institutes for Research (AIR) conducted the standard-setting workshop to recommend achievement standards for the Rhode Island Next Generation Science Assessment (RI NGSA) and Vermont Science Assessments (VTSA) at grades 5, 8, and 11. The workshop was conducted August 5–6 2019, at the Grappone Conference Center, 70 Constitution Avenue, Concord, New Hampshire.

The RI NGSA and the VTSA are designed to measure attainment of the Next Generation Science Standards. The assessments are comprised of item clusters and stand-alone items. Item clusters represent a series of interrelated student interactions directed toward describing, explaining, and predicting scientific phenomena. Stand-alone items are added to increase the coverage of the test while limiting increases in testing time and any burdens on students and schools. Test items were developed by AIR in conjunction with a group of states working to implement three-dimensional NGSS. Test items were developed to ensure that each student is administered a test meeting all elements of the Rhode Island and Vermont Science Assessment blueprints, which were constructed to align to the NGSS.

Rhode Island and Vermont science educators, serving as standard-setting panelists, followed a standardized and rigorous procedure to recommend achievement standards demarcating each achievement level. To recommend achievement standards for the new science assessments, panelists participated in the Assertion Mapping Procedure (AMP), an adaptation of the Item-Descriptor (ID) Matching procedure (Ferrara & Lewis, 2012). Consistent with ordered-item procedures generally (e.g., Mitzel, Lewis, Patz, & Green, 2001), workshop panelists reviewed and recommended achievement standards using an ordered set of scoring assertions derived from student interactions within items. Because the new science items—specifically the item clusters—represent multiple, interdependent interactions through which students engage in scientific phenomena, scoring assertions cannot be meaningfully evaluated independently of the item interactions from which they are derived. Thus, panelists were presented ordered scoring assertions for each item separately rather than for the test overall. Panelists mapped each scoring assertion to the most apt achievement-level descriptor.

Panelists reviewed Achievement-Level Descriptors (ALDs) describing the degree to which students have performed on the NGSS. Range ALDs were reviewed and revised by educator panels prior to the standard-setting workshop. After reviewing the range ALDs, standard-setting panelists worked to identify knowledge and skills characteristics of students just qualifying for entry into each achievement level.

Working through the ordered scoring assertions for each item, panelists mapped each assertion into one of the four achievement levels—Beginning to Meet Expectations, Approaching Expectations, Meeting Expectations, and Exceeding Expectations. The panelists performed the assertion mapping in two rounds of standard setting during the two-day workshop. Panelists' mapping of the scoring assertions was used to identify the location of the three achievement standards used to classify student achievement—Approaching Expectations, Meeting Expectations, and Exceeding Expectations. Mapping of scoring assertions in round 1 was based on consideration of test content only. Following round 1, panelists were provided with feedback about the mappings of their fellow panelists and discussed their mappings as a group. Panelists were then provided contextual information about the percentage of students who would meet or exceed each of the achievement standards recommended in round 1.

Twenty-six Rhode Island and Vermont science educators were selected to serve as science standard-setting panelists, with nine participants serving on the elementary and middle school panels, and eight participants serving on the high school panel. The panelists represented a group of experienced teachers and curriculum specialists, as well as district administrators and other stakeholders. The composition of the panel ensured that a diverse range of perspectives contributed to the standard-setting process. The panel was also representative in terms of gender, race/ethnicity, and region of the states.

1.1 STANDARD-SETTING WORKSHOP

1.1.1 Overall Structure of the Workshop

The key features of the workshops included the following:

- The standard-setting procedure produced three recommended achievement standards (Approaching Expectations, Meeting Expectations, and Exceeding Expectations) that will be used to classify student science achievement on the Rhode Island and Vermont NGSS Assessments.
- Panelists recommended achievement standards in two rounds.
- Context data, including the percentage of students who performed at or above the achievement level associated with each individual assertion, was provided to panelists following the first round of recommending achievement standards.
- The standard-setting workshops were conducted online using AIR's online standard-setting tool. A laptop computer was provided for each panelist at the workshop.

1.1.2 Results of the Standard-Setting Workshop

The science scores are expressed on an integer-valued scale ranging from 1 to 120. Table 1 displays the achievement standards recommended by the standard-setting panelists. Note that the scale for each grade will be re-centered around the Level 3 Standard after final approval of the standards. The scale values of the standards will shift accordingly, but the shift will not affect the percentages at or above each of the achievement standards.

Table 1. Achievement Standards Recommended for Science

Grade	Level 2 Approaching	Level 3 Meeting	Level 4 Exceeding
5	45	68	75
8	41	63	77
11	39	63	74

Table 2 indicates the percentage of students who will reach or exceed each of the achievement standards in 2019.

Table 2. Percentage of Students Reaching or Exceeding Each Recommended Science Achievement Standard in 2019

Grade	State	Level 2 Approaching	Level 3 Meeting	Level 4 Exceeding
5	**Combined**	**74**	**24**	**12**
	Rhode Island	72	23	12
	Vermont	78	26	13
8	**Combined**	**80**	**35**	**10**
	Rhode Island	78	32	9
	Vermont	84	39	12
11	**Combined**	**90**	**35**	**16**
	Rhode Island	89	31	14
	Vermont	92	42	21

Figure 1 through Figure 3 represent those values graphically.

Figure 1. Percentage of Combined Students Reaching or Exceeding Each Recommended Science Achievement Standard in 2019

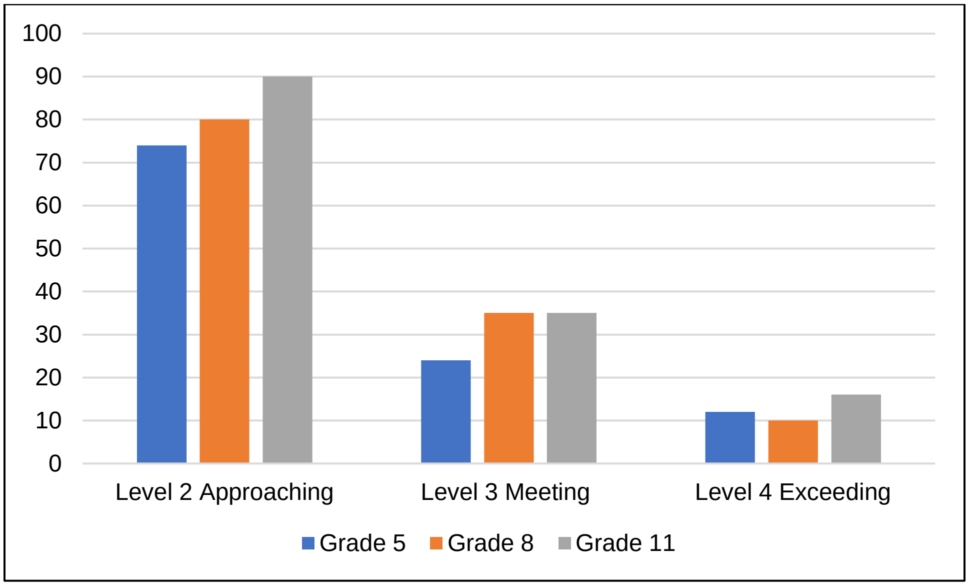


Figure 2. Percentage of Rhode Island Students Reaching or Exceeding Each Recommended Science Achievement Standard in 2019

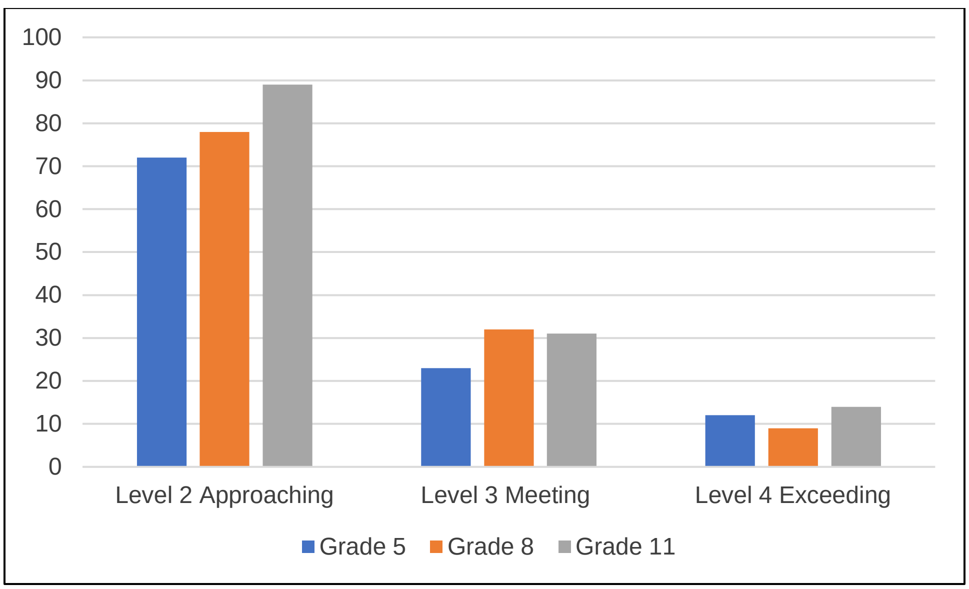


Figure 3. Percentage of Vermont Students Reaching or Exceeding Each Recommended Science Achievement Standard in 2019

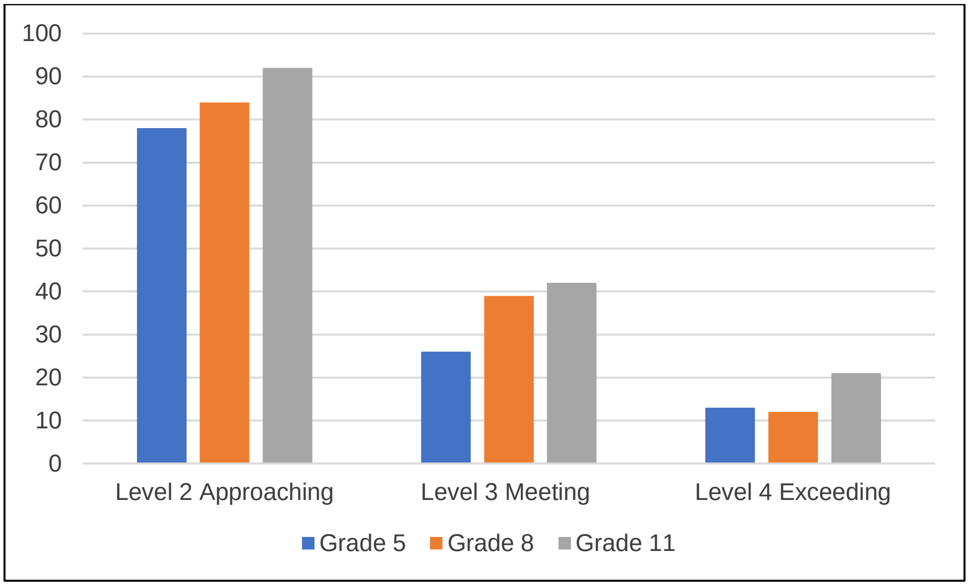


Table 3 indicates the percentage of students classified within each of the achievement levels in 2019. The values are displayed graphically in Figure 4 through Figure 6.

Table 3. Percentage of Students Classified Within Each Science Achievement Level in 2019

Grade	State	Level 1 Beginning to Meet	Level 2 Approaching	Level 3 Meets	Level 4 Exceeds
5	**Combined**	**26**	**50**	**12**	**12**
	Rhode Island	28	49	11	12
	Vermont	22	52	13	13
8	**Combined**	**20**	**45**	**25**	**10**
	Rhode Island	22	46	23	9
	Vermont	16	45	27	12
11	**Combined**	**10**	**55**	**19**	**16**
	Rhode Island	11	58	17	14
	Vermont	8	50	21	21

Figure 4. Percentage of Combined Students Classified Within Each Science Achievement Level in 2019

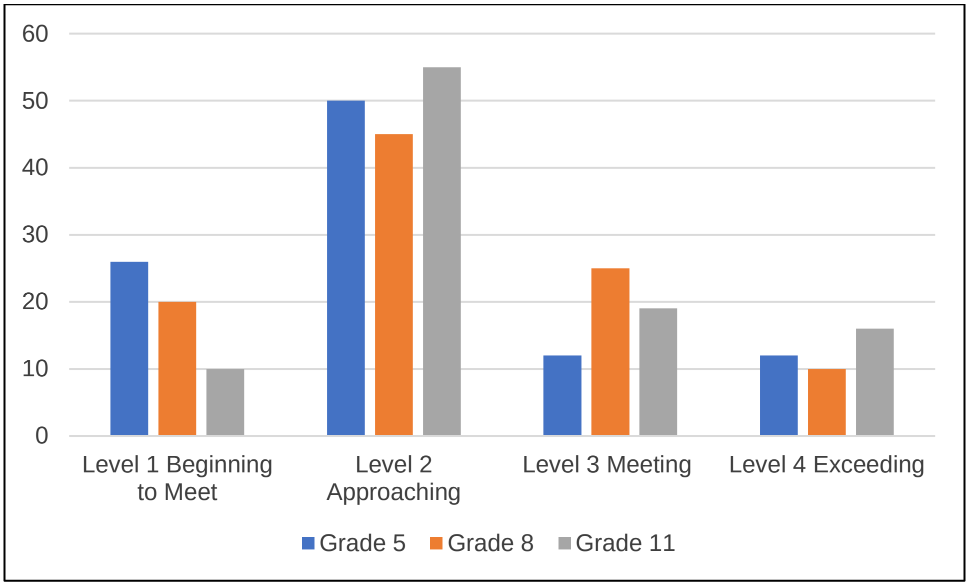


Figure 5. Percentage of Rhode Island Students Classified Within Each Science Achievement Level in 2019

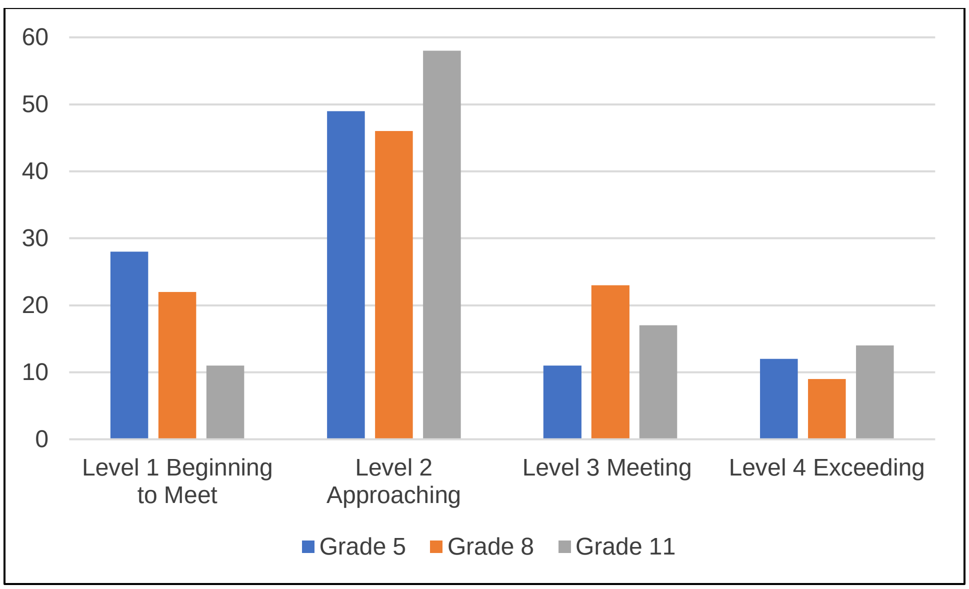
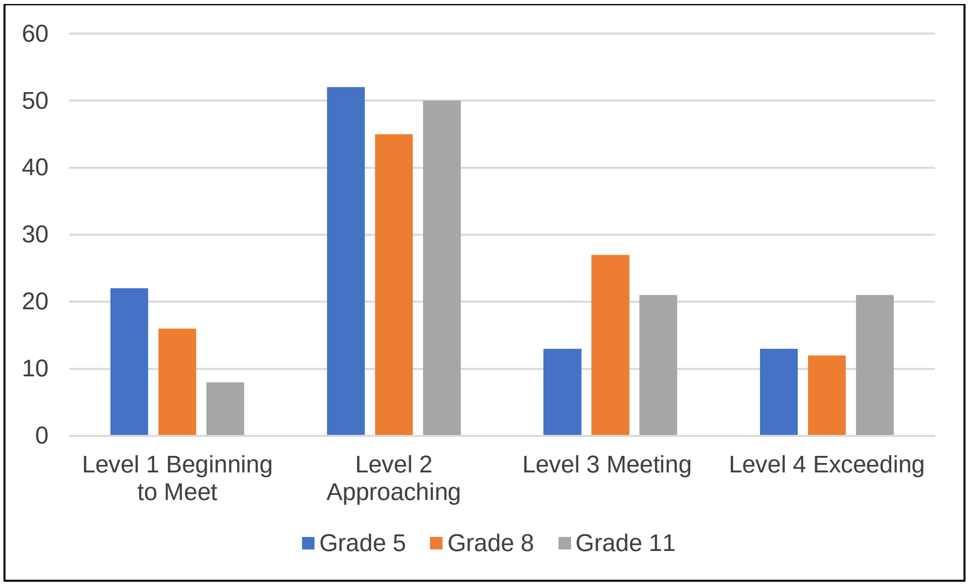


Figure 6. Percentage of Vermont Students Classified Within Each Science Achievement Level in 2019



2. INTRODUCTION

Rhode Island and Vermont adopted the Next Generation Science Standards (NGSS) in 2013. The Rhode Island Department of Education (RIDE) and the Vermont Agency of Education (VT AOE) and its assessment vendor, the American Institutes for Research (AIR), developed and administered a new assessment to measure the new standards. In spring 2019, they administered new assessments aligned to the NGSS to all grade 5, 8, and 11 students in Rhode Island and Vermont. These new assessments, the Rhode Island Next Generation Science Assessment (RI NGSA) and the Vermont Science Assessment (VTSA), were developed jointly by both states and measure the science knowledge and skills of Rhode Island and Vermont students in grades 5, 8, and 11.

Rhode Island provides information about its assessment on its website at https://www.ride.ri.gov/InstructionAssessment/Assessment/NGSAAssessment.aspx and at https://ri.portal.airast.org/get-started/test-administration-guidance.stml.

Vermont provides similar information on its website at https://education.vermont.gov/student-learning/assessments/state-and-local-assessments/science and also at https://vt.portal.airast.org/resources/vermont-science-assessment/.

New tests require new achievement standards to link achievement on the test to the content standards. RIDE and VT AOE contracted AIR to establish cut scores for the new tests. To fulfill this responsibility, AIR

- implemented an innovative, defensible, valid, and technically-sound method;

- provided training on standard setting to all participants;
- oversaw the process;
- computed real-time feedback data to inform the process; and
- produced a technical report documenting the method, approach, process, and outcomes.

Achievement standards were recommended for grades 5, 8 and 11 science in August 2019. The purpose of this report is to document the standard-setting process for the RI NGSA and the VTSA and resulting achievement standard recommendations.

3. The Next Generation Science Standards

The Next Generation Science Standards (NGSS) tests assess the learning objectives described by the NGSS, adopted in 2013.

Information about the NGSS is available at: www.nextgenscience.org.

These Standards reflect the latest research and advances in modern science and differ from previous science standards in multiple ways. First, rather than describe general knowledge and skills that students should know and be able to do, they describe specific performances that demonstrate what students know and can do. The NGSS refers to these performed knowledge and skills as *performance expectations*. Second, while unidimensionality is a typical goal of standards (and the assessments that measure them), the NGSS are intentionally multi-dimensional.

Each performance expectation incorporates all three dimensions from the NGSS Framework—a science or engineering practice, a disciplinary core idea, and a crosscutting concept. Third, while traditional standards do not consider other subject areas, the NGSS connects to other subjects like the Common Core mathematics and English language arts (ELA) standards. Another unique feature of the NGSS is the assumption that students should learn all science disciplines, rather than select a few, as is traditionally done in many high schools, where students may elect to take biology and chemistry but not physics or astronomy.

Figure 7 shows the structure of the NGSS for a single grade 5 performance expectation, 5-PS1-1.

Figure 7. Structure of NGSS Performance Expectations

Students who demonstrate understanding can:

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

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. • Use models 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 and the effects of air on larger particles or objects.	**Scale, Proportion, and Quantity** • Natural objects exist from the very small to the immensely large.

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels:
2.PS1.A ; **MS.PS1.A**

Common Core State Standards Connections:

ELA/Literacy -

RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-PS1-1)*

Mathematics -

MP.2	Reason abstractly and quantitatively. *(5-PS1-1)*
MP.4	Model with mathematics. *(5-PS1-1)*
5.NBT.A.1	Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. *(5-PS1-1)*
5.NF.B.7	Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. *(5-PS1-1)*
5.MD.C.3	Recognize volume as an attribute of solid figures and understand concepts of volume measurement. *(5-PS1-1)*
5.MD.C.4	Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. *(5-PS1-1)*

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Source: https://www.nextgenscience.org/pe/5-ps1-1-matter-and-its-interactions

4. Rhode Island and Vermont's NGSS Science Assessments

Due to the unique features of the NGSS, items and tests based on the NGSS, such as Rhode Island and Vermont's science assessment tests, must also incorporate similarly unique features. The most impactful of these changes is that NGSS tests are multi-dimensional and are thus comprised mostly of *item clusters*, which represent a series of interrelated student interactions directed toward describing, explaining, and predicting scientific phenomena.

4.1 Item Clusters and Stand-Alone Items

Item clusters include a stimulus and a series of questions that generally take students about 6–12 minutes to complete. They consist of a *phenomenon*, which is an observable fact or design problem that an engaged student explains, models, investigates, or designs, to complete a series of activities (comprised of multiple interactions) using the knowledge and skills described by the performance expectation. For example, in Figure 7, proficiency in this single performance expectation requires activities that demonstrate the ability to analyze and evaluate data, knowledge of properties and purposes of different forms of matter, and the application of experimental cause and effect. The stimulus in an item cluster explicitly states a task or goal (for example, "In the questions that follow, you will develop a model that will allow you to identify moons of Jupiter.") and subsequent interactions build upon or relate to the task or response to previous questions. The interactions within an item cluster all address the same phenomenon.

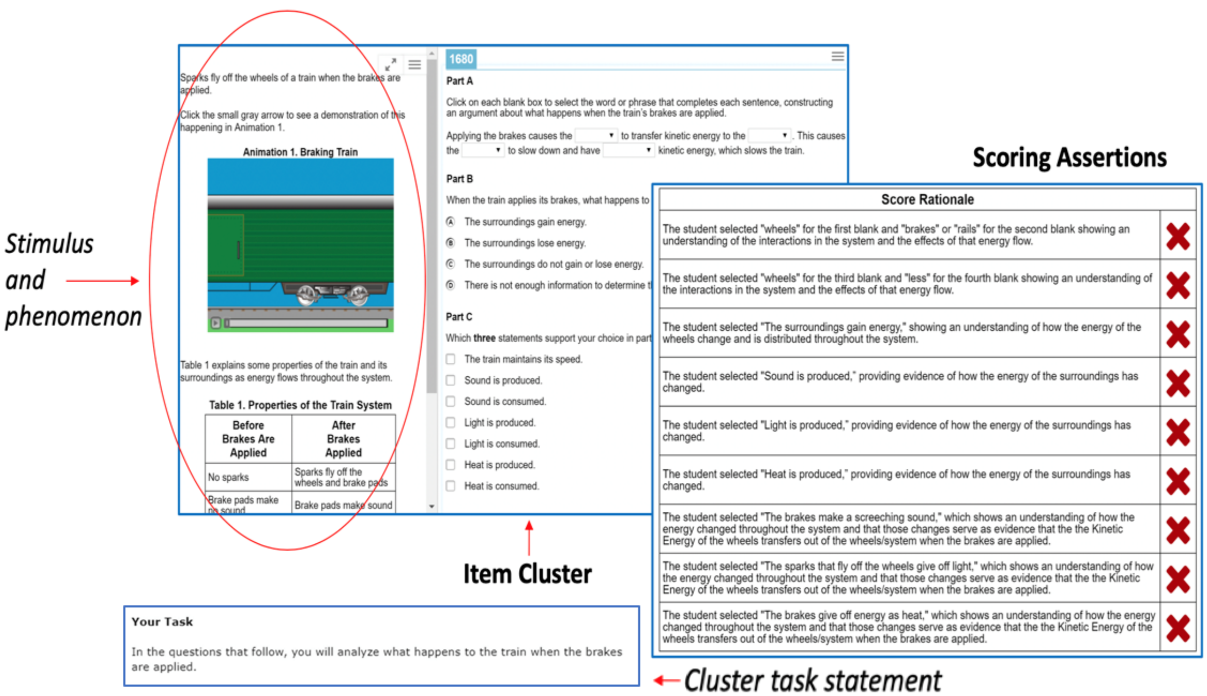
Some added stand-alone items increase the coverage of the test without also increasing testing time or testing burden. Stand-alone items are shorter, unrelated to other items, and generally take students 1–3 minutes to complete. Within each item cluster, there are a variety of interaction types including selected response, multi-select, table match, edit in-line choice, and simulations of science investigations. Stand-alone items can also be the aforementioned types.

4.2 Scoring Assertions

Each item cluster and stand-alone item assumes a series of explicit assertions about the knowledge and skills that a student demonstrates based on specific features of the student's responses across multiple interactions. *Scoring assertions* capture each measurable moment and articulate what evidence the student has provided as a means to infer a specific skill or concept. Some stand-alone items have more than one scoring assertion, while all item clusters have multiple scoring assertions.

Figure 8 illustrates an item cluster and associated scoring assertions.

Figure 8. Example NGSS Item Cluster and Scoring Assertions

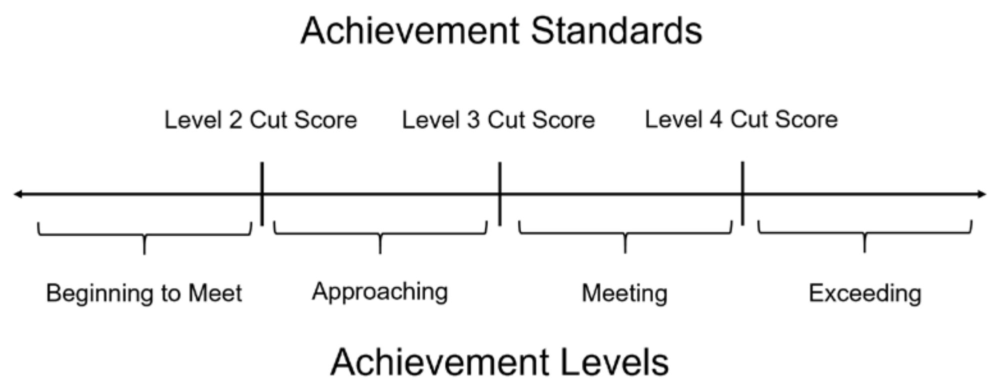


5. Standard Setting

Twenty-six educators from Rhode Island and Vermont convened at the Grappone Conference Center in Concord, New Hampshire, from August 5–6, 2019, to complete two rounds of standard setting to recommend three achievement standards for the RI NGSA and the VTSA science tests.

Standard setting is the process used to define achievement on the test. Achievement levels are defined by achievement standards, or cut scores, that specify how much of the performance expectations students must know and be able to do in order to meet the minimum for each achievement level. As shown in Figure 9, three achievement standards are sufficient to define Rhode Island and Vermont's four achievement levels.

Figure 9. Three Achievement Standards Defining Rhode Island and Vermont's Four Achievement Levels



The cut scores are derived from the knowledge and skills measured by the test items that students at each achievement level are expected to be able to answer correctly.

5.1 The Assertion-Mapping Procedure

A new approach to setting achievement standards is necessary for tests based on the Next Generation Science Standards (NGSS) due to the structure of the performance expectations and, subsequently, the structure of test items assessing the performance expectations. While traditional tests and measurement models assume unidimensionality, tests based on the NGSS adopt a three-dimensional conceptualization of science understanding. Each item cluster or stand-alone item aligns to a science practice, one or more crosscutting concepts, and one disciplinary core idea. Accordingly, the new science assessments are comprised mostly of item clusters representing a series of interrelated student interactions directed toward describing, explaining, and predicting scientific phenomena. Some stand-alone items are added to increase the coverage of the test without also increasing testing time or testing burden.

Within each item, a series of explicit assertions are made about the knowledge and skills that a student has demonstrated based on specific features of the student's responses across multiple interactions. For example, a student may correctly graph data points indicating that they can construct a graph showing the relationship between two variables, but may make an incorrect inference about the relationship between the two variables, thereby not supporting the assertion that the student can interpret relationships expressed graphically.

While some other assessments, especially ELA, comprise items probing a common stimulus, the degree of interdependence among such items is limited, and student performance on such items can be evaluated independently of student achievement on other items within the stimulus set. This is not the case with the new science items, which may, for example, involve multiple steps in which students interact with products of previous steps. However, unlike with traditional stimulus- or passage-based items, the conditional dependencies between the interactions and resulting assertions of an item cluster are too substantial to ignore because those item interactions and assertions are more intrinsically related to each other. The interdependence of student interactions within items has consequences both for scoring and recommending achievement standards.

To account for the cluster-specific variation of related item clusters, additional dimensions can be added to the Item Response Theory (IRT) model. Typically, these are nuisance dimensions unrelated to student ability. Examples of IRT models that follow this approach are the bi-factor model (Gibbons & Hedeker, 1992) and the testlet model (Bradlow, Wainer, & Wang, 1999). The testlet model is a special case of the bi-factor model (Rijmen, 2010).

Because the item clusters represent performance tasks, the Body of Work (BoW) method could also be appropriate for recommending achievement standards. However, the BoW method is manageable only with small numbers of performance tasks and quickly becomes onerous when the number of item clusters approaches 10 or more.

To address these challenges, AIR psychometricians designed a new method for setting achievement standards on new tests of the NGSS. AIR implemented this method for three state assessments in 2018.

The test-centered Assertion-Mapping Procedure (AMP) is an adaptation of the Item-Descriptor (ID) Matching procedure (Ferrara & Lewis, 2012) that preserves the integrity of the item clusters while also taking advantage of ordered-item procedures, such as the Bookmarking procedure used frequently for other accountability tests.

The main distinction between AMP and existing ordered-item procedures (e.g., Mitzel, Lewis, Patz, & Green, 2001) is that the panelists evaluate scoring assertions rather than individual items. Scoring assertions are not test items, but inferences that are supported (or not) by students' responses in one or more interactions within an item cluster or stand-alone item. Because item clusters represent multiple, interdependent interactions through which students engage in scientific phenomena, scoring assertions cannot be meaningfully evaluated independently of the item from which they are derived. Therefore, the scoring assertions from the same item cluster or stand-alone item are always presented together. Within each item cluster or stand-alone item, scoring assertions are ordered by empirical difficulty consistent with ordered-item procedures. One can think of the resulting booklet as consisting of different chapters, where each chapter represents an item cluster or stand-alone item. Within each chapter, the (ordered) pages represent scoring assertions. Similar to ID matching, panelists are asked to map each scoring assertion to the most apt achievement-level descriptor during two rounds of standard setting. Like the Bookmark method, assertion mappings are made independently with the goal of convergence over two rounds of rating, rather than consensus.[1]

[1] AIR historically implements two rounds of standard setting as best practice in the Bookmark method and extends this practice to the AMP method. In addition to lessening the panelists' burden of having to repeat a cognitively

5.2 Workshop Structure

During the workshop, one large meeting room served as an all-participant training room. This room broke into three separate working rooms, one for each set of grade-level panels, after the all-group orientation. As shown in Figure 10, three separate panels set achievement standards for each grade.

Figure 10. Workshop Panels per Room

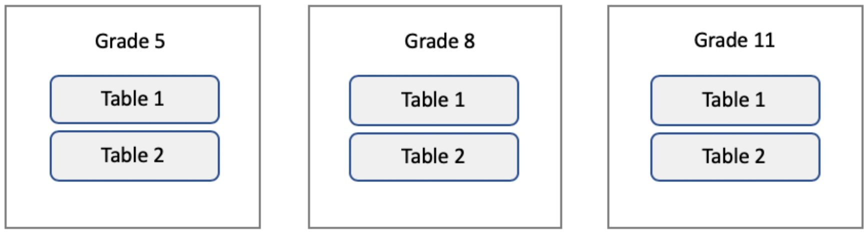


Table 4 summarizes the composition of the tables and the number of facilitators and panelists assigned to each. The 26 standard-setting participants included table leaders and panelists from Rhode Island and Vermont who taught in the content area and grade level for the standards being set.

Table 4. Table Assignments

Room	Grade	Tables (Table Leaders)	Panelists (Per Table)	Number of Panelists		Facilitator	Facilitator Assistant
				Rhode Island	Vermont		
1	5	Overall (2)	9	4	5	Jim McCann	Matt Davis
		Table 1 (1)	5	2	3		
		Table 2 (1)	4	2	2		
2	8	Overall (2)	9	7	2	Kevin Dwyer	Hibbah Haddam
		Table 1 (1)	4	3	1		
		Table 2 (1)	5	4	1		
3	11	Overall (2)	8	6	2	Meg McMahon	Kam Mangis de Mark
		Table 1 (1)	4	3	1		
		Table 2 (1)	4	3	1		

demanding task for a third time, using two rounds introduces significant cost efficiency by reducing the number of days needed for standard setting. Panels typically converge in round 2, and panelists completing two rounds report levels of confidence in the outcomes that are similar to the confidence expressed by panelists participating in three rounds. Psychometric evaluation of the reliability and variability in results from two and three rounds are generally consistent. AIR has used two rounds in standard setting in more than 16 states and 34 assessments, beginning in 2001 with the enactment of NCLB.

5.3 Participants and Roles

5.3.1 Department of Education Staff

Staff from Rhode Island Department of Education (RIDE) and the Vermont Agency of Education (VT AOE) were present throughout the process and provided overall policy context and answered any policy questions that arose.

From RIDE, they included:

- Phyllis Lynch, Director, State Assessment
- Erin Escher, Science Specialist
- Kate Schulz, Instructional Improvement/Science Specialist
- Kamlyn Keith, Assessment Specialist
- Ana Karantonis, Assessment Specialist

From VT AOE, attendees included:

- Margaret Carrera-Bly, Science Specialist
- Gabriel McGann, Statewide Assessment Coordinator

5.3.2 AIR Staff

AIR facilitated the workshop and the sessions in each of the content-area rooms, provided psychometric and statistical support, and oversaw technical set-up and logistics. AIR team members included:

- Dr. Stephan Ahadi, Managing Director of Psychometrics, facilitated and oversaw all AMP processes and tasks. He provided training to participants, including the facilitators and table leaders.
- Dr. Frank Rijmen, Director of Psychometrics, supervised all psychometric analyses conducted during and after the workshop.
- Dr. Mengyao Cui, Psychometrician, provided psychometric analyses.
- Alesha Ballman, Psychometric Project Coordinator, oversaw analytics technology and psychometrics.
- Azza Hussein and Matthew Andersen, Psychometric Support Assistants, provided support as needed.
- Elizabeth Mortimer, SooYun Chung, and Hannah Binder, members of the Program Management Team, managed process and logistics throughout the meeting.
- Drew Azar, System Support Agent, set up, tested, and troubleshot technology during the workshop.

5.3.3 Observers

Barbara Plake, a member of the Technical Advisory Committee (TAC) for Rhode Island and Vermont, attended the workshop. As an observer, she did not interact with panelists or impact the process in any way.

5.3.4 Room Facilitators

An AIR room facilitator and assistant facilitator guided the process in each room. Facilitators were content experts experienced in leading standard-setting processes, had led standard-setting processes before, and could answer any questions about the workshop or about the items or what the items were intended to measure. They also monitored time and motivated panelists to complete tasks within the scheduled time. Facilitators included the individuals below.

- Jim McCann served as the grade 5 room facilitator, and Matt Davis served as assistant room facilitator.
- Kevin Dwyer served as the grade 8 room facilitator, and Hibbah Haddam served as assistant room facilitator.
- Meg McMahon served as the grade 11 room facilitator, and Kam Mangis de Mark served as assistant room facilitator.

Each facilitator was trained to be extensively knowledgeable of the constructs, processes, and technologies used in standard setting.

5.3.5 Educator Participants

To establish achievement standards, the RIDE and the VT AOE recruited a diverse variety of participants from across Rhode Island and Vermont. Panelists included science teachers, administrators, and representatives from other stakeholder groups (e.g., higher education) to ensure that a diverse range of perspectives contributed to the standard-setting process and product. In recruiting panelists, RIDE and VT AOE targeted participants who were representative of the gender and geographic representation of the teacher population found in both states and the diversity of the students they serve. All participants also had to be familiar with NGSS content and tests.

Overall, panelists were 23 percent male and 8 percent non-white. Ninety-two percent were teachers (all of whom taught science), and eight percent were either coaches or administrators. Most worked in schools (81 percent), and exactly half represented large districts. Panelists came from rural (38 percent), suburban (38 percent) and urban (23 percent) districts. Table 5 summarizes the characteristics of the panels.

Table 5. Panelist Characteristics

	Percentage of Panelists by Panel			
	Grade 5	**Grade 8**	**Grade 11**	**Overall**
Characteristics				
Male	11%	0%	63%	23%
Non-White	0%	11%	13%	8%
Stakeholder Group				
Administrator	0%	11%	0%	4%
Coach	11%	0%	0%	4%
Teacher	78%	56%	100%	77%
Teacher, Coach	11%	0%	0%	4%
Teacher, Other	0%	11%	0%	4%
Teacher, Specialist	0%	11%	0%	4%
Teacher, Specialist, Coach	0%	11%	0%	4%
Current Position				
District	0%	22%	0%	8%
School	89%	67%	88%	81%
School, District	11%	0%	13%	8%
School, District, Other	0%	11%	0%	4%
District Size				
Large	33%	56%	63%	50%
Medium	22%	22%	25%	23%
Small	44%	22%	13%	27%
District Urbanicity				
Urban	0%	44%	25%	23%
Suburban	22%	33%	63%	38%
Rural	78%	22%	13%	38%
Primary Grades Taught				
ES (grades K–5)	67%	0%	0%	23%
MS (grades 6–8)	0%	78%	0%	27%
HS (grades 9–12)	0%	0%	100%	31%
ES and MS (grades 1–8)	33%	22%	0%	19%
MS and HS (grades 6–12)	0%	0%	0%	0%
ES, MS, and HS (all grades)	0%	0%	0%	0%
N/A (Non-educators)	0%	0%	0%	0%
Subjects Taught				
Science	100%	100%	100%	100%

	Percentage of Panelists by Panel			
	Grade 5	**Grade 8**	**Grade 11**	**Overall**
Other (including N/A)	0%	0%	0%	0%

For results of any judgment-based method to be valid, the judgments must be made by qualified individuals. Participants in the Rhode Island and Vermont standard-setting workshop were highly qualified and brought a variety of experience and expertise. Many had taught for more than 11 years, over a third had taught for more than 20 years, and 42 percent also had additional professional experience outside the classroom. Many had experience teaching special populations; 92 percent taught students receiving free/reduced price lunch, 69 percent taught English language learners (ELLs), and 96 percent taught students on an Individualized Educational Program (IEP). The participants represented a range of stakeholders, such as educators, administrators, parents, and business leaders. Table 6 summarizes the qualifications of the panelists.

Table 6. Panelist Qualifications

	Percentage of Panelists by Grade			
	Grade 5	**Grade 8**	**Grade 11**	**Overall**
Highest Degree				
Bachelors	44%	22%	13%	27%
Masters	56%	78%	88%	73%
Doctorate	0%	0%	0%	0%
Other	0%	0%	0%	0%
Years teaching experience				
0 years	0%	0%	0%	0%
1–5 years	22%	0%	13%	12%
6–10 years	0%	22%	13%	12%
11–15 years	22%	22%	25%	23%
16–20 years	22%	22%	13%	19%
21+ years	33%	33%	38%	35%
Years teaching experience in assigned grade/subject				
0 years	0%	0%	0%	0%
1–5 years	56%	11%	13%	27%
6–10 years	11%	22%	13%	15%
11–15 years	22%	11%	25%	19%
16–20 years	0%	11%	13%	8%
21+ years	11%	44%	38%	31%
Other professional experience in education	33%	56%	38%	42%
Years professional experience in education				

	Percentage of Panelists by Grade			
	Grade 5	**Grade 8**	**Grade 11**	**Overall**
0 years	67%	44%	63%	58%
1–5 years	11%	44%	25%	27%
6–10 years	11%	0%	0%	4%
11–15 years	11%	0%	0%	4%
16–20 years	0%	0%	0%	0%
21+ years	0%	11%	13%	8%
Experience teaching special student populations				
Students receiving free/reduced price lunch	89%	100%	88%	92%
English Language Learners	44%	89%	75%	69%
Students on an IEP	100%	100%	88%	96%

Note. Percentages in table describe all participants, not just educator participants. Abbreviation Key: Individualized Education Plan (IEP).

Appendix A. Standard-Setting Panelist Characteristics provides additional information about the individuals participating in the standard-setting workshop.

5.3.6 Table Leaders

The RIDE and the VT AOE pre-selected table leaders from the participant pool for their specialized knowledge or experience with the assessment, items, or Next Generation Science Standards. In addition to serving as panelists and mapping assertions, table leaders had the additional responsibility of ensuring that table activities remain focused, ensuring that panelists understand their assignment and alerting workshop leaders to any issues encountered by panelists.

Table leaders trained as a group early in the morning of the first day to ensure that each table leader was knowledgeable of the constructs, processes, and technologies used in standard setting and was able to adhere to a standardized process across the grade/subject committees. Training consisted of an overview of their responsibilities and some process guidance.

Table leaders provided the following support throughout the workshop:

- Led table discussions
- Helped panelists see the “big picture”
- Monitored the security of materials
- Monitored panelist understanding and reported issues or misunderstandings to room facilitators
- Maintained a supportive atmosphere of professionalism and respect

5.4 MATERIALS

5.4.1 Achievement-Level Descriptors

With the adoption of the new standards in science, and the development of new statewide assessments to assess achievement of those standards, Rhode Island and Vermont must adopt a similar system of achievement, or achievement standards, to determine whether students have met the learning goals defined by the new standards in science.

Determining the nature of the categories into which students are classified is a prerequisite to standard setting. These categories, or achievement levels, are associated with achievement-level descriptors (ALDs) that define the content-area knowledge, skills, and processes that students at each achievement level can demonstrate.

ALDs link the content standards (NGSS performance expectations) to the achievement standards. There are four types of ALDs:

1. *Policy ALDs*. These are brief descriptions of each achievement level that do not vary across grade or content area.
2. *Range ALDs*. Provided to panelists to review and endorse during the workshop, these detailed grade- and content-area-specific descriptions communicate exactly what students performing at each level know and can do.
3. *Threshold ALDs*. Typically created during standard setting and used for standard setting only, these describe what a student Just Barely scoring into each achievement level knows and can do. They may also be called Target ALDs or Just Barely ALDs.
4. *Reporting ALDs*: These are much-abbreviated ALDs (typically 350 or fewer characters) created following state approval of the achievement standards used to describe student achievement on score reports.

Rhode Island and Vermont use four achievement levels to describe student achievement: “Beginning to Meet Expectations,” “Approaching Expectations,” “Meeting Expectations,” and “Exceeding Expectations.” At the policy-level, these achievement levels are defined as:

- **Beginning to Meet Expectations.** Students who achieve at this level demonstrate initial understanding of knowledge and skills needed to apply three dimensions of science to question, evaluate, and explain science phenomena. Student performance based on assessment results begins to meet grade-level expectations.
- **Approaching Expectations.** Students who achieve at this level demonstrate minimal understanding of knowledge and skills needed to apply three dimensions of science to question, evaluate, and explain science phenomena. Student performance based on assessment results partially meets grade-level expectations.
- **Meeting Expectations.** Students who achieve at this level demonstrate satisfactory understanding of knowledge and skills needed to apply three dimensions of science to question, evaluate, and explain science phenomena. Student performance based on assessment results meets grade-level expectations.

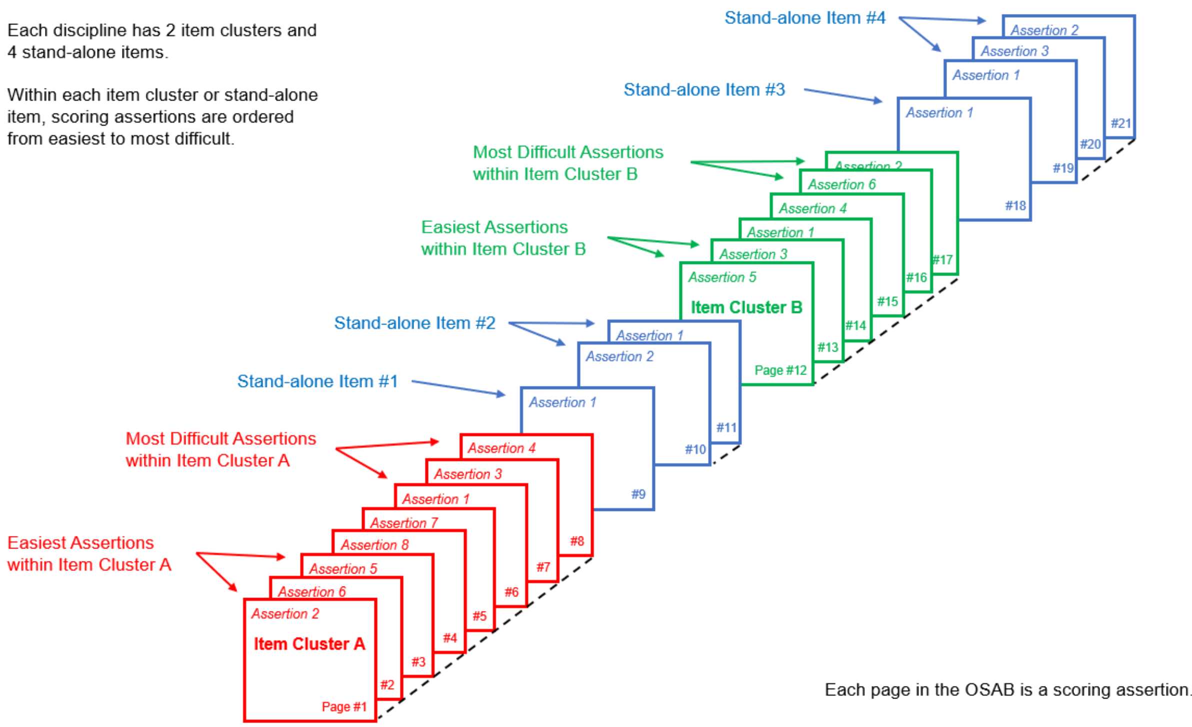
- **Exceeding Expectations.** Students who achieve at this level demonstrate advanced understanding of knowledge and skills needed to apply three dimensions of science to question, evaluate, and explain science phenomena. Student performance based on assessment results exceeds grade-level expectations.

Appendix B: Achievement-Level Descriptors provides the final ALDs for the RI NGSA and the VTSA.

5.4.2 Ordered Scoring Assertion Booklets

Like the Bookmark method used for establishing achievement standards for traditional science tests, the AMP method uses booklets of ordered test materials for setting standards. Instead of test items, the AMP uses scoring assertions presented in grade-specific booklets called ordered scoring assertion booklets (OSABs). Each OSAB represents one possible testing instance resulting from applying the test blueprints to the item bank. Figure 11 describes the structure of the OSAB.

Figure 11. Ordered Scoring Assertion Booklet (OSAB)



For the OSABs, the item clusters and stand-alone items are presented by discipline; Earth and Space Sciences items were presented first, then Life Sciences items, and then Physical Sciences items. Two item clusters and four stand-alone items represent each discipline. Within a discipline, item clusters and stand-alone items were intermixed, just like item clusters and stand-alone items would be selected at random by the algorithm that was used to assemble operational tests linearly on the fly.

Within each item cluster or stand-alone item, scoring assertions are ordered by difficulty. Easier assertions are those that the most students were able to demonstrate, and difficult assertions are those that the fewest students were able to demonstrate. Note that assertions were ordered by difficulty within items only. Across all items, this was generally not the case; for example, the most difficult assertion of an item presented early on in the OSAB was typically more difficult than the easiest assertion of the next item in the OSAB. That is, the order of assertions in Figure 11 represents the order of presentation to the panelists, but assertions were not ordered by overall difficulty across all items.

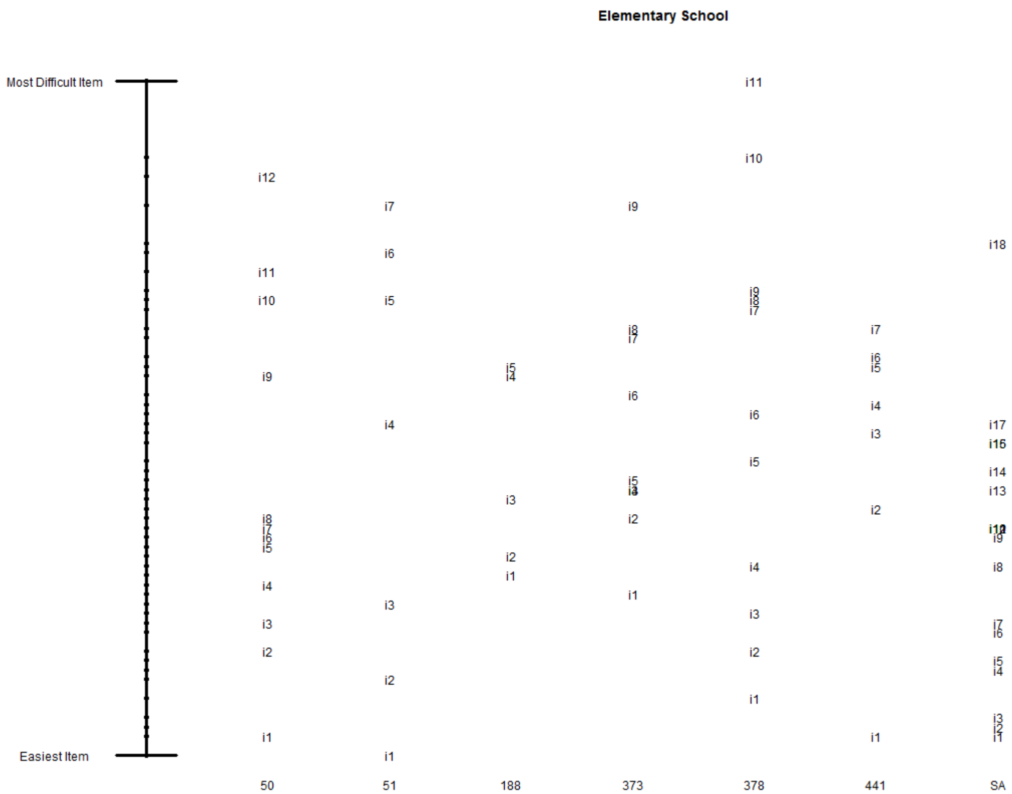
Not all items have assertions that will map onto all achievement levels. For example, an item cluster may have assertions that map onto “Beginning to Meet Expectations,” “Approaching Expectations,” and “Meeting Expectations,” but not “Exceeding Expectations.”

Each OSAB contains three disciplines and 18 items (item clusters and stand-alone items). The grade 5 OSAB contained 69 assertions, the grade 8 OSAB contained 78 assertions, and the grade 11 OSAB contained 78 assertions. Each was comprised of six item clusters and 12 stand-alone items.

5.4.3 Assertion Maps

Assertion Maps listed all scoring assertions in the OSAB by page number, item ID, and item type (i.e., part of an item cluster or stand-alone item) and plotted all assertions by difficulty. The maps provided panelists with context about student performance on the assertions in the OSAB, describing the difficulty of each assertion in the underlying OSAB. This was to help panelists easily identify more- or less-difficult assertions and compare the difficulty of assertions across items. The assertion maps were provided during the OSB review. After Round 1, the assertion maps were updated to also display the tentative standards. Figure 12 presents the assertion map for grade 5. The assertions maps for grades 8 and 11 are presented in Appendix C. Standard-Setting Assertion Maps.

Figure 12. Elementary School Assertion Map

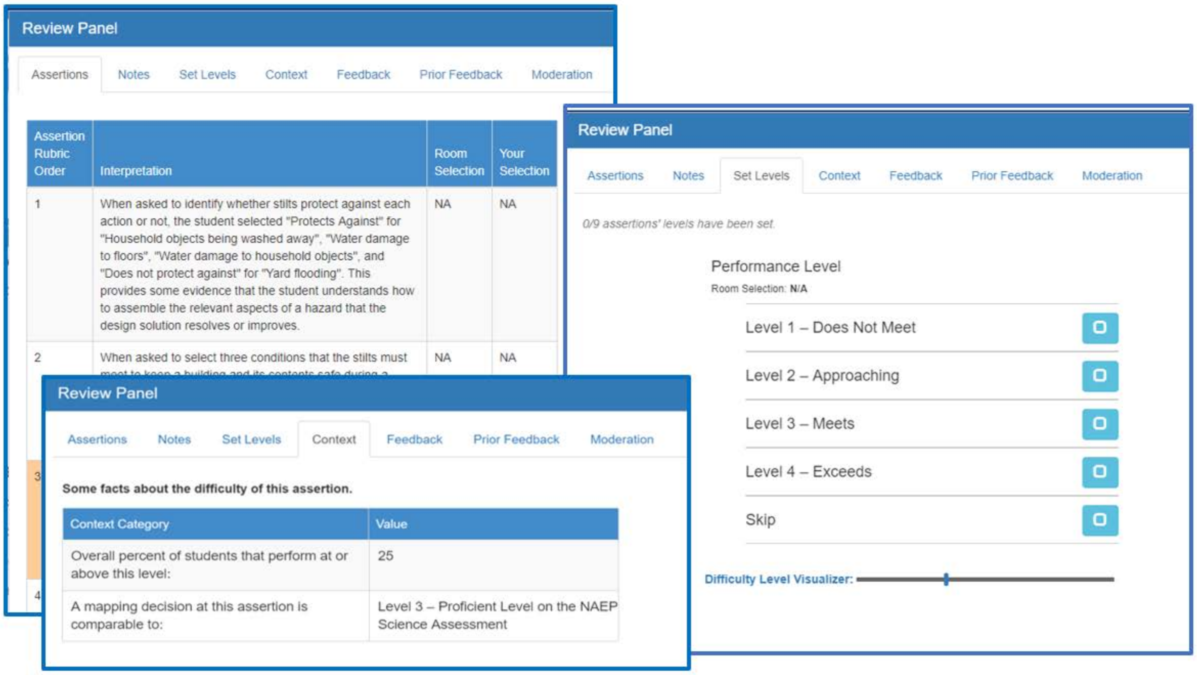


5.5 WORKSHOP TECHNOLOGY

The standard-setting panelists used AIR's online application for standard setting. Each panelist used an AIR laptop or Chromebook on which they took the test, reviewed item clusters, stand-alone items, and ancillary materials, and mapped assertions to achievement levels.

Using tabs in the review panel of the toolbar (see Figure 13), panelists could review the items and scoring assertions, determine the relative difficulty of assertions to other assertions in the same item, examine the content alignment of each item (via the alignment of the assertions within an item, which all align to the same performance expectation), assign assertions to achievement levels, add notes and comments on the assertions as they reviewed them, and review context data. Additionally, they had access to a *difficulty visualizer*, a graphic representation of the difficulty of each assertion relative to the all other assertions in the OSAB (not just within the item). Panelists also reviewed their own assertion placement, their table's placement, the other tables' placement, and the overall placement for all tables.

Figure 13. Example Features in Standard-Setting Tool



A full-time AIR IT specialists oversaw laptop setup and testing, answered questions, and ensured that technological processes ran smoothly and without interruption throughout the meeting.

5.6 Events

The standard-setting workshop occurred over a period of two days. Table 7 summarizes each day's events, and this section describes each event listed in greater detail. Appendix D. Standard-Setting Workshop Agenda provides the full workshop agenda.

Table 7. Standard-Setting Agenda Summary

Day 1: Monday, August 5, 2019
• Table leader orientation • Registration • Large-group introductory training • Take the test • ALD review • OSAB review
Day 2: Tuesday, August 6, 2019

- OSAB review (continued)
- Assertion-mapping training
- Round 1—assertion mapping
- Round 1—feedback and context data review and discussion
- Round 2—assertion mapping
- Round 2—feedback and context data review
- Workshop evaluation and debrief

5.6.1 Table Leader Orientation

Table leaders met as a group early in the morning of the first day for a briefing on the constructs, processes, and technologies used in standard setting. The objective of the training was to ensure everyone followed a standardized process across all grade panels.

Table leaders were to provide the following throughout the workshop:

- Help panelists see the "big picture"
- Lead table discussions
- Support panelists with tasks
- Monitor security of materials
- Monitor panelist understanding and report issues or misunderstandings to room facilitators
- Maintain a supportive atmosphere of professionalism and respect

In addition to these responsibilities, table leaders also served as panelists and set individual cut scores.

Appendix E. Standard-Setting Training Slides provides the slides used during the table leader orientation.

5.6.2 Registration

As panelists arrived at the workshop, they received packets of materials to refer to during the workshop and signed affidavits of non-disclosure, affirming that they would not reveal any secure information they would have access to during the workshop.

5.6.3 Large-Group Introductory Training

Phyllis Lynch from RIDE and Gabriel McGann from VT AOE welcomed panelists to the workshop and provided context and background for the Rhode Island and Vermont NGSS Assessments. Dr. Stephan Ahadi then oriented participants to the workshop by describing the purpose and objectives of the meeting, explaining the process to be implemented to meet those objectives and outlining the events that would happen each day. He reviewed the responsibilities of the three groups of people at the workshop: panelists, AIR staff, and RIDE and VT AOE personnel. He explained that panelists were selected because they were experts, and how the process to be implemented over the two days was designed to elicit and apply their expertise to recommend new cut scores. Finally, he described how standard setting works and what would happen once the panelists had finalized their recommendations. Appendix E. Standard-Setting Training Slides provides the slides used during the large-group training.

5.6.4 Confidentiality and Security

Workshop leaders and room facilitators addressed confidentiality and security during orientation and again in each room. Standard setting uses live science test items from the operational NGSS test, requiring confidentiality to maintain their security. Participants were instructed not to do any of the following during or after the workshop:

- Discuss the test items outside of the meeting
- Remove any secure materials from the room during breaks or at the end of the day
- Discuss judgments or cut scores (their own or others') with anyone outside of the meeting
- Discuss secure materials with non-participants
- Use cell phones in the meeting rooms
- Take notes on anything other than provided materials
- Bring any other materials into the workshop

Participants could have general conversations about the process and days' events, but workshop leaders warned them against discussing details, particularly those involving test items, cut scores, and any other confidential information.

5.6.5 Take the Test

Following the large-group introductory training, participants broke out into their separate grade-level rooms. As an introduction to the standard-setting process, panelists took a form of the test that students took in 2019, in the grade level to which they would be setting achievement standards. They took the tests online via the same tool used to deliver operational tests to students, and the testing environment closely matched that of students when they took the test.

Taking the same test students take provides the opportunity to interact with and become familiar with the test items and the look and feel of the student experience while testing. They could score their responses and had 90 minutes to interact with the test.

5.6.6 Achievement-Level Descriptor Review

After taking the test, panelists completed a thorough review of the ALDs for their assigned grade. They identified key words describing the skills necessary for achievement at each level and discussed the skills and knowledge that differentiated achievement in each of the four levels.

Facilitators encouraged panelists to pay special attention to the transition areas between achievement levels and consider the characteristics of students who Just Barely qualify for entry into the achievement level from those just below. These students are not typical of students in the achievement level; they are poor examples of the achievement level, but they do Just Barely meet the expectation.

Reviewing the ALDs ensured that participants understood what students are expected to know and be able to do, how much knowledge and skills students are expected to demonstrate at each level of achievement, and how to differentiate performance at each level of achievement.

5.6.7 Ordered Scoring Assertion Booklet Review

After reviewing the ALDs, panelists independently reviewed the item clusters, stand-alone items, and assertions in the OSAB. They took notes on each assertion to document the interactions required by each and described why an assertion might be more or less difficult than the previous assertion within the item. They also noted how each assertion related to the ALDs.

After reviewing the item interactions and scoring assertions individually, panelists engaged in discussion with table members about the skills required and relationships among the reviewed test materials and achievement levels. This process ensured that panelists built a solid understanding of how the scoring assertions relate to the item interactions and how the items relate to the ALDs, and also helped to facilitate a common understanding among workshop panelists.

5.6.8 Assertion-Mapping Training

After reviewing the entire OSAB, facilitators described the processes for mapping assertions and determining cut scores. They explained that the objective of standard setting is aspirational; to identify what all students should know and be able to do, and not to describe what they currently know and can do.

Panelists were instructed to match each assertion to the achievement level best supported by the assertion using the ALDs, the difficulty visualizer (described in Section 5.5), their notes from the OSAB review, and their professional judgments. Figure 14 graphically describes the assertion-mapping process.

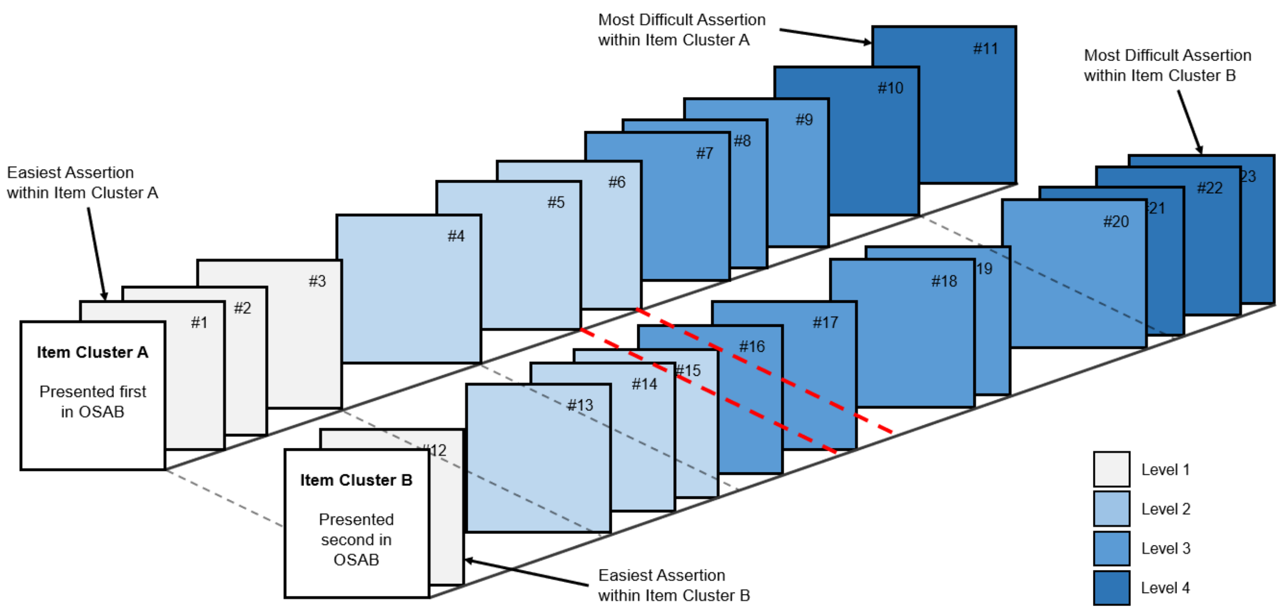
Facilitators provided the following three-part process to guide the mapping of assertions onto ALDs:

1. How does the student interaction give rise to the assertion? Did they plot, select, or write something?
2. Why is this assertion more difficult to achieve than the previous one?
3. Which ALD best describes this assertion?

It was emphasized that assertions within an item were ordered by difficulty, and therefore, the assigned achievement levels should be ordered, as well. Within each item, panelists were not allowed to place an assertion into a lower achievement level than the level at which the previous assertions had been placed. If panelists felt very strongly that an assertion was out of order in the OSAB, they were asked to skip (not assign any achievement level to) the assertion. However, this was to be used as a last resort.

Because the assertion mapping was done separately for each item, it was possible that there was no perfect ordering of the assigned levels of the assertions across all items as a function of assertion difficulty. It was allowed (and frequently occurred) that an assertion of one item had a higher difficulty but lower assigned achievement level than another assertion from a different item. For example, in Figure 14, the difficulty of the assertion on page 6 of item cluster A ("Level 2") has a higher difficulty than the assertion on page 17 of item cluster B ("Level 3"). However, it was expected for the higher achievement levels to be assigned more frequently with increasing assertion difficulty across items. Appendix E. Standard-Setting Training Slides provides the training slides used during the breakout room training.

Figure 14. Example of Assertion Mapping



Note. Figure 14 describes scoring assertion mapping across two item clusters, where the assertions on pages 1, 2, 3, and 12 are mapped onto Level 1, the assertions on pages 4, 5, 6, 13, 14 and 15 are mapped onto Level 2, the assertions on pages 7, 8, 9, 16, 17, 18, 19, and 20 are mapped onto Level 3, and the assertions on pages 10, 11, 21, 22, and 23 are mapped onto Level 4.

5.6.9 Practice Quiz

Panelists completed a practice quiz prior to beginning a practice round. The quiz assessed panelists' understanding in multiple ways. They must be able to:

- describe where "Just Barely" students fall on an achievement scale;
- indicate on a diagram how achievement standards define achievement levels;
- identify more- and less-difficult scoring assertions in the OSAB; and
- answer questions about the assertion-mapping process and online application.

Room facilitators reviewed the quizzes with the panelists and provided additional training for incorrect responses on the quiz. Appendix F. Standard-Setting Practice Quiz provides the quiz that panelists completed prior to mapping any assertions.

5.6.10 Practice Round

Following the practice quiz, panelists practiced mapping assertions to ALDs in a short practice OSAB consisting of one item cluster. The purpose of the practice round was to ensure that panelists were comfortable with the technology, items, item interactions, and scoring assertions prior to mapping any assertions in the OSAB. Panelists discussed their practice mappings and asked questions, and room facilitators provided clarifications and further instructions until everyone had successfully completed the practice round.

5.6.11 Readiness Form

After completing the practice round, and prior to mapping assertions in round 1, panelists completed a readiness assertion form. On this form, panelists asserted that their training was sufficient for them to understand the following concepts and tasks:

- The concept of a student who Just Barely meets the criteria described in the ALDs
- The structure, use, and importance of the OSAB
- The process to determine and map assertions to ALDs in the standard-setting tool
- The readiness to begin the round 1 task

The readiness form for round 2 focused on affirming understanding of the context data supplied after round 1. On this form, all panelists affirmed the following:

- Understanding the context data
- Understanding the feedback data
- Understanding the round 2 task, and
- Readiness to complete the round 2 task

Room facilitators reviewed the readiness forms and provided additional training to panelists not asserting understanding or readiness. However, every panelist affirmed readiness before mapping assertions in both rounds of the workshop. Appendix G. Standard-Setting Readiness Forms provides the form that panelists completed prior to each round of standard setting. Notwithstanding the readiness forms and additional training, the room facilitator for grade 11 flagged one panelist for not fully understanding the task of mapping assertions to ALDs. After a discussion with AIR psychometricians and RIDE and VT AOE staff, it was decided to let the panelists proceed to round 1 but monitor the actual ratings.

5.7 ASSERTION MAPPING

Panelists mapped assertions independently, using the ALDs, their notes from reviewing each assertion, and the difficulty visualizer to place each of the assertions into one of the four achievement levels.

5.7.1 Calculating Cut Scores from the Assertion Mapping

A propriety algorithm utilized RP67 (for grades 5 and 8) and RP50 (for grade 11) to minimize misclassifications to calculate cut scores based on the assertion mappings.[2] Each cut score was defined as the score point that minimized the weighted number of discrepancies between the mappings implied by the cut score and the observed mappings. The weights were defined as the inverse of the observed frequencies of each level. For each cut score, only the assertions that were mapped to the two adjacent levels were considered (e.g., for the second cut, only the assertions that were mapped onto the levels "Approaching" and "Meeting" were used). Specifically, et n_k be the number of assertions put at achievement level k, t_k be the cut to be estimated, d_i be the assigned performance level and θ_i be the RP value of the ith assertion. For each assertion placed at levels k and $k+1$, define the misclassification indicator as

$$z_{ik}|t_k = \begin{cases} 1 \text{ if } (d_i = k \text{ and } t_k \leq \theta_i) \text{ or } (d_i = k+1 \text{ and } t_k > \theta_i) \\ 0 \text{ otherwise} \end{cases}$$

The cut t_k is then estimated by minimizing a loss function based on the weighted number of misclassifications

$$\underset{t_k}{\arg\min} \left(\frac{1}{n_k} \sum_{i \in \{d_i = k\}} z_{ik}|t_k + \frac{1}{n_{k+1}} \sum_{i \in \{d_i = k+1\}} z_{ik}|t_k \right)$$

Cut scores at the table and grade level were computed using the same method while taking into account the assigned levels of all the raters at the table and grade, respectively. Applying these cut scores to the 2019 test data created data describing the percentage of students falling into each achievement level. This algorithm calculated cut scores from the assertion maps by panelist, by table, and for the room.

5.7.2 Feedback Data and Impact Data

Feedback included the cut scores corresponding to the assertion mappings for each panelist, each table, and for the room overall (across both tables). In addition, panelists were shown impact data based on the cut scores resulting from their assertion mappings. Impact data was defined for panelists as the percentages of students who would reach or exceed each of the achievement standards given the assertion mappings. Percentages were calculated using real student data from

[2] Typically, the probability used in standard setting is .67 ("RP67" [Huynh, 1994]). RP67 is the assertion difficulty point where 67% of the students would earn the score point. The reason to adopt RP50 for grade 11 was because the difficulty of most items exceeded students' abilities. RP50 better aligned with the achievement-level descriptor (ALD) and therefore led to more-appropriate performance cut scores. Using the RP50 prevented panelists from mapping the first cut score onto the lowest-difficulty assertions on the test. This approach has been taken by other high-stakes tests, such as the Smarter Balanced Assessments (see Cizek & Koons, 2014).

the 2019 NGSS administration. This information allowed panelists to compare their mappings to other panelist's mappings to evaluate the impact they might have.

Feedback also included review of a variance monitor, part of AIR's online standard-setting tool that color codes the variance of assertion classifications. For all assertions, the variance monitor shows the achievement level to which each panelist assigned the assertion. The tool highlights assertions that panelists have assigned to different achievement levels. Room facilitators and panelists reviewed and discussed the assertions with the most variable mappings.

5.7.3 Context Data

Panelists were provided with additional context data to inform their round 2 assertion mappings. Context data included the percentage of students who performed at or above the proficiency level associated with each individual assertion. Percentages were calculated using real student data from the Rhode Island and Vermont 2019 NGSS administration.

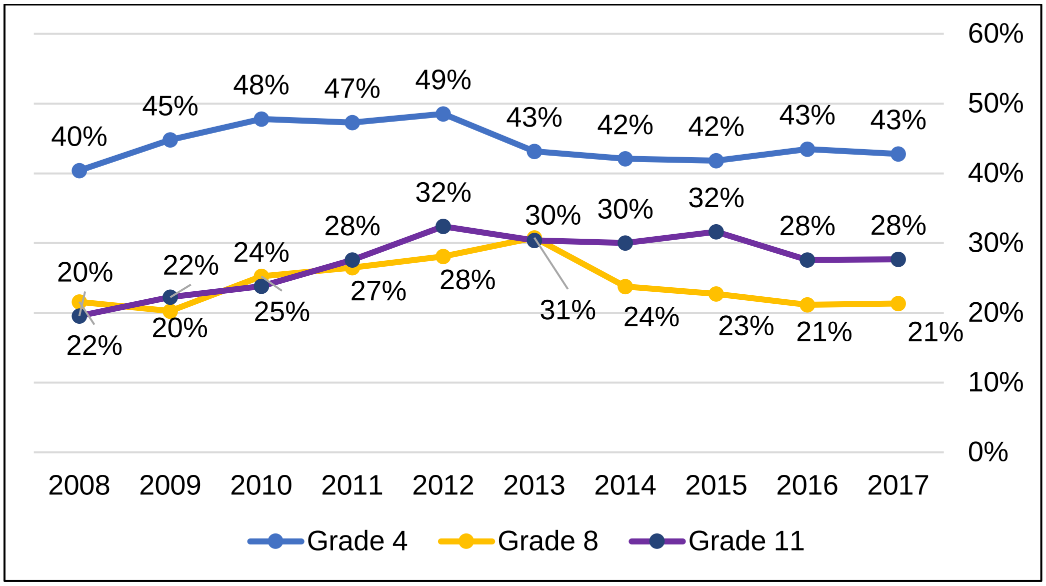
5.7.4 Articulation

To be adoptable, achievement standards for a statewide system must be coherent across grades and subjects. There should be no irregular peaks and valleys, and they should be orderly across subjects with no dramatic differences in expectation. Workshop leaders described the following characteristics of well-articulated standards and asked panelists to consider articulation in round 2:

- The cut scores for each achievement level should increase smoothly with each increasing grade.
- The cut scores should result in a reasonable percentage of students at each achievement level; reasonableness can be determined by the percentage of students in the achievement levels on historical tests, or contemporaneous tests measuring the same or similar content.
- Barring significant content standard changes (e.g., major changes in rigor), the percentage proficient on new tests should not be radically different from the percentage proficient on historical tests.

To support panelists as they considered articulation, they were provided with the percentage of students proficient on the previous science assessment (see Figure 15).

Figure 15. Rhode Island and Vermont Proficiency on NECAP Science Assessment



They were also provided with the percentage proficient on the previous National Assessment of Educational Progress (NAEP) science assessment (see Table 8).

Table 8. Achievement on NAEP Science Assessment

	Average Scale Score Grade 4	Percentage at or Above Proficient Grade 4	Average Scale Score Grade 8	Percentage at or Above Proficient Grade 8
Rhode Island	152	36	151	32
Vermont	163	48	163	44
National Public	153	37	153	33

Each table spent time reviewing and discussing the assertion mappings and context data, beginning with table-level feedback and discussion, and progressing to room-level discussion. After completing these discussions, panelists again worked through the OSAB, independently mapping assertions to achievement levels for round 2.

5.8 Workshop Results

The AIR online standard-setting tool automatically computes the results and context data for each round, and then AIR room facilitators and psychometricians present the round 1 results for each grade.

5.8.1 Round 1

Table 9 presents the achievement standards and associated context data from round 1. Based on the round 1 results, and depending on grade, between 61 and 95 percent of students would fall at or above Approaching Expectations, between 24 and 45 percent would fall at or above Meeting Expectations, and between 1 and 11 percent would fall at Exceeding Expectations.

Table 9. Round 1 Results

Grade and Table	Cut Scores			Context Data		
	AE	ME	EE	AE	ME	EE
Grade 5	**47**	**68**	**100**	**70**	**24**	**1**
Table 1	47	68	100	70	24	1
Table 2	53	67	78	57	26	9
Grade 8	**51**	**63**	**77**	**61**	**35**	**10**
Table 1	51	63	82	61	35	5
Table 2	41	66	77	80	28	10
Grade 11	**34**	**58**	**79**	**95**	**45**	**11**
Table 1	62	65	79	37	31	11
Table 2	34	58	72	95	45	19

Note. The grade-level row summarizes the room data (across both tables). Context data describes the percentage of students falling at or above each of the achievement standards based on the recommended round 1 cut scores. Achievement standard abbreviation key: AE = Approaching Expectations, ME = Meeting Expectations, EE = Exceeding Expectations.

After reviewing the feedback data, workshop facilitators provided panelists with additional instructions for completing round 2. They described the goal of round 2 as one of convergence, but not consensus, on a common achievement standard. Each table then spent time reviewing and discussing assertion mappings. After completing these discussions, panelists again worked through the OSAB, mapping assertions for round 2.

As discussed in Section 5.6.10, the room facilitator for grade 11 flagged one panelist before round 1 started for having difficulties with the mapping task. The results of round 1 confirmed this observation. The standards computed for this rater showed an aberrant pattern with a value for the "Meeting Expectations" standard lower than the value for the "Approaching Expectations" standard.

5.8.2 Round 2

Table 10 presents the recommended achievement standards and associated context data for round 2. The panelist of grade 11 that was flagged for not understanding the mapping task again assigned mappings that resulted in the same aberrant pattern of computed achievement standards as observed after round 1 when computing cuts based on the ALD assignments of this rater only. Therefore, the panelist was excluded from computation of the achievement standards for round 2.

Table 10. Round 2 Results

Grade and Table	Cut Scores			Context Data		
	AE	ME	EE	AE	ME	EE
Grade 5	**45**	**68**	**75**	**74**	**24**	**12**
Table 1	45	68	75	74	24	12
Table 2	45	67	78	74	26	9
Grade 8	**41**	**63**	**77**	**80**	**35**	**10**
Table 1	41	63	83	80	35	5
Table 2	41	63	77	80	35	10
Grade 11	**39**	**63**	**74**	**90**	**35**	**16**
Table 1	39	66	83	90	29	8
Table 2	34	63	74	95	35	16

Note. The grade-level row summarizes the room data (across both tables). Context data describes the percentage of students falling at or above each of the achievement standards based on the recommended round 2 cut scores. Achievement standard abbreviation key: AE = Approaching Expectations, ME = Meeting Expectations, EE = Exceeding Expectations.

Based on the round 2 results, and depending on grade, between 74 and 90 percent of students would fall at or above Approaching Expectations, between 24 and 35 percent would fall at or above Meeting Expectations, and between 10 and 16 percent would fall at Exceeding Expectations. Figure 16 represents those values graphically.

Figure 16. Percentage of Students Reaching or Exceeding Each Recommended Science Achievement Standard in 2019

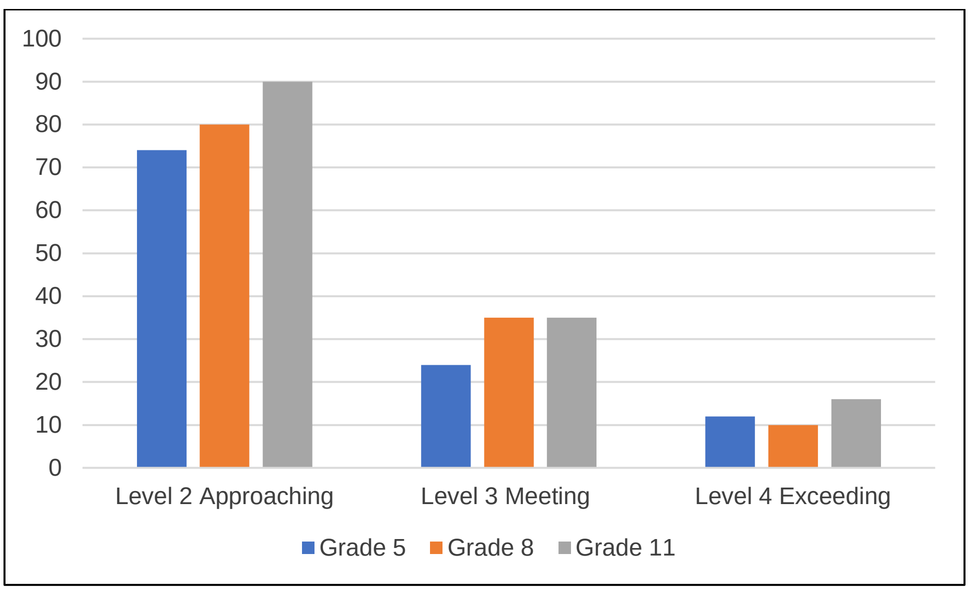


Table 11 indicates the percentage of students classified within each of the achievement levels in 2019. The values are displayed graphically in Figure 17 through Figure 19.

Table 11. Percentage of Students Classified Within Each Recommended Science Achievement Level in 2019

Grade	State	Level 1 Beginning to Meet	Level 2 Approaching	Level 3 Meets	Level 4 Exceeds
5	**Combined**	**26**	**50**	**12**	**12**
	Rhode Island	28	49	11	12
	Vermont	22	52	13	13
8	**Combined**	**20**	**45**	**25**	**10**
	Rhode Island	22	46	23	9
	Vermont	16	45	27	12
11	**Combined**	**10**	**55**	**19**	**16**
	Rhode Island	11	58	17	14
	Vermont	8	50	21	21

Figure 17. Percentage of Combined Students Classified Within Each Recommended Science Achievement Level in 2019

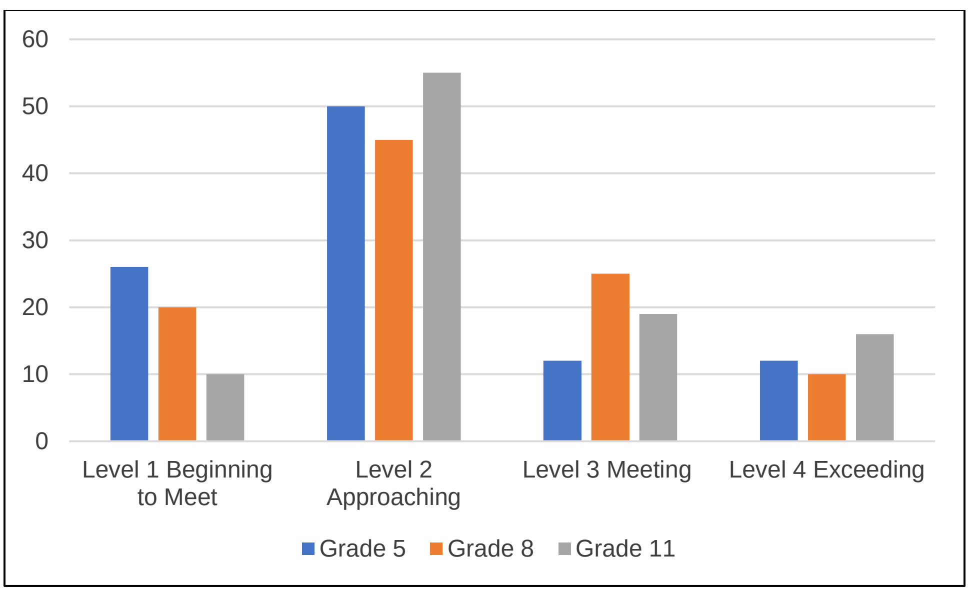


Figure 18. Percentage of Rhode Island Students Classified Within Each Recommended Science Achievement Level in 2019

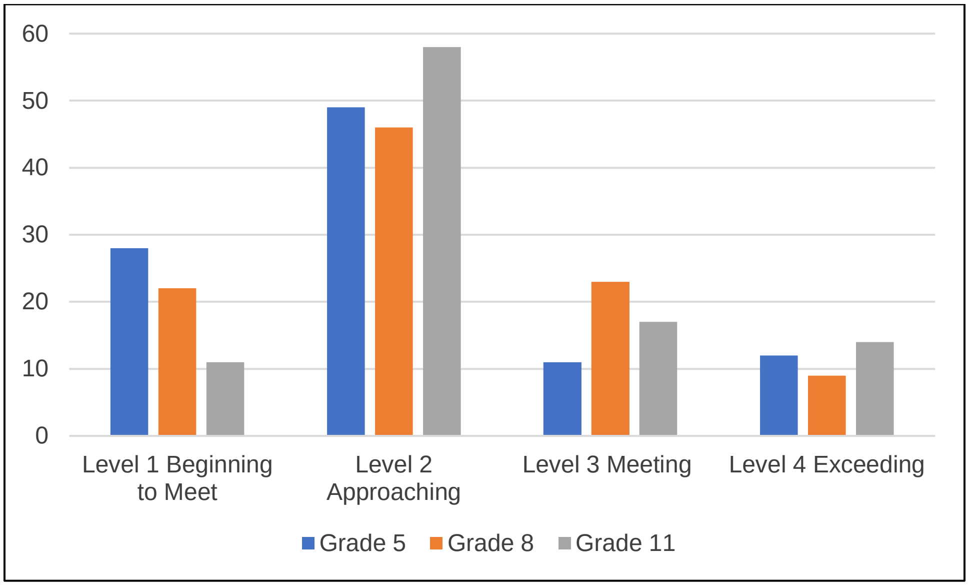
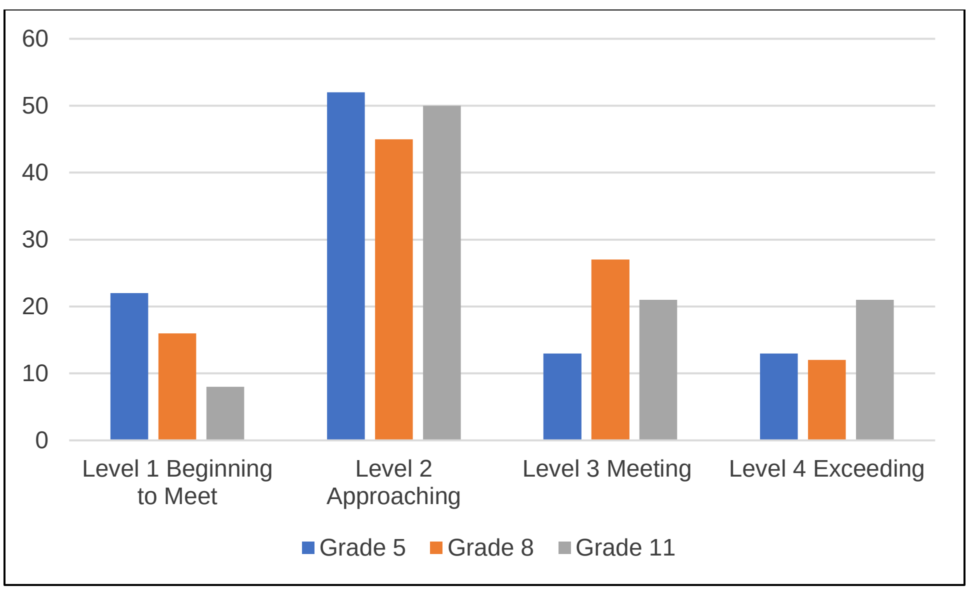


Figure 19. Percentage of Vermont Students Classified Within Each Recommended Science Achievement Level in 2019



5.8.3 Post Workshop Refinements

Following the workshop, the RIDE and the VT AOE made some refinements to the workshop recommendations by lowering some cut scores. Table 12 presents the final achievement standards for state adoption. Figure 20 through Figure 22 represent those values graphically. Additional information on the rationale for the post–standard-setting workshop refinements is included in Appendix H.

Table 12. Post–Standard-Setting Workshop: Final Cut Scores (Change from Workshop Recommendation) and Context Data

Grade	State	Cut Scores (Revision)			Context Data		
		AE	ME	EE	AE	ME	EE
5	**Combined**	40 (–5)	63 (–5)	75	**83**	**34**	**12**
	Rhode Island				81	32	12
	Vermont				85	38	13
8	**Combined**	41	63	77	**80**	**35**	**10**
	Rhode Island				78	32	9
	Vermont				84	39	12
11	**Combined**	39	63	74	**90**	**35**	**16**
	Rhode Island				89	31	14
	Vermont				92	42	21

Note. Context data describes the percentage of students falling at or above each of the achievement standards based on the final cut scores. Achievement standard abbreviation key: AE = Approaching Expectations, ME = Meeting Expectations, EE = Exceeding Expectations.

Figure 20. Post–Standard-Setting Workshop: Percentage of Combined Students Reaching or Exceeding Each Science Achievement Standard in 2019

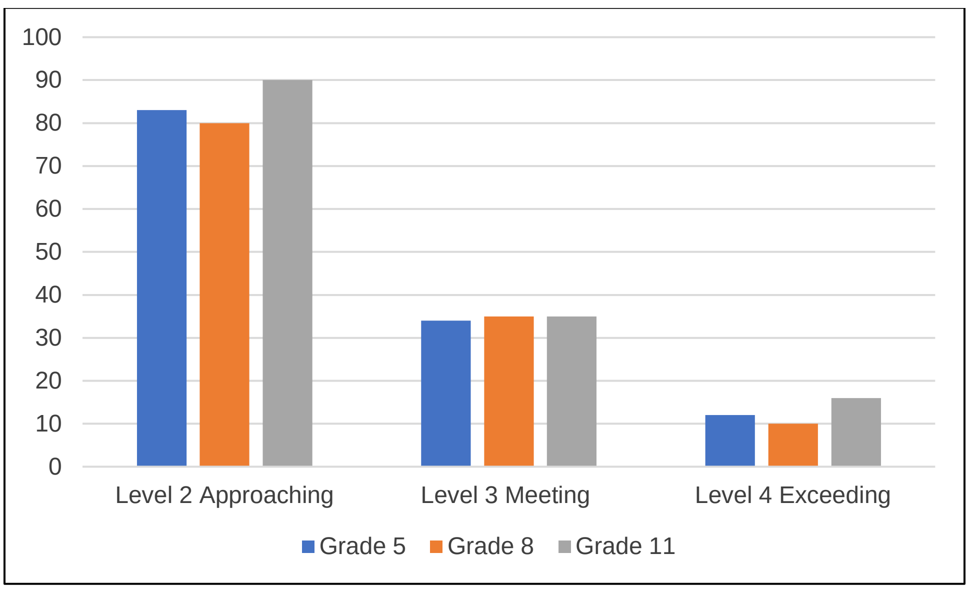


Figure 21. Post–Standard-Setting Workshop: Percentage of Rhode Island Students Reaching or Exceeding Each Science Achievement Standard in 2019

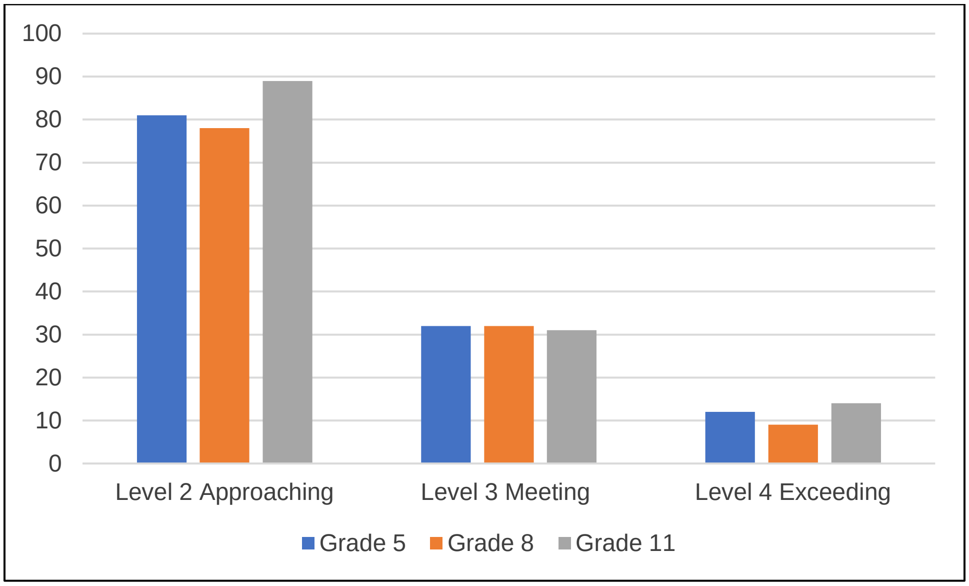


Figure 22. Post–Standard-Setting Workshop: Percentage of Vermont Students Reaching or Exceeding Each Science Achievement Standard in 2019

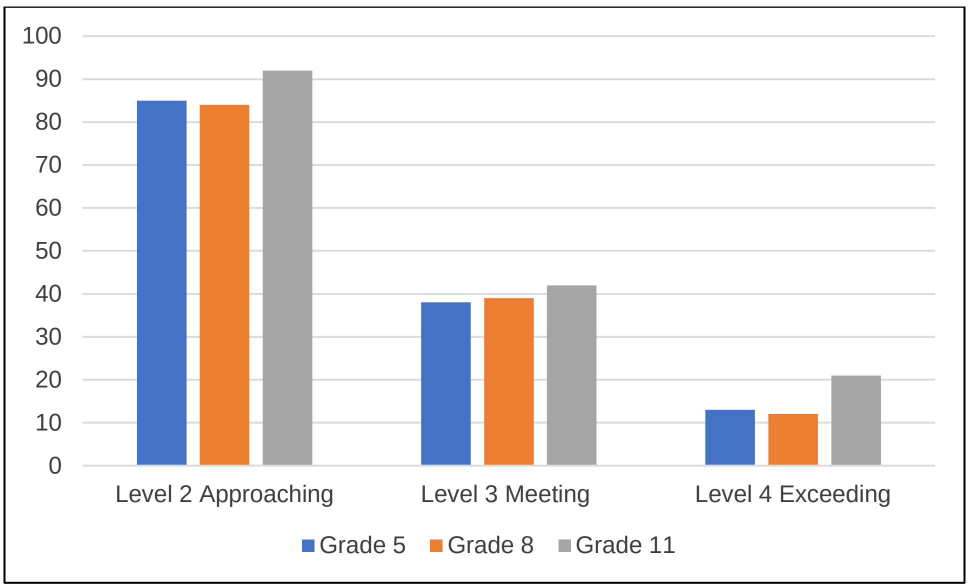


Table 13 indicates the percentage of students classified within each of the achievement levels in 2019 resulting from RIDE and VT AOE refinements to the recommended achievement standards. The values are displayed graphically in Figure 23 through Figure 25.

Table 13. Post–Standard-Setting Workshop: Percentage of Students Classified Within Each Science Achievement Level in 2019

Grade	State	Level 1 Beginning to Meet	Level 2 Approaching	Level 3 Meeting	Level 4 Exceeding
5	**Combined**	**17**	**49**	**22**	**12**
	Rhode Island	19	49	20	12
	Vermont	15	47	25	13
8	**Combined**	**20**	**45**	**25**	**10**
	Rhode Island	22	46	23	9
	Vermont	16	45	27	12
11	**Combined**	**10**	**55**	**19**	**16**
	Rhode Island	11	58	17	14
	Vermont	8	50	21	21

Figure 23. Post–Standard-Setting Workshop: Percentage of Combined Students Classified Within Each Science Achievement Level in 2019

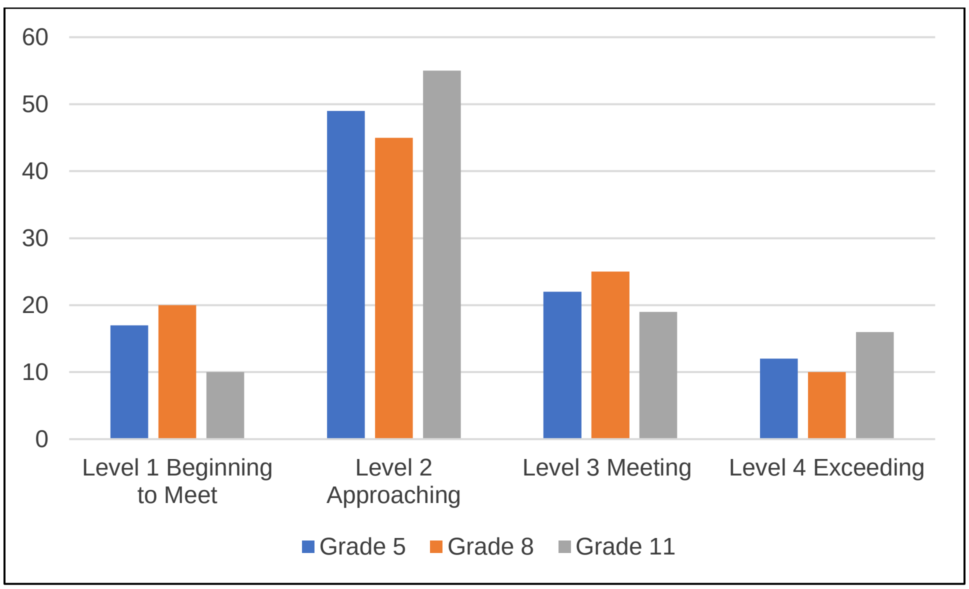


Figure 24. Post–Standard-Setting Workshop: Percentage of Rhode Island Students Classified Within Each Science Achievement Level in 2019

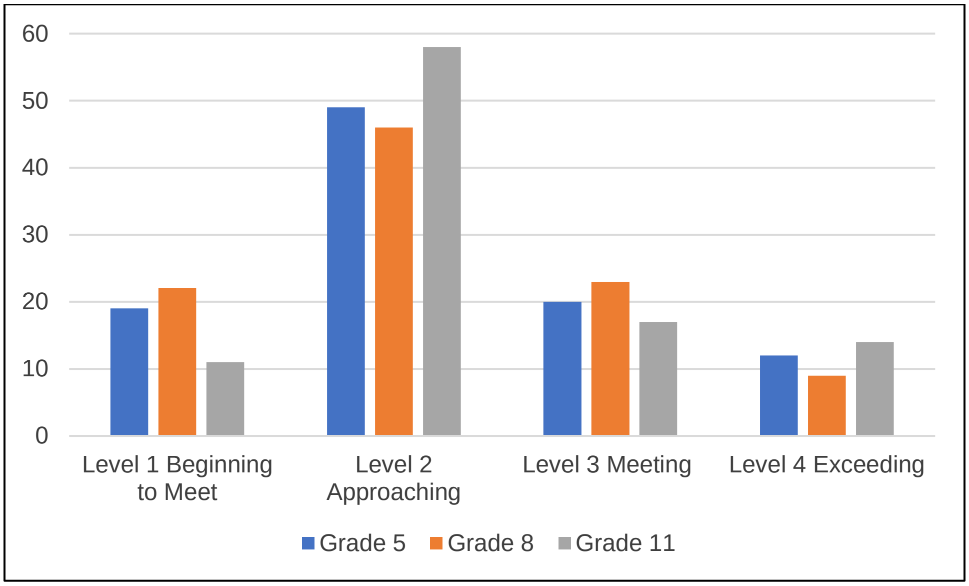
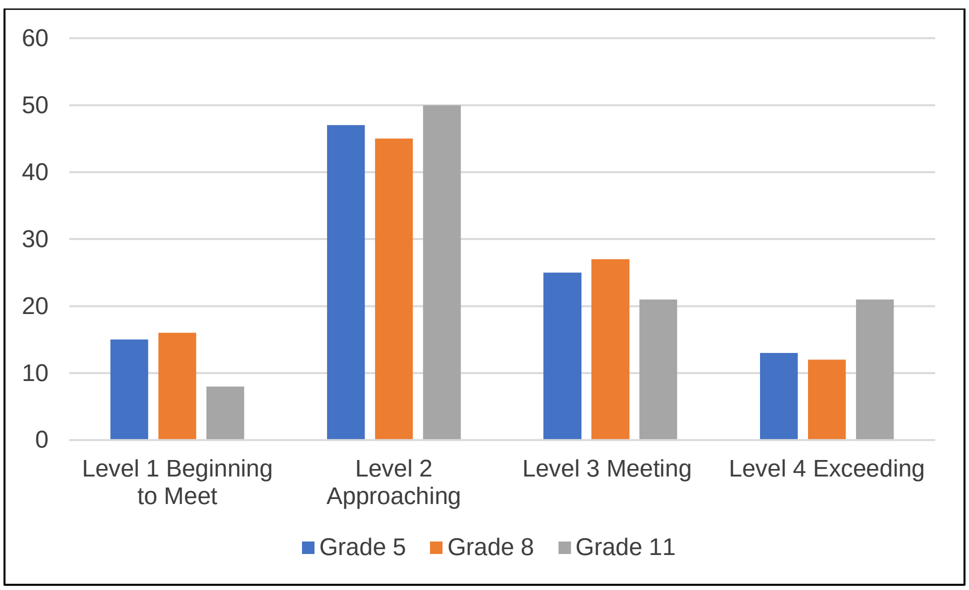


Figure 25. Post–Standard-Setting Workshop: Percentage of Vermont Students Classified Within Each Science Achievement Level in 2019



As mentioned in section 1.1.2, the scale for each grade will be re-centered around the Level 3 Standard after final approval of the standards. After the post workshop refinements, the Level 3 cut score was set at 63 on the proposed scale for all three grades. In order to center the reporting scale around the Level 3 Standard, the scale was translated by minus 3, the difference between tentative and final cut scores expressed on the reporting scale. Table 14 presents the final achievement standards after centering around the Level 3 Standard. The percentages at or above each of the achievement standards are not affected.

Table 14. Final Cut Scores After Re-Centering Around Level 3 Standards

Grade	Cut Scores		
	AE	ME	EE
5	37	60	72
8	38	60	74
11	36	60	71

Note. Achievement standard abbreviation key: AE = Approaching Expectations, ME = Meeting Expectations, EE = Exceeding Expectations.

5.9 WORKSHOP EVALUATIONS

After finishing all activities, panelists completed online workshop evaluations independently, in which they described and evaluated their experience taking part in the standard setting. Table 15, Table 16, Table 17, Table 18, and Table 19 summarize the results of the evaluations. Evaluation items endorsed by fewer than 90% of panelists are discussed in text, and the least endorsed items are discussed in terms of the number and type of response.

Generally, workshop participants indicated clarity in the instructions, materials, data, and process (see Table 15). However, 63 percent of grade 11 panelists indicated the ALDs were clear and 75 percent of grade 5 panelists indicated the OSABs were clear.

Table 15. Evaluation Results: Clarity of Materials and Process

Please rate the clarity of the following components of the workshop.	Percentage “Somewhat Clear” or “Very Clear”			
	Grade 5	Grade 8	Grade 11	Overall
Instructions provided by the workshop leader	88%	100%	88%	92%
Achievement-Level Descriptors (ALDs)	100%	100%	63%	88%
Ordered Scoring Assertion Booklet (OSAB)	75%	100%	100%	92%
Panelist agreement data	100%	100%	100%	100%
Context data (percentage of students who would reach any standard you select)	88%	100%	88%	92%
Assertion map	100%	100%	88%	96%

Note. Number of responses = 25 (grade 5 responses = 8, grade 8 responses = 9, grade 11 responses = 8). Evaluation options included “Very Unclear,” “Somewhat Unclear,” “Somewhat Clear,” and “Very Clear.”

In fact, some panelists indicated having too much time to complete some tasks (see Table 16). Nine panelists indicated the large-group training was too long, six indicated having too little time to review ALDs, and two indicated having too much time to review the ALDs. Five panelists indicated having too much time for mapping scoring assertions while three reported spending too much time on round 1 discussion, and one reported not spending enough time on the round 1 discussion.

Table 16. Evaluation Results: Appropriateness of Process

How appropriate was the amount of time you were given to complete the following components of the standard-setting process?	Percentage Responding "About Right"			
	Grade 5	Grade 8	Grade 11	Overall
Large-group orientation	63%	78%	50%	64%
Experiencing the online assessment	88%	100%	75%	88%
Reviewing the Achievement-Level Descriptors (ALDs)	50%	100%	50%	68%
Reviewing the Ordered Scoring Assertion Booklet (OSAB)	88%	100%	75%	88%
Mapping your scoring assertions to achievement levels in each round	63%	89%	88%	80%
Round 1 discussion	88%	100%	63%	84%

Note. Number of responses = 25 (grade 5 responses = 8, grade 8 responses = 9, grade 11 responses = 8). Evaluation options included "Too Little," "Too Much," and "About Right."

Participants appreciated the importance of the multiple factors contributing to assertion mapping, with all but a single panelist in some grades rating each factor as important or very important (see Table 17).

Table 17. Evaluation Results: Importance of Materials

How important were each of the following factors in your mapping of scoring assertions to achievement levels?	Percentage Responding "Somewhat Important" or "Very Important"			
	Grade 5	Grade 8	Grade 11	Overall
Achievement-Level Descriptors (ALDs)	100%	100%	88%	96%
Your perception of the difficulty of the scoring assertions and items in general	88%	100%	88%	92%
Your experience with students	100%	100%	100%	100%
Discussions with other panelists	100%	100%	100%	100%
Room agreement data (room, table, and individual cuts)	100%	100%	88%	96%
Context data (percentage of students who would reach any standard you select)	88%	100%	88%	92%
Assertion map	100%	100%	88%	96%

Note. Number of responses = 25 (grade 5 responses = 8, grade 8 responses = 9, grade 11 responses = 8). Evaluation options included "Not Important," "Somewhat Important," and "Very Important."

Although participant understanding of the workshop processes and tasks was high (see Table 18), three grade 11 panelists disagreed that the procedures used were fair and unbiased, four panelists disagreed that the ALDs provided clear expectations, and three panelists indicated the context data was not helpful.

Table 18. Evaluation Results: Understanding Processes and Tasks

At the end of the workshop, please rate your agreement with the following statements.	**Percentage "Agree" or "Strongly Agree"**			
	Grade 5	**Grade 8**	**Grade 11**	**Overall**
I understood the purpose of this standard-setting workshop.	100%	100%	100%	100%
The procedures used to recommend achievement standards were fair and unbiased.	100%	100%	63%	88%
The training provided me with the information I needed to recommend achievement standards.	100%	100%	100%	100%
Taking the online assessment helped me to better understand what students need to know and be able to do to answer each question.	100%	89%	100%	96%
The Achievement-Level Descriptors (descriptions of what students within each achievement level are expected to know and be able to do) provided a clear picture of expectations for student achievement at each level.	75%	100%	75%	84%
I understood how to review each assertion in the Ordered Scoring Assertion Booklet to determine what students must know and be able to do to answer each assertion correctly.	100%	100%	100%	100%
I understood how to map assertions to the most apt achievement level.	100%	100%	100%	100%
I found the assertion map helpful in my decisions about the assertions I mapped to achievement levels.	100%	100%	88%	96%
I found the context data (percentage of students who would achieve at the level indicated by the assertion difficulty) and discussions helpful in my decisions about the assertions I mapped to achievement levels.	88%	100%	75%	88%
I found the panelist agreement data (room, table, and individual cuts) and discussion helpful in my decisions about assertions I mapped to achievement levels.	100%	100%	88%	96%
I felt comfortable expressing my opinions throughout the workshop.	100%	100%	100%	100%
Everyone was given the opportunity to express his or her opinions throughout the workshop.	100%	100%	100%	100%

Note. Number of responses = 25 (grade 5 responses = 8, grade 8 responses = 9, grade 11 responses = 8). Evaluation options included "Strongly Disagree," "Disagree," "Agree," and "Strongly Agree."

Participants agreed that the standards set during the workshop reflected the intended grade-level expectations (see Table 19).

Table 19. Evaluation Results: Student Expectations

Please read the following statement carefully and indicate your response.	**Percentage Indicating "Agree" or "Strongly Agree"**			
	Grade 5	**Grade 8**	**Grade 11**	**Overall**
A student performing at Level 2 is approaching expectations for the grade.	100%	100%	100%	100%

Please read the following statement carefully and indicate your response.	**Percentage Indicating "Agree" or "Strongly Agree"**			
	Grade 5	**Grade 8**	**Grade 11**	**Overall**
A student performing at Level 3 is meeting expectations for the grade.	100%	100%	100%	100%
A student performing at Level 4 is exceeding expectations for the grade.	100%	89%	100%	96%

Note. Number of responses = 25 (grade 5 responses = 8, grade 8 responses = 9, grade 11 responses = 8). Evaluation options included "Strongly Disagree," "Disagree," "Agree," and "Strongly Agree."

5.9.1 Workshop Participant Feedback

Finally, panelists responded to two open-ended questions: "What suggestions do you have to improve the training or standard-setting process?" and "Do you have any additional comments? Please be specific."

Twenty-three panelists responded to the first question, and nine responded to the second. Most responses indicated the training was effective and the process was clear. Participants provided minor suggestions, such as shortening or lengthening the time allocated for some tasks, making the rooms smaller or the tables larger, and providing less practice time and more task completion time. Many commented on the value of discussions and interactions with other panelists.

Additional participant comments included:

"Thank you for the opportunity and the experience. Greatly appreciated."

"I am quite pleased that I was selected to work on this and provide input. While the task was quite intense, it was a valuable learning experience."

6. VALIDITY EVIDENCE

Validity evidence for standard setting is established in multiple ways. First, standard setting should adhere to the standards established by appropriate professional organizations and be consistent with the recommendations for best practices in the literature and established validity criteria. Second, the process should provide the necessary evidence required of states to meet federal peer review requirements. We describe each of these in the following sections.

6.1 EVIDENCE OF ADHERENCE TO PROFESSIONAL STANDARDS AND BEST PRACTICES

The Next Generation Science Standards (NGSS) science standard-setting workshop was designed and executed consistent with established practices and best-practice principles (Hambleton & Pitoniak, 2006; Hambleton, Pitoniak, & Copella, 2012; Kane, 2001; Mehrens, 1995). The process also adhered to the following professional standards recommended in *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 2014) related to standard setting:

- *Standard 5.21*: When proposed score interpretation involves one or more cut scores, the rationale and procedures used for establishing cut scores should be documented clearly.
- *Standard 5.22*: When cut scores defining pass-fail or proficiency levels are based on direct judgments about the adequacy of item or test performances, the judgment process should be designed so that the participants providing the judgments can bring their knowledge and experience to bear in a reasonable way.
- *Standard 5.23*: When feasible and appropriate, cut scores defining categories and distinct substantive interpretations should be informed by sound empirical data concerning the relation of test performance to the relevant criteria.

The sections of this report documenting the rationale and procedures used in the standard-setting workshop address Standard 5.21. The AMP standard-setting procedure is appropriate for tests of this type—with interrelated sets of three-dimensional item clusters and scaled using Item Response Theory (IRT). Section 5.1 provides the justification for and the additional benefits of selecting the AMP method to establish the cut scores; and Sections 5.6 through 5.7.1 document the process followed to implement the method.

The design and implementation of the AMP procedure address Standard 5.22. The method directly leverages the subject-matter expertise of the panelists placing assertions into achievement levels and incorporates multiple, iterative rounds of ratings in which panelists modify their judgments based on feedback and discussion. Panelists apply their expertise in multiple ways throughout the process by

- understanding the test, test items, and scoring assertions (from an educator and student perspective);
- describing the knowledge and skills measured by the test;
- identifying the skills associated with each test item scoring assertion;
- describing the skills associated with student performance in each achievement level;
- identifying which test item scoring assertions students at each achievement level should be able to answer correctly; and
- evaluating and applying feedback and reference data to the round 2 recommendations and considering the impact of the recommended cut scores on students.

Panelists' understanding of the AMP was assessed with a quiz prior to the Practice round. Additionally, panelists' readiness evaluations provided evidence of a successful orientation to the process and understanding of the process, while their workshop evaluations provide evidence of confidence in the process and resulting recommendations.

The recruitment process resulted in panels that were representative of important regional and demographic groups who were knowledgeable about the subject area and students' developmental level. Section 5.3.5 summarizes details about the panel demographics and qualifications.

The provision of benchmark and context data to panelists after round 1 addresses Standard 5.23. This empirical data provides necessary and additional context describing student performance given the recommended standards.

Further evidence of the validity of the AMP as a standard setting process and the adherence to professional standards and best practices is provided by the observations of an independent standard setting expert. The observations of Dr. Barbara Plake, who was present during the entire standard setting workshop, are presented in Appendix I. Synopsis of Validity Evidence for the Cutscores. Dr. Plake concluded her report as follows:

> *These steps [of the standard-setting workshop] are consistent with current practice for the conducting a test-centered standard-setting method. For the most part, these steps were successfully implemented and when minor issues emerged they were handled immediately and appropriately. There is no evidence to suggest that there is any reason to question the validity of the resultant cutscores produced by these panels.*

The Rhode Island and Vermont Technical Advisory Committee for the Science Assessment also endorsed the standard setting method and the final standards during their October 2019 meeting.

6.2 Evidence in Terms of Peer Review Critical Elements

The United States Department of Education (USDOE) provides guidance for the peer review of state assessment systems. This guidance is intended to support states in meeting statutory and regulatory requirements under Title I of the Elementary and Secondary Education Act of 1965 (ESEA, USDOE, 2015). The critical elements described in this section are relevant to standard setting; evidence supporting each element immediately follows.

> Critical Element 1.2: Substantive involvement and input of educators and subject-matter experts

Rhode Island and Vermont educators played a critical role in establishing achievement levels for the MSSA tests. They created the item clusters, reviewed and revised the ALDs, mapped assertions to achievement levels to delineate performance at each achievement level, considered benchmark data and the impact of their recommendations, and formally recommended achievement standards.

Many subject-matter experts contributed to developing Rhode Island's and Vermont's achievement standards. Contributing educators were subject-matter experts in their content area, in the content standards and curriculum that they teach, and in the developmental and cognitive capabilities of their students. AIR's facilitators were subject-matter experts in the subjects tested and in facilitating effective standard-setting workshops. The psychometricians performing the analyses and calculations throughout the meeting were subject-matter experts in the measurement and statistics principles required of the standard-setting process.

> Critical Element 6.2: Achievement standards setting. The state used a technically sound method and process that involved panelists with appropriate experience and expertise for setting its academic achievement standards and academic achievement standards to ensure they are valid and reliable.

Four pieces of evidence to support this critical element include:

1) The rationale for and technical sufficiency of the AMP method selected to establish achievement standards (Section 5.1)
2) Documentation that the method used for setting cut scores allowed panelists to apply their knowledge and experience in a reasonable manner and supported the establishment of reasonable and defensible cut scores (Section 5.6, 5.7 and 6.1)
3) Panelists self-reported readiness to undertake the task (Sections 5.6.8 and 5.6.10) and confidence in the workshop process and outcomes (Section 5.7) supporting the validity of the process
4) The standard-setting panels consisted of panelists with appropriate experience and expertise, including content experts with experience teaching Rhode Island's and Vermont's science content standards, and individuals with experience and expertise teaching special population and general education students in Rhode Island and Vermont (Section 5.3.5 and Appendix A. Standard-Setting Panelist Characteristics).

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Appendix A

Standard-Setting Panelist Characteristics

Standard-Setting Panelist Characteristics

Table A-1. Standard-Setting Panelists, Science Grade 5

State	Position	Gender	Race/ Ethnicity	Level of Education	Years Teaching Experience	Years Professional Experience	Table Leader
Rhode Island	Teacher, Coach	Female	White	Bachelor's degree	21+ years	1–5 years	Yes
Vermont	Teacher	Female	White	Bachelor's degree, +45 hours in graduate classes	16–20 years	0 years	
Rhode Island	Teacher	Female	White	Bachelor's degree, Master's degree, National Board Certified	21+ years	11–15 years	
Vermont	Teacher	Male	White	Master's degree	11–15 years	0 years	
Vermont	Teacher	Female	White	Bachelor's degree, Master's degree	1–5 years	0 years	
Vermont	Teacher	Female	White	Bachelor's degree	1–5 years	0 years	Yes
Vermont	Coach	Female	White	Master's degree	11–15 years	0 years	
Rhode Island	Teacher	Female	White	Bachelor's degree	21+ years	0 years	
Rhode Island	Teacher	Female	White	Master's degree	16–20 years	6–10 years	

Table A-2. Standard-Setting Panelists, Science Grade 8

State	Position	Gender	Race/ Ethnicity	Level of Education	Years Teaching Experience	Years Professional Experience	Table Leader
Rhode Island	Teacher, Department Head K–12	Female	White	Bachelor's degree, Master's degree	16–20 years	1–5 years	Yes
Rhode Island	Administrator	Female	White	Master's degree	11–15 years	21+ years	
Rhode Island	Teacher, Specialist	Female	White	Master's degree	16–20 years	0 years	
Vermont	Teacher, Specialist, Coach	Female	White	Master's degree	6–10 years	1–5 years	
Vermont	Teacher	Female	White	Bachelor's degree, Master's degree	11–15 years	0 years	Yes
Rhode Island	Teacher	Female	White	Master's degree	6–10 years	0 years	
Rhode Island	Teacher	Female	Asian	Bachelor's degree	21+ years	0 years	
Rhode Island	Teacher	Female	White	Bachelor's degree, Master's degree	21+ years	1–5 years	
Rhode Island	Teacher	Female	White	Bachelor's degree	21+ years	1–5 years	

Table A-3. Standard-Setting Panelists, Science Grade 11

State	Position	Gender	Race/ Ethnicity	Level of Education	Years Teaching Experience	Years Professional Experience	Table Leader
Rhode Island	Teacher	Female	White	Master's degree	21+ years	21+ years	Yes
Vermont	Teacher	Male	East Asian & White	Master's degree	11–15 years	0 years	
Rhode Island	Teacher	Male	White	Bachelor's degree, Master's degree	21+ years	0 years	
Rhode Island	Teacher	Female	White	Master's degree	1–5 years	0 years	
Vermont	Teacher	Male	White	Master's degree	16–20 years	0 years	Yes
Rhode Island	Teacher	Female	White	Master's degree	11–15 years	1–5 years	
Rhode Island	Teacher	Male	White	Master's degree	21+ years	1–5 years	
Rhode Island	Teacher	Male	White	Bachelor's degree	6–10 years	0 years	

Appendix B

Achievement-Level Descriptors

Achievement-Level Descriptors

Exhibit B-1. Grade 5 Science Achievement-Level Descriptors

Students that are a level _____ may be able to do things like...	1	2	3	4
Earth and Space Sciences				
ESS1: Earth's Place in the Solar System	Identify data, either in graphical displays or in a model, that would help explain observable features of Earth's landscape, the appearance of stars in the night sky, or the patterns created from the orbit and rotation of the Sun-Earth-Moon System.	Represent data in graphical displays, and explain the ordered, observable features of Earth's landscape, the appearance of stars in the night sky, or the patterns created from the orbit and rotation of the Sun-Earth-Moon System.	Analyze and interpret graphical displays of data to use as evidence in order to explain the ordered, observable features of Earth's landscape, the appearance of stars in the night sky, or the patterns created from the orbit and rotation of the Sun-Earth-Moon System.	Evaluate and revise graphical displays of data to make a prediction regarding the ordered, observable features of Earth's landscape, the appearance of stars in the night sky, or the patterns created from the orbit and rotation of the Sun-Earth-Moon System.
ESS2: Earth's Systems	Make observations from data and/or collect information to identify parts of a model and reveal patterns that would show how the interactions between Earth's four major systems might cause patterned features of the Earth, including climate, distribution of water, and physical and biological constructive and deconstructive forces.	Represent data sets or graphs and/or carry out investigations using models or information that show how the interactions between Earth's four major systems might cause patterned features of the Earth, including climate, distribution of water, and physical and biological constructive and deconstructive forces.	Develop and/or use simple models, carry out investigations, or evaluate evidence using mathematical thinking, reasoning, and information regarding how the interactions between Earth's four major systems might cause patterned features of the Earth, including climate, distribution of water, and physical and biological constructive and deconstructive forces.	Revise a model, analyze the data sets from an investigation using mathematical thinking, and research how to better communicate or predict how the interactions between Earth's four major systems might cause patterned features of the Earth, including climate, distribution of water, and physical and biological constructive and deconstructive forces.

Students that are a level _____ may be able to do things like…	1	2	3	4
ESS3: Earth and Human Activity	Use information and observations from sources to identify either weather-related hazards on humans, or human activity on the Earth's resources and environments.	Identify reliable sources and use obtained information to compare multiple solutions to help explain the cause-and-effect relationship of either weather-related hazards on humans, or human activity on the Earth's resources and environments.	Obtain and use evidence from reliable sources to generate and evaluate the merits or accuracy of a solution that could explain and reduce the cause-and-effect relationship of either weather-related hazards on humans, or human activity on the Earth's resources and environments.	Evaluate, compare, and revise a solution to a problem, using evidence obtained from reliable sources, to predict changes that can occur in the cause-and-effect relationships of either weather-related hazards on humans, or human activity on the Earth's resources and environments.
Life Sciences				
LS1: From Molecules to Organisms: Structure and Processes	Identify components of a model that represent parts of a life cycle or behavioral systems of organisms; **and** make observations about organisms that need food for energy, and materials to grow and repair their internal and external structures.	Develop and/or use a simple model to represent the life cycles or behavioral systems of organisms to support an argument; **and** identify data as evidence to support that organisms need food for energy, and materials to grow and repair their internal and external structures.	Develop and/or use a model to describe patterns in the life cycles or behavioral systems of organisms; **and** use evidence to construct an argument that organisms need food for energy, and materials to grow and repair their internal and external structures.	Evaluate and revise a model that describes patterns in the life cycles or behavioral systems of organisms when a variable changes; **and** compare and refine arguments that organisms need food for energy, and materials to grow and repair their internal and external structures.
LS2: Ecosystems: Interactions, Energy, and Dynamics	Identify the parts of a model that represent interactions of organisms within an ecosystem, and the cycling of matter through those interactions; **and** identify data that can show how an ecosystem changed.	Develop and/or use a simple model to describe the interactions of organisms within an ecosystem, and the cycling of matter through those interactions; **and** collect	Develop and/or use a model to describe the interactions of organisms within an ecosystem, and the cycling of matter through those interactions; **and** use evidence to show the effect	Evaluate and revise a model that describes the interactions of organisms within an ecosystem, and the cycling of matter through those interactions when more information is given; **and** predict the effects of an

Students that are a level ____ may be able to do things like...	1	2	3	4
		evidence that shows how an ecosystem can change.	that occurs when one part of the ecosystem is changed.	ecosystem when one part of the ecosystem is changed.
LS3: Heredity: Inheritance and Variation of Traits	Collect and record data from pictures, drawings, and/or text to help explain that organisms inherit the information that dictates how they look and function; **and** make an observation about an organism when its environment changes.	Use data collected from tables and various graphical displays to support an explanation that organisms inherit the information that dictates how they look and function; **and** identify information that would help explain what happens to an organism if the environment changes.	Analyze and interpret various forms of data to construct an explanation that organisms inherit the information that dictates how they look and function; **and** construct an explanation using evidence that supports that an organism has changed in response to environmental changes.	Construct, analyze, and interpret tables and graphical displays of data in order to construct and revise an explanation that organisms inherit the information that dictates how they look and function; **and** predict what would happen to an organism if its environment continues to change.
LS4: Biological Evolution: Unity and Diversity	Identify patterns in past or present organism characteristics that can be used as evidence to support that when there is a change in the environment, certain individual organisms could have variations in traits that lead to advantages in survival and reproduction; **and** use observations from pictures, drawings, and/or writings to support that current, living organisms can survive in particular environments	Identify and/or record past and present observations that could either provide evidence that when there is a change in the environment, certain individual organisms could have variations in traits that lead to advantages in survival and reproduction, or that living organisms resemble organisms that once lived on Earth; **and** identify data that can be used to compare the merits of a solution that can affect a population of organisms.	Analyze and interpret past and present organism characteristics to either provide evidence that when there is a change in the environment, certain individual organisms could have variations in traits that lead to advantages in survival and reproduction, or that living organisms resemble organisms that once lived on Earth; **and** analyze and compare the merits of a solution that can affect a population of organisms.	Analyze and interpret past and present organism characteristics to evaluate and revise a constructed explanation that states that with a change in the environment, certain individual organisms could have variations in traits that lead to advantages in survival and reproduction, or that living organisms resemble organisms that once lived on Earth; **and** compare sets of data to help argue the merits of a solution that could affect a population of organisms.

Students that are a level _____ may be able to do things like...	**1**	**2**	**3**	**4**
	only or resemble organisms that once lived on Earth.			
Physical Sciences				
PS1: Matter and Its Interactions	Make observations about variables that are controlled to determine if a chemical reaction occurs and a new substance is created; measure and graph quantities to show matter is always conserved regardless of the change that occurs; **and** use a model to show that matter made of particles too small to be seen exists.	Organize and test variables that are controlled to determine if a chemical reaction occurs and a new substance is created; measure and graph quantities to show matter is always conserved regardless of the change that occurs; **and** develop a simple model to show that matter made of particles too small to be seen exists.	Plan and conduct an investigation in which variables are controlled to determine if a chemical reaction occurs and a new substance is created; measure and graph quantities to show matter is always conserved regardless of the change that occurs; **and** develop a model to show that matter made of particles too small to be seen exists.	Revise and conduct an investigation in which variables are controlled to determine if a chemical reaction occurs and a new substance is created; measure and graph quantities to show matter is always conserved regardless of the change that occurs; **and** evaluate and revise a model to show that matter made of particles too small to be seen exists.
PS2: Motion and Stability: Forces and Interactions	Use questions and components of an investigation that observe the relationship between magnetism and/or gravity and an object's motion.	Use observations from an investigation to provide evidence to support an argument about cause-and-effect relationships between balanced and unbalanced forces (magnetism and/or gravity) and an object's motion.	Ask questions, plan, and conduct an investigation, and/or use produced data to provide evidence to create and support an argument about cause-and-effect relationships between balanced and unbalanced forces (magnetism and/or gravity) and an object's motion.	Ask questions, conduct and compare two different investigations, and/or use produced data to provide evidence to predict cause-and-effect relationships between balanced and unbalanced forces (magnetism and/or gravity) and an object's motion.
PS3: Energy	Ask questions based on observations about how energy can be used as a fuel or food, or be	Make observations using produced data to ask questions about how energy can be used as a	Use models to ask questions and/or use produced data to provide evidence on how energy can be used as a fuel	Evaluate and revise models and/or use produced data to ask questions to make predictions or provide evidence

Students that are a level _____ may be able to do things like...	**1**	**2**	**3**	**4**
	transferred from stored and/or motion energy to different forms like sound, light, and electrical currents.	fuel or food, or be transferred from stored and/or motion energy to different forms like sound, light, and electrical currents.	or food, or be transferred from stored and/or motion energy to different forms like sound, light, and electrical currents.	for how energy can be used as a fuel or food, or be transferred from stored and/or motion energy to different forms like sound, light, and electrical currents.
PS4: Waves and Their Applications in Technologies for Information Transfer	Identify parts of a wave model; **and** identify observations that would help explain how reflected light from objects causes objects to be seen.	Develop and/or use a simple model to make observations about waves and the transfer of information; **and** record evidence that would help explain how reflected light from objects causes objects to be seen.	Create a solution or develop and/or use a model to describe and compare patterns of waves and the transfer of information; **and** use evidence to support an explanation for how reflected light from objects causes objects to be seen.	Revise a model to make predictions and compare patterns of waves and transfer of information; **and** use evidence to construct an explanation for how reflected light from objects causes objects to be seen.

Exhibit B-2. Grade 8 Science Achievement-Level Descriptors

Students that are a level _____ may be able to do things like...	**1**	**2**	**3**	**4**
Earth and Space Sciences				
ESS1: Earth's Place in the Solar System	Identify components of a model that measure and collect evidence to explain the similarities and differences in the patterned motions of the Sun-Earth-Moon System, the role of gravity in the motion of galaxies and the solar system, or the relative occurrence of events in the Earth’s and the solar system’s history.	Develop and/or use a simple model or graphical display to identify data from tables and other graphical displays that can be used as pieces of evidence to explain the patterned motions of the Sun-Earth-Moon System, the role of gravity in the motion of galaxies and the solar system, or the relative occurrences of events in the Earth’s and the solar system’s history.	Develop and/or use a model using graphical displays of data that explain the patterned motions of the Sun-Earth-Moon System, the role of gravity in the motion of galaxies and the solar system, or the relative occurrence of events in the Earth’s and the solar system’s history.	Evaluate and revise a model based on constraints and data limitations that explain the patterned motions of the Sun-Earth-Moon System, the role of gravity in the motion of galaxies and the solar system, or the relative occurrence of events in the Earth’s and the solar system’s history.
ESS2: Earth's Systems	Make measurements and/or observations from graphical data to help identify the components of a model that help explain the patterns in the flow or cycles of energy and matter throughout Earth’s systems, including the sun and Earth’s interior as primary energy sources; **and** identify evidence to explain that Earth’s processes have changed the Earth’s surface at	Use a model or investigation to identify patterns from bar graphs, pictographs, and other various graphical data that support how energy and matter flow or cycle throughout Earth’s systems, including the sun and Earth’s interior as primary energy sources; **and** organize evidence to explain how Earth’s processes have changed its surface at varying spatial and time scales.	Analyze data from an investigation to develop, use and/or revise a model that shows patterns in the flow or cycles of energy and matter throughout Earth’s systems, including the sun and Earth’s interior as primary energy sources; **and** interpret evidence to construct an explanation for how Earth’s processes have changed its surface at varying spatial and time scales.	Evaluate and revise a model to generate data that supports an explanation that shows patterns in how energy and matter flow or cycle throughout Earth’s systems, including the sun and Earth’s interior as primary energy sources; **and** evaluate the impact of new data by predicting how the Earth’s processes will change the Earth’s surface at varying spatial and time

Students that are a level _____ may be able to do things like...	1	2	3	4
	varying spatial and time scales.			scales if a new variable is introduced.
ESS3: Earth and Human Activity	Identify scientific questions using collected and/or graphically represented evidence regarding the dependency of humans on the environment for different resources; **and** identify evidence that can help design a simple solution that minimizes the effect of humans on the environment or explain the observed patterns that emerge between natural hazards and their related geological forces.	Ask questions about data or apply scientific ideas about the uneven distribution of natural resources and human dependence on the environment for those resources to design a simple solution that minimizes the effect of humans on the environment; **and** explain the history of natural hazards and their related geological forces.	Analyze and interpret sets of data regarding the uneven distribution of natural resources and human dependence on the environment for those resources to ask questions and design a solution that could minimize the effect of humans on the environment; **and** explain the observable patterns seen in the data from the history of natural hazards and their related geological forces.	Analyze and interpret sets of data regarding the uneven distribution of natural resources and human dependence on the environment for those resources to evaluate and revise a question that can modify a design solution that minimizes the effect of humans on the environment, explain the effect of humans on the environment; **and** predict future patterns of natural hazards when considering the impact of humans on the environment.
Life Sciences				
LS1: From Molecules to Organisms: Structure and Processes	Organize information from an investigation to identify components of a model or support an argument using evidence to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals	Gather and organize information from an investigation to support an argument using evidence, and develop and/or use a simple model to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and	Gather and synthetize data from an investigation to engage in an argument using evidence, and develop and/or use a model to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into	Evaluate and revise a model or explanation using investigative data as evidence to support an argument that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy

Students that are a level ____ may be able to do things like...	1	2	3	4
	convert energy into food sources, but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.	animals convert energy into food sources, but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.	food sources, but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.	into food sources, but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.
LS2: Ecosystems: Interactions, Energy, and Dynamics	Identify components of a model to explain the dynamic relationships and interactions between the diverse types of living and nonliving parts of an ecosystem, including the flow of energy and the cycling of matter among organisms and abiotic components of an ecosystems; **and** organize multiple graphical displays of data to support a solution to mitigate disruptions to any part of an ecosystem by human access to natural resources.	Develop and/or use a simple model to explain the dynamic relationships and interactions between the diverse types of living and nonliving parts of an ecosystem, including the flow of energy and the cycling of matter among biotic and abiotic components; **and** organize data in multiple graphical displays to identify patterns which support a solution to mitigate disruptions to any part of an ecosystem by human access to natural resources.	Develop and/or use a model to explain and predict the dynamic relationships and interactions between the diverse types of living and nonliving parts of an ecosystem, including the flow of energy and the cycling of matter among biotic and abiotic components; **and** analyze and interpret multiple graphical displays of data to design a solution to mitigate disruptions of any part of an ecosystem by human access to natural resources.	Analyze and/or revise a model that explains and supports the dynamic relationships and interactions between the diverse types of living and nonliving parts of an ecosystem, including the flow of energy and the cycling of matter among biotic and abiotic components when a variable in the system is changed; **and** evaluate limitations of data when analyzing and interpreting multiple graphical displays of data to design a solution to mitigate disruptions of any part of an ecosystem by human access to natural resources.
LS3: Heredity: Inheritance	Identify the components of a model that describe the	Develop and/or use a simple model to represent cause-	Develop and/or use a model to describe the relationship	Evaluate and revise a model that explains the

Students that are a level _____ may be able to do things like...	1	2	3	4
and Variation of Traits	relationship among variables that show why sexual/asexual reproduction may have different results of genetic variation in offspring, and how complex and microscopic structural changes to genes (mutations) can be analyzed to determine how they affect the structure and function of an organism.	and-effect relationships to describe either why sexual/asexual reproduction may have different results of genetic variation in offspring, and why structural changes to genes (mutations) affect the structure and function of an organism.	among variables that show either why sexual/asexual reproduction may have different results of genetic variation in offspring, and how complex and microscopic structural changes to genes (mutations) can be analyzed to determine how they affect the structure and function of an organism.	relationship among variables that show either why sexual/asexual reproduction may have different results of genetic variation in offspring, or predicts what changes would occur in the function of an organism if there is a mutation in the organism's genes.
LS4: Biological Evolution: Unity and Diversity	Identify evidence in data sets to show that a species has changed over time; **and** identify scientific ideas to support an explanation for how humans influence the biodiversity of an area, and how natural or artificial selection can give some organisms an advantage in survival and reproduction.	Organize and identify the patterns in large data sets to explain why species can change over time, and communicate the similarities or differences found in past and present organisms or fossil records of past environmental conditions; **and** gather and use data to construct an explanation for how humans influence the biodiversity of an area, and how natural or artificial selection can give some organisms an advantage in survival and reproduction.	Analyze and interpret the patterns in large data sets to explain why species can change over time, and communicate the similarities or differences found in past and present organisms or fossil records of past environmental conditions; **and** gather and synthesize data to construct an explanation for how humans influence the biodiversity of an area, and how natural or artificial selection can give some organisms an advantage in survival and reproduction.	Analyze and evaluate an explanation using large data sets that show the similarities or differences found in past and present organisms or fossil records of past environmental conditions; **and** apply concepts of statistics and probability (variability) to form an explanation for how humans influence the biodiversity of an area, and how natural or artificial selection can give some organisms an advantage in survival and reproduction.
Physical Sciences				

Students that are a level _____ may be able to do things like...	1	2	3	4
PS1: Matter and Its Interactions	Identify the components of a model that explain the conservation of mass and why when two substances react, the properties of matter are a function of the composition of atoms and molecules that make up matter, as well as the thermal energy.	Develop and/or use a simple model to explain the conservation of mass when two substances react; **and** interpret data on the properties of matter to determine if a chemical reaction has occurred, such as function of the composition of atoms and molecules that make up matter, as well as the thermal energy.	Analyze patterns in graphical displays of data and develop and/or use a model to explain the conservation of mass when two substances react; **and** use the properties of matter to determine if a chemical reaction has occurred, such as function of the composition of atoms and molecules that make up matter, as well as thermal energy.	Evaluate and revise a model to explain the conservation of mass when two substances react; **and** use evidence to predict how changes to the molecular structure or thermal energy of matter can affect its properties.
PS2: Motion and Stability: Forces and Interactions	Investigate a question by conducting an investigation, and identify data regarding the relationship between mass, force, and motion, and the attractive and repulsive forces that act at a distance (electric, magnetic, and gravitational forces) that could be used to support a claim.	Identify questions, conduct an investigation, and organize and use data to make a claim regarding the relationship between mass, force, and motion, and the attractive and repulsive forces that act at a distance (electric, magnetic, and gravitational).	Ask questions, plan, and conduct an investigation, and analyze and interpret data to make and support a claim regarding the relationship between mass, force, and motion, and the attractive and repulsive forces that act at a distance (electric, magnetic, and gravitational).	Ask questions to conduct, evaluate, and revise an investigation; **and** analyze and evaluate data to predict and support a claim regarding the relationship between mass, force, and motion, and the attractive and repulsive forces that act at a distance (electric, magnetic, and gravitational).
PS3: Energy	Identify components of a model that investigate how kinetic and potential energy interact, transform, or transfer to another object; **and** collect and record data	Develop and/or use a simple model to describe how kinetic and potential energy interact, transform, or transfer to another object; **and** collect and record data regarding the	Develop and/or use a model or investigation to construct an argument to support a claim about how kinetic and potential energy interact, transform, or transfer to	Evaluate and/or revise a model to predict changes to the interaction of kinetic and potential energy, including how energy is transformed or transferred to another

Students that are a level _____ may be able to do things like...	1	2	3	4
	regarding the temperature and total energy of a system and its dependency on a variety of factors, including the types and states of matter, as well as the amount of matter involved.	temperature and total energy of a system and its dependence on a variety of factors, including the types and states of energy, as well as the amount of matter involved to support an argument.	another object; **and** analyze data from an investigation to provide evidence that the temperature and total energy of a system is dependent on a variety of factors, including the types and states of energy, as well as the amount of matter involved.	object; **and** apply concepts of statistics and probability when providing evidence to construct an argument that supports a claim that the temperature and total energy of a system is dependent on a variety of factors, including the types and states of matter, as well as the amount of matter involved.
PS4: Waves and Their Applications in Technologies for Information Transfer	Identify the mathematical components in a model to describe the patterns observed between wave characteristics and wave energy; **and** select a claim with evidence to show that waves are reflected, absorbed, or transmitted through various materials.	Use mathematical representations in a model to describe the patterns observed between wave characteristics and wave energy; **and** support a claim with evidence to show that waves are reflected, absorbed, or transmitted through various materials.	Develop and/or use mathematical representations in a model to describe the patterns observed between wave characteristics and wave energy; **and** construct a claim supported by evidence to show that waves are reflected, absorbed, or transmitted through various materials.	Evaluate and revise a mathematical model to predict patterns between wave characteristics and wave energy; **and** integrate qualitative, quantitative, and technical data to provide evidence to support a claim that waves are reflected, absorbed, or transmitted through various materials.

Exhibit B-3. Grade 11 Science Achievement-Level Descriptors

Students who are a level ______ may be able to do things like....	1	2	3	4
Earth and Space Sciences				
ESS1: Earth's Place in the Solar System	Identify components and limitations of a model that uses mathematical representations to explain the characteristics, processes, and life cycles of objects in the solar system; **and** identify and critique evidence that shows the motion of objects in our solar system and Earth's early formation and geologic history.	Use existing mathematical concepts and processes to explain algorithms and models that explain the characteristics, processes, and life cycles of objects in the solar system; **and** construct an explanation, which uses the relationship between different variables, for the motion of objects in our solar system and Earth's early formation and geologic history.	Develop and/or use mathematical models to collect data and explain the characteristics, processes, and life cycles of objects in the solar system; **and** construct an explanation based on qualitative and quantitative evidence for the motion of objects in our solar system and Earth's early formation and geological history.	Evaluate and revise a mathematical model to make predictions regarding the characteristics, processes, and life cycles of objects in the solar system; **and** construct and revise an explanation based on evidence, scientific theories, and laws for the motion of objects in our solar system and Earth's early formation and geological history.
ESS2: Earth's Systems	Identify components and limitations of a model or investigation, including mathematical algorithms and computations, to show that energy flows into and out of one Earth system, and how energy flow can cause feedback effects to occur with other Earth systems, specifically with the planet's interactions with water, solar radiation,	Conduct an investigation or use an existing model, including mathematical algorithms and computations, to show that energy flows into and out of one Earth system, and how energy flow can cause feedback effects to occur with other Earth systems, specifically with the planet's interactions with water, solar radiation, geologic systems, and climate.	Develop and/or use a model to generate and use quantitative data from an investigation to analyze and use as evidence as support that variations in energy flow into or out of Earth systems will cause feedback effects with other Earth systems, specifically with the planet's interactions with water, solar radiation, geologic systems, and climate.	Evaluate and/or revise an investigation or computational model to predict changes that can occur to the Earth's feedback mechanisms when a variable is either added or changed; **and** analyze the collected data by applying concepts of statistics and probability to show how energy flow into or out of an Earth system, specifically with the planet's interactions with water, solar

Students who are a level ______ may be able to do things like....	**1**	**2**	**3**	**4**
	geologic systems, and climate.			radiation, geologic systems, and climate, affect those feedback effects.
ESS3: Earth and Human Activity	Identify and construct graphical displays of data that can be used to explain how human activity has been influenced by the availability of natural resources, natural hazards, and climate change; **and** use mathematical representations and/or algorithms to identify the impact of climate change on Earth's systems and human society and how human society has impacted the Earth's systems.	Use data from graphical displays to support a claim that human activity has been influenced by the availability of natural resources, natural hazards, and climate change; **and** use a computational simulation or model to identify the rate of climate change and its impact on Earth's systems and human society to observe relationships for how human society has impacted the Earth's systems.	Evaluate data and construct an explanation for how human activity has been influenced by the availability of natural resources, natural hazards, and climate change; **and** mathematically analyze information from natural resource data with a computational simulation or representation of climate models to predict the rate of climate change and its impact on Earth's systems and human society to illustrate relationships for how human society has impacted the Earth's systems.	Use mathematical thinking to evaluate and/or revise an explanation for how human activity has been influenced by the availability of natural resources, natural hazards, and climate change; **and** create a computational simulation or representation of natural resource data and climate models relationships to predict the rate of climate change and its impact on Earth's systems and human society, and how human society has impacted the Earth's systems.
Life Sciences				
LS1: From Molecules to Organisms: Structure and Processes	Identify the relationships between variables that contribute to the feedback mechanisms that maintain homeostasis through the structure, function, and processes of living systems; **and** identify the components and limitations of a model that can be used	Conduct an investigation to collect data which will serve as evidence for a model that shows that feedback mechanisms maintain homeostasis through the structure, function, and processes of living systems; **and** use collected data to support a claim	Plan and conduct an investigation, and develop and use a model to show that feedback mechanisms maintain homeostasis through the structure, function, and processes of living systems; **and** evaluate data from an investigation to construct an explanation for how cellular	Plan and conduct an investigation, and evaluate and revise a model to explain what happens to the feedback mechanisms that maintain homeostasis through the structure, function, and processes of living systems when a variable is changed; **and**

Students who are a level ______ may be able to do things like....	1	2	3	4
	to support an explanation for how cellular respiration moves energy and matter through the body, forming different products, transferring energy, and replicating DNA and protein synthesis.	regarding how cellular respiration moves energy and matter through the body, forming different products, transferring energy, and replicating DNA and protein synthesis.	respiration moves energy and matter through the body, forming different products, transferring energy, and replicating DNA and protein synthesis.	apply scientific reasoning, theory and/or models to make and support a claim that cellular respiration moves energy and matter through the body, forming different products, transferring energy, and replicating DNA and protein synthesis.
LS2: Ecosystems: Interactions, Energy, and Dynamics	Use mathematical representations to identify components or variables in the cycling and flow of matter and energy among organisms in an ecosystem; **and** identify evidence to explain the interactions of biotic and abiotic factors in maintaining the population and diversity of organisms in an ecosystem.	Use mathematical representations to construct an explanation with data that shows how energy and matter flow and cycle among organisms in an ecosystem; evaluate and identify patterns seen in data that can be used as evidence to explain the interactions of biotic and abiotic factors in maintaining the population and diversity of organisms in an ecosystem; **and** identify disturbances in conditions; biological, physical, or human induced, that may result in a new ecosystem.	Create and/or use mathematical, computational and algorithmic representations to support claims about the cycling of matter and flow of energy among organisms in an ecosystem; **and** use evidence and reasoning to construct an explanation for how interactions with biotic and abiotic factors in ecosystems maintain the population and diversity of organisms, but that disturbances in conditions; biological, physical, or human induced, may result in a new ecosystem.	Evaluate and revise a computational model or simulation that can explain that the cycling of matter and flow of energy among organisms in an ecosystem can be disturbed when a new variable is introduced; use mathematical and computational evidence to argue that interactions with biotic and abiotic factors in ecosystems maintain the population and diversity of organisms; **and** predict how an ecosystem might change with a disturbance in conditions; biological, physical, or human induced.

Students who are a level ______ may be able to do things like....	**1**	**2**	**3**	**4**
LS3: Heredity: Inheritance and Variation of Traits	Identify an observation or model of DNA, chromosomes, and traits; **and** use graphical displays of data to identify evidence which supports a claim about genetic and environmental factors that may affect the variation and distribution of traits in a population.	Ask a question that requires sufficient, empirical evidence to answer regarding the relationship of DNA, chromosomes, and traits; **and** analyze data to support a claim defending an argument about genetic and environmental factors and their effect on variation within a population.	Analyze a model or theory in order to ask a question which determines the relationship between the role of DNA and chromosomes, and traits; **and** apply concepts of statistics and probability when analyzing evidence in order to make and defend a claim about genetic and environmental factors that may affect the variation and distribution of traits in a population.	Use a question to analyze and evaluate the relationship between the role of DNA and chromosomes, and traits; **and** apply concepts of statistics and probability when analyzing evidence in order to predict the variation and distribution of traits in population when a genetic and environmental factor is changed.
LS4: Biological Evolution: Unity and Diversity	Identify and use genetic and anatomical evidence obtained from texts and mathematical representations to support that the evolution, extinction, and formation of new species is based on different environmental factors; **and** identify causal and correlational relationships of environmental conditions and population adaptations.	Construct and/or use graphical displays of data to provide genetic and anatomical evidence for how given factors have resulted in diversity through evolution, extinction, and formation of new species; **and** analyze data to distinguish between causal and correlational relationships to support that environmental conditions can lead to adaptations within populations.	Use genetic and anatomical information obtained from texts, mathematical, computational, and/or algorithmic representations to construct an explanation for how given factors have resulted in diversity through evolution, extinction, and formation of new species; **and** generate and analyze mathematical data to support the argument that environmental conditions can lead to adaptations within populations.	Use genetic and anatomical information obtained from texts and/or mathematical, computational and/or algorithmic representations to evaluate and revise an explanation to predict what would happen to a current species when a given factor is changed; **and** predict and support the adaptations a population may experience when environmental conditions are changed.
Physical Sciences				

Students who are a level ______ may be able to do things like....	**1**	**2**	**3**	**4**
PS1: Matter and Its Interactions	Recognize the patterns in the periodic table and identify variables and limitations of a model that provide an explanation for the properties and characteristics of matter; **and** apply mathematical concepts to an investigation that produces data to identify evidence for an explanation that any chemical process that occurs between matter is due to a collision of molecules, change in energy, and atom configuration of the elements involved.	Use the periodic table to develop a model of atomic structure, including simple computations and algorithms, and to provide an explanation for the properties and characteristics of matter; **and** collect data from an investigation that can be analyzed for patterned evidence to support the claim that any chemical process that occurs between matter is due to a collision of molecules, change in energy, and atom configuration of the elements involved.	Use the periodic table, subatomic structures, and corresponding electrical interactions to construct an investigation and/or mathematical model that explains the properties and characteristics of matter; **and** provide quantitative and qualitative evidence that any chemical processes that occur between matter is due to a collision of molecules, change in energy and atom configuration of the elements involved.	Use the periodic table, subatomic structures, and corresponding electrical interactions to evaluate and/or revise a mathematical model or investigation that predicts the properties and characteristics of matter when a component is changed; **and** construct and/or revise an explanation that any chemical processes that occur between matter are due to the collision of molecules, change in energy, and atom configuration of elements.
PS2: Motion and Stability: Forces and Interactions	Use mathematical concepts and processes to help identify limitations or components of an investigation that shows the relationship between either force and the distance between interacting objects, or force, mass, and acceleration; **and** interpret graphical displays of data to identify evidence that	Collect and/or produce data to distinguish between causal and correlational relationships between force and the distance between interacting objects, or force, mass, and acceleration; **and** use mathematical and graphical representations to describe the motion of an object.	Plan and conduct an investigation to collect data to serve as the basis for a model that explains the relationship between either force and the distance between interacting objects, or force, mass, and acceleration; **and** use mathematical, graphical, and computational analysis to observe patterns to explain	Evaluate and revise an investigation, or predict changes to an investigative outcome, when a variable is changed when modeling the relationship between either force and the distance between interacting objects, or force, mass, and acceleration; **and** use scientific ideas, principles and/or evidence to revise an

Students who are a level ______ may be able to do things like....	**1**	**2**	**3**	**4**
	supports how an object moves.		changes in the motion of an object.	explanation and predict changes in the motion of an object when new information is introduced.
PS3: Energy	Identify components and variables of an investigation to describe how energy transfers within and between systems; **and** develop and/or use a model to identify evidence that energy is neither created nor destroyed but converted into less useful forms.	Collect and/or use mathematical data from an investigation to serve as the basis for a model that provides evidence of energy transfer within and between systems; **and** develop and/or use a model to support that energy is neither created nor destroyed, but converted into less useful forms.	Develop and/or use a mathematical model, using collected or produced data from an investigation, to describe how energy transfers within and between systems; **and** provide empirical data supporting that energy is neither created nor destroyed, but converted into less useful forms.	Evaluate and revise a mathematical model, using scientific ideas, principles, theories and/or newly added information or data, to predict how energy transfers within and between systems; **and** provide quantitative, empirical data supporting that energy is neither created nor destroyed, but converted into less useful forms.
PS4: Waves and Their Applications in Technologies for Information Transfer	Integrate qualitative and quantitative information to identify data that shows the relationship between wavelength, amplitude, and frequency, and other wave phenomena; **and** use mathematical representations to identify components of energy transfer by waves.	Collect and use quantitative data, hypotheses and/or conclusions to collect and use evidence that shows the relationship between wavelength, amplitude, and frequency, and other wave phenomena; **and** use mathematics and algorithmic thinking to describe energy transfer by waves.	Analyze technical science information to evaluate a claim regarding the relationship between wavelength, amplitude, and frequency, and other wave phenomena; **and** create and/or use computational models to explain how energy transfers and the effects on the wave due to the nature of a wave medium.	Evaluate models and technical science information to provide evidence of the relationship between wavelength, amplitude, and frequency, and other wave phenomena; **and** use mathematical, computational and/or algorithmic produced data to predict the effects on the wave due to the nature of a wave medium.

Appendix C

Standard-Setting Assertion Maps

Standard-Setting Assertion Maps

Exhibit C-1. Standard-Setting Assertion Map, Science Grade 5

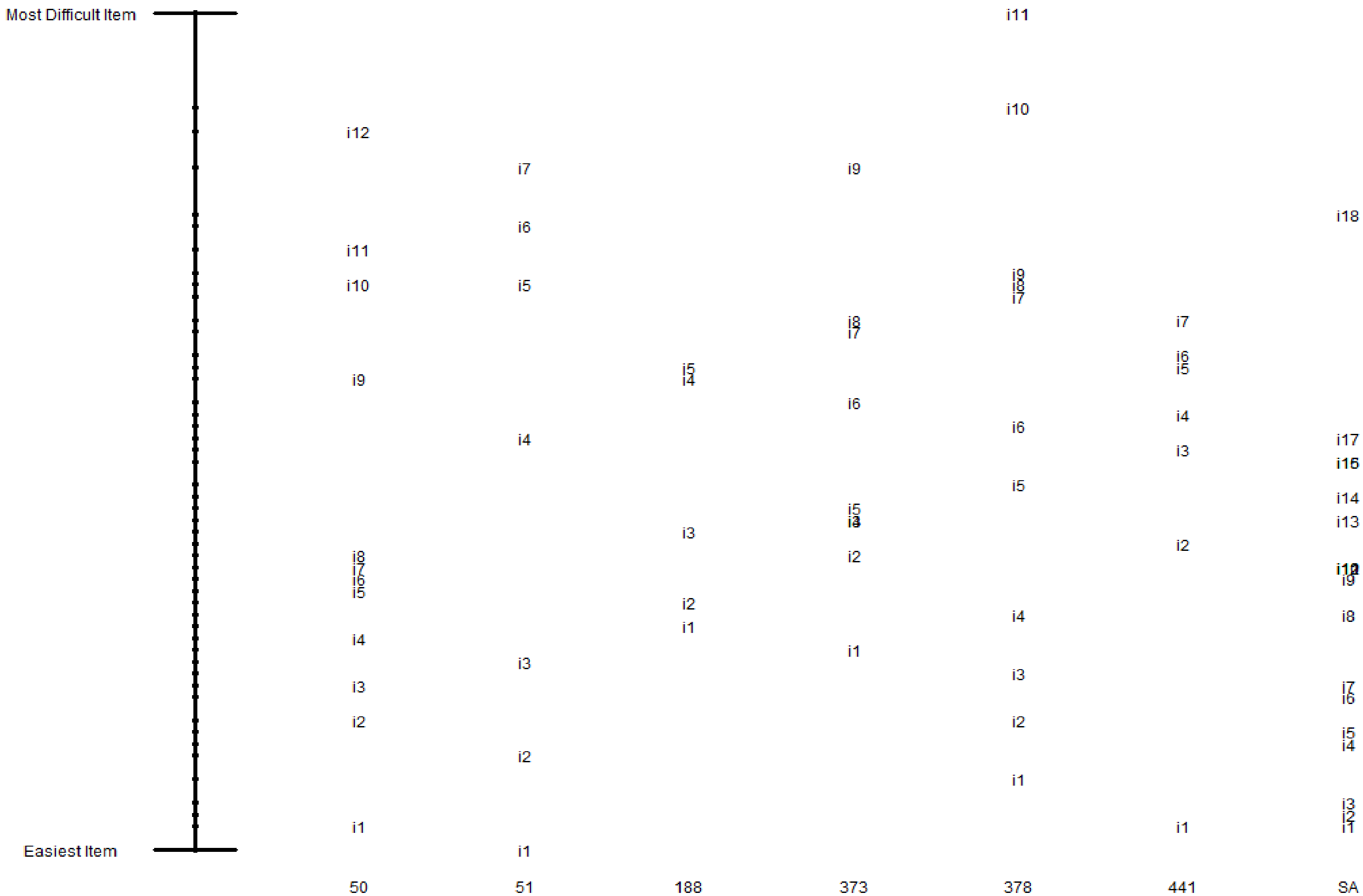


Exhibit C-2. Standard-Setting Assertion Map, Science Grade 8

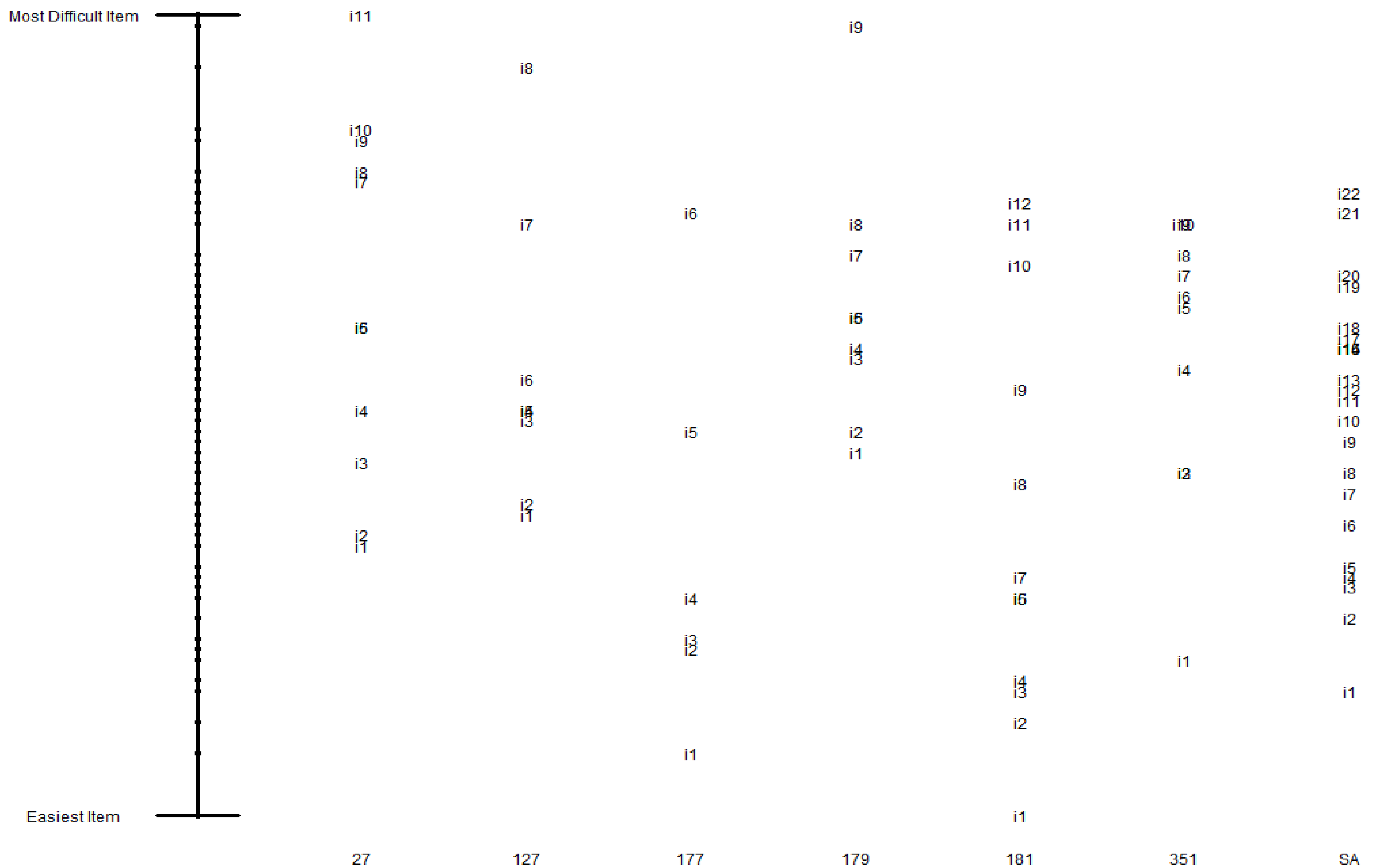
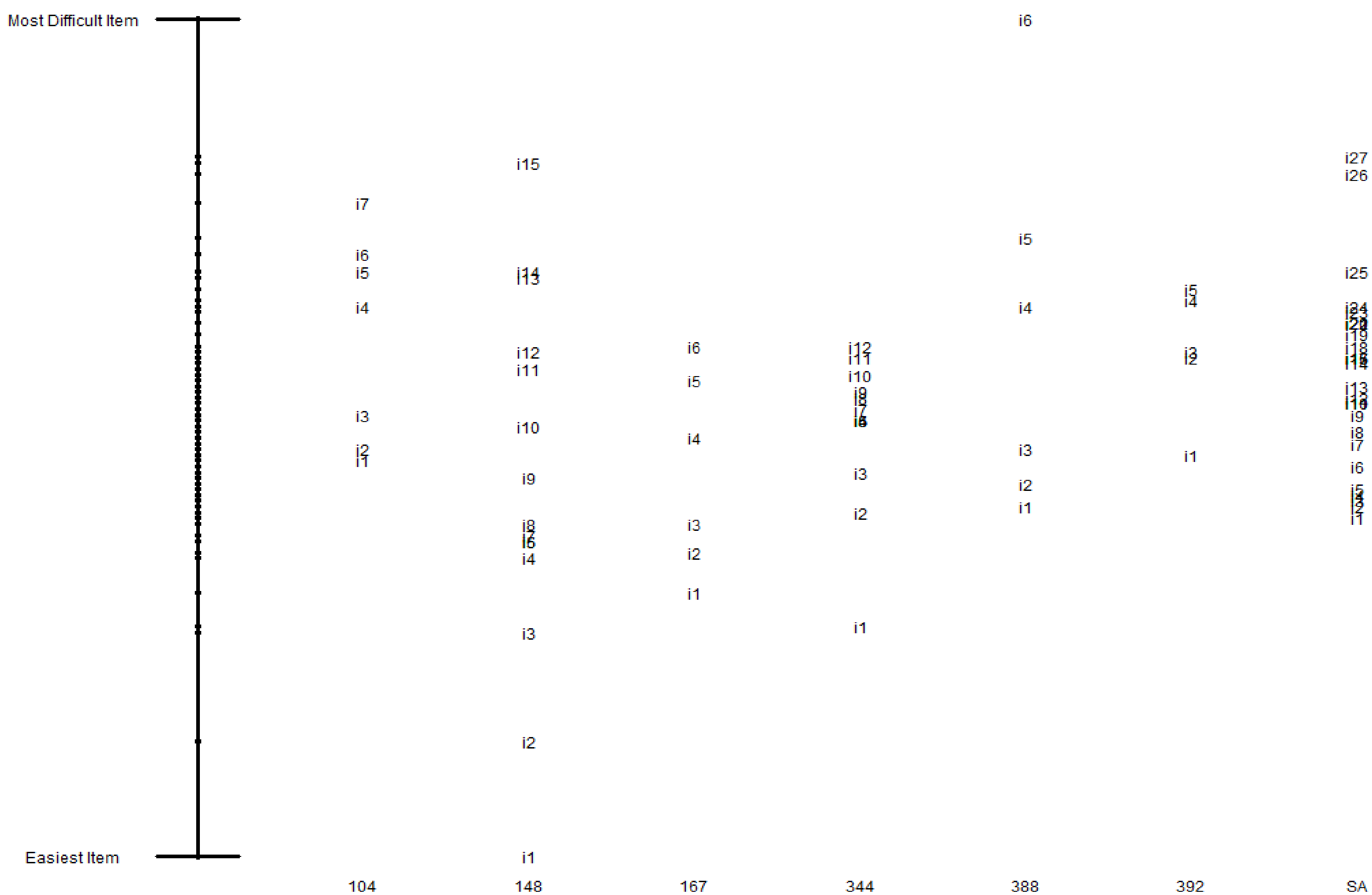


Exhibit C-3. Standard-Setting Assertion Map, Science Grade 11



Appendix D

Standard-Setting Workshop Agenda

Standard-Setting Workshop Agenda

Exhibit D-1. Day 1 Standard-Setting Workshop Agenda

RIDE Rhode Island Department of Education

VERMONT AGENCY OF EDUCATION

2019 Standard Setting for Rhode Island and Vermont Multi-State Science Assessment

SCIENCE EDUCATOR PANEL AGENDA

August 5 – 6, 2019

Day 1 – Monday, August 5, 2019

8:00 – 8:30 a.m.	**Orientation for Table Leaders**
8:00 – 8:30 a.m.	**Registration and morning refreshments** Panelists receive folders, sign non-disclosure agreement
8:30 – 8:45 a.m.	**Welcome and introductions from Rhode Island Department of Education (RIDE) and Vermont Agency of Education (AOE)**
8:45 – 9:30 a.m.	**Large-group introductory training** Welcome and introductions Purpose of standard-setting workshop Description of the NGSS test design General overview of standard-setting procedures and key concepts ▪ Achievement-Level Descriptors ▪ Stand-alone items and item clusters Item interactions Scoring assertions ▪ Item Cluster Review ▪ Assertion Mapping – 2 Rounds ▪ Panelist feedback and context data
9:30 – 9:45 a.m.	**Break, and separate into small group rooms**
9:45 – 11:15 a.m.	**Panelists experience online operational test environment**
11:15 – 12:15 p.m.	**Review Achievement-Level Descriptors (ALDs)** Parse ALDs to identify specific claims within achievement levels Identify knowledge and skills differentiating student achievement between levels
12:15 – 1:00 p.m.	**Lunch**
1:00 – 2:00 p.m.	**Continue discussions of ALDs**

AIR ASSESSMENT | AIR.ORG 1

Day 1 – Monday, August 5, 2019	
2:00 – 4:30 p.m.	**Review of OSAB Items**
	Composition of the Item Clusters and Stand-alone Items
	Training on how to review Item Clusters and Stand-alone Items
	▪ How do the item interactions support the scoring assertion?
	▪ Why is this assertion more difficult than the previous assertion?
	▪ How does the scoring assertion relate to the ALDs?
	Instruction in accessing the Item Clusters and Stand-alone Items
	Review of Item Clusters and Stand-alone Items
4:30 p.m.	**Adjourn**

Exhibit D-2. Day 2 Standard-Setting Workshop Agenda

Day 2 – Tuesday, August 6, 2019	
8:00 – 10:00 a.m.	**Continued review of OSAB Items with morning refreshments**
10:00 – 10:45 a.m.	**Training on Assertion-Mapping task**
	Review of Assertion-Mapping key concepts
	▪ Achievement-Level Descriptors
	▪ Ordered Scoring Assertions
	Training on Assertion-Mapping tool
	Practice Assertion-Mapping task and Standard-Setting Quiz
10:45 – 11:00 a.m.	**Break**
11:00 – 12:30 p.m.	**Round 1 Assertion Mapping**
	Review of Assertion-Mapping procedures and key concepts
	Completion of Assertion-Mapping Readiness Form
	Round 1 Assertion Mapping
12:30 – 1:30 p.m.	**Lunch**
1:30 – 2:00 p.m.	**Review panelist feedback data and discuss Round 1 results**
	How to use panelist agreement feedback data
	Presentation and discussion of Round 1 panelist agreement feedback data
	Training on usage of Context Data
2:00 – 3:30 p.m.	**Round 2 Assertion Mapping**
	Review of Assertion-Mapping procedures and key concepts
	Completion of Assertion-Mapping Readiness Form
	Round 2 Assertion Mapping
3:30 – 4:30 p.m.	**Workshop Evaluations and debrief**
4:30 p.m.	**Adjourn**

Appendix E

Standard-Setting Training Slides

Exhibit E-1. Table Leader Orientation Slides

RIDE Rhode Island Department of Education

VERMONT AGENCY OF EDUCATION

AIR AMERICAN INSTITUTES FOR RESEARCH®

STANDARD SETTING: Science Table Leader Orientation

August 5 – 6, 2019, The Grappone Conference Center, Concord, NH
Rhode Island and Vermont Science Assessment

2

Table Leader Orientation

Workshop Leaders

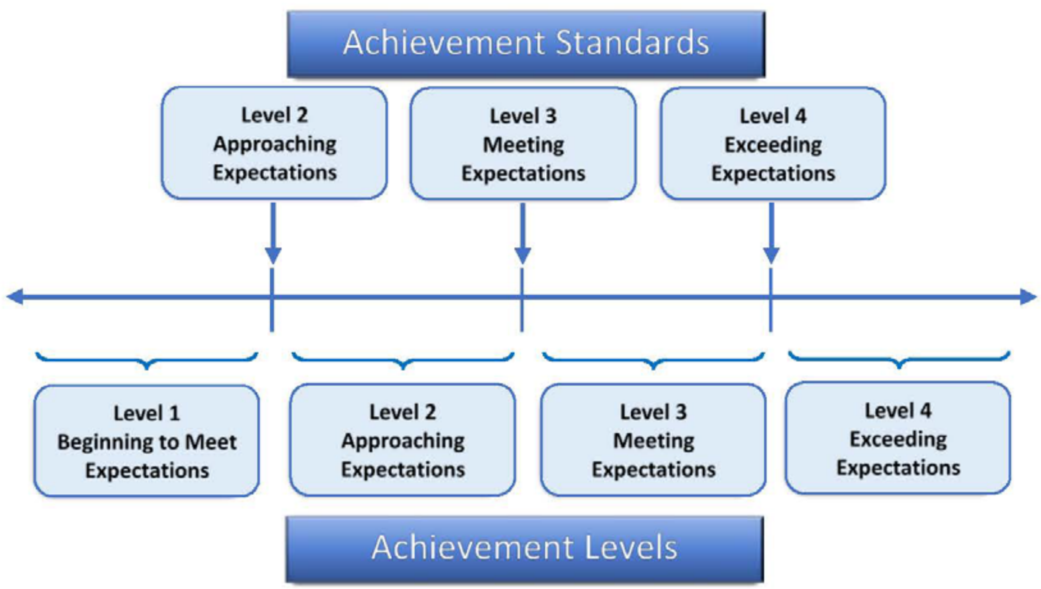
3

- American Institutes for Research
  - Psychometrics
    - Stephan Ahadi
    - Frank Rijmen
  - Room Facilitators
    - Grade 5: Jim McCann
    - Grade 8: Kevin Dwyer
    - Grade 11: Meg McMahon

Goal of the Standard Setting Workshop

4

- Recommend to the states three achievement standards to differentiate the four achievement levels on the Rhode Island and Vermont Science Assessments in grades 5, 8, & 11



Main Workshop Activities

5

- Large Group Introductory Training
- Panel Training
  - Take the online test
  - Review Achievement-Level Descriptors (ALDs)
  - Discuss students who are just barely described by each ALD
  - Review the Ordered Scoring Assertion Booklet
- Recommend Achievement Standards
  - Two rounds
  - Panelist feedback and context data following Round 1
- Workshop Evaluation

Table Leader Role and Responsibilities

6

- Work with standard setting staff to:
  - Facilitate discussions
  - Report any concerns
  - Distribute and collect forms
  - Help ensure that panelists carry out their roles effectively

Final Reminders

7

- Much work to do in a short time span
- Atmosphere should be relaxed but on task
- Value input from all panelists, actively invite each individual to express their point of view
- Orderly, focused, and efficient discussions, but not controlling
- Remind panelists about test security
- Bring any concerns to the Workshop Facilitator
- Ask questions!

Exhibit E-2. Large Group Training Slides

RIDE Rhode Island Department of Education

VERMONT AGENCY OF EDUCATION

AIR AMERICAN INSTITUTES FOR RESEARCH®

STANDARD SETTING: Science Large-Group Training

August 5 – 6, 2019, The Grappone Conference Center, Concord, NH
Rhode Island and Vermont Science Assessment

2 Large-Group Training

State Education Representatives

3

- Vermont Agency of Education
  - Margaret Carrera-Bly – Science Specialist
  - Gabriel McGann – Statewide Assessment Coordinator
- Rhode Island Department of Education
  - Phyllis Lynch – Director, State Assessment
  - Erin Escher – Science Specialist
  - Kate Schulz – Instructional Improvement/Science Specialist
  - Kamlyn Keith – Assessment Specialist
  - Ana Karantonis – Assessment Specialist
- RI and VT TAC member: Barbra Plake, Ph.D.

Workshop Leaders

4

- American Institutes for Research
  - Psychometrics
    - Stephan Ahadi
    - Frank Rijmen
    - Mengyao Cui
  - Room Facilitators
    - Grade 5: Jim McCann
    - Grade 8: Kevin Dwyer
    - Grade 11: Meg McMahon

Main Workshop Activities

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  - Discuss students who are just barely described by each ALD
  - Review the Ordered Scoring Assertion Booklet
- Recommend Achievement Standards
  - Two rounds
  - Panelist feedback data and context data following Round 1
- Workshop Evaluation

Importance of Confidentiality

6

- **DO NOT**
  - Discuss the test items outside of this meeting.
  - Remove any secure materials from the room on breaks or at the end of the day.
  - Discuss judgments or cut scores (yours or others) with anyone outside of the meeting.
  - Discuss secure materials with non-participants.
  - Use cell phones in the meeting rooms. (*Please turn your cell phone ringer off.*)
- General conversations about the process and days' events are acceptable.
- Notes should be taken using provided materials only.
- The only materials allowed on the table are standard-setting materials.

Importance of Security

7

- No cell phones or tablets in the room
  - Please take calls outside of the room
  - Please refrain from texting in the room
  - Taking pictures is not permitted
- Do not take materials outside the room
  - Leave all materials on the table
  - These will be collected by Workshop Leaders

Standard Setting

8

- Systematic process by which trained participants use their knowledge of academic content standards, test items, and student achievement to recommend cut-scores associated with each achievement level on the test
- Provides a frame of reference for interpreting test scores

Reason for New Standards

9

- Rhode Island and Vermont adopted the Next Generation Science Standards in 2013
- In spring 2019, assessments aligned to the Next Generation Science Standards (NGSS) were administered to all students in Rhode Island and Vermont at grades 5, 8, and 11

Goal of the Standard Setting Workshop

10

- Recommend to the states three achievement standards to differentiate the four achievement levels on the Rhode Island and Vermont Science Assessment in grades 5, 8, & 11

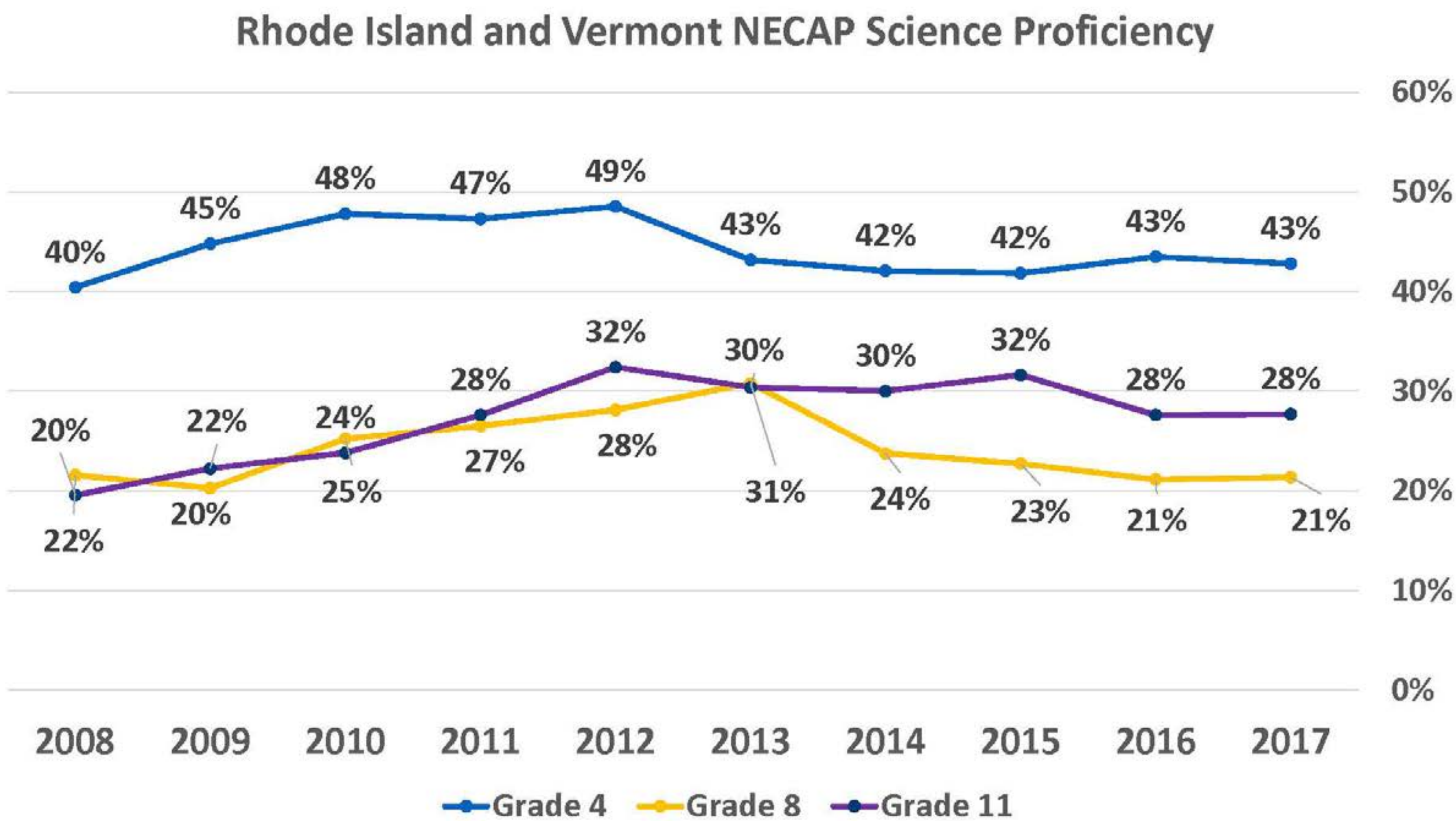
We have done this before…

11

- In 2005, Rhode Island and Vermont, as part of NECAP, set standards for the NECAP Reading and Mathematics assessments in grades 3-8 and Writing in grades 5 and 8.
- In 2007, Rhode Island and Vermont, as part of NECAP, set standards for the NECAP Reading, Writing, and Mathematics assessments in grade 11.
- In 2008, Rhode Island and Vermont, as part of NECAP, set standards for the NECAP Science assessments in grades 5, 8, and 11.
- In 2015, Rhode Island set standards for the English Language Arts/Literacy PARCC assessments in grades 3-8 and high school.
- In 2015, Vermont set standards for English Language Arts and Mathematics Smarter Balanced assessment in grades 3-8 and 11.

Historical NECAP Results

12



2015 NAEP Science Results

13

	Average Scale Score Grade 4	Percent At or Above Proficient Grade 4	Average Scale Score Grade 8	Percent At or Above Proficient Grade 8
Rhode Island	152	36	151	32
Vermont	163	48	163	44
National Public	153	37	153	33

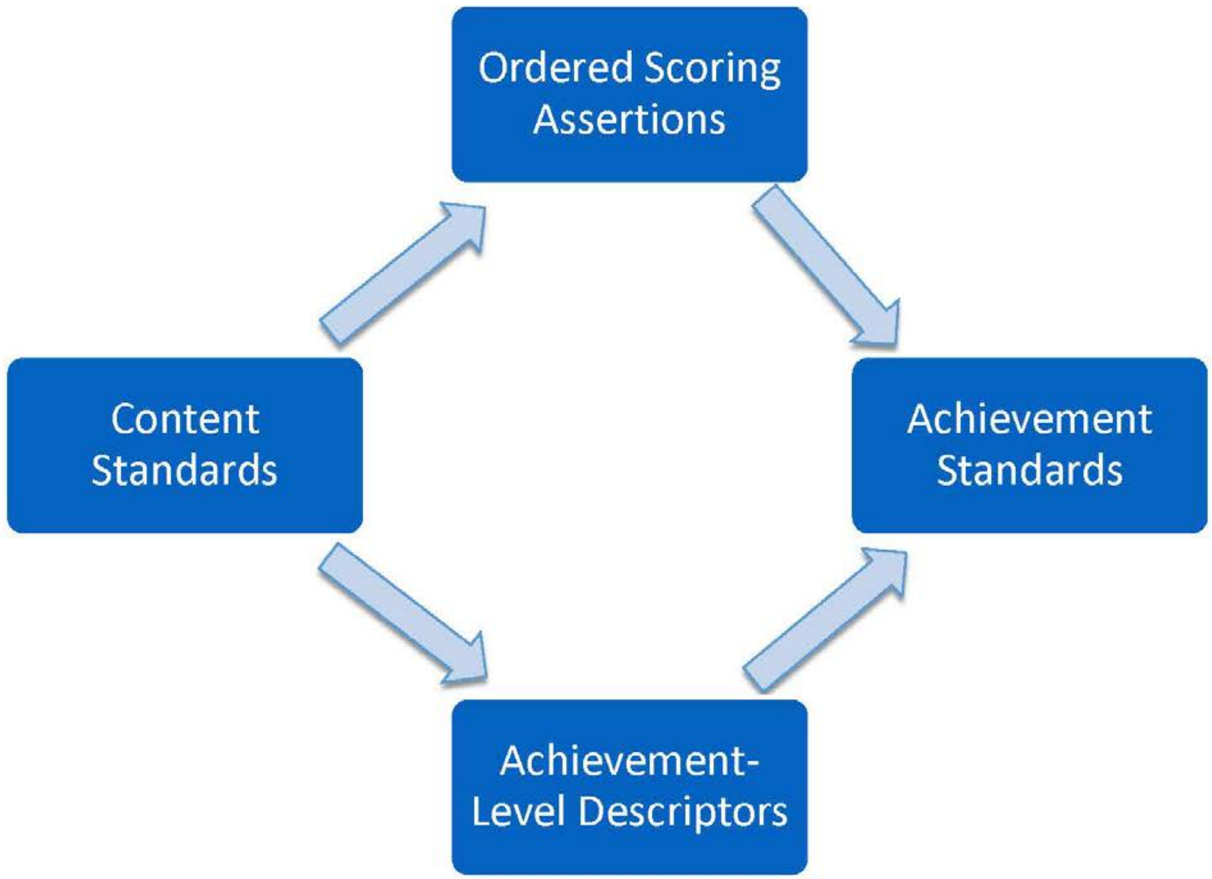
Description of the NGSS Test Design

14

- Grades 5, 8, and 11 tests assess students' understanding of the NGSS across the corresponding grade band (3-5, 6-8, and high school)
- NGSS assessments at each grade include 6 item clusters and 12 stand-alone items
  - **Item clusters** include a stimulus and a series of questions that generally take students about 6-12 minutes to complete
  - **Stand-alone items** are shorter and generally take 1-3 minutes to complete
- All items ask students to use science and engineering practices and apply their understanding of disciplinary core ideas and crosscutting concepts to make sense out of real-world phenomena
- Test configuration for spring 2019 administration
  - 4 segments with 2 distinct sessions of equal length:
    - Life Sciences
    - Physical Sciences
    - Earth/Space Sciences
  - Segments, and the items within each segment, are assigned randomly

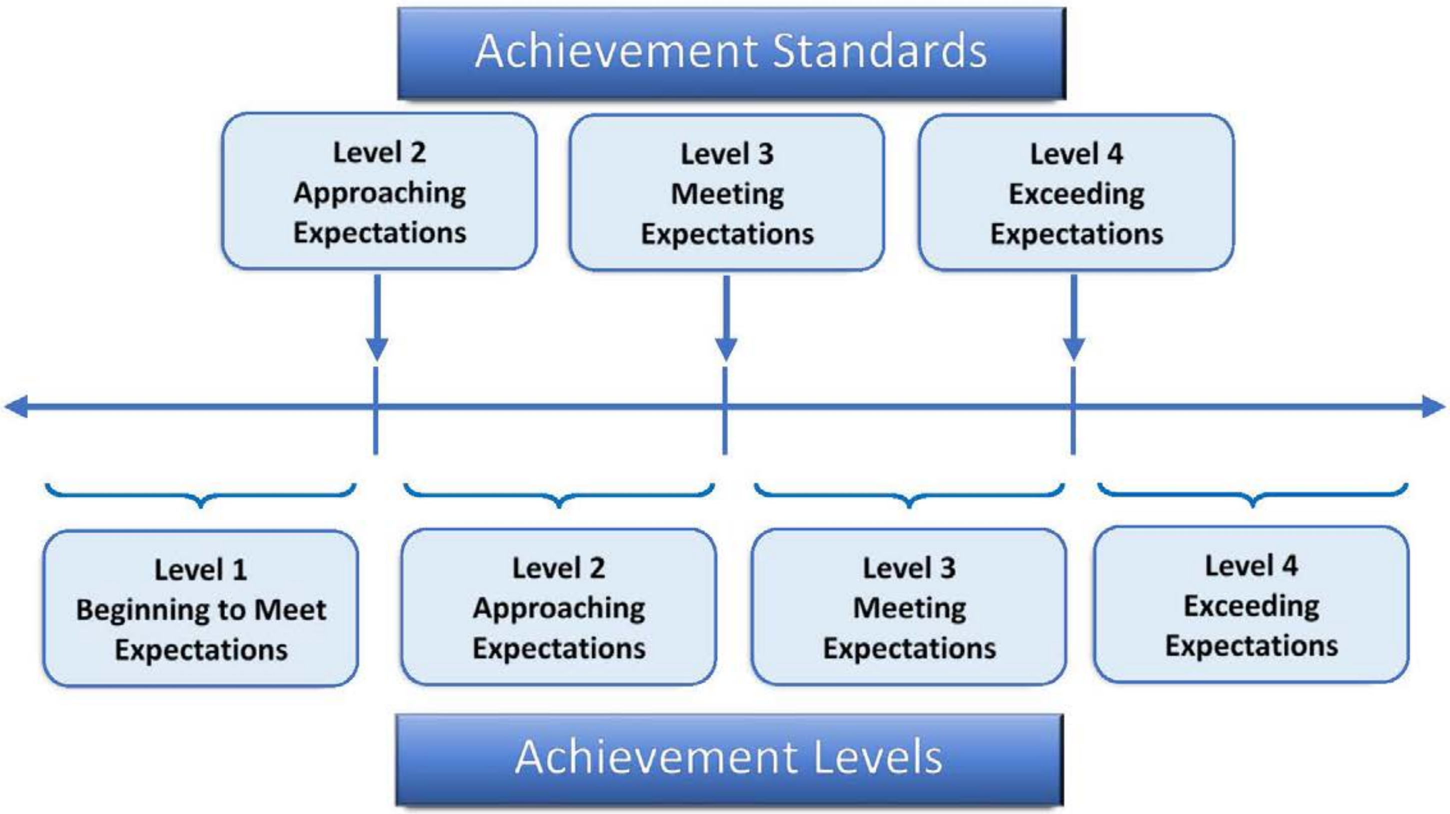
From Content Standards to Achievement Standards

15



Achievement Standards and Achievement Levels

16



Achievement-Level Descriptors (ALDs)

17

- Describe what students within each achievement level are expected to know and be able to do
- ALDs are the link between the content and achievement standards

Policy/Reporting ALDs

18

- **Beginning** – Students who achieve at this level demonstrate initial understanding of knowledge and skills needed to apply three dimensions of science to question, evaluate and explain science phenomena. Student performance based on assessment results begins to meet grade level expectations.
- **Approaching** – Students who achieve at this level demonstrate minimal understanding of knowledge and skills needed to apply three dimensions of science to question, evaluate and explain science phenomena Student performance based on assessment results partially meet grade level expectations.
- **Meeting** – Students who achieve at this level demonstrate satisfactory understanding of knowledge and skills needed to apply three dimensions of science to question, evaluate and explain science phenomena. Student performance based on assessment results meet grade level expectations.
- **Exceeding** – Students who achieve at this level demonstrate advanced understanding of knowledge and skills needed to apply three dimensions of science to question, evaluate and explain science phenomena. Student performance based on assessment results exceed grade level expectations.

Grade 8 ALDs – Level 3 Meeting Expectations

19

Life Sciences

- **MS-LS1:** Gather and synthetize data from an investigation to engage in an argument using evidence and develop and/or use a model to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into food sources but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.
- **MS-LS2:** Develop and/or use a model to explain and predict the dynamic relationships and interactions between the diverse types of living and nonliving parts of an ecosystem, including the flow of energy and cycling of matter among biotic and abiotic components; and analyze and interpret multiple graphical displays of data to design a solution to mitigate disruptions fo any part of an ecosystem by human access to natural resources.
- **MS-LS3:** Develop and/or use a model to describe the relationship among variables that show either why sexual/asexual reproduction may have different results of genetic variation in offspring and how complex and microscopic structural changes to genes (mutations) can be analyzed to determine how they affect the structure and function of an organism.
- **MS-LS4:** Analyze and interpret the patterns in large data sets to explain why species can change over time and communicate the similarities or differences found in past and present organisms or fossil records of past environmental conditions; and gather and synthesize data to construct an explanation for how humans influence the biodiversity of an area, and natural or artificial selection can give some organisms an advantage in survival and reproduction.

Grade 8 ALDs Across Achievement Levels

20

MS-LS1 From Molecules to Organisms: Structures and Processes

- **Level 1 – Beginning to Meet Expectations:** **Organize information** from an investigation to identify components of a model or support an argument using evidence to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into food sources but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.
- **Level 2 – Approaching Expectations:** **Gather and organize information** from an investigation to support an argument using evidence and develop and/or use a simple model to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into food sources but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.
- **Level 3 – Meeting Expectations:** **Gather and synthetize data** from an investigation to engage in an argument using evidence and develop and/or use a model to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into food sources but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.
- **Level 4 – Exceeding Expectations:** **Evaluate and revise** a model or explanation using investigative data as evidence to support an argument that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into food sources but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.

Assertion Mapping Procedure (AMP)

21

- Test-centered procedure
- Employs an ordered item procedure adapted to accommodate new multiple interaction item types
- Maps ordered scoring assertions to ALDs
- Is being employed to recommend achievement standards in multiple states assessing three-dimensional science standards

Key Elements of the Assertion Mapping Procedure

22

- Achievement-level descriptors (ALDs)
- Ordered scoring assertions
- Assertion mapping in multiple rounds
  - Panelist feedback and group discussion
  - Context data

Important Concepts

23

- "Just barely" meets the achievement level
  - Differentiate students who just barely qualify for entry into achievement level from those just below
- Assertion mapping
  - Match each scoring assertion to the ALD that the assertion best supports
- Ordering of assertions
  - Assertions are ordered by difficulty
  - Mapping of assertions to ALDs should reflect the ordering – no inversions

Ordered Scoring Assertions

24

- The ordered scoring assertion booklet (OSAB) constitutes a test administration:
  - A test form that meets test blueprint specifications
- It is important to evaluate scoring assertions as they relate to the item interactions
- Assertions within items are ordered by difficulty
  - Assertions within an item may not represent all ALDs

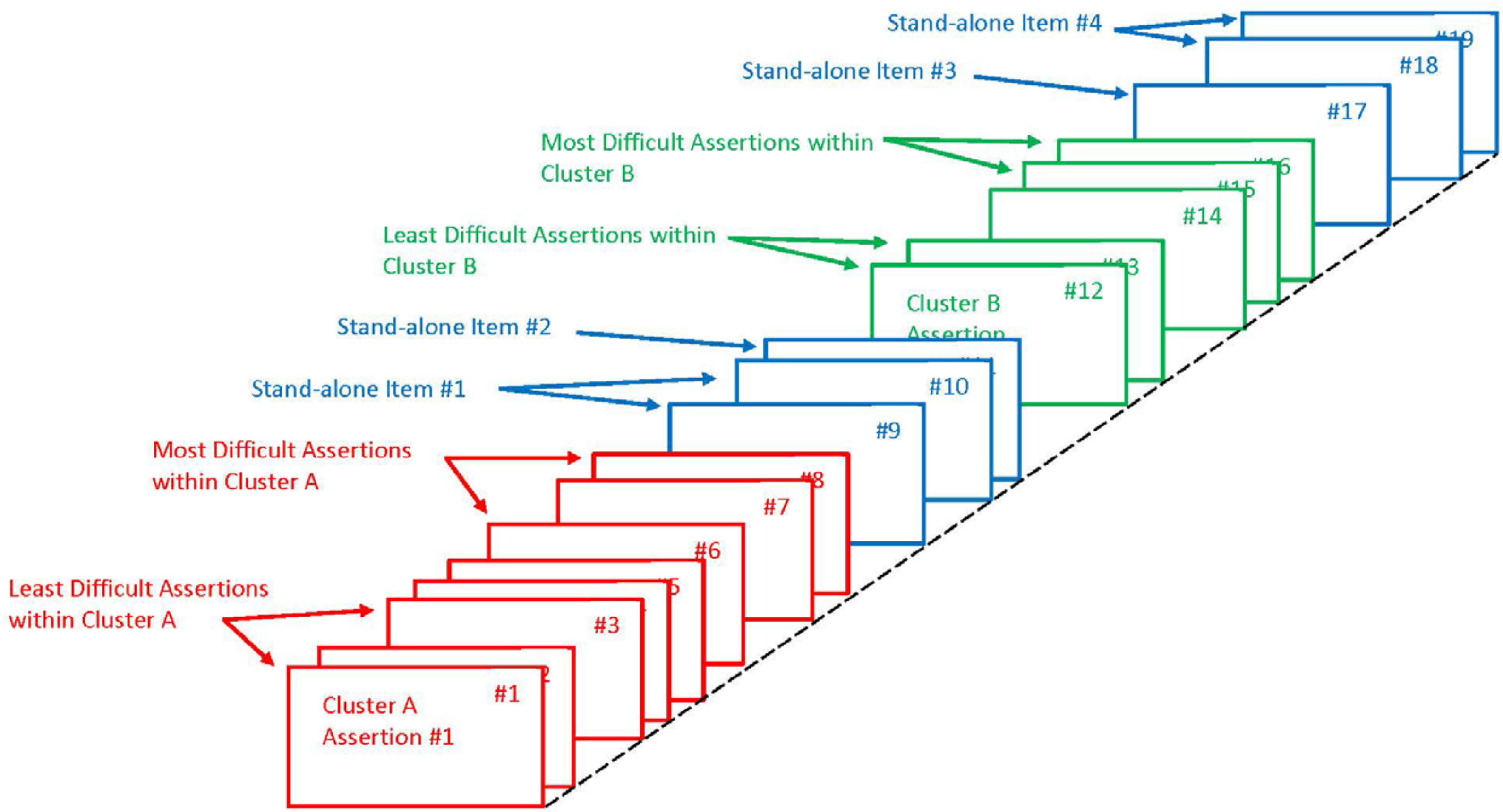
What If an Assertion Seems Out of Order?

25

- Assertion ordering is based on student achievement
- Assertions may seem out of order because they are ordered by difficulty, and not by content or cognitive process
- Identify why a scoring assertion is more difficult than the assertions before it, and easier than the assertions following it
  - Pay special attention to the interactions supporting the assertions
  - Assertions may be more or less difficult because of the underlying interactions

Assertion Mapping Task

26



Studying the Items and Scoring Assertions

27

- Working individually, for each scoring assertion ask yourself
  1. *How do the item interactions support the scoring assertion?*
  2. *Why is this assertion more difficult than the previous assertions?*
  3. *How does the scoring assertion relate to the ALDs?*
- Working as a group
  - Discuss how item interactions support scoring assertions
  - Discuss ordering of scoring assertions
  - Discuss how scoring assertions are related to the ALDs

What If an Item Seems Wrong or Unfair?

28

- Do not let yourself get distracted – this is not an item review meeting
- If you believe something is wrong with an item interaction or scoring assertion, tell the Workshop Leader, then skip over the assertion as you review the rest of the assertions within the item

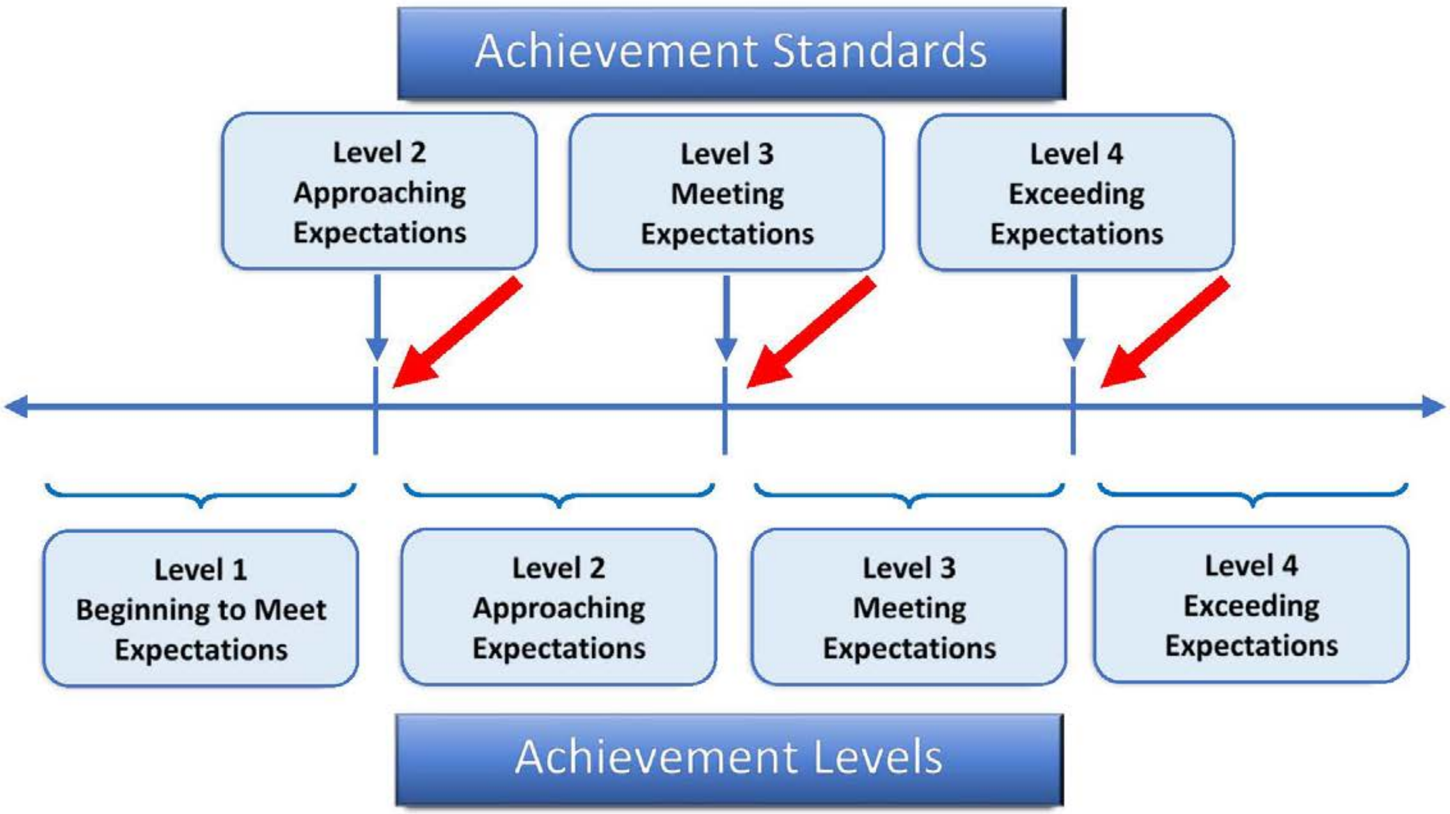
"Just Barely" Meets the Achievement Standard

29

- When considering each achievement level, we are especially interested in the transition areas between achievement levels
- Pay attention to characteristics of students who ***just barely*** qualify for entry into the achievement level from those just below
  - Not a typical example of students in the achievement level
  - Although they are not good examples of the achievement level, they do still meet the standard, or description in the ALD

Just Barely

30



Assertion Mapping Task

31

- Map assertions to achievement levels
  - Consider what differentiates students who just barely qualify for entry into the achievement level from those not quite ready for entry into the achievement level.
  - Evidence that the student has demonstrated knowledge and skills necessary for entry into the achievement level.
- Map assertions in the online standard setting tool

Group Feedback and Discussion

32

- Goals
  - Add important information to your thinking
  - Develop common understandings
  - Inform possible re-evaluation of assertion mapping decisions
- Expectation is converging judgments
  - Consensus not a requirement or goal

Context Data

33

- Percentage of students reaching or exceeding the standard based on assertion mapping
- Group discussion
  - Does the percentage of students reaching or exceeding the current recommended achievement standard seem reasonable?
  - What are the implications for the achievement standards?
  - All achievement standard recommendations should be based on content rationales

Break Into Groups

34

Panel	Room	Facilitator	Facilitator Assistant
Grade 5 Science	Salon A	Jim McCann	Matt Davis
Grade 8 Science	Salon B	Kevin Dwyer	Hibbah Haddam
Grade 11 Science	Salon C	Meg McMahon	Kam Mangis de Mark

Exhibit E-3. Breakout Room Slides

Rhode Island Department of Education

VERMONT AGENCY OF EDUCATION

AIR AMERICAN INSTITUTES FOR RESEARCH

STANDARD SETTING: Science Grade 8

August 5 – 6, 2019, The Grappone Conference Center, Concord, NH
Rhode Island and Vermont Science Assessment

2

Standard Setting Day 1

Recommending Achievement Standards for Grade 8 Science

Standard-Setting Forms

3

- Read, sign, and turn-in Non-Disclosure Form
- Complete Online Panelist Information Form

Importance of Security

4

- No cell phones or tablets in the room
  - Please take calls outside of the room
  - Please refrain from texting in the room
  - Taking pictures is not permitted
- Do not take materials outside of the room
  - Leave all materials on the table, these will be collected by workshop leaders

Day 1 Agenda

5

- Online Test Experience
- Review ALDs
- Lunch
- ALD Discussion
- Review Ordered Scoring Assertion Booklet (OSAB)

6

Operational Test Review

Review of Items – 3D Composition

7

For States, By States

MS-LS1-1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: 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 and varied cells.]

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

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.

- Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation.

Disciplinary Core Ideas

LS1.A: Structure and Function

- 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).

Crosscutting Concepts

Scale, Proportion, and Quantity

- Phenomena that can be observed at one scale may not be observable at another scale.

Connections to Engineering, Technology and Applications of Science

Interdependence of Science, Engineering, and Technology

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.

Review of Items – 3D Composition

8

- Three-Dimensional Science Standards
- Each 3D “standard” is a blend of one or two **“big ideas” from a science discipline (DCI)**, one of several **scientific activities that are common to the doing of all science (SEP)**, and one of a number of **broad themes that are found across scientific disciplinary boundaries (CCC)**.

Review of Items – 3D Composition

9

Three-Dimensional Science Standards

Scientific and Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas
▸ Asking questions or defining problems ▸ Developing and using models ▸ Planning and carrying out investigations ▸ Analyzing and interpreting data ▸ Using mathematics and computational thinking ▸ Constructing explanations and designing solutions ▸ Engaging in argument from evidence ▸ Obtaining, evaluating, and communicating information	▸ Patterns ▸ Cause and effect: mechanism and explanation ▸ Scale, proportion, and quantity ▸ Systems and system models ▸ Energy and matter: flows, cycles, and conservation ▸ Structure and function ▸ Stability and change	▸ Earth and Space Science ▸ Life Science ▸ Physical Science ▸ Engineering

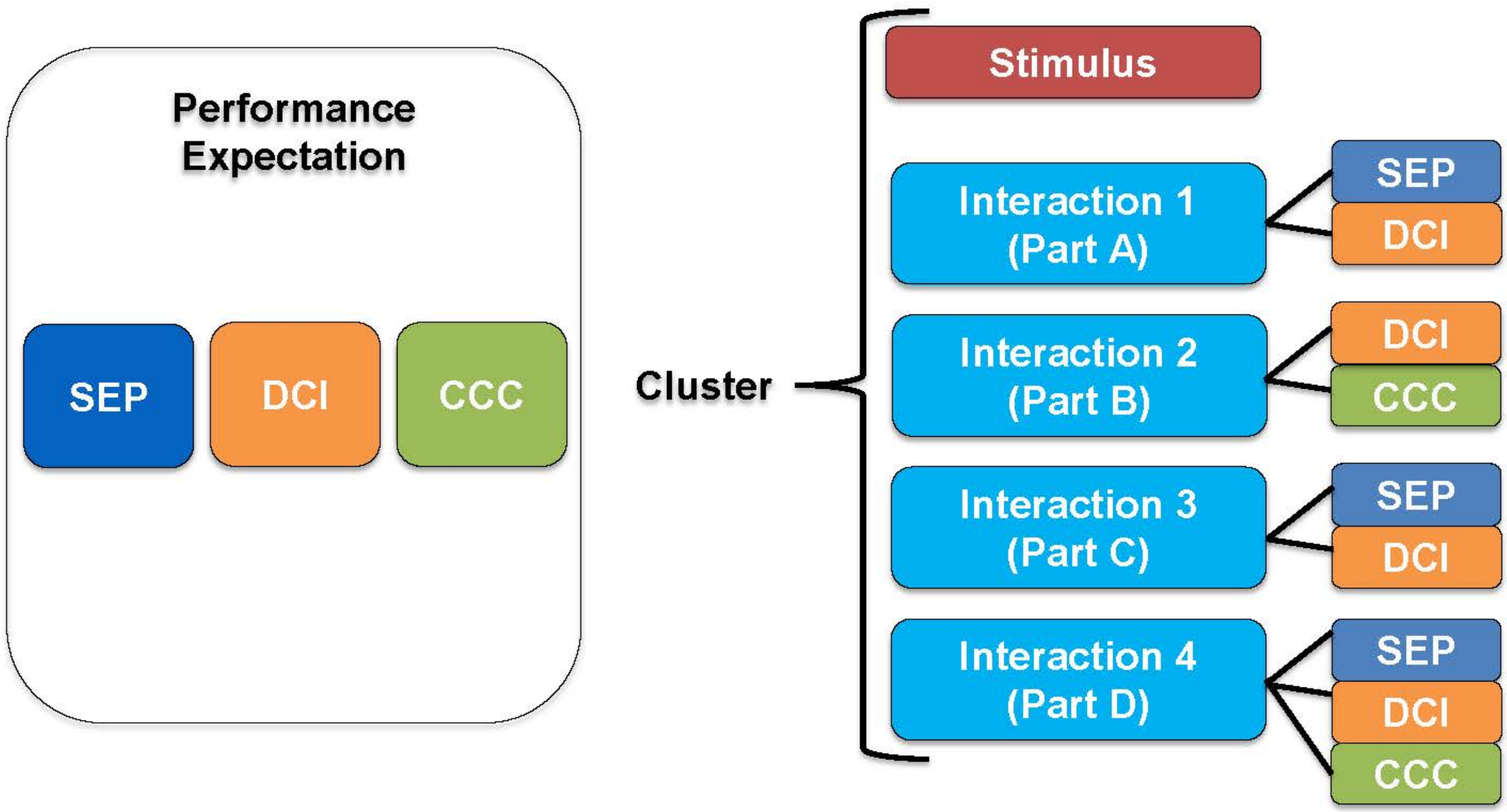
Structure of Item Clusters

10

- Each cluster begins with a ***phenomenon***, which is the observation about the natural world which anchors the entire cluster. The interactions within the cluster all address the phenomenon.
- Each cluster engages the student in a grade-appropriate, meaningful ***scientific activity*** aligned to a specific standard.
- A ***cluster task statement*** comes at the end of the stimulus and an overview of the point of the cluster.
- Each measurable moment is captured with a ***scoring assertion***. These assertions clearly articulate what evidence the student has provided as a means to infer a specific skill or concept.

Review of Clusters – Composition

11



Review of Items – Composition Example

12

Sparks fly off the wheels of a train when the brakes are applied.

Click the small gray arrow to see a demonstration of this happening in Animation 1.

Animation 1. Braking Train

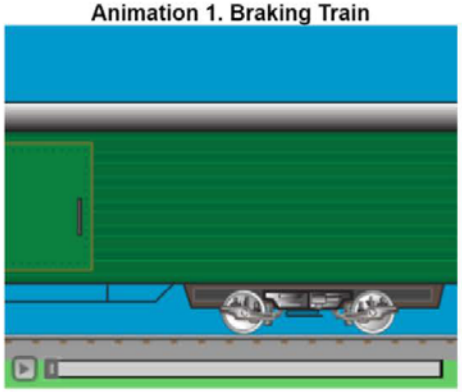


Table 1 explains some properties of the train and its surroundings as energy flows throughout the system.

Table 1. Properties of the Train System

Before Brakes Are Applied	After Brakes Applied
No sparks	Sparks fly off the wheels and brake pads
Brake pads make no sound	Brake pads make sound

1680

Part A

Click on each blank box to select the word or phrase that completes each sentence, constructing an argument about what happens when the train's brakes are applied.

Applying the brakes causes the [▼] to transfer kinetic energy to the [▼]. This causes the [▼] to slow down and have [▼] kinetic energy, which slows the train.

Part B

When the train applies its brakes, what happens to the energy of the surroundings?

(A) The surroundings gain energy.

(B) The surroundings lose energy.

(C) The surroundings do not gain or lose energy.

(D) There is not enough information to determine the energy of the surroundings.

Part C

Which **three** statements support your choice in part B?

- [ ] The train maintains its speed.
- [ ] Sound is produced.
- [ ] Sound is consumed.
- [ ] Light is produced.
- [ ] Light is consumed.
- [ ] Heat is produced.
- [ ] Heat is consumed.

Review of Items – Scoring Assertions

13

Score Rationale	
The student selected "wheels" for the first blank and "brakes" or "rails" for the second blank showing an understanding of the interactions in the system and the effects of that energy flow.	✖
The student selected "wheels" for the third blank and "less" for the fourth blank showing an understanding of the interactions in the system and the effects of that energy flow.	✖
The student selected "The surroundings gain energy," showing an understanding of how the energy of the wheels change and is distributed throughout the system.	✖
The student selected "Sound is produced," providing evidence of how the energy of the surroundings has changed.	✖
The student selected "Light is produced," providing evidence of how the energy of the surroundings has changed.	✖
The student selected "Heat is produced," providing evidence of how the energy of the surroundings has changed.	✖
The student selected "The brakes make a screeching sound," which shows an understanding of how the energy changed throughout the system and that those changes serve as evidence that the the Kinetic Energy of the wheels transfers out of the wheels/system when the brakes are applied.	✖
The student selected "The sparks that fly off the wheels give off light," which shows an understanding of how the energy changed throughout the system and that those changes serve as evidence that the the Kinetic Energy of the wheels transfers out of the wheels/system when the brakes are applied.	✖
The student selected "The brakes give off energy as heat," which shows an understanding of how the energy changed throughout the system and that those changes serve as evidence that the the Kinetic Energy of the wheels transfers out of the wheels/system when the brakes are applied.	✖

Experience the Online Assessment

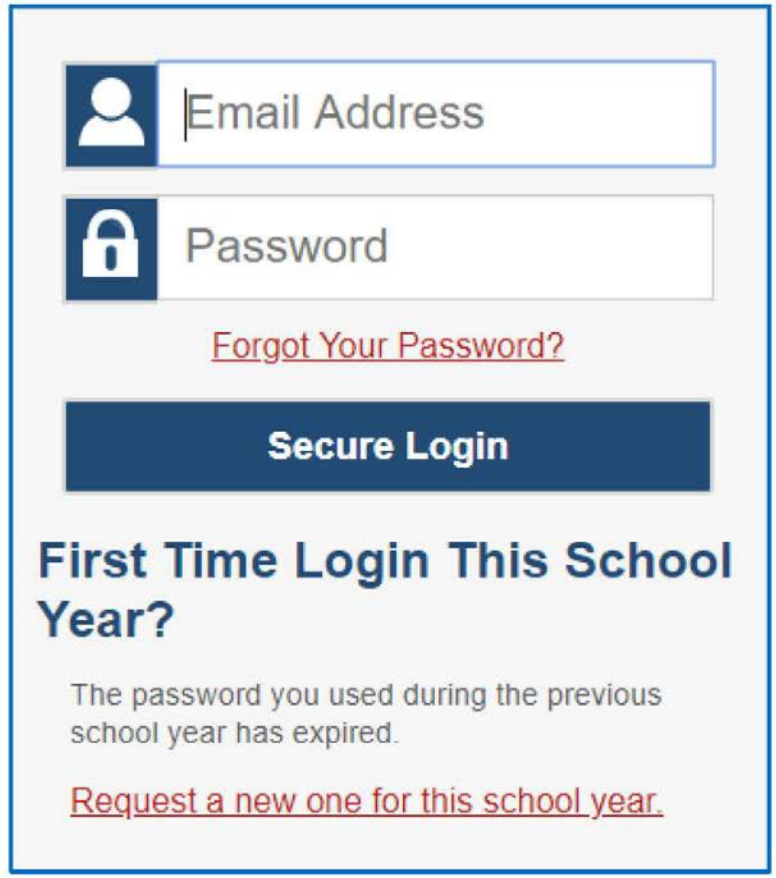
14

- Time to “Take the Test”
- Items administered in spring 2019
- Interface is similar to the online test environment that the students experienced
- This is an opportunity to interact with the items
- No need to “complete” the test, you will have more time later to become very familiar with the items
- You can score your responses
- You have ~90 minutes (stop at 11:15 am)

Accessing the Online Assessment

15

- Open the Chrome browser
- Sign in with your User Name and Password



16

Experience Online Operational Test Environment

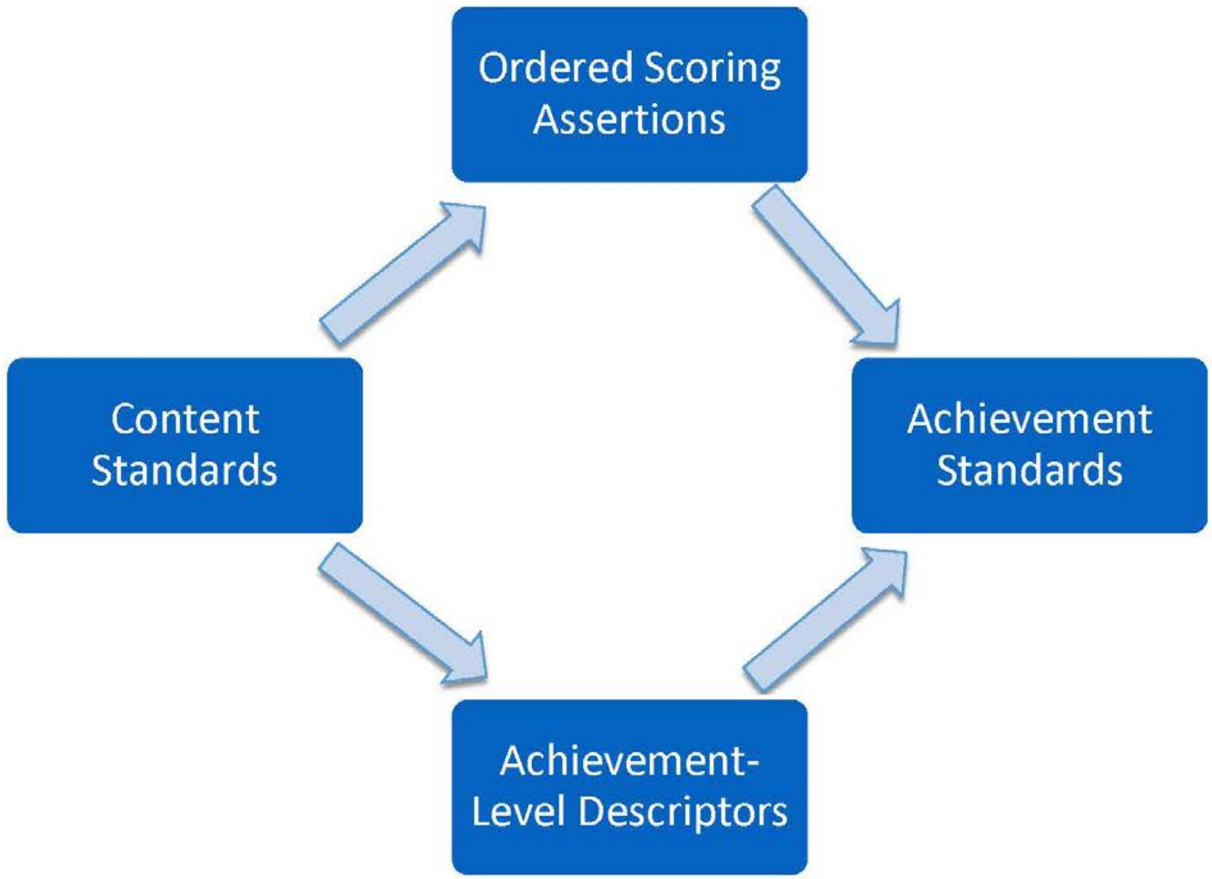
Step 2: Take the Operational Test

17

ALD Review

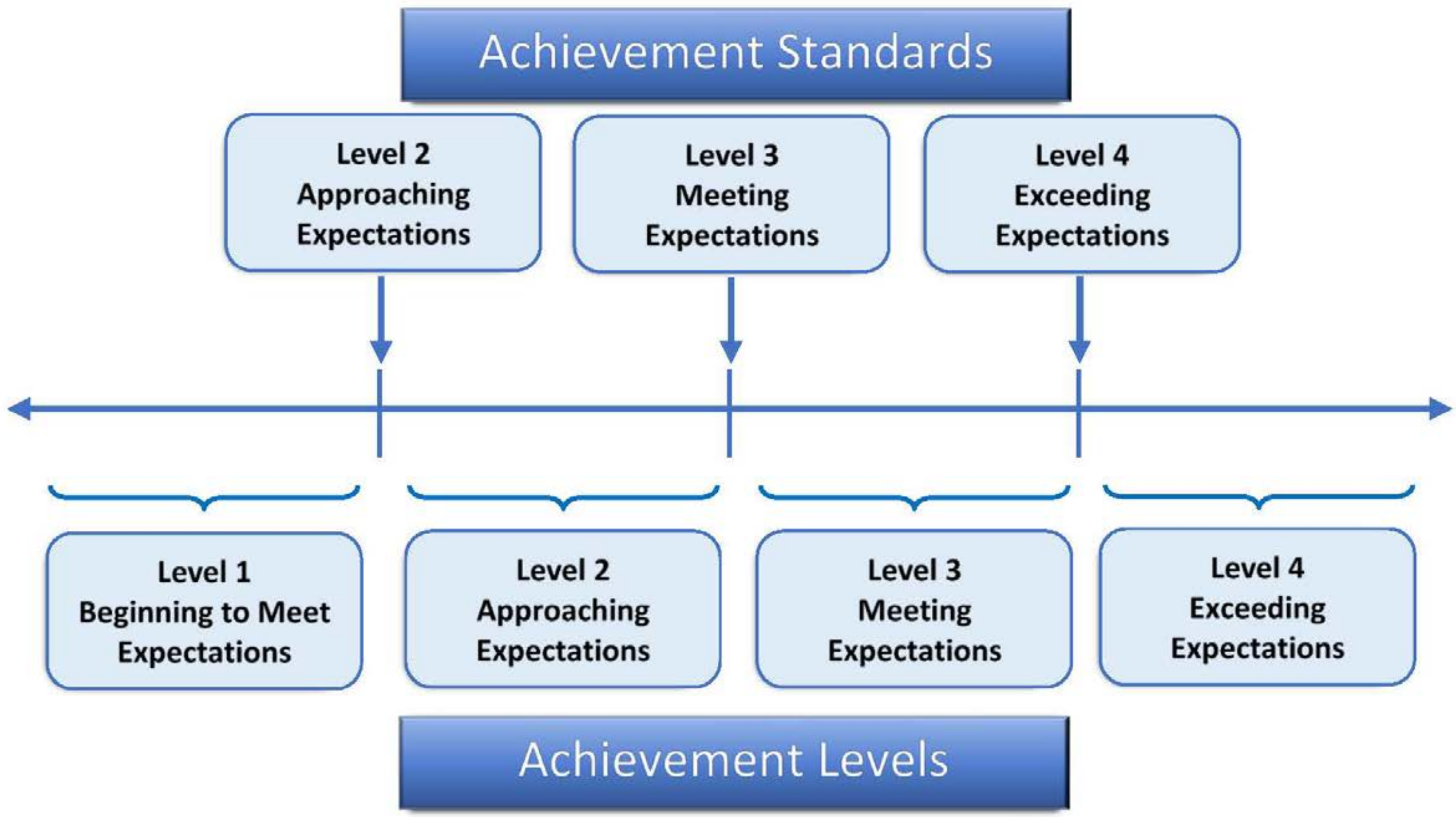
From Content Standards to Achievement Standards

18



Achievement Standards and Achievement Levels

19



Achievement-Level Descriptors (ALDs)

20

- Describe what students within each achievement level are expected to know and be able to do
- ALDs are the link between content and achievement standards

Grade 8 ALDs – Level 3 Meeting Expectations

21

Life Sciences

- **MS-LS1:** Gather and synthetize data from an investigation to engage in an argument using evidence and develop and/or use a model to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into food sources but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.
- **MS-LS2:** Develop and/or use a model to explain and predict the dynamic relationships and interactions between the diverse types of living and nonliving parts of an ecosystem, including the flow of energy and cycling of matter among biotic and abiotic components; and analyze and interpret multiple graphical displays of data to design a solution to mitigate disruptions fo any part of an ecosystem by human access to natural resources.
- **MS-LS3:** Develop and/or use a model to describe the relationship among variables that show either why sexual/asexual reproduction may have different results of genetic variation in offspring and how complex and microscopic structural changes to genes (mutations) can be analyzed to determine how they affect the structure and function of an organism.
- **MS-LS4:** Analyze and interpret the patterns in large data sets to explain why species can change over time and communicate the similarities or differences found in past and present organisms or fossil records of past environmental conditions; and gather and synthesize data to construct an explanation for how humans influence the biodiversity of an area, and natural or artificial selection can give some organisms an advantage in survival and reproduction.

Grade 8 ALDs Across Achievement Levels

22

MS-LS1 From Molecules to Organisms: Structures and Processes

- **Level 1 – Beginning to Meet Expectations:** Organize information from an investigation to identify components of a model or support an argument using evidence to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into food sources but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.
- **Level 2 – Approaching Expectations:** Gather and organize information from an investigation to support an argument using evidence and develop and/or use a simple model to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into food sources but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.
- **Level 3 – Meeting Expectations:** Gather and synthetize data from an investigation to engage in an argument using evidence and develop and/or use a model to explain that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into food sources but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.
- **Level 4 – Exceeding Expectations:** Evaluate and revise a model or explanation using investigative data as evidence to support an argument that all living things are made up of cells that work together to form more complex structures and systems; both plants and animals convert energy into food sources but the process to do so is different; characteristic animal behaviors and specialized plant structures affect the probability of reproduction.

Parse and Review the ALDs

23

- Take a few minutes to review the ALDs taking notice of the verbs and skills that differentiate the achievement levels
  - Think about how the skills change from Level 1 to Level 4
  - Think about the skills and knowledge these students can demonstrate
  - Idea is to get a common mental representation of these students

  REMEMBER: Not every piece of content will be represented in the ALDs
- ALD Discussion

Threshold “Just Barely” ALDs

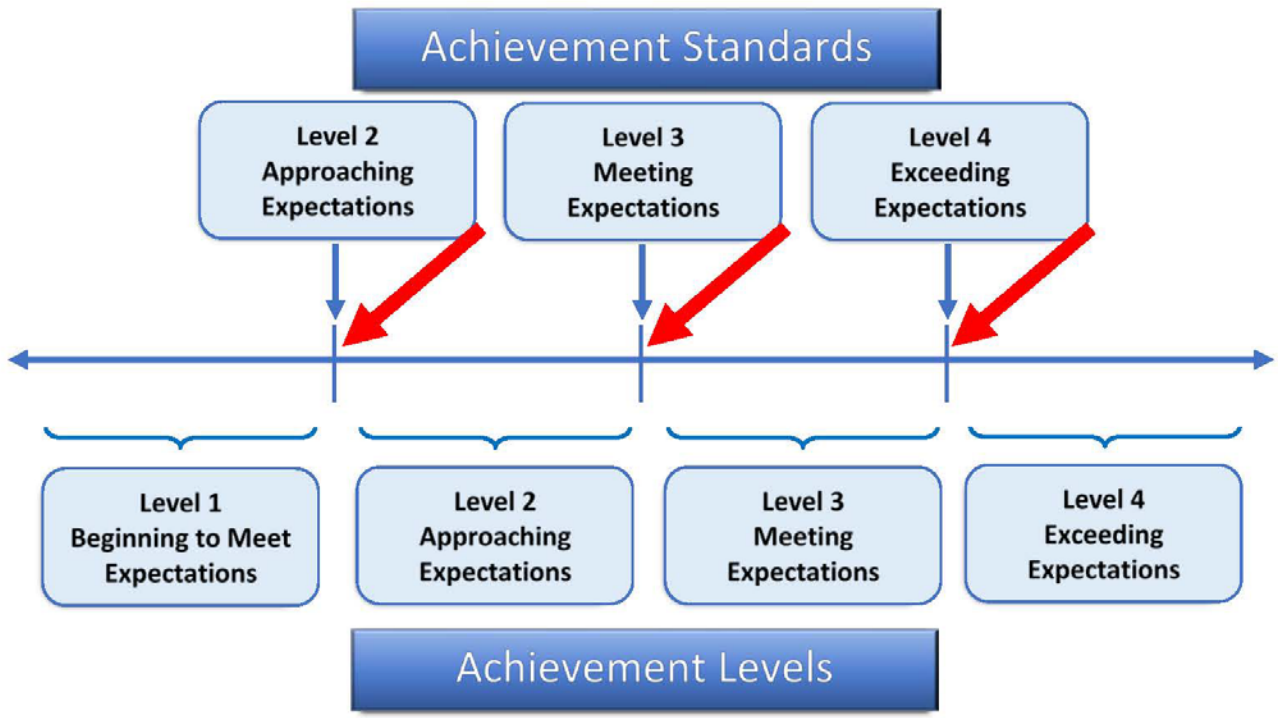
24

- When considering each achievement level, we are especially interested in the transition areas between achievement levels
- Pay attention to characteristics of students who ***just barely*** qualify for entry into the achievement level from those just below
  - Not a typical example of students in the achievement level
  - Although they are poor examples of the achievement level, they do meet the standard, or description in the ALD
    - Just barely Level 2 – Approaching Expectations
    - Just barely Level 3 – Meeting Expectations
    - Just barely Level 4 – Exceeding Expectations

Threshold "Just Barely" ALDs

25

- Not typical of students in the achievement level; although just barely, they do reach the standard



Purpose of Just Barely Discussion

26

- Identify the types of skills these students can demonstrate
- Come to a common understanding of these skills and big ideas

Just Barely Discussion

27

- Think about what skills, concepts, or knowledge a just barely student would need to have to enter into each level
- As a group we will discuss the skills that a just barely student needs to have to gain entry into each of the four levels
- For each achievement level think about:
  - What skills and knowledge must the student demonstrate to qualify for entrance into this achievement level?
  - How does this differ from the upper range of the adjacent achievement level?

28

Review of Ordered Scoring Assertion Booklet (OSAB)

Step 4: Review of Ordered Scoring Assertion Booklet

Ordered Scoring Assertion Booklet

29

- The ordered scoring assertion booklet (OSAB) represents the full range of performance expectations assessed by the blueprint
- It is important to evaluate scoring assertions as they relate to the item interactions
- Within the OSAB, the scoring assertions are ordered from easiest to most difficult, within an item
  - Assertions within an item may not represent all ALDs

Review of Items – Composition Example

30

Sparks fly off the wheels of a train when the brakes are applied.

Click the small gray arrow to see a demonstration of this happening in Animation 1.

Animation 1. Braking Train

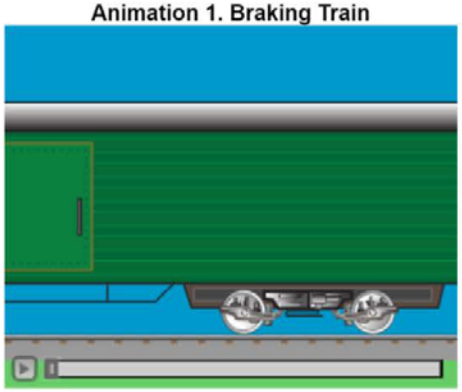


Table 1 explains some properties of the train and its surroundings as energy flows throughout the system.

Table 1. Properties of the Train System

Before Brakes Are Applied	After Brakes Applied
No sparks	Sparks fly off the wheels and brake pads
Brake pads make no sound	Brake pads make sound

1680

Part A

Click on each blank box to select the word or phrase that completes each sentence, constructing an argument about what happens when the train's brakes are applied.

Applying the brakes causes the [▾] to transfer kinetic energy to the [▾]. This causes the [▾] to slow down and have [▾] kinetic energy, which slows the train.

Part B

When the train applies its brakes, what happens to the energy of the surroundings?

- Ⓐ The surroundings gain energy.
- Ⓑ The surroundings lose energy.
- Ⓒ The surroundings do not gain or lose energy.
- Ⓓ There is not enough information to determine the energy of the surroundings.

Part C

Which **three** statements support your choice in part B?

- ☐ The train maintains its speed.
- ☐ Sound is produced.
- ☐ Sound is consumed.
- ☐ Light is produced.
- ☐ Light is consumed.
- ☐ Heat is produced.
- ☐ Heat is consumed.

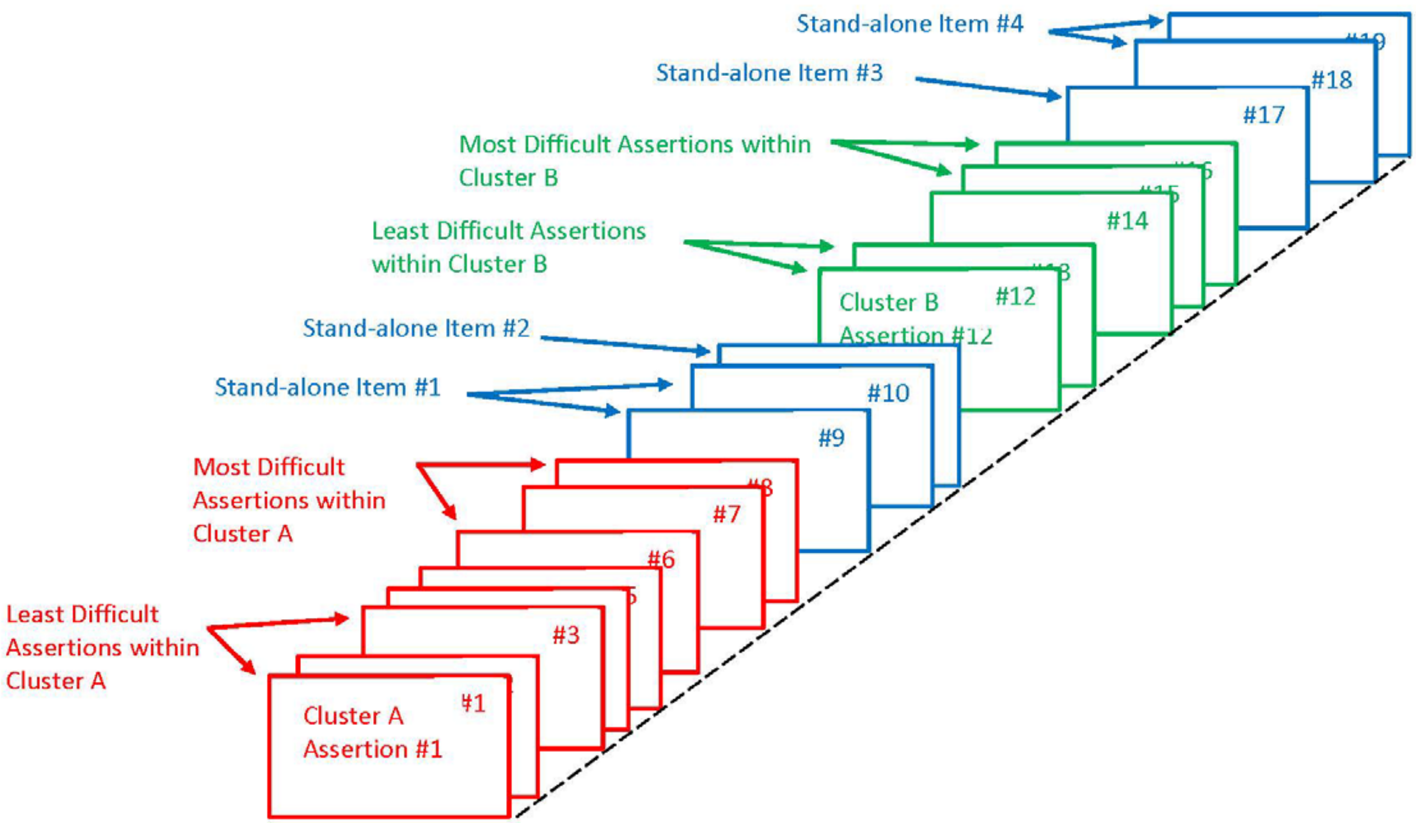
Review of Items – Scoring Assertions

31

Score Rationale	
The student selected "wheels" for the first blank and "brakes" or "rails" for the second blank showing an understanding of the interactions in the system and the effects of that energy flow.	✖
The student selected "wheels" for the third blank and "less" for the fourth blank showing an understanding of the interactions in the system and the effects of that energy flow.	✖
The student selected "The surroundings gain energy," showing an understanding of how the energy of the wheels change and is distributed throughout the system.	✖
The student selected "Sound is produced," providing evidence of how the energy of the surroundings has changed.	✖
The student selected "Light is produced," providing evidence of how the energy of the surroundings has changed.	✖
The student selected "Heat is produced," providing evidence of how the energy of the surroundings has changed.	✖
The student selected "The brakes make a screeching sound," which shows an understanding of how the energy changed throughout the system and that those changes serve as evidence that the the Kinetic Energy of the wheels transfers out of the wheels/system when the brakes are applied.	✖
The student selected "The sparks that fly off the wheels give off light," which shows an understanding of how the energy changed throughout the system and that those changes serve as evidence that the the Kinetic Energy of the wheels transfers out of the wheels/system when the brakes are applied.	✖
The student selected "The brakes give off energy as heat," which shows an understanding of how the energy changed throughout the system and that those changes serve as evidence that the the Kinetic Energy of the wheels transfers out of the wheels/system when the brakes are applied.	✖

Ordered Scoring Assertion Booklet

32



What If an Assertion Seems Out of Order?

33

- Assertion ordering is based on student achievement
- Assertions may seem out of order because they are ordered by difficulty, not by content or cognitive process
- Identify why a scoring assertion is more difficult than the assertions before it, and easier than the assertions following it (within an item)
  - Pay special attention to the interactions supporting the assertions
  - Assertions may be more or less difficult because of the underlying interactions
  - Think about how the phenomenon may affect the difficulty of the task (difficulty of similar tasks between items may vary)

Ordered Scoring Assertion Booklet

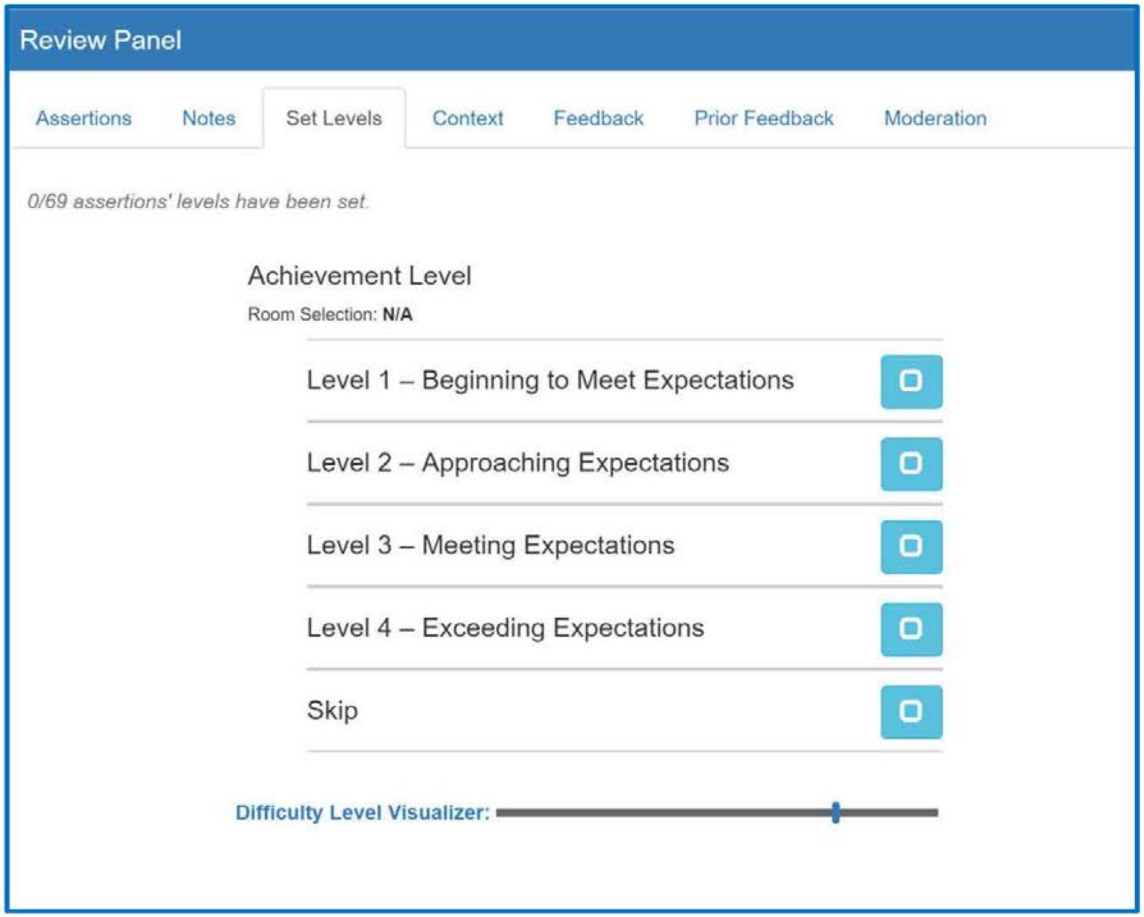
34

- See the **Difficulty Level Visualizer** – graphic representation of the difficulty of each assertion relative to the student population

- Example of how to use this:
  - After reviewing the item and scoring assertion you believe this is a relatively difficult concept. However, you see it is on the far left of the scale, ask yourself:
    - *What made this so easy for the student?*
    - *Is the student really "analyzing" or perhaps it is a concept that is very familiar to students and it is more of a rote concept?*

Ordered Scoring Assertion Booklet

35



What If an Item Seems Wrong or Unfair?

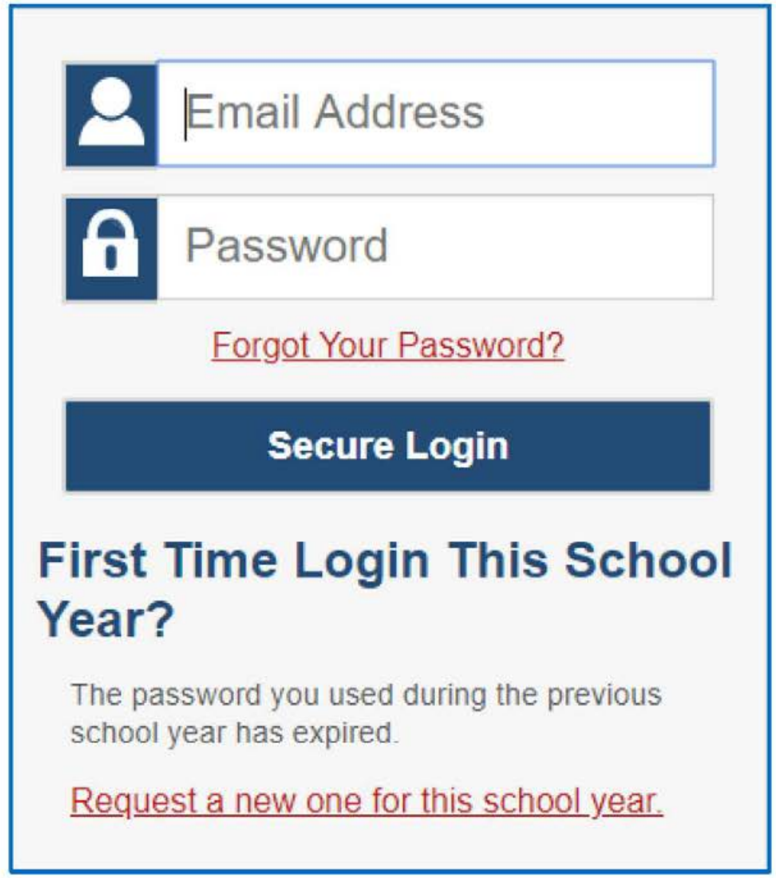
36

- Do not let yourself get distracted – this is not an item review meeting
- If you believe something is wrong with an item interaction or scoring assertion, tell the workshop leader, then skip over the assertion as you review the rest of the assertions within the item

Accessing the OSAB

37

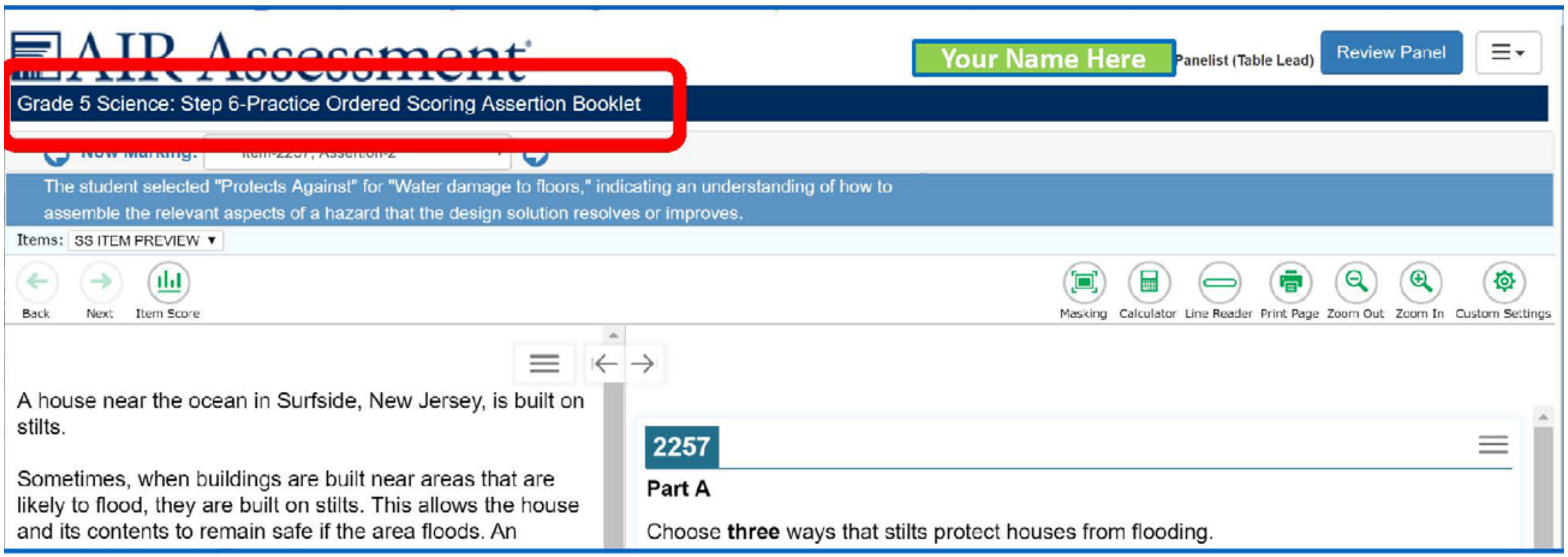
- Open the Chrome browser
- Sign in with your User Name and Password



Navigating the OSAB

38

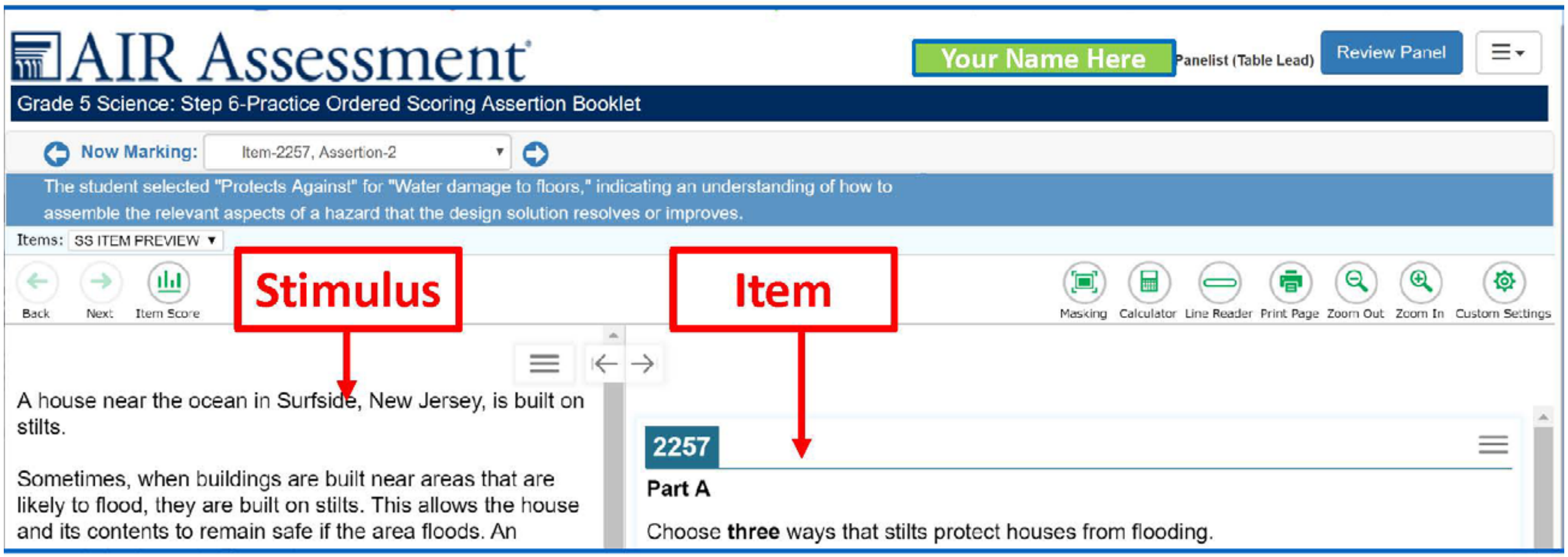
- Test and step we are working on shown at the top of the screen



Navigating the OSAB

39

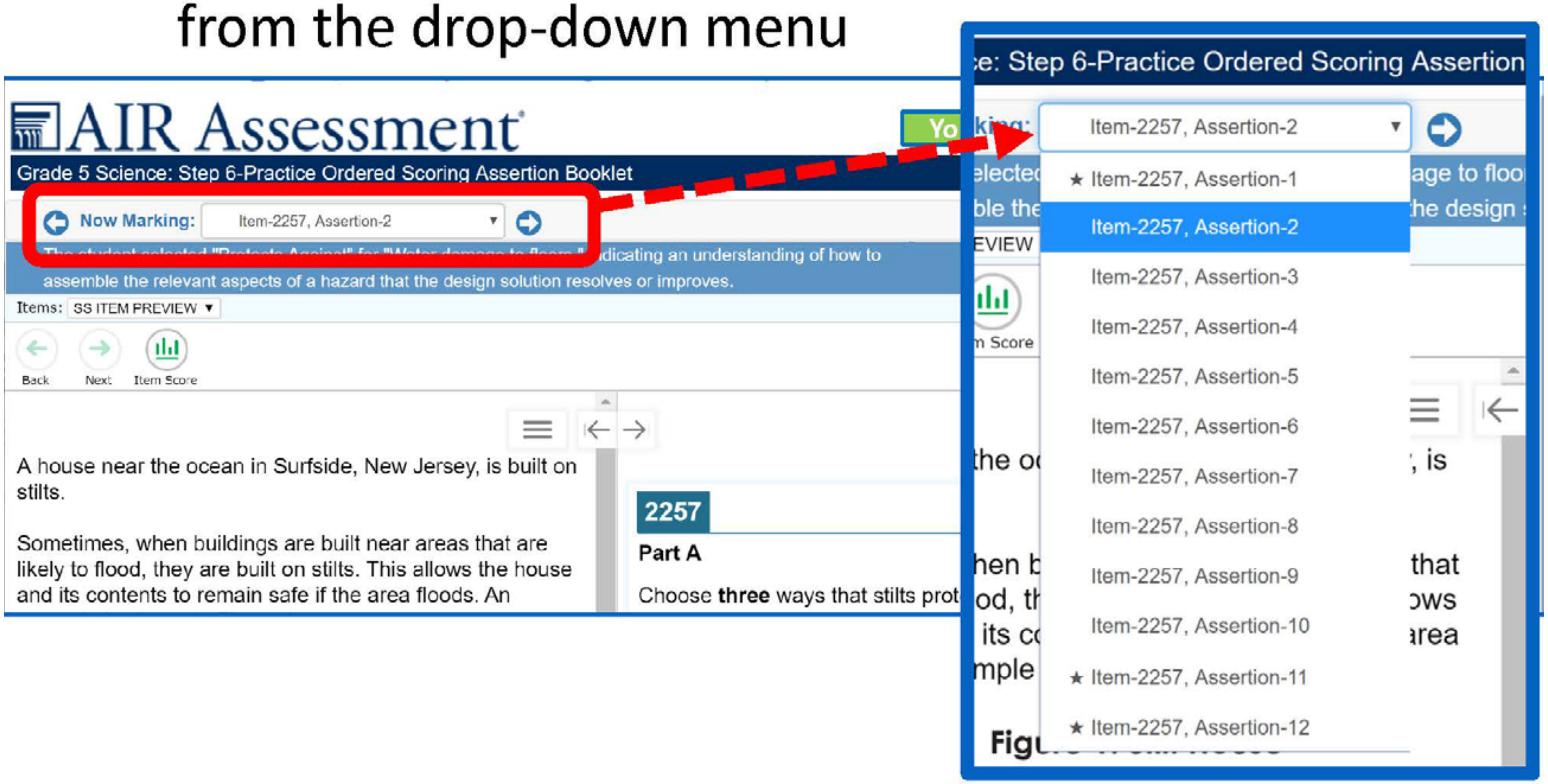
- View the stimulus on the left side of the screen and the item on the right



Navigating the OSAB

40

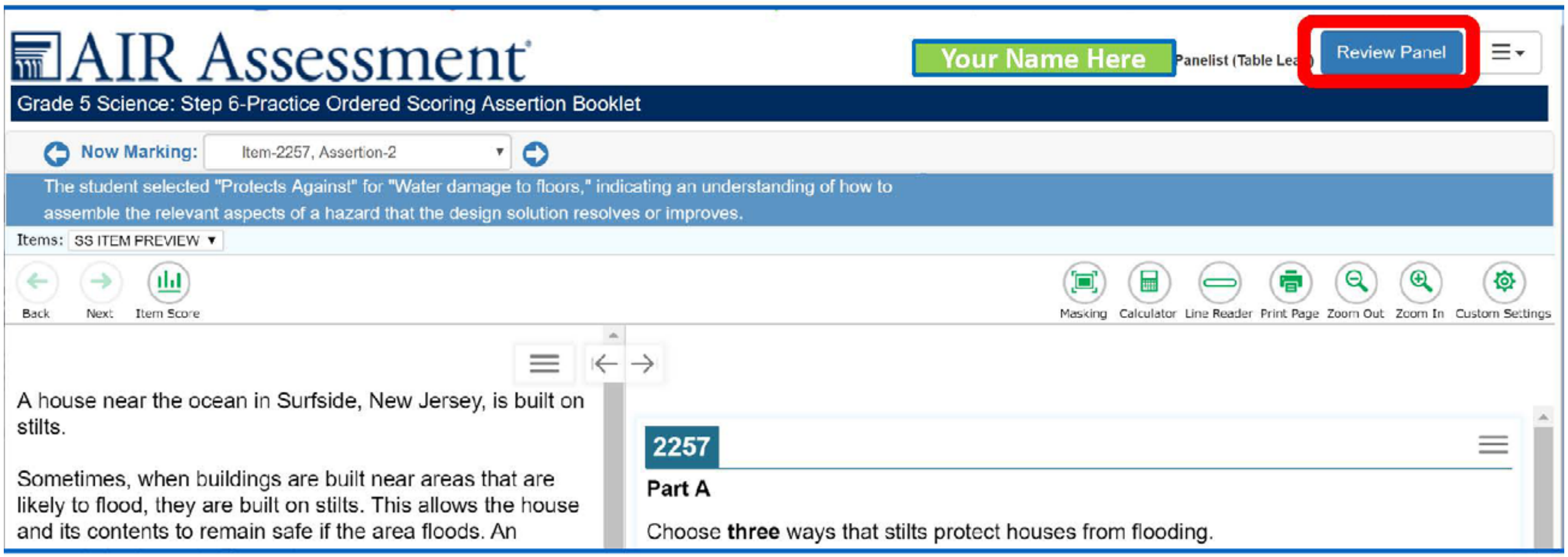
- Move forward in the OSAB or select an assertion from the drop-down menu



Navigating the OSAB

41

- Access the Review Panel



Navigating the OSAB – Review Panel

42

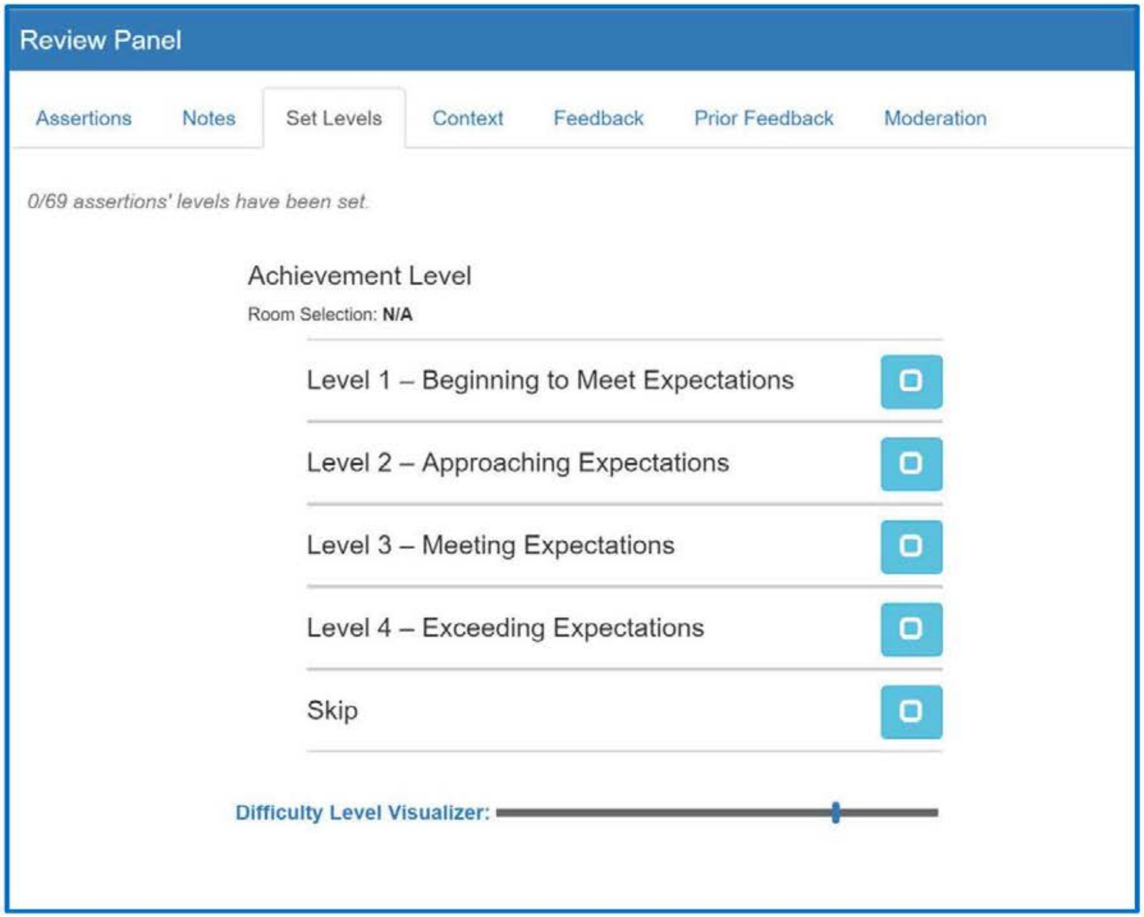
Review Panel

Assertions | Notes | Set Levels | Context | Feedback | Prior Feedback | Moderation

Assertion Rubric Order	Interpretation	Room Selection	Your Selection
1	When asked to identify whether stilts protect against each action or not, the student selected "Protects Against" for "Household objects being washed away", "Water damage to floors", "Water damage to household objects", and "Does not protect against" for "Yard flooding". This provides some evidence that the student understands how to assemble the relevant aspects of a hazard that the design solution resolves or improves.	NA	NA
2	When asked to select three conditions that the stilts must meet to keep a building and its contents safe during a flood, the student selected "resist strong water current." This provides some evidence that the student understands how to identify constraints that the design solution must meet.	NA	NA
3	When asked to select three conditions that the stilts must meet to keep a building and its contents safe during a flood, the student selected "support the weight of the building." This provides some evidence that the student understands how to identify constraints that the design solution must meet.	NA	NA
4	When asked to select three conditions that the stilts must	NA	NA

Navigating the OSAB – Review Panel

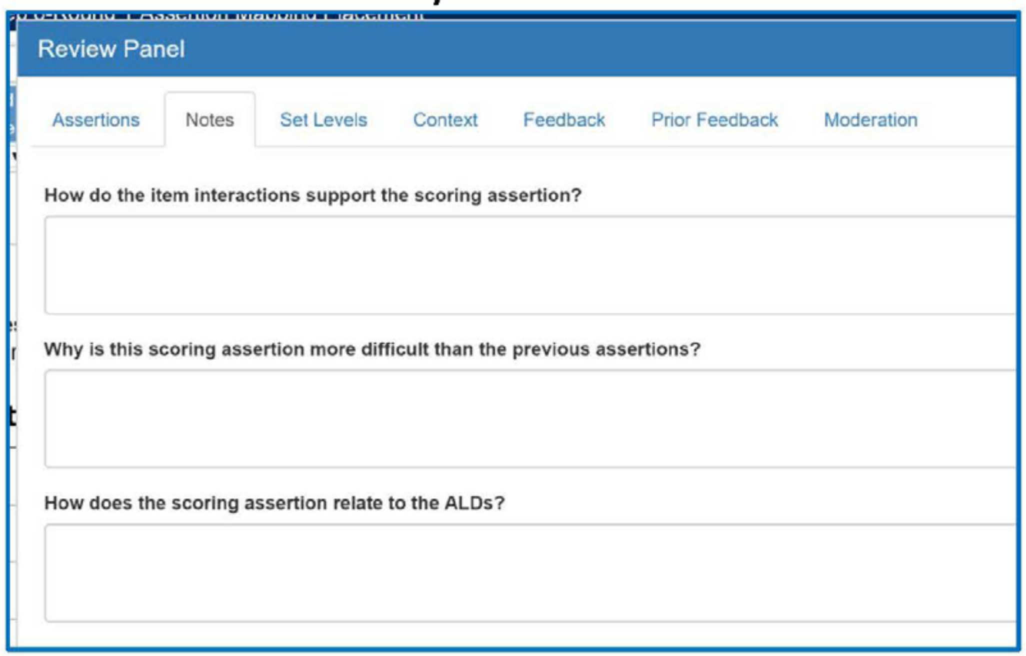
43



Navigating the OSAB – Review Panel

44

- "Notes" tab – this is for your reference



- "Context" tab – presents context data

Review of the Ordered Scoring Assertion Booklet

45

- Let's review the items together

Studying the Items and Scoring Assertions

46

- We will first, work together on a set of items, for each scoring assertion asking and answering:
  1. *How do the item interactions support the scoring assertion?*
  2. *Why is this assertion more difficult than previous assertions (within the item)?*
  3. *How does the scoring assertion relate to the ALDs?*
- Then, working individually review the stand-alone items.
- Adjourn at 4:30 pm
- Tomorrow: 8:00 am – continue OSAB review

47

Standard Setting Day 2

Recommending Achievement Standards for Grade 8 Science

Day 2 Agenda

48

- Continue review and discussion of OSAB
- Training on Assertion Mapping
- Round 1 Assertion Mapping
- Feedback and discussion
- Round 2 Assertion Mapping

49

OSAB Discussions

Discussion of the OSAB

50

- Discuss with your table:
    1. *How do the item interactions support the scoring assertion?*
    2. *Why is this assertion more difficult than the previous assertions (within the item)?*
    3. *How does the scoring assertion relate to the ALDs?*
- Then, working as a group by item, discuss the three questions above. Also consider:
    - Did you skip anything?
    - Were you surprised at the level of difficulty of any assertions?
- Continue taking notes and discussions until 10:00 am

51

Training on Assertion Mapping

Assertion Mapping Key Concepts

52

- Achievement-Level Descriptors (ALDs)
- Ordered scoring assertions
- Assertion mapping in multiple rounds
  - Panelist feedback and group discussion
  - Context data

Assertion Mapping Procedure

53

- Test-centered procedure
- Ordered item procedure adapted to accommodate new multiple interaction item types
- Map ordered scoring assertions to ALDs
- Is being employed to recommend achievement standards for multiple states administering similar 3D science assessments

Important Concepts

54

- Assertion mapping
  - Match each scoring assertion to the achievement level that the assertion best supports
- Ordering of assertions
  - For assertion mapping, assertions are ordered by difficulty within an item
  - **Assertions within an item may not represent all ALDs**
  - Mapping of assertions to achievement levels should reflect the ordering
    - No inversions within an item*
  - Pay attention to the Difficulty Level Visualizer across items

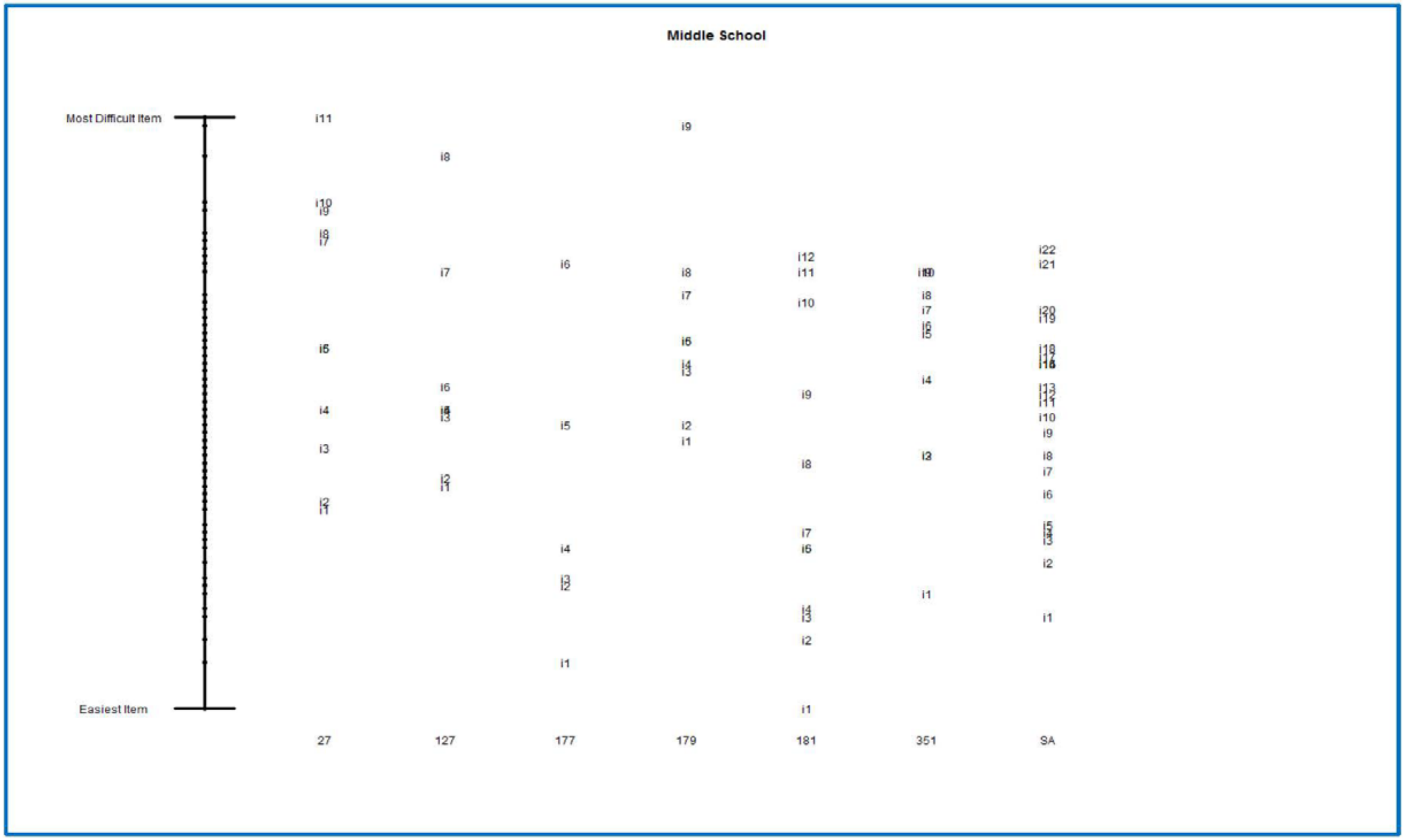
Mapping Ordered Assertions to Achievement Levels

55

- You will map each scoring assertion to an achievement level using the following tools:
  - Achievement Level Descriptors
  - Difficulty Level Visualizer
  - Your professional judgement (and notes)
- Remember, scoring assertions are ordered from easiest to most difficult within each item
- If you think that a subsequent assertion is at a lower level than a previous assertion, you might have been premature at setting the level for the earlier assertion
- You may “Skip” if an assertion seems to be out of place
  - Only use as a last resort

Assertion Map

56



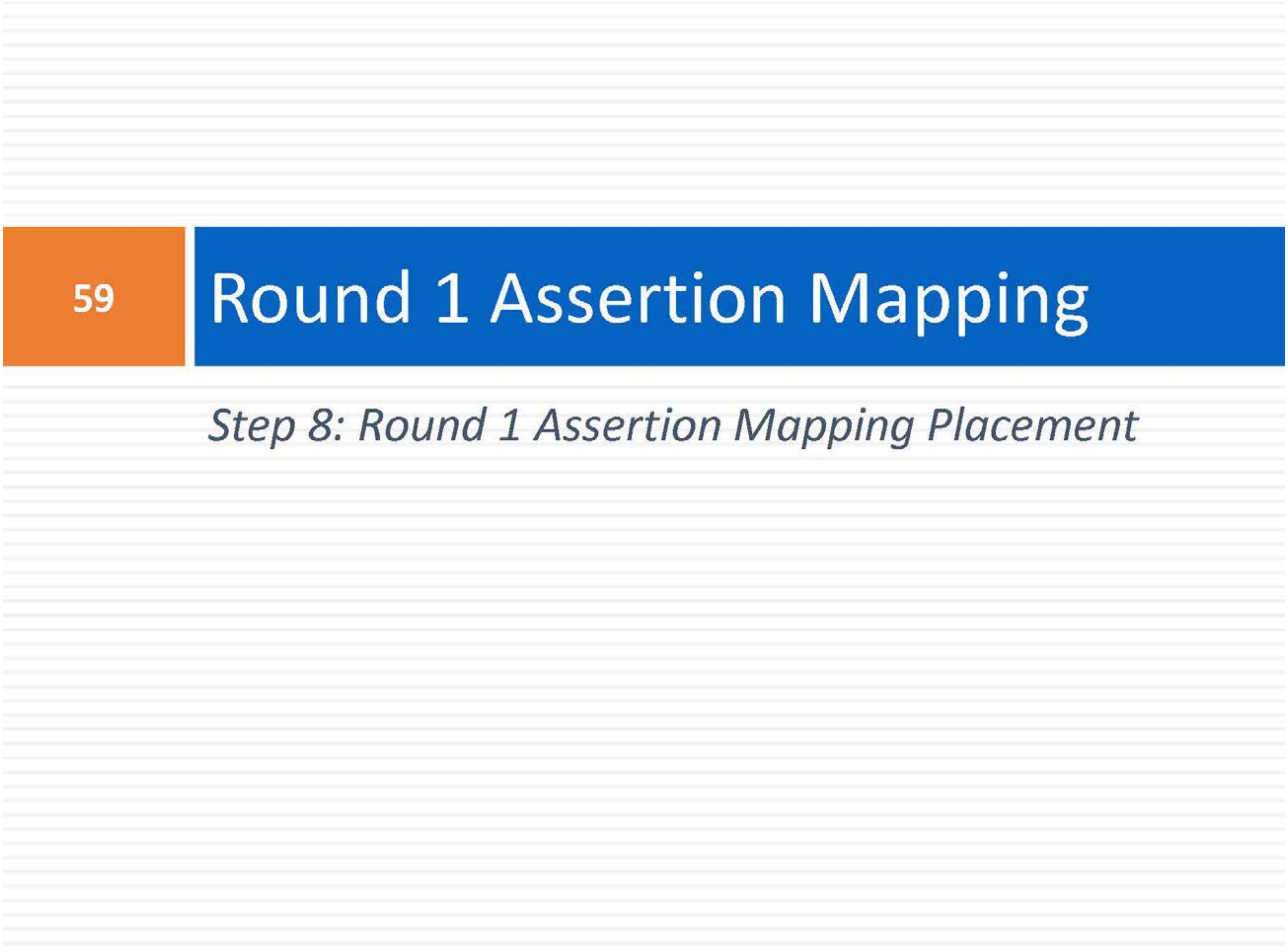
57

Quiz

Practice Online Assertion Mapping Activity

58

- Purpose of this activity is to practice mapping assertions in the online environment. This is meant to help you become familiar with the tool and process.
  - Shortened version of the OSAB
  - One cluster
- Log into the system and review the cluster and ordered scoring assertions answering the three questions as you go
- Then, map each scoring assertion to an achievement level and click “confirm”
- This is meant to help you become familiar with the tool and process


59
Round 1 Assertion Mapping
Step 8: Round 1 Assertion Mapping Placement

Round 1 Readiness Form

60

- Any questions?
- Is everyone ready for Round 1?
- If so, please fill out the readiness form

Round 1 – Mapping Assertions to Achievement Levels

61

- You will use the next 1½ hours to map each scoring assertion to an achievement level
- Use the tools and documents along with your professional judgment
- Scoring assertions are ordered from easiest to most difficult within each item
- If you feel that a subsequent assertion is at a lower level than a previous assertion, then you might have been premature at setting the level for the earlier assertion
- Should be a logical progress of achievement levels (within an item)
  - No inversions
- You may "Skip" if, after consideration, the assertion seems to be out of place
  - Use as last resort
- When you have assigned all assertions click on the "Confirm" button
- This is an individual task
- Lunch is at 12:30 pm

62

Feedback

Step 10: Results of Round 1

Group Feedback and Discussion

63

- Goals
  - Add important information to your thinking
  - Develop common understandings
  - Inform possible re-evaluation of assertion mapping decisions
- Expectation is converging judgments
  - Consensus is not a requirement or goal

Context Data

64

- Percentage of students reaching/exceeding the standard based on assertion mapping

Review Panel

Assertions | Notes | Set Levels | Context | Feedback | Prior Feedback | Moderation

Some facts about the difficulty of this assertion.

Context Category	Value
Overall percent of Rhode Island and Vermont students that perform at or above this level:	39

Context Data

65

- Group discussion
  - Does the percentage of students reaching or exceeding the current recommended achievement standard seem reasonable?
  - What are the implications for the achievement standards?
  - All achievement standard recommendations should be based on content rationales

Feedback Table

66

Feedback Chart

67

Variance Monitor

68

- Consensus is NOT required, convergence is a goal
- Let's see where we have the most variance
- Discuss within each table for 15 minutes
- Then, we will come together for group conversation for 15 minutes

69

Round 2 Assertion Mapping

Step 12: Round 2 Assertion Mapping Placement

Round 2 Readiness Form

70

- Any questions?
- Is everyone ready for Round 2?
- If so, please fill out the readiness form

Round 2 – Mapping Ordered Assertions to Achievement Levels

71

- You will use the next 1½ hours to map each scoring assertion to an achievement level
- Use the tools and documents along with your professional judgment, **context data**, and **feedback data**
- Scoring assertions are ordered from easiest to most difficult within each item
- If you feel that a subsequent assertion is at a lower level than a previous assertion, then you might have been premature at setting the level for the earlier assertion
  - No inversions
- You may "Skip" if, after consideration, the assertion seems to be out of place
  - Use as a last resort
- When you have assigned all assertions click on the "Confirm" button
- This is an individual task
- You have until 3:30 pm
- **Complete evaluations**

72

Round 2 Results

Step 14: Results of Round 2

Appendix F

Standard-Setting Practice Quiz

Standard-Setting Practice Quiz

Exhibit F-1. Standard-Setting Practice Quiz

2019 Standard Setting for Rhode Island and Vermont Multi-State Science Assessment

SCIENCE EDUCATOR PANEL – ASSERTION MAPPING PRACTICE QUIZ

Panelist ID Number: ______________________________

Committee (e.g., Grade 8 Science): ______________________________

1. Here is a graphic that illustrates the relationship between achievement standards that you will recommend and the achievement levels that they demarcate:

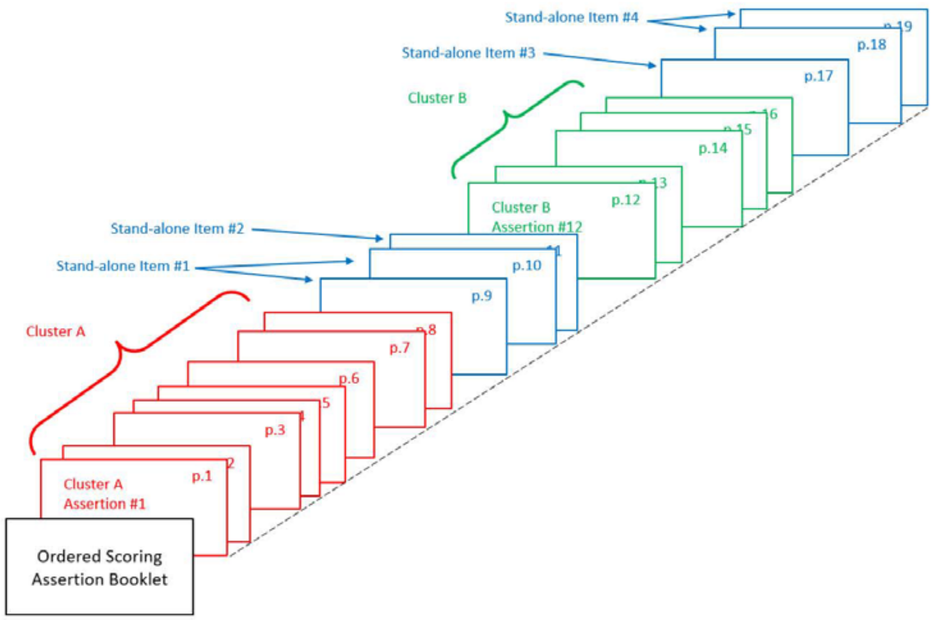
On the graphic above, illustrate where on the achievement continuum the group of students that are just barely described by each achievement-level descriptor are located:

   a. Indicate for yourself where students who are just barely described by the Meeting Expectations ALD are located.
   b. Indicate for yourself where students who are just barely described by the Approaching Expectations ALD are located.
   c. Indicate for yourself where students who are just barely described by the Exceeding Expectations ALD are located.

2. Which achievement standard differentiates between the Approaching Expectations achievement level and the Meeting Expectations achievement level? Please circle your answer.
   a. Approaching Expectations
   b. Meeting Expectations
   c. Exceeding Expectations

AIR ASSESSMENT | AIR.ORG 1

3. Here is a hypothetical Ordered Scoring Assertion Booklet that consists of pages 1 through 19:



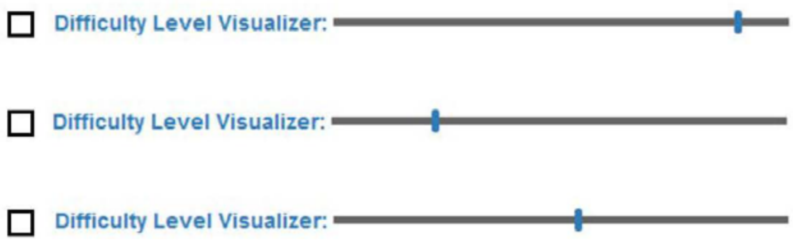
Within each stand-alone item or item cluster within the Ordered Scoring Assertion Booklet, scoring assertions are ordered by difficulty. In the OSAB presented above, is the assertion on page 7 of the OSAB easier, more difficult, or about the same as the assertion on page 3?

a. The assertion on page 7 is easier than the assertion on page 3
b. The assertion on page 7 is more difficult than the assertion on page 3
c. The assertion on page 7 is about the same as the assertion on page 3
d. The difficulty of the assertions on pages 7 and 3 cannot be compared in this graphic because they are not within the same item

4. Do you have to assign each scoring assertion to an achievement level (or use the skip button)? Please circle your answer.

a. YES
b. NO

5. Below are three different scoring assertions' difficulty level visualizers. Please (1) circle the most difficult scoring assertion, and (2) place a checkmark next to the least difficult scoring assertion.



Appendix G

Standard-Setting Readiness Forms

Standard-Setting Readiness Forms

Exhibit G-1. Standard-Setting Round 1 Readiness Form

RIDE Rhode Island Department of Education

VERMONT AGENCY OF EDUCATION

2019 Standard Setting for Rhode Island and Vermont Multi-State Science Assessment

SCIENCE EDUCATOR PANEL – READINESS FORM

Preparation for Round 1 Assertion Mapping

Panelist ID number: ____________________________

Committee (e.g., Grade 8 Science): ____________________________

		Yes	No
a.	The workshop training has prepared me to review the Achievement-Level Descriptors.	❑	❑
b.	The workshop training has prepared me to review the Ordered Scoring Assertion Booklet (OSAB).	❑	❑
c.	The workshop training has clearly explained and prepared me to map scoring assertions to Achievement-Level Descriptors in the Standard-Setting Tool.	❑	❑

I have answered, "Yes" to the above questions and I understand what I need to do to map scoring assertions to achievement levels.

Yes________ No________ Initials________

If I answered "No" to any of the above questions, I received additional training.

Yes________ No________ Initials________

Following the additional training, I feel sufficiently trained on what I need to do to map scoring assertions to achievement levels.

Yes________ No________ Initials________

AIR ASSESSMENT | AIR.ORG 1

Exhibit G-2. Standard-Setting Round 2 Readiness Form

2019 Standard Setting for Rhode Island and Vermont Multi-State Science Assessment

SCIENCE EDUCATOR PANEL – READINESS FORM

Preparation for Round 2 Assertion Mapping

Panelist ID number: ____________________________

Committee (e.g., Grade 8 Science): ____________________________

		Yes	No
a.	The workshop training has fully explained how to use the context data (student data) when considering my assertion mapping decisions.	❑	❑
b.	The training fully explained the panel feedback data that was presented.	❑	❑
c.	I understand my task for Round 2.	❑	❑

I have answered "Yes" to the above questions and I understand what I need to do to map my scoring assertions to achievement levels.

Yes________ No________ Initials________

If I answered "No" to any of the above questions, I received additional training.

Yes________ No________ Initials________

Following the additional training, I feel sufficiently trained on what I need to do to map my scoring assertions to achievement levels.

Yes________ No________ Initials________

Appendix H

Rationale for Post-Standard-Setting Workshop Refinements

RI NGSA Standard Setting Recommendations

Confidential

August 2019

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Description of the NGSS Test Design

- Grades 5, 8, and 11 tests assess students' understanding of the NGSS across the corresponding grade band (3-5, 6-8, and high school)
- NGSS assessments at each grade include 6 item clusters and 12 stand-alone items
  - **Item clusters** include a stimulus and a series of questions that generally take students about 6-12 minutes to complete
  - **Stand-alone items** are shorter and generally take 1-3 minutes to complete
- All items ask students to use science and engineering practices and apply their understanding of disciplinary core ideas and crosscutting concepts to make sense out of real-world phenomena
- Test configuration for spring 2019 administration
  - 4 segments with 2 distinct sessions of equal length:
    - Life Sciences
    - Physical Sciences
    - Earth/Space Sciences
  - Segments, and the items within each segment, are assigned randomly

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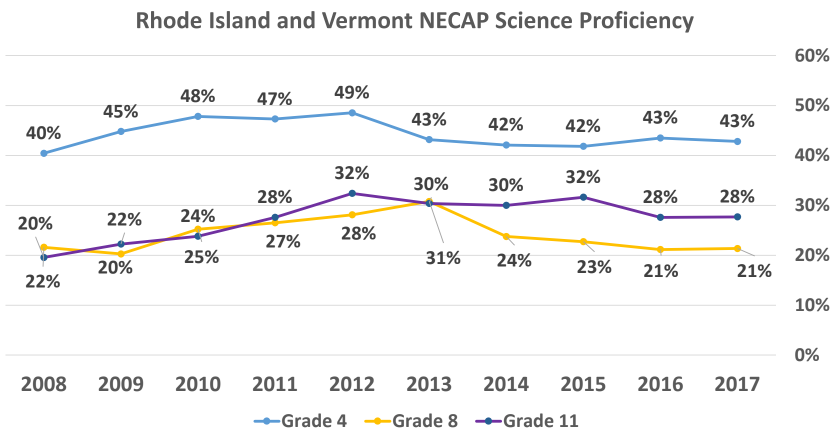
Historical NECAP Results



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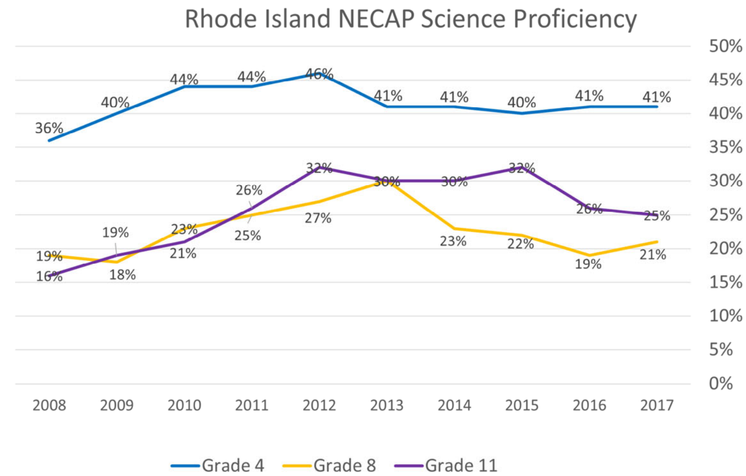
Historical NECAP Results



2015 NAEP Science Results

	Average Scale Score Grade 4	Percent At or Above Proficient Grade 4	Average Scale Score Grade 8	Percent At or Above Proficient Grade 8
Rhode Island	152	36	151	32
Vermont	163	48	163	44
National Public	153	37	153	33

Panelists Recommendations for MSSA Achievement Level Cut Scores

Table 1: Achievement Standards Recommended for Science (source AIR)

Grade	Level 2 Approaching	Level 3 Meeting	Level 4 Exceeding
5	45	68	75
8	41	63	77
11	39	63	74

Panelists Recommendations for MSSA Achievement Level Cut Scores

Table 2: Percentage of Students Reaching or Exceeding Each Achievement Standard in 2019 in Science (source AIR)

Grade	State	Level 2 Approaching	Level 3 Meeting	Level 4 Exceeding
5	Combined	74	24	12
	RI	72	23	12
	VT	78	26	13
8	Combined	80	35	10
	RI	78	32	9
	VT	84	39	12
11	Combined	90	35	16
	RI	89	31	14
	VT	92	42	21

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Item Performance Analysis

Table 3 Student Performance (% correct) on Scored Assertions				
Grade	# of assertions	Mean (median)	25% percentile	75th percentile
5	497	57% (59%)	44%	73%
8	359	47% (49%)	33%	62%
11	545	36% (36%)	23%	48%

Median performance

- Grade 5 students scored 57% correct or higher on half of the assertions
- Grade 8 students scored 47% correct or higher on half of the assertions
- Grade 11 students scored 36% correct or higher on half of the assertions

75th percentile

- Grade 5 students scored 73% correct or higher on one-fourth of the assertions
- Grade 8 students scored 62% correct or higher on one-fourth of the assertions
- Grade 11 students scored 48% correct or higher on one-fourth of the assertions

Overall, Grade 5 students performed better than students at Grades 8 and 11 on the items administered to them on the science test.

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On the MSSA tests, each scored 'item' is referred to as an assertion. On each assertion, students received a raw score of 0 for an incorrect response/action or 1 for a correct response/action. Although student scale scores and achievement levels are not based directly on raw scores, these assertion scores do provide a good picture of how students performed on the items that were placed in front of them.

For each of the three tests, we examined the percentage of students responding correctly to each assertion. The data in Table 3 describes student performance across all of the assertion administered at that grade level.

Relative Rigor of the Achievement Standards

On each grade level test, the location of the achievement level cut scores can be described in terms of the relative difficulty of the items on the test. The practical range of the difficulty scale runs from -4.0 to +4.0 (representing approximately 8 standard deviations) with negative values indicating the 'easier' assertions and positive values indicating the assertions that were more 'difficult' for students.

Table 4 Relative Difficulty of the Achievement Level Cuts from Standard Setting

Grade	Level 1 – 2 Cut "Approaching"	Level 2 – Level 3 Cut "Meeting"	Level 3 – Level 4 Cut "Exceeding"
5	-0.65	0.71	1.15
8	-0.93	0.37	1.20
11	-1.20	0.13	0.94

Although the content of the items and the achievement level descriptors must also be taken into account, the data suggests that the Grade 5 panelists were more stringent panelists at Grades 8 and 11.

The higher values at Grade 5 for each of the achievement level cut scores indicates that the recommendations of the Grade 5 panel were higher relative to the other items on the test than the cuts at Grades 8 and 11.
Each of the achievement level cuts at Grade 11 is significantly lower relative to the difficulty of the items on the test than the achievement level cuts at Grades 5 and 8.

Recommended Cuts and Impact Data

Table 5: Achievement Standards Recommended for Science (Estimated)

Grade	Level 2 Approaching	Level 3 Meeting	Level 4 Exceeding
5[1]	40	63	75
8	41	63	77
11	39	63	74

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Based on a review of the data described in this document, the following achievement level cuts are recommended as a solution to bring the Grade 5 recommended achievement level cut scores in line with the cut scores on the other tests in terms of relative difficulty and also to attain more consistent achievement level results across grade levels. Given student performance on the items administered to them after a rigorous test development process, there is no reason based on the data available to believe that the Grade 5 student performance is significantly worse than performance of students at other grade level relative to the new science content and performance standards.

These final recommendations adjust only two of the nine achievement level cut scores resulting from the standard setting panelists' judgments. Both adjustments bring the Grade 5 achievement level cuts and results more in line with panelists' judgments at Grades 8 and 11.

Recommended Cuts and Impact Data

Table 6: Percentage of Students Reaching or Exceeding Each Achievement Standard in 2019 in Science (Estimated)

Grade	State	Level 2 Approaching	Level 3 Meeting	Level 4 Exceeding
5	Combined	83	34	12
8	Combined	80	35	10
11	Combined	90	35	16

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Based on a review of the data described in this document, the following achievement level cuts are recommended as a solution to bring the Grade 5 recommended achievement level cut scores in line with the cut scores on the other tests in terms of relative difficulty and also to attain more consistent achievement level results across grade levels. Given student performance on the items administered to them after a rigorous test development process, there is no reason based on the data available to believe that the Grade 5 student performance is significantly worse than performance of students at other grade level relative to the new science content and performance standards.

These final recommendations adjust only two of the nine achievement level cut scores resulting from the standard setting panelists' judgments. Both adjustments bring the Grade 5 achievement level cuts and results more in line with panelists' judgments at Grades 8 and 11.

Appendix I

Synopsis of Validity Evidence for the Cut Scores

Synopsis of Validity Evidence for the Cutscores Derived from the Grades 5, 8, and 11 Standard Setting for Rhode Island and Vermont's MSSA Science Assessment

Report Prepared by Barbara S. Plake, Ph.D.
August 6, 2019

INTRODUCTION

Rhode Island and Vermont commissioned a standard setting activity prepared and conducted by AIR. The purpose of this report is to provide an overall impression of the evidence to support the validity of the recommended cutscores for the MSSA Science Assessments for Rhode Island and Vermont in grades 5, 8 and 11.

ADMINISTRATION OF THE STANDARD SETTING PANELS

The standard setting panelists met in Concord, NH August 5-6 to establish their recommended cutscores. Panelists met in grade groups, with panelists in grade 5 meeting as one panel, likewise middle school and high school panelists comprised separate panels. Each grade panel was led by a trained facilitator. The standard setting began with a general session for all panelists where an overview of the MSSA assessment system was provided followed by a general overview of the activities the panelists were to engage in over the item mapping standard setting process.

The panelists provided two rounds of ratings once they had engaged in an in-depth training process which included a) taking the test, b) reviewing the ALDs for the relevant assessment, c) discussing borderline performance level for levels 2, 3 and 4, and d) participating in a practice exercise for setting cuts for one cluster. Prior to embarking on setting their round 1 cuts, panelists filled out a training evaluation, which was reviewed by the panel facilitator to ensure all panelists indicated their preparedness to move into the operational rounds and to answer any outstanding questions or concerns by the panelists.

Between rounds, feedback was provided. This feedback focused on the impact of their R1 results and on specific assertions where there was the most disagreement across panelists. Full group and table level discussions followed. Following these discussions, panelists completed their Round 2 assertion classifications.

VALIDITY EVIDENCE FOR THE PANELISTS CUTSCORES

These steps are consistent with current practice for the conducting a test-centered standard setting method. For the most part, these steps were successfully implemented and when minor issues emerged, they were handled immediately and appropriately. There is no evidence to suggest that there is any reason to question the validity of the resultant cutscores produced by these panels.