New Hampshire NECAP Science Assessment Information

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New Hampshire NECAP Science Assessment Information

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State Science Assessment in New Hampshire

The state of New Hampshire adopted the NH Science Frameworks in February 1995. These frameworks, based on the draft *National Science Education Standards*[1] and *Benchmarks for Science Literacy*[2], provided guidance for what we would assess in our state science assessment. We tested all students in NH in science at the ends of grades 6 and 10 to determine how well districts were developing science curricula which would improve what all students should know and be able to do in science. Due to budgetary constraints, New Hampshire suspended the NHEIAP Science Assessment in school year 2003-2004.

In May of 2004 the state of New Hampshire, Rhode Island and Vermont began work on the NECAP Science Assessment to meet the NCLB requirements for Science for each state. We began with the Big Ideas or Unifying Themes of Science and then looked at how those concepts intersected with the content domains of Earth Space, Life, and Physical Sciences. We divided the content domains, to ensure we covered all of the significant topics, into statements of "Enduring Knowledge." The intersections (between each unifying theme and each enduring knowledge statement) were where we crafted specific content and performance rich "targets" that would guide the development of questions for the assessment.

During the process, each state brought in grade level and content experts to review and refine wording and techniques. We consulted documents on student understand if science, misconception of science and relied on the *National Science Education Standards*[3], *Benchmarks for Science Literacy*[4], and the *Atlas for Science Literacy*[5].

Originally we developed assessment targets for almost all of the intersections between big ideas and domain enduring knowledge statements. It became obvious that we needed to select the "targets" that best fit the content and grade level of the students involved, and could be assessed on an on-demand assessment. In New Hampshire, the NECAP Science Assessment Targets have been included in the Grade Span Expectations (GSEs) and have been highlighted by a bold box. These targets can be viewed along with other proficiencies which should be assessed at the local level.

The NECAP Science Assessment will be given in the spring at the end of Grades 4, 8, and 11 and will consist of three sessions. The first two sessions will have multiple choice and constructed response items and will be from the three domains (questions from each domain will be clustered to allow for higher order and increased depth of knowledge). The third session will be a performance based session which will assess the inquiry skills of the students based on 13 constructs of inquiry that we adopted. The Pilot test will be given to all students in all three states May 2007. The first operational test will follow in May 2008.

[1] *National Science Education Standards*, © 1995, National Academy of Science
[2] *Benchmarks for Science Literacy*, © 1993, American Association for the Advancement of Science
[3] *National Science Education Standards*, © 1995, National Academy of Science
[4] *Benchmarks for Science Literacy*, © 1993, American Association for the Advancement of Science
[5] *Atlas for Science Literacy*, © 2001, American Association for the Advancement of Science

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Rationale for Addressing Unifying Themes/Big Ideas of NECAP Science Assessment

(Adapted from K. Hess, working draft 2005)

The conceptual approach of the NECAP Science Assessment is supported by recommendations of the National Research Council (NRC) for designing science assessments to satisfy the No Child Left Behind Act. The NRC, located in Washington, is a division of the congressional chartered National Academies, which provides research for the government, scientists, engineers, and the public. A recent article, NRC Weighs in on States' Science Assessments (www.edweek.org, published July 13, 2005) describes a committee of testing experts and university researchers convened by the research council to produce the report Systems for State Science Assessment. The authors of the report say “the tests should be built around 'organizing principles' or 'big ideas' of science, such as evolution and molecular theory, to give students a stronger sense of how different aspects of the discipline connect.”

Organizing curriculum and assessment around the unifying themes, or big ideas, of science is not a new idea. References to big ideas of science appear in many national science standards documents written in the 1990s. The American Association for the Advancement of Science describes it this way: “Some powerful ideas often used by mathematicians, scientists, and engineers are not the intellectual property of any one field or discipline. Indeed, notions of system, scale, change and constancy, and models have important applications in business and finance, education, law, government and politics, and other domains, as well as in mathematics, science, and technology. These common themes are really ways of thinking rather than theories or discoveries.” (AAAS, 1993, page 261)

Unifying Themes represent the key organizing concepts that pervade science education, crossing traditional science domain boundaries and making up the inquiry tools that scientists use to better investigate and understand phenomena (NAEP Science Framework, 1994). Statements of Enduring Knowledge represent the fundamental knowledge of the domains of science. “They are called 'enduring' because they contain essential ideas that students need to internalize and retain in order to achieve science literacy” (Grade Expectations for VT's Framework of Standards and learning Opportunities, 2004). The NECAP Science Assessment Targets integrate six Unifying Themes/Big Ideas of Science with Statements of Enduring Knowledge for the domains of Life Science, Earth/Space Science, and Physical Science. The Unifying Themes/Big Ideas listed below are further described on the pages that follow.

- Scientific Inquiry
- Nature of Science
- Systems and Energy
- Models and Scale
- Patterns of Change
- Form and Function

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Scientific Inquiry (INQ)
Scientific Inquiry is more complex than popular conceptions would have it. It is, for instance, a more subtle and demanding process than the naive idea of "making a great many careful observations and then organizing them." It is far more flexible than the rigid sequence of steps commonly depicted in textbooks as "the scientific method." It is much more than just "doing experiments," and it is not confined to laboratories. More imagination and inventiveness are involved in scientific inquiry than many people realize, yet sooner or later strict logic and empirical evidence must have their day. (AAAS, 1993)

The Inquiry focus in the NECAP Science Assessment will be on the ability to question, hypothesize, predict, design and critique investigations, conduct investigations, use science tools and techniques, collect, organize, and interpret/analyze data, use evidence to draw conclusions, develop explanations, and communicate understanding.

Nature of Science (NOS)
Generalizations about how the scientific enterprise operates would be empty without concrete examples. Consider, for example, the proposition that new ideas are shaped by the context in which they are conceived; are often rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly, through contributions from many different investigators. Without historical examples, such generalizations would be no more than slogans, however well they might be remembered. (AAAS, 1993)

The Nature of Science focus in the NECAP Science Assessment will be on the use of tools and technology, how fundamental theories change when applying new evidence and reasoning, how scientists build on the work of others, and attitudes and dispositions of science (e.g., avoiding bias, divergent ideas, healthy skepticism).

Systems and Energy (SAE)
“One of the essential components of higher-order thinking is the ability to think about a whole in terms of its parts and, alternatively, about parts in terms of how they relate to one another and to the whole… If these can be specified quantitatively, a computer simulation of the system might be run to study its theoretical behavior, and so provide a way to define problems and investigate complex phenomena.” (AAAS, 1993) The concept of energy, which cuts across all fields of the natural sciences and technology, is often used to analyze how systems function. As described in Benchmarks for Science Literacy, “Most of what goes on in the universe-from exploding stars and biological growth to the operation of machines and the motion of people- involves some form of energy being transformed into another.” (AAAS, 1993)

The Systems and Energy focus in the NECAP Science Assessment is on order and organization, interactions, interdependence, equilibrium, energy transfer, and cycles.

Models and Scale (MAS)
“Models can be physical, mathematical, or conceptual. They are very effective tools for learning about the things they are intended to resemble. Physical models (such as model rockets) are the most obvious to children. Whether models are physical, mathematical, or conceptual, their usefulness as an instructional device lies in suggesting how things either do work or might work.

The more sophisticated concept has to do with the effect of changes in scale. Specifically, the way things work may change with scale." (Mission to Mars: Project Based Learning, http://www.edb.utexas.edu/missiontomars/unify.html).
The Models and Scale focus in the NECAP Science Assessment is on evidence and explanations through models, proportions, magnitude, relationships, and relativity.

Patterns of Change (POC)
"Much of science and mathematics has to do with understanding how change occurs in nature and in social and technological systems, and much of technology has to do with creating and controlling change. Constancy, often in the midst of change, is also the subject of intense study in science… Somewhat different aspects of constancy are described by the terms stability, conservation, equilibrium, steady state, and symmetry. These various ideas are interrelated in some subtle ways." (AAAS, 1993)

The Patterns of Change focus in the NECAP Science Assessment is on cycles, constancy and change, and evolutionary change.

Form and Function (FAF)
"Form and function are complementary aspects of objects, organisms, and systems in the natural and designed world. The form or shape of an object or system is frequently related to use, operation, or function. Function frequently relies on form. Understanding of form and function applies to different levels of organization. Students should be able to explain function by referring to form and explain form by referring to function." (NRC, 1996)

The Form and Function focus in the NECAP Science Assessment is on understanding form and function in the natural world. While form and function in the designed world may be included as it relates to other targets that address technology, form and function as it relates to engineering design will be assessed locally at this time.

PLEASE NOTE: In the NH Frameworks for Science Literacy K-12, specific proficiencies dealing with these Big Ideas- by grade span- can be found in the Science Process Skills section under SPS 1 (Inquiry) and SPS 2 (Unifying Themes/Big Ideas).

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Table 3.1 Item Types for NECAP Science Assessment		
Item Type	**Description**	**Purpose**
1-point Multiple Choice items (MC)	The multiple-choice items will consist of four alternative answers. While distracters will be plausible and reflect common errors, they must be unambiguously wrong in the judgment of experts. The use of distracters with common misconceptions is very desireable. Each item will be scored with an answer key and be worth one score point.	**The multiple-choice items will primarily be used in Session 1 and 2** to assess understanding of specific terms, concepts, and skills related to the three domains of science. These items will typically assess student performance at Levels 1 and 2 Depth of Knowledge.
2-point Short Answer items (SA)	Short answer items will allow students to construct brief responses usi text (e.g., a few phrases or a sentence), labeling diagrams, or perhaps creating a simple scientific drawing of observations, predictions, lab s up, etc. Each item will be assessed using a 2-point, task-specific analytical rub	**The short answer items will only be used in Session 3** to assess understanding of inquiry or science concepts. Because of the brevity of the response, these items will typically assess student performance at Levels 1 and 2 Depth of Knowledge.
3-point Constructed Response items (3-CR)	Constructed response items will include items requiring a more full response (such as selecting data or evidence to support a concept or a stated explanation), as well as items requiring some analysis of data or explanations of scientific reasoning. Each item will be assessed using a task-specific analytical rubric and be will be worth three points.	**3-CR items will only be used in Session 3,** assessing inquiry. The purpose of these items is to require that students explain or analyze concepts while applying aspects of scientific inquiry (e.g., developing explanations, planning, conducting, and critiquing investigations). These items will typically assess student performance at Levels 2 or 3 Depth of Knowledge.
4-point Constructed Response items (4-CR)	Constructed response items will include items requiring a more full response (such as selecting details or evidence to support a concept or stated explanation), as well as items requiring some analysis or providing explanations of reasoning. Each item will be assessed using a task-specific analytical rubric and will be worth four points.	**4-CR items will only be used in Sessions 1 and 2,** assessing domains of science/science content. The purpose of these items is to require that students explain science concepts or interpret/analyze how science concepts apply to real-world phenomena or specific situations. These items will typically assess student performance at Levels 2 or 3 Depth of Knowledge.
Extended Response task for Inquiry (ER)	Extended response (ER) tasks will give students the opportunity to apply their skills and understanding of inquiry and scientific investigation within the context of science concepts. All items will require students to construct short or longer responses, providing insights into students' abilities to generate, rather than recognize scientific concepts and to make connections among science concepts and inquiry skills. *A set of related items*, using a mix of SA and 3-CR items, will comprise the ER task. Items will be aligned to 13 possible constructs described in Section VI (page 33) for assessing inquiry. Each ER task will generate approximately 16-18 total score points.	**Session 3 will focus on assessing inquiry using an ER task.** The purpose of these tasks is to assess students' ability to apply a variety of inquiry skills and knowledge to specific science concepts. As a set, these items reflect a higher overall cognitive demand (e.g., planning, conceptual understanding, and scientific reasoning) primarily assessing Levels 2 and 3 Depths of Knowledge. The performance aspect of these tasks allows students to manipulate materials, objects, or data to analyze or solve scientific problems.

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Depth of Knowledge (DOK) Levels for Science

(Based on Webb, 1997 and March 2002 and TIMSS Science Assessment Framework, 2003)

Level 1

Recall and Reproduction requires recall of information, such as a fact, definition, term, or a simple procedure, as well as performing a simple science process or procedure. Level 1 only requires students to demonstrate a rote response, use a well-known formula, follow a set procedure (like a recipe), or perform a clearly defined series of steps. A "simple" procedure is well-defined and typically involves only one step. Verbs such as *identify, recall, recognize, use, calculate,* and *measure* generally represent cognitive work at the recall and reproduction level. Simple word problems that can be directly translated into and solved by a formula are considered Level 1. Verbs such as *describe* and *explain* could be classified at different DOK levels, depending on the complexity of what is to be described and explained.

A student answering a Level 1 item either knows the answer or does not: that is, the answer does not need to be figured out or solved. In other words, if the knowledge necessary to answer an item automatically provides the answer to the item, then the item is at Level 1. If the knowledge necessary to answer the item does not automatically provide the answer, the item is at least at Level 2.

Level 2

Skills and Concepts includes the engagement of some mental processing beyond recalling or reproducing a response. The content knowledge or process involved is more complex than in level 1. Items require students to make some decisions as to how to approach the question or problem. Keywords that generally distinguish a Level 2 item include *classify, organize, estimate, make observations, collect and display data,* and *compare data*. These actions imply more than one step. For example, to compare data requires first identifying characteristics of the objects or phenomenon and then grouping or ordering the objects. Level 2 activities include making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts.

Some action verbs, such as *explain, describe,* or *interpret* could be classified at different DOK levels, depending on the complexity of the action. For example, interpreting information from a simple graph, requiring reading information from the graph, is a Level 2. An item that requires interpretation from a complex graph, such as making decisions regarding features of the graph that need to be considered and how information from the graph can be aggregated, is at Level 3.

Level 3

Strategic Thinking requires deep knowledge using reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands at Level 3 are complex and abstract. The complexity does not result only from the fact that there could be multiple answers, a possibility for both Levels 1 and 2, but because the multi-step task requires more demanding reasoning. In most instances, requiring students to explain their thinking is at

Level 3; requiring a very simple explanation or a word or two should be at Level 2. An activity that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3. Experimental designs in Level 3 typically involve more than one dependent variable. Other Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and using concepts to solve non-routine problems.

Level 4

Extended Thinking requires high cognitive demand and is very complex. Students are required to make several connections– relate ideas within the content area or among content areas– and have to select or devise one approach among many alternatives on how the situation can be solved. Many on-demand assessment instruments will not include any assessment activities that could be classified as Level 4. However, standards, goals, and objectives can be stated in such a way as to expect students to perform extended thinking. "Develop generalizations of the results obtained and the strategies used and apply them to new problem situations," is an example of a Grade 8 objective that is a Level 4. Many, but not all, performance assessments and open-ended assessment activities requiring significant thought will be at a Level 4.

Level 4 requires complex reasoning, experimental design and planning, and probably will require an extended period of time either for the science investigation required by an objective, or for carrying out the multiple steps of an assessment item. However, the extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Level 2 activity. However, if the student conducts a river study that requires taking into consideration a number of variables, this would be a Level 4.

Please see chart on the next page for sample descriptors.

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Sample Descriptors for each of the DOK Levels in Science (Adapted from K. Hess, working draft 2005)			
Level 1: Recall and Reproduction	**Level 2: Skills and Concepts**	**Level 3: Strategic Thinking**	**Level 4: Extended Thinking**
• Recall or recognize a fact, term, definition, simple procedure (such as one step), or property • Demonstrate a rote response • Use a well-known formula • Represent in words or diagrams a scientific concept or relationship • Provide or recognize a standard scientific representation for simple phenomenon • Perform a routine procedure, such as measuring length • Perform a **simple** science process or a set procedure (like a recipe) • Perform a clearly defined set of steps • Identify, calculate, or measure **NOTE: If the knowledge necessary to answer an item automatically provides the answer, it is a Level 1.**	• Specify and explain the relationship between facts, terms, properties, or variables • Describe and explain examples and non-examples of science concepts • Select a procedure according to specified criteria and perform it • Formulate a routine problem given data and conditions • Organize, represent, and compare data • Make a decision as to how to approach the problem • Classify, organize, or estimate • Compare data • Make observations • Interpret information from a simple graph • Collect and display data **NOTE: If the knowledge necessary to answer an item does not automatically provide the answer, then the item is at least a Level 2. Most actions imply more than one step.**	• Interpret information from a complex graph (such as determining features of the graph or aggregating data in the graph) • Use reasoning, planning, and evidence • Explain thinking (beyond a simple explanation or using only a word or two to respond) • Justify a response • Identify research questions and design investigations for a scientific problem • Use concepts to solve non-routine problems/more than one possible answer • Develop a scientific model for a complex situation • Form conclusions from experimental or observational data • Complete a multi-step problem that involves planning and reasoning • Provide an explanation of a principle • Justify a response when more than one answer is possible • Cite evidence and develop a logical argument for concepts • Conduct a designed investigation • Research and explain a scientific concept • Explain phenomena in terms of concepts **NOTE: Level 3 is complex and abstract. If more than one response is possible, it is at least a Level 3 and calls for use of reasoning, justification, evidence, as support for the response.**	• Select or devise approach among many alternatives to solve problem • Based on provided data from a complex experiment that is novel to the student, deduct the fundamental relationship between several controlled variables. • Conduct an investigation, from specifying a problem to designing and carrying out an experiment, to analyzing its data and forming conclusions • Relate ideas *within* the content area or *among* content areas • Develop generalizations of the results obtained and the strategies used and apply them to new problem situations **NOTE: Level 4 activities often require an extended period of time for carrying out multiple steps; however, time alone is not a distinguishing factor if skills and concepts are simply repetitive over time.**

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***Preliminary* DOK Ceiling Levels for NECAP Science Assessment Targets** have been established to guide item development. Table 2.5 provides the intended DOK ceiling levels for NECAP Science Assessment Targets.

Table 2.5 - *Preliminary* DOK Ceilings (using Table 2.2 Descriptors) for NECAP Science Assessment Targets

Science Domains by EK Statement	Grade 4 Targets with DOK	Grade 8 Targets with DOK	Grade 11 Targets with DOK
LS1 Survival of organisms	1 – DOK 2a, b, g 2 – DOK 1a, b 3 – DOK 2h, i 4 – DOK 2a	1 – DOK 3h 2 – DOK 2a 3 – DOK 2a, b, h 4 – DOK 2a, b	1 – DOK 3d 2 – DOK 3d
LS2 Matter and energy in ecosystems	5 – DOK 1a, b 6 – DOK 2a	5 – DOK 2a, d 6 – DOK 2a 7 – DOK 2a	3 – DOK 2a 4 – DOK 2a 5 – DOK 3b, k
LS3 Organisms change over time	7 –DOK 2a	8 – DOK 2a, h 9 – DOK 2b	6 – DOK 3d 7 – DOK 3j 8 – DOK 3a, f
LS4 Humans are similar, yet unique	8 –DOK 2a, h 9 –DOK 2a, b	10 – DOK 3a, b 11 – DOK 2a, b 12 – DOK 1a, d	9 – DOK 3d, h 10 – DOK 3h
PS1 Properties and structure of matter	1 –DOK 3h 2 –DOK 2a 3 –DOK 2a	1 –DOK 2a, c, d, e, i 2 –DOK 2e, g, j 3 –DOK 2a, j, k 4 –DOK 2a, b 5 –DOK 2a, g	1 –DOK 2a, c, h, i 2 –DOK 3a, b, c, d 3 –DOK 2a, b 4 –DOK 3c, g, j
PS2 Energy	4 –DOK 2a, b 5 –DOK 2a,h, i 6 –DOK 2a, c, i	6 –DOK 3c, j, l, o 7 –DOK 3c, h	5 –DOK 2a, b, c 6 –DOK 3a, c, h 7 –DOK 2a, b
PS3 Forces and motion	7 –DOK 2a, j 8 –DOK 2a, b, e, g, h, i	8 –DOK 2a, e, g, i, j,	8 –DOK 3a, c, h 9 –DOK 2a, b 10 –DOK 2a
ESS1 Earth and earth materials	1 –DOK 2b, e, g 2 –DOK 3c, h 3 –DOK 1a, i 4 –DOK 2a, b 5 –DOK 2a, b 6 –DOK 2a, b, g, h	1 –DOK 3c, d, l 2 –DOK 2a 3 –DOK 2a, b 4 –DOK 3j, o 5 –DOK 3c, d, h, k	1 –DOK 3a, c, d, f, l 2 –DOK 3l 3 –DOK 3o 4 –DOK 2a
ESS2 Solar system		6 –DOK 2a, g, h, j 7 –DOK 3c, d, k 8 –DOK 3j, o	
ESS3 Universe and galaxies			5 –DOK 3c, k, l 6 –DOK 3b, c, d, l, o 7 –DOK 3o 8 –DOK 2a, b

Use of Depth of Knowledge (DOK) "ceilings" - Implications for item development
Test developers and item writers should align items with the target's DOK ceiling, but consider how the "set of test items" provides a range of cognitive demand. *Developers will articulate a strategy for assuring alignment with intended DOK ceiling levels and for providing a range of DOK within "item sets" for assessing domains of science.*

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Assessing Inquiry on the NECAP Science Assessment

Because inquiry is such a fundamental process for understanding science, the NECAP Science Assessment will incorporate a performance-based test session to evaluate student understanding and abilities in this important area. At each grade level, student will engage in a scenario-driven task. At all grade levels, the task will be developed from *one* NECAP Science Assessment Target from the specific grade span. Only targets with an INQ designation are eligible to be the focus of the performance assessment. Each year the domain will rotate so that one year there will be a Life Science Performance followed by Physical Science or Earth Space Science the next year.

Development of test the scenarios and performance tasks will be guided by the thirteen constructs of inquiry found on the Inquiry Constructs chart which follows. The four broad areas of inquiry to be assessed include: formulating questions and hypothesizing; planning and critiquing of investigations; conducting investigations; and developing and evaluating explanations.

Performance at Grade Four: Students will always be given materials which they will use to collect their own data and draw basic conclusions (design and carry out an experiment). Questions will be developed from all four broad areas of inquiry.

Performance at Grade Eight: Students may be given materials and asked to design and carryout an experiment (similar to grade four); or at this grade level, students could be given data and evidence from field experiences or experiments and be asked to evaluate or process them in accordance with all four broad areas of inquiry.

Performance at Grade Eleven: At this grade level students will *never* be given materials and asked to design an experiment. The performance at this level will primarily focus on the last column on the Inquiry Constructs chart: developing and evaluating ideas. Questions representing the other broad areas may be used for a specific task.

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Inquiry Constructs for the NECAP Science Assessment

NECAP Science Schema for Assessing Scientific Inquiry, with DOK levels for constructs				
Broad areas of Inquiry to be assessed	**Formulating Questions and Hypothesizing**	**Planning and Critiquing of Investigations**	**Conducting Investigations**	**Developing and Evaluating Explanations**
Constructs for each Broad Area of Inquiry (including intended DOK Ceiling Levels, based on Webb Depth of Knowledge Levels for Science) ***Inquiry Constructs answer the question:*** ***What is it about the broad area of Inquiry that we want students to know and be able to do?***	**1.** Analyze information from observations, research, or experimental data for the purpose of formulating a question, hypothesis, or prediction: **(DOK 3)** **1a.** Appropriate for answering with scientific investigation **1b.** For answering using scientific knowledge **2.** Construct coherent argument in support of a question, hypothesis, prediction **(DOK 2 or 3 depending on complexity of argument)** **3.** Make and describe observations in order to ask questions, hypothesize, make predictions related to topic **(DOK 2)**	**4.** Identify information/evidence that needs to be collected in order to answer the question, hypothesis, prediction **(DOK 2 – routine; DOK 3 non-routine/more than one dependant variable)** **5.** Develop an organized and logical approach to investigating the question, including controlling variables **(DOK 2 – routine; DOK 3 non-routine)** **6.** Provide reasoning for appropriateness of materials, tools, procedures, and scale used in the investigation **(DOK 2)**	**7.** Follow procedures for collecting and recording qualitative or quantitative data, using equipment or measurement devices accurately **(DOK 1 – use tools; routine procedure; DOK 2 – follow multi-step procedures; make observations)** **8.** Use accepted methods for organizing, representing, and manipulating data **(DOK 2 – compare data; display data)** **9.** Collect sufficient data to study question, hypothesis, or relationships **(DOK 2 – part of following procedures)** **10.** Summarize results based on data **(DOK 2)**	**11.** Analyze data, including determining if data are relevant, artifact, irrelevant, or anomalous **(DOK 2 – specify relationships between facts; ordering, classifying data)** **12.** Use evidence to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis **(DOK 3)** **13.** Communicate how scientific knowledge applies to explain results, propose further investigations, or construct and analyze alternative explanations **(DOK 3)**

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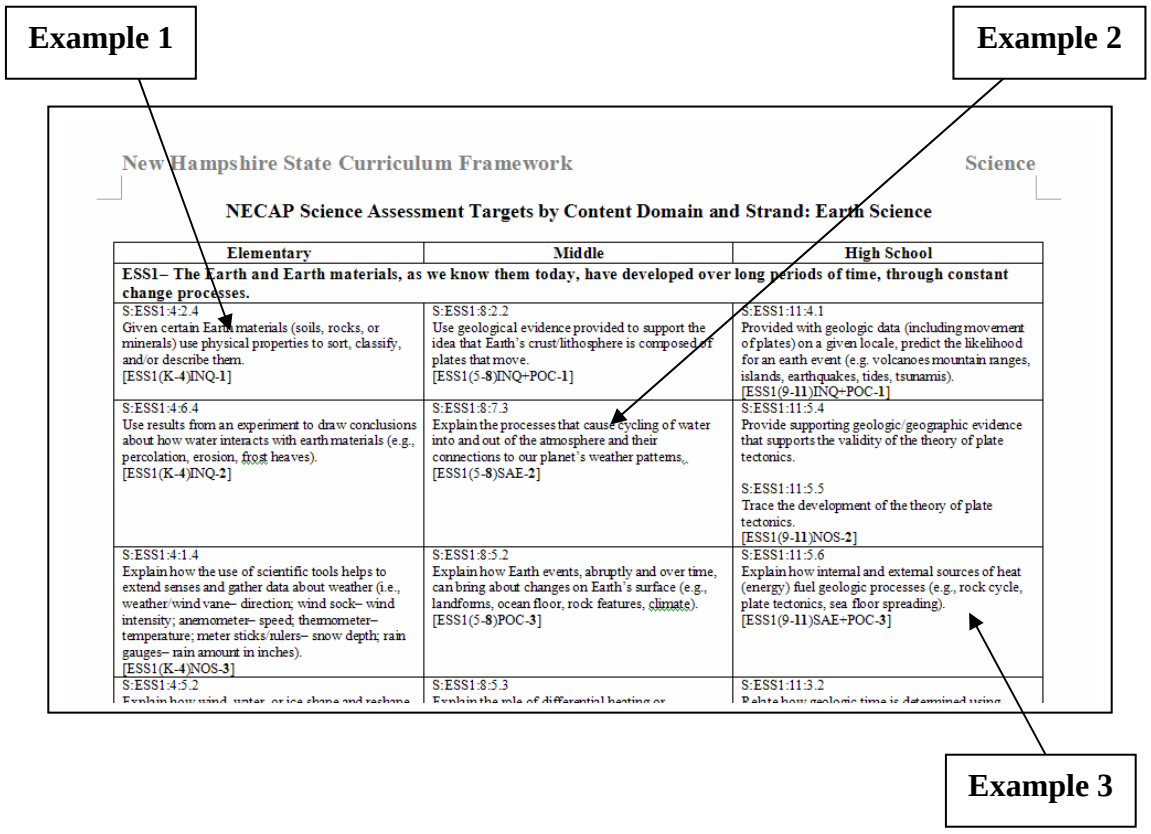
How to Read the NECAP Science Assessment Target Codes

Found below the text of the Assessment Target is a unique code that identifies the enduring knowledge statement, the grade levels, and the Big Ideas (Unifying Themes) that the content will be approached from. The last number just is the number in a sequence. Please note: sometimes the NH and NECAP code may have different Enduring Knowledge numbers. Also, some Assessment Targets may be found in more than one location in the NH Frameworks.

Example 1: [ESS1(K-**4**)INQ-**1**]
ESS1 = Earth Space Science EK1
Grade Tested will be grade 4
INQ = Inquiry
1 = This was the first target on the list for this domain and grade level

Example 2: [ESS1(5-**8**)SAE-**2**]
ESS1 = Earth Space Science EK1
Grade Tested will be grade 8
SAE = Systems and Energy
2 = This was the second target on the list for this domain and grade level

Example 3: [ESS1(9-**11**)SAE+POC-**3**]
ESS1 = Earth Space Science EK1
Grade Tested will be grade 11
SAE = Systems and Energy
POC = Patterns of Change
3 = This number indicates that this was the third target on the list for this domain



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Numbers and Distribution of Targets by Domain and Grade Span

Number and Distribution of Science Assessment Targets by Grade Span (Draft July 2005).				
Science Domain	**Statements of Enduring Knowledge (EK)**	**Elem K-4**	**Middle 5-8**	**High School 9-11**
Life Science	**LS 1** All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, and species).	**4**	**4**	**2**
	LS 2 Matter cycles and energy flows through an ecosystem.	**2**	**3**	**3**
	LS 3 Groups of organisms show evidence of change over time (structures, behaviors, and biochemistry).	**1**	**2**	**3**
	LS 4 Humans are similar to other species in many ways, and yet are unique among Earth's life forms.	**2**	**3**	**2**
	Life Science Totals	**9**	**12**	**10**
Earth & Space Science	**ESS 1** The Earth and earth materials as we know them today have developed over long periods of time, through continual change processes.	**6**	**5**	**4**
	ESS 2 The earth is part of a solar system, made up of distinct parts that have temporal and spatial interrelationships.	**0**	**3**	**0**
	ESS 3 The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time	**0**	**0**	**4**
	Earth/Space Science Totals	**6**	**8**	**8**
Physical Science	**PS 1** All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another *(independent of size or amount of substance)*	**3**	**5**	**4**
	PS 2 Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.	**3**	**2**	**3**
	PS 3 The motion of an object is affected by forces.	**2**	**1**	**3**
	Physical Science Totals	**8**	**8**	**10**
Total NECAP Science Assessment Targets		**23**	**28**	**28**

NECAP Science Assessment Targets by Content Domain and Strand: Earth Science

Elementary	Middle	High School
ESS1– The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.		
S:ESS1:4:2.4 Given certain Earth materials (soils, rocks, or minerals) use physical properties to sort, classify, and/or describe them. [ESS1(K-**4**)INQ-**1**]	S:ESS1:8:2.2 Use geological evidence provided to support the idea that Earth's crust/lithosphere is composed of plates that move. [ESS1(5-**8**)INQ+POC-**1**]	S:ESS1:11:4.1 Provided with geologic data (including movement of plates) on a given locale, predict the likelihood for an earth event (e.g. volcanoes mountain ranges, islands, earthquakes, tides, tsunamis). [ESS1(9-**11**)INQ+POC-**1**]
S:ESS1:4:6.4 Use results from an experiment to draw conclusions about how water interacts with earth materials (e.g., percolation, erosion, frost heaves). [ESS1(K-**4**)INQ-**2**]	S:ESS1:8:7.3 Explain the processes that cause cycling of water into and out of the atmosphere and their connections to our planet's weather patterns. [ESS1(5-**8**)SAE-**2**]	S:ESS1:11:5.4 Provide supporting geologic/geographic evidence that supports the validity of the theory of plate tectonics. S:ESS1:11:5.5 Trace the development of the theory of plate tectonics. [ESS1(9-**11**)NOS-**2**]
S:ESS1:4:1.4 Explain how the use of scientific tools helps to extend senses and gather data about weather (i.e., weather/wind vane– direction; wind sock– wind intensity; anemometer– speed; thermometer– temperature; meter sticks/rulers– snow depth; rain gauges– rain amount in inches). [ESS1(K-**4**)NOS-**3**]	S:ESS1:8:5.2 Explain how Earth events, abruptly and over time, can bring about changes on Earth's surface (e.g., landforms, ocean floor, rock features, climate). [ESS1(5-**8**)POC-**3**]	S:ESS1:11:5.6 Explain how internal and external sources of heat (energy) fuel geologic processes (e.g., rock cycle, plate tectonics, sea floor spreading). [ESS1(9-**11**)SAE+POC-**3**]
S:ESS1:4:5.2 Explain how wind, water, or ice shape and reshape the Earth's surface. [ESS1(K-**4**)INQ+SAE-**4**]	S:ESS1:8:5.3 Explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate. [ESS1(5-**8**)SAE+POC-**4**]	S:ESS1:11:3.2 Relate how geologic time is determined using various dating methods (e.g., radioactive decay, rock sequences, fossil records). [ESS1(9-**11**)INQ+POC+MAS-**4**]
S:ESS1:4:1.3 Based on data collected from daily weather observations, describe weather changes or weather patterns. [ESS1(K-**4**)POC-**5**]	S:ESS1:8:6.4 Using data about a rock's physical characteristics, make and support an inference about the rock's history and connection to the rock cycle. [ESS1(5-**8**)SAE+POC-**5**]	

S:ESS1:4:2.3 Given information about Earth materials, explain how their characteristics lend themselves to specific uses. [ESS1(K-**4**)FAF-**6**]		
ESS2– The Earth is part of a solar system, made up of distinct parts, which have temporal and spatial interrelationships.		
	S:ESS2:8:3.4 Compare and contrast planets based on data provided about size, composition, location, orbital movement, atmosphere, or surface features (includes moons). [ESS2(5-**8**)MAS-**6**]	
	S:ESS2:8:4.1 Explain how technological advances have allowed scientists to re-evaluate or extend existing ideas about the Solar System. [ESS2(5-**8**)NOS-**7**]	
	S:ESS2:8:1.4 Explain the temporal or positional relationships between or among the Earth, Sun and Moon (e.g., night/day, seasons, year, tide). S:ESS2:8:3.5 Explain how gravitational force affects objects in the Solar System (e.g., moons, tides, orbits, satellites). [ESS2(5-**8**)SAE+POC-**8**]	
ESS3– The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time.		
		S:ESS3:11:3.5 Explain how scientific theories about the structure of the universe have been advanced through the use of sophisticated technology (e.g., space probes and visual, radio and x-ray telescopes). [ESS3(9-**11**)NOS-**5**]

		S:ESS3:11:3.3 Provide scientific evidence that supports or refutes the "Big Bang" theory of how the universe was formed. [ESS3(9-**11**)NOS-**6**]
		S:ESS3:11:3.4 Based on the nature of electromagnetic waves, explain the movement and location of objects in the universe or their composition (e.g., red shift, blue shift, line spectra). [ESS3(9-**11**)SAE-**7**]
		S:ESS3:11:2.3 Explain the relationships between or among the energy produced from nuclear reactions, the origin of elements, and the life cycles of stars. [ESS3(9-**11**)POC+SAE-**8**]
TOTAL ESS = 6	**TOTAL ESS = 8**	**TOTAL ESS = 8**

NECAP Science Assessment Targets by Content Domain and Strand: Life Science		
Elementary	**Middle**	**High School**
LS1– All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).		
S:LS1:4:1.2 Sort/classify different living things using similar and different characteristics; and describe why organisms belong to each group or cite evidence about how they are alike or not alike. [LS1(K-**4**)INQ+POC-**1**]	S:LS1:8:2.5 Using data and observations about the biodiversity of an ecosystem, make predictions or draw conclusions about how the diversity contributes to the stability of the ecosystem. [LS1(5-**8**)INQ+SAE-**1**]	S:LS1:11:2.8 Use data and observation to make connections between, to explain, or to justify how specific cell organelles produce/regulate what the cell needs or what a unicellular or multi-cellular organism needs for survival (e.g., protein synthesis, DNA transport, nerve cells). [LS1(9-**11**)INQ+SAE+FAF-**1**]
S:LS1:4:2.4 Identify the basic needs of plants and animals in order to stay alive (i.e., water, air, food, space). [LS1(K-**4**)SAE-**2**]	S:LS1:8:1.2 Describe or compare how different organisms have mechanisms that work in a coordinated way to obtain energy, grow, move, respond, provide defense, enable reproduction, or maintain internal balance (e.g., cells, tissues, organs and systems). [LS1(5-**8**)SAE+FAF-**2]**	S:LS1:11:3.4 Explain or justify with evidence how the alteration of the DNA sequence may produce new gene combinations that make little difference, enhance capabilities, or can be harmful to the organism (e.g., selective breeding, genetic engineering, mutations). [LS1(9-**11**)FAF+POC-**2**]
S:LS1:4-3.4 Predict, sequence, or compare the life stages of organisms (plants and animals): e.g., put images of life stages of an organism in order, predict the next stage in sequence, and compare two organisms. [LS1(K-**4**)POC–**3**]	S:LS1:8:3.6 Compare and contrast sexual reproduction with asexual reproduction. [LS1(5-**8**)POC-**3**]	
S:LS1:4:2.3 Identify and explain how the physical structures of an organism (plants or animals) allow it to survive in its habitat/environment (e.g., roots for water; nose to smell fire). [LS1(K-**4**)FAF-**4**]	S:LS1:8:2.4 Explain relationships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism. [LS1(5-**8**)FAF-**4]**	

LS2– Energy flows and matter recycles through an ecosystem.		
S:LS2:4:2.2 Recognize that energy is needed for all organisms to stay alive and grow or identify where a plant or animal gets its energy. [LS2(K-**4**)SAE-**5]**	S:LS2:8:1.3 Using data and observations, predict outcomes when abiotic/biotic factors are changed in an ecosystem. [LS2(5-**8**)INQ+SAE-**5**]	S:LS2:11:1.5 Using data from a specific ecosystem, explain relationships or make predictions about how environmental disturbance (human impact or natural events) affects the flow of energy or cycling of matter in an ecosystem. [LS2(9-**11**)INQ+SAE-**3**]
S:LS2:4:3.2 Describe ways plants and animals depend on each other (e.g., shelter, nesting, food). [LS2(K-**4**)SAE-**6]**	S:LS2:8:2.2 Given a scenario, trace the flow of energy through an ecosystem, beginning with the sun, through organisms in the food web, and into the environment (includes photosynthesis and respiration). [LS2(5-**8**)SAE-**6**]	S:LS2:11:2.3 Trace the cycling of matter (e.g., carbon cycle) and the flow of energy in a living system from its source through its transformation in cellular, biochemical processes (e.g., photosynthesis, cellular respiration, fermentation). [LS2(9-**11**)POC+SAE-**4**]
	S:LS2:8:3.6 Given an ecosystem, trace how matter cycles among and between organisms and the physical environment (includes water, oxygen, food web, decomposition and recycling, but not carbon cycle nor nitrogen cycle). [LS2(5-**8**)SAE-**7**]	S:LS2:11:1.6 Explain or evaluate potential bias in how evidence is interpreted in reports concerning a particular environmental factor that impacts the biology of humans. [LS2(9-**11**)NOS-**5]**
LS3– Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).		
S:LS3:4:1.3 Using information (data or scenario), explain how changes in the environment can cause organisms to respond (e.g., survive there and reproduce, move away, die). [LS3(K-**4**)SAE-**7**]	S:LS3:8:2.3 Use a model, classification system, or dichotomous key to illustrate, compare, or interpret possible relationships among groups of organisms (e.g., internal and external structures, anatomical features). [LS3(5-**8**)MAS+FAF-**8**]	S:LS3:11:2.5 Explain how evidence from technological advances supports or refutes the genetic relationships among groups of organisms (e.g., DNA analysis, protein analysis). [LS3(9-**11**)NOS-**6**]
	S:LS3:8:3.5 Cite examples supporting the concept that certain traits of organisms may provide a survival advantage in a specific environment and therefore, an increased likelihood to produce offspring. [LS3(5-**8**)POC-**9**]	S:LS3:11:3.9 Given a scenario, provide evidence that demonstrates how sexual reproduction results in a great variety of possible gene combinations and contributes to natural selection (e.g., Darwin's finches, isolation of a species, Tay Sach's disease). [LS3(9-**11**)INQ+POC-**7**]

		S:LS3:11:2.6 Given information about living or extinct organisms, cite evidence to explain the frequency of inherited characteristics of organisms in a population; or explain the evolution of varied structures (with defined functions) that affected the organisms' survival in a specific environment (e.g., giraffe, wind pollination of flowers). [LS3(9-**11**)INQ+FAF+POC-**8**]
LS4– Humans are similar to other species in many ways, and yet are unique among Earth's life forms.		
S:LS4:4:3.1 Identify what the physical structures of humans do (e.g., sense organs– eyes, ears, skin, etc.) or compare physical structures of humans to similar structures of animals. [LS4(K-**4**)FAF-**8**]	S:LS4:8:2.4 Use data and observations to support the concept that environmental or biological factors affect human body systems (biotic and abiotic). [LS4(5-**8**)INQ-**10**]	S:LS4:11:2.6 Use evidence to make and support conclusions about the ways that humans or other organisms are affected by environmental factors or heredity (e.g., pathogens, diseases, medical advances, pollution, mutations). [LS4(9-**11)**INQ+NOS-**9**]
S:LS4:4:3.2 Distinguish between characteristics of humans that are inherited from parents (i.e., hair color, height, skin color, eye color) and others that are learned (e.g., riding a bike, singing a song, playing a game, reading). [LS4(K-**4**)POC-**9**]	S:LS4:8:3.4 Using data provided, select evidence that supports the concept that genetic information is passed on from both parents to offspring. [LS4(5-**8**)INQ+POC-**11**]	S:LS4:11:3.3 Explain how the immune system, endocrine system, or nervous system works and draw conclusions about how systems interact to maintain homeostasis in the human body. [LS4(9-**11**)SAE+FAF-**10**]
	S:LS4:8:3.3 Describe the major changes that occur over time in human development from single cell through embryonic development to new born (i.e., group of cells during the first trimester, organs form during the second, organs mature during the third). [LS4(5-**8**)POC-**12**]	
TOTAL LS = 9	**TOTAL LS = 12**	**TOTAL LS = 10**

NECAP Science Assessment Targets by Content Domain and Strand: Physical Science		
Elementary	**Middle**	**High School**
PS1– All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).		
S:PS1:4:2.5 Collect and organize data about physical properties in order to classify objects or draw conclusions about objects and their characteristic properties (e.g., temperature, color, size, shape, weight, texture, flexibility). [PS1(K-**4**)INQ-**1**]	S:PS1:8:2.4 Investigate the relationships among mass, volume and density. [PS1(5-**8**)INQ-**1**]	S:PS1:11:2.6 Use physical and chemical properties as determined through an investigation to identify a substance. [PS1(9-**11**)INQ-**1**]
S:PS1:4:2.4 Make a prediction about what might happen to the state of common materials when heated or cooled; or categorize materials as solid, liquid, or gas. [PS1(K-**4**)POC-**2**]	S:PS1:8:2.5 Given data about characteristic properties of matter (e.g., melting and boiling points, density, solubility), identify, compare, or classify different substances. [PS1(5-**8**)INQ+POC-**2**]	S:PS1:11:1.5 Scientific thought about atoms has changed over time. Using information (narratives or models of atoms) provided, cite evidence that changed our understanding of the atom and the development of atomic theory. [PS1(9-**11**)MAS+NOS-**2**]
S:PS1:4:1.2 Use measures of weight (data) to demonstrate that the whole equals the sum of its parts. [PS1(K-**4**)SAE-**3**]	S:PS1:8:1.6 Collect data or use data provided to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter). S:PS2:8:2.2 Collect data or use data provided to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter). [PS1(5-**8**)INQ+SAE-**3]**	S:PS1:11:2.7 Explain how properties of elements and the location of elements on the periodic table are related. [PS1(9-**11**)POC-**3]**
	S:PS1:8:2.6 Represent or explain the relationship between or among energy, molecular motion, temperature, and states of matter. [PS1(5-**8**)SAE+MAS-**4**]	S:PS1:11:1.6 Model and explain the structure of an atom or explain how an atom's electron configuration, particularly the outermost electron(s), determines how that atom can interact with other atoms. [PS1(9-**11**)MAS+FAF-**4**]

	S:PS1:8:1.7 Given graphic or written information, classify matter as atom/molecule or element/compound (not the structure of an atom). [PS1(5-**8**)MAS-**5]**	
PS2– Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.		
S:PS2:4:3.6 Given a specific example or illustration (e.g., simple closed circuit, rubbing hands together) predict the observable effects of energy (i.e., the bulb lights, a bell rings, hands warm up). A test item may ask, "What will happen when…?" [PS2(K-**4**)SAE-**4**]	S:PS2:8:1.5 Given a real-world example, show that within a system, energy transforms from one form to another (i.e., chemical, heat, electrical, gravitational, light, sound, mechanical). [PS2(5-**8**)SAE+POC-**6**]	S:PS2:11:2.5 Demonstrate how transformations of energy produce some energy in the form of heat and therefore the efficiency of the system is reduced (chemical, biological, and physical systems). [PS2(9-**11**)POC+SAE-**5**]
S:PS2:4:3.7 Use observations of light in relation to other objects/substances to describe the properties of light (i.e., can be reflected, refracted, or absorbed). [PS2(K-**4**)SAE-**5**]	S:PS2:8:3.6 Use data to draw conclusions about how heat can be transferred (convection, conduction, radiation). [PS2(5-**8**)INQ+SAE+POC-**7**]	S:PS2:11:3.10 Using information provided about chemical changes, draw conclusions about the energy flow in a given chemical reaction (e.g., exothermic reactions, endothermic reactions). [PS2(9-**11**)INQ+SAE-**6**]
S:PS2:4:3.8 Experiment, observe, or predict how heat might move from one object to another. [PS2(K-**4**) INQ+SAE-**6**]		S:PS2:11:1.5 Explain relationships between and among electric charges, magnetic fields, electromagnetic forces, and atomic particles. [PS2(9-**11**)SAE-**7**]
PS3– The motion of an object is affected by force.		
S:PS3:4:2.1 Use data to predict how a change in force (greater/less) might affect the position, direction of motion, or speed of an object (e.g., ramps and balls). [PS3(K-**4**)INQ+SAE-**7**]	S:PS3:8:1.3 Use data to determine or predict the overall (net) effect of multiple forces (e.g., friction, gravitational, magnetic) on the position, speed, and direction of motion of objects. [PS3(5-**8**)INQ+POC-**8**]	S:PS3:11:1.8 Given information (e.g., graphs, data, diagrams), use the relationships between or among force, mass, velocity, momentum, and acceleration to predict and explain the motion of objects. [PS3(9-**11**)INQ+POC-**8**]
S:PS3:4:1.5 Use observations of magnets in relation to other objects to describe the properties of magnetism (i.e., attract or repel certain objects or has no effect). [PS3(K-**4**)INQ+SAE-**8**]		S:PS3:11:2.3 Apply the concepts of inertia, motion, and momentum to predict and explain situations involving forces and motion, including stationary objects and collisions. [PS3(9-**11**)POC-**9**]
		S:PS3:11:2.4 Explain the effects on wavelength and frequency as electromagnetic waves interact with matter (e.g., light diffraction, blue sky). [PS3(9-**11**)SAE-**10**]
TOTAL PS = 8	**TOTAL PS = 8**	**TOTAL PS = 10**

Preliminary Distribution of Emphasis

In grades 8 and 11, score points for common items will be evenly distributed across the four reporting categories, even though there may not be an equal number of assessment targets for each science domain. In grade 4, Inquiry and Life Science will have slightly greater emphasis (and more score points) than Earth/Space Science and Physical Science. Additionally, specific targets have been identified for *greater assessment emphasis* (meaning that CR items, ER items, or several MC items will address those targets whenever possible). These targets are called "high-emphasis" assessment targets.*

The Distribution of Emphasis for Reporting Categories is described in Table 2.1 below.

Table 2.1 *Preliminary* Science Distribution of Emphasis by Reporting Category (June 2005)
Percentages of Score Points and Number of Related Assessment Targets

Reporting Categories	Grade 4		Grade 8		Grade 11	
	% Score points	Number of targets	% Score points	Number of targets	% Score points	Number of targets
Life Science LS1, LS2, LS3, LS4	**30%**	9	**25%**	12	25%	10
Earth/Space Science ESS1, ESS2, ESS3	**20%**	6	**25%**	8	25%	8
Physical Science PS1, PS2, PS3	**20%**	8	**25%**	8	25%	10
Inquiry Combinations of one or more targets from one EK/domain	**30%**	NA	**25%**	NA	25%	NA

High-Emphasis" Assessment Targets

The state content committee used an extensive resource review to determine which assessment targets should receive *greater instructional emphasis*, and therefore receive greater assessment emphasis - meaning devoting more test items and/or more test score points to these targets, when choices need to be made. These high-emphasis targets, which represent about half of the total assessment targets per grade span, have been identified for *potential* multiple test score points (e.g., CR items, ER items, or several MC items). Table 2.2 lists the high-emphasis targets with their preliminary DOK ceiling levels. To the degree possible, CR items, ER items, and/or at least two MC items should be aligned to these high-emphasis targets. All high emphasis targets will be assessed every year using at least one common item.

Table 2.2 – High-Emphasis Assessment Targets with *Preliminary* DOK Ceilings*

Science Domains by EK Statement	Grade 4 Targets with DOK	Grade 8 Targets with DOK	Grade 11 Targets with DOK
LS1 Survival of organisms	1 – DOK 2a, b, g 2 – DOK 1a, b	1 – DOK 3h 2 – DOK 2a	1 – DOK 3d 2 – DOK 3d
LS2 Matter and energy in ecosystems	6 – DOK 2a	5 – DOK 2a, d 6 – DOK 2a	3 – DOK 2a
LS3 Organisms change over time		8 – DOK 2a, h	8 – DOK 3a, f
LS4 Humans are similar, yet unique	8 –DOK 2a, h	11 – DOK 2a, b	
PS1 Properties and structure of matter	1 –DOK 3h	1 –DOK 2a, c, d, e, i 2 –DOK 2e, g, j 4 –DOK 2a, b	3 –DOK 2a, b 4 –DOK 3c, g, j
PS2 Energy		6 –DOK 3c, j, l, o	6 –DOK 3a, c, h
PS3 Forces and motion	7 –DOK 2a, j	8 –DOK 2a, e, g, i, j,	8 –DOK 3a, c, h 9 –DOK 2a, b 10 –DOK 2a
ESS1 Earth and earth materials	1 –DOK 2b, e, g 2 –DOK 3c, h 4 –DOK 2a, b 5 –DOK 2a, b	2 –DOK 2a 3 –DOK 2a, b 5 –DOK 3c, d, h, k	1 –DOK 3a, c, d, f, l 3 –DOK 3o
ESS2 Solar system		6 –DOK 2a, g, h, j 8 –DOK 3j, o	
ESS3 Universe and galaxies			6 –DOK 3b, c, d, l, o 7 –DOK 3o 8 –DOK 2a, b

* See pages 15-18 for a description of Depth of Knowledge (DOK) levels in science. Coding for DOK ceilings are aligned with the descriptions on page 17. For example, "2a" means Level 2 DOK and the description for "a" – Specify and explain the relationship between facts, terms, properties, or variables.