WASL
Washington Assessment of Student Learning

A Component of the Washington State Assessment Program

Science

Test and Item Specifications

Grade 10

September 17, 2002

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I. PURPOSE of ASSESSMENT TOOL

The purpose of this assessment tool is to measure Washington tenth grade students' level of proficiency in Benchmark 3 of the science Essential Academic Learning Requirements (science EALRs approved July 17, 1998). These science EALRs consist of three standards. The first standard focuses on the scientific concepts and principles of the physical, Earth, space, and life sciences. The second standard focuses on the skills and processes of science and technology. The third standard focuses on understanding the nature and context of science and technology.

II. ESSENTIAL ACADEMIC LEARNING REQUIREMENTS STRANDS and LEARNING TARGETS for SCIENCE

In keeping with the science EALRs and the science EALR Interpretation and Clarification document (Interim Version May 7, 1999), these standards have been regrouped into the following strands. These five strands have letter codes, (PC, SI, etc.), short names (Properties & Characteristics, Systems & Interconnections, etc.), and a color code in eth order of the colors of the rainbow, red, orange, yellow, green, blue.

PC Strand **Properties & Characteristics in the Physical, Earth, Space, and Life Sciences** Red

PC01 1.1.1 Properties of Substances
PC01 1.1.2 Motion of Objects
PC01 1.1.3 Wave Behavior
PC02 1.1.4 Nature & Properties of Earth Materials
PC03 1.1.5 Basis of Biological Diversity

SI Strand **Systems & Interconnections in the Physical, Earth, Space, and Life Sciences** Orange

SI01 1.2.1 Systems Physical, SI02 Earth/Space, SI03 Life, and SI04 Integrated
SI01 1.2.2 Energy Sources & Kinds
SI01 1.2.3 Energy Transfer & Transformation
SI01 1.2.4 Structure of Matter
SI01 1.2.5 Physical/Chemical Changes
SI02 1.2.6 Components & Patterns of Earth Systems
SI02 1.2.7 Components of the Solar System Beyond
SI03 1.2.8 Structure & Organization of Living Systems
SI03 1.2.9 Molecular Basis of Heredity
SI03 1.2.10 Human Biology

CH Strand	**Changes in Matter & Energy in the Physical, Earth, Space, and Life Sciences**	Yellow
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CH02 1.3.3	Processes & Interactions in Earth Systems	
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IP02 2.1.2	Designing & Conducting Investigations	
IP03 2.1.3	Explanation	
IP04 2.1.4	Modeling	
IP05 2.1.5	Communication	
IP06 2.2.1	Identifying Problems	
IP07 2.2.2	Designing & Testing Solutions	
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NC Strand	**Nature and Context of Science and Technology**	Blue
NC01 3.1.1	Intellectual Honesty	
NC02 3.1.2	Limitations of Science & Technology	
NC03 3.1.3	Dealing with Inconsistencies	
NC04 3.1.4	Evaluating Methods of Investigations	
NCO5 3.1.5	Evolution of Scientific Ideas	
NC06 3.2.1	All Peoples Contribute to Science & Technology	
NC07 3.2.2	Relationship of Science & Technology	
NC08 3.2.3	Careers & Occupations using Science, Mathematics, & Technology	

III. TEST CONTENT ORGANIZATION and CRITERION

The test forms for the tenth-grade science test will consist of 45 items, resulting in 66 points per form. Items will be written at a reading level appropriate for a tenth-grade audience. Test forms will include four to six scenarios with five to eight items associated with each and several stand alone items.

Item Types

The items used in this assessment include multiple choice, short answer and extended response. The multiple choice and short answer questions assess conceptual understanding; short answer and extended response items assess applications of concepts and skills. All three types of questions are used to assess the strands.

Multiple Choice Items (MC)**:** There will be 30 multiple choice items per form, worth one point each. Each multiple-choice item will have four responses:

- The correct answer and three distractors.
- Distractors will be developed based on the types of errors students are most likely to make.
- Correct responses will be approximately equally distributed among As, Bs, Cs, and Ds.

Short Answer Items (SA): The student will construct a short response. There will be 12 short answer items per form, worth two points each. For example:

- Given a scientific phenomenon, the student will write an explanation
- Describe a scientific concept or phenomenon
- Give another context in which the concept applies
- Provide a rationale for conclusion using scientific evidence

Extended Response Items (ER): The student will construct a longer response. There will be three extended-response items, worth four points each. For example:

- Provide a design for a scientific investigation
- Describe the effects of a change in some part of a system
- Propose possible scientific solutions to human problems

Composition of a 45-item Test

Type of Item	Number of Items	Total Points	Percent of Total Score
Multiple Choice	30	30	45%
Short Answer	12	24	37%
Extended Response	3	12	18%
Total	45	66	100%

Multiple choice and short answer items will be used to assess targets in Cognitive Category I: understanding. Multiple choice, short answer, and extended response items will assess targets in Cognitive Category II: application of conceptual understandings. Short answer items and extended response items will be used to assess targets in Cognitive Category II: thinking and process skills.

Cognitive Level of Items

Items will be classified according to their usage level (type of cognitive ability required for solution). Category I items will assess a student's knowledge of scientific concepts or principles and comprehension of scientific information. Category II items will assess the application of content in a science context, the application of science in a real-life context, the analysis of scientific information, the generation of ideas/models, and evaluation of scientific information or models.

Cognitive Distribution of Items

Cognitive Categories	Items	Points
Category I Conceptual Understanding, and Comprehension	16 – 18	16 – 18 (24 – 27%)
Category II Application, Analysis, Synthesis, and Evaluation	27 – 29	48 – 50 (73 – 76%)
Totals	**45**	**66**

Item Cards

An item card will accompany each item. The item card shall include the following information in the following order:

1. Item Code: a number for tracking purpose
2. Item Order in Scenario
3. Scenario Title or Stand Alone Item name indicating content description
4. EALR Code: strand and learning target (i.e. PC01 1.1.1)
5. Item Characteristic: letter of characteristic (i.e. PC01 1.1.1 a)
6. Curricular Area: Physical (PS), Context Physical (CPS), Earth/Space (ES), Context Earth/Space (CES), Life (LS), Context Life (CLS), Integrated (IS), or Context Integrated (CIS)
7. Grade Level: 10, 8, or 5
8. Cognitive Level: (Category I or II)
9. Item Type: (MC, SA, ER)
10. Keyed Correct Answer Key
11. Word count and reading level from Microsoft Word
12. Latest Revision Date
13. Pilot Year and Form
14. Data Review Date
15. Fairness Review Date
16. Content Review Date
17. Writer Information: when, what organization or event (i.e. May 2002 Designing Scenarios)

Operational Test Forms

Each operational test form will contain items in common with another test form, but the vast majority of items will be **unique** to each form. The test will be administered in **two periods**, each of which will be about **80 minutes long**, plus an additional 10 minutes per session for set-up and directions. It is intended that each of the two parts of the test will contain 22 or 23 items in approximately the following proportions: fifteen multiple-choice, six short-answer, and one or two extended responses.

Pilot Test Forms

Each pilot test forms usually follow the same specifications as an operational except for the number of items. However, pilot forms may be designed to test specific types of scenarios and items, therefore, a pilot form may not cover the breath of learning targets of an operational exam. Pilot forms will have 40 items to be administered in **two periods**, each of which will be about **60 minutes long**, plus an additional 10 minutes per session for set-up and directions. It is intended that each of the two parts of the test will contain 20 items in approximately the following proportions: twelve multiple-choice, six short-answer, and one or two extended responses.

Test Scoring

Each multiple-choice item is worth one point, each short-answer item is worth two points, and each extended-response item is worth four points.

Scoring criteria will focus on the clear understanding of scientific ideas and concepts, effective application of scientific inquiry, effective application of problem solving, and effective communication of solutions based on inquiry.

- In cases of constructed-responses, there will be no attention to conventions of writing (sentence structure, word choice, usage, grammar, spelling, and mechanics), as long as the writing or diagramming does not interfere with the communication.

- In cases of mathematical analysis of information, there will be no score points awarded for simply carrying out correct mathematics without indication of understanding of the concept being measured or manipulated.

IV. REPORTING SCHEMA and ITEM DISTRIBUTION

Reporting Schema

Student results will be reported as their scores in each of the five strands.

Item Distribution

All Essential Academic Learning Requirements strands will be addressed in each test form. The overall item distribution in an operational test form is intended to look as follows:

Essential Academic Learning Requirements Strands (# of Learning Targets & Page Color)	Multiple Choice	Short Answer	Extended Response	Range of Points	Percent of Total
PC Properties & Characteristics (5 targets on red pages)				6-8	40%
conceptual understanding (I)	1-2	0-1			
application/analysis (II)	1-2	1-3			
SI Systems & Interconnections (10 targets on orange pages)				8-12	
conceptual understanding (I)	2-3	1-2			
application/analysis (II)	1-2	2-3	0-1		
CH Changes in Matter & Energy (10 targets on yellow pages)				8-12	
conceptual understanding (I)	2-3	1-2			
application/analysis (II)	1-2	2-3	0-1		
IP Skills & Processes of Science & Technology (8 targets on green pages)				28-30	60%
scientific inquiry	3-4	3-5	0-1		
problem solving	2-3	1-2	0-1		
NC Nature & Contexts of Science & Technology (8 targets on blue pages)				10-12	
nature of science	1-2	1-2	0-1		
science, technology, & society	1-2	1			
Total Number of Items	**30**	**12**	**3**	**45**	
Total Number of Points	**30**	**24**	**12**	**66**	

V. GENERAL CHARACTERISTICS of SCENARIOS and ITEMS

All Scenarios

Scenarios developed for this assessment are to conform to the following considerations. These considerations include, but are not limited, to the following:

1. Scenarios will be real examples of what students would encounter beyond school or investigations of which they can relate.
2. Scenarios should be **necessary but not sufficient** for student response. Some questions may be strongly related to the inquiry and can be asked in association with an inquiry scenario rather than in a stand-alone manner. These related questions will come at the end of the scenario's associated questions.
3. Scenarios must be one of the themes of this assessment: scientific inquiry, technological problem solving, or systems.
4. Scenarios are short, textual information less than 350 words.
5. Scenarios will **not** be a reading burden, written at 8th grade level.
6. Scenarios should have a lot of "white space," **not** a lot of text.
7. Vocabulary will be as common or simple as possible (i.e. an air-tight lid could be described as a lid that does not allow air in or out).
8. Scenarios will provide opportunity for assessment of more than one EALR strand through natural, not forced, connections.
9. Scenarios may be a combination of up to three elements (i.e. a graph, a diagram, and a written description).
10. Scenarios will always explain why a picture or diagram is included.
11. Titles for scenarios should be accurate, friendly, catchy, and interesting but not distracting or misleading. Avoid titles that may have copyright issues.
12. Scenarios will have five to eight questions associated with them.
13. More than one question should be possible for a given scenario element.
14. Character names on each form will be representative of the ethnic diversity of Washington students. The names will generally be short and simple to read.
15. Investigations should be written in past tense because the investigation has already happened.
16. Anything under a title should be on the same page (procedures, data, etc.).
17. Steps of procedures, or anything else, should have some white space between the steps (6 to 12 points, 1.5 to 2 spaces).
18. Use 12 pt. New Century Schoolbook font for text and 12 pt. Arial font for data and diagrams.
19. Diagrams should be high quality with labels.
    a. Bolded titles should be included as needed for clarification above the diagram
    b. Labels should be in a different font, not bolded, with slightly curved arrows that point to object or component of the object.
    c. Labels should be consistent with references in the text.
    d. Diagrams should provide visual context for potentially unfamiliar words or objects (i.e. birdfeeder on a window sill to clue in unfamiliar objects).
    e. Simple, direct, not cluttered, familiar layouts to students at given grade.
    f. Use 'black line master" quality so that diagrams photocopy well.

20. Data is presented in a simple and clear manner with lots of "white space."
    a. Bolded titles and text for column and row labels of chart.
    b. Use the format that fits best with the data with minimum verbiage.
    c. Data may include numbers, words or symbols.
    d. Limit total number of 'data cells' to 40 (i.e. 4x10, 5x8).
    e. When conditions are labeled A, B, C, etc, the chart/data table should briefly describe the condition as well as the A, B, C, etc. (i.e. Jar 1 blue food coloring)
21. Graphs, tables, or figures must be clearly associated with their intended questions. Graphics will appear either on the same page as the scenario or on the facing page. If there is any reasonable chance of confusion, page references will direct students to look at the appropriate graphic.
22. In development, when the scenario is finished, all unnecessary language should be removed (i.e. Adriana and Tuan ~~are in the same science class and~~ both participate in track).
23. For development, scenarios must have a summary sheet illustrating the design of the scenario and accompanying items as follows.

Title:								**Grade: 10**		
Description:										
Item Description		**EALR Strand, Learning Target, and Item Characteristic**						**Item Type**		
		Systems			**Inquiry & Problem Solving**					
		Properties and Characteristics	**Systems and Interconnections**	**Changes in Matter & Energy**	**Inquiry and Problem Solving**	**Nature and Context**		**Multiple Choice**	**Short Answer**	**Extended Response**
1										
2										
3										
4										
5										
6										
7										
8										
Note: Items must cover more than one EALR strand					**Total**					
					Ideal Totals			3 to 6	1 to 2	1 to 0

All Items

Items developed for this assessment are to conform to the following considerations. These considerations include, but are not limited to, the following:

1. Assessment items will focus on events, situations, and phenomena that are real world as well as scientific and to which fifth grade students can relate.
2. Items will be connected to informative scenarios/stimuli that are necessary but not sufficient for demonstration of conceptual understanding.
3. Items assessing application of a concept or skill will involve understandable, realistic situations to which as many students as possible can relate.
4. Focus of items will be on what ALL children should know and be able to do as they exit eighth grade.
5. Each assessment form will contain items assessing learning targets from all strands according to the assessment schema.
6. Items should serve specific purposes; each should assess something important rather than trivial.
7. Items must go beyond recall of facts; examinees must use and apply concepts (if we can easily look it up in a book, it doesn't belong on a state assessment).
8. Concepts within each discipline (e.g. physical, earth, space, or life science) shall be the focus of the assessment rather than vocabulary knowledge or simple facts.
9. Items shall focus on the 'big ideas' of science:
    - Properties, classification, & characteristics
    - Structure & function of parts of systems
    - Change in & interaction of systems
    - Interdependence
    - Model
10. Items should elicit rich thinking even in multiple-choice items.
11. Items should require upper levels of Bloom's taxonomy:

    Level I
    - Conceptual Understanding
    - Comprehension

    Level II
    - Application (in scientific and 'real-life' situations)
    - Analysis (in scientific and 'real-life' situations)
    - Synthesis (using scientific knowledge/thinking/skills to generate new ideas, plans, hypotheses, to draw conclusions, etc.)
    - Evaluation (in scientific and 'real-life' situations)
12. Responses to items and selection of an answer choice show clear understanding relevant to the learning target—not just a "sort of" relationship
13. Some items present phenomena and ask for explanations, predictions, and potential investigations (This is not meant to be narrowly prescriptive).
14. Inquiry items are grounded in the procedures and concepts of the relevant content area(s).
15. The items shall be precise and clear.
16. All items are to avoid bias and should not be offensive to any group of students. The items should not display stereotyped representations of gender, race, persons with disabilities, or cultural or religious groups.
17. All items must clearly indicate what is expected in a response.
18. Items in each form are to be balanced by gender and are gender-neutral for active/passive roles.
19. Pictorial representations shall be realistic and authentic for the respective grade.

Inquiry Scenarios

Inquiry scenarios developed for this assessment are to conform to the following considerations. These considerations include, but are not limited to, the following:

1. Statements that introduce an inquiry should be brief, two to five sentences, while describing the reasons, or contexts for the inquiry.
2. Inquiry scenarios should deal only with the concepts and processes of the EALRs. Scenarios should not "teach" EALR concepts. However, in some cases, information may be included to clarify specific language (i.e. name of a bacteria) or explain connections between the data and concepts (i.e. temperature differences as a measure of relative humidity).
3. Inquiry scenarios should model good investigations. Initial investigations will not be problematic. However, questions may present flawed investigations as a follow-up to initial investigation in order to ask what can be done to improve it.
4. The investigative question must be included or implied in the description of an investigation. The question may be left out in order to ask a MC item such as, "What is the investigative question?"
5. Formal or controlled investigations must be written with the following format: Question, Hypothesis, Materials, Procedure, Data, and Conclusion. The 'Question' and 'Conclusion' sections may be left out of the scenario in order to ask students about them.
6. The Hypothesis must be included in the description of the investigation.
7. Procedures of investigations should be easily read. Steps should be used for formal or controlled investigations. However, observations in nature can be described without being in step format.
8. Procedures should be succinct, approximately eight steps.
9. Procedures should state or imply the following variables: controlled, manipulated (independent), responding (dependent).
10. The investigation should include a control condition, an unchanged investigative situation to serve as a basis for comparison.
11. Procedures should describe how often measurements are taken.

Inquiry Items

Inquiry items developed for this assessment are to conform to the following considerations. Inquiry items ask students to **apply** their conceptual understanding of investigations in the following manners:

1. Identify the investigative question.
2. Identify questions that can be investigated scientifically.
3. Design an investigation based upon a given investigative question.
4. Identify variables as controlled, manipulated (independent), and responding (dependent).
5. Identify a control condition in an investigation as an unchanged situation to serve as a basis for comparison.
6. Explain how an investigation is a fair test of a hypothesis or a cause-effect relationship.
7. Describe the technology (measurement tools, electronics, computers, etc.) needed to do scientific inquiry.
8. Write a conclusion for the investigation. A standard items reads as follows:

   Write a conclusion to the investigation.

   Be sure to:

   - Answer the investigative question.

   OR

   - Explain whether or not the prediction is supported by the data.

   AND

   - Give data from the table to support your conclusion.

9. Identify safety precautions in investigations.
10. Identify sources of error in measurement or describe how to improve measurement error.
11. Summarize an investigation to describe the data or results. This summary is different from a conclusion.
12. Design tests to answer questions such as, "What chemical is in the container?"
13. Describe how a model (physical and/or mathematical) can be used to represent a system.
14. Compare the design of a different investigation of the same investigative question.
15. Based upon data from the current investigation, predict the results of an extension of this or a similar investigation.

Systems Scenarios

Systems scenarios developed for these assessments are to conform to the following considerations. These considerations include, but are not limited to, the following:

1. Description of the system as an object or connections of objects within some defined boundaries.
2. Description of the system inputs, transfers, and/or outputs of matter, information, and/or energy.
3. Description of the appropriate phenomena associated with the system (i.e. phases of the Moon in an Earth, Moon, Sun system).
4. A labeled picture or labeled diagram of the system.
5. Only one system should be explored in a scenario. There may be many smaller systems within the main system and the main systems may be connected to other systems, however, the focus of a scenario should be a single system. Avoid multiple systems.
6. Scenarios should not "teach" EALR concepts. Scenarios should only deal with concepts and processes articulated in the science EALRs. However, if there is content that students must know in order to analyze the system (i.e. a name of a particular chemical or bacteria), it may be included in a brief paragraph.
7. Some examples of systems are: bicycle & human leg, cell reproductive system, ecosystem, human health, environmental health, human organ system, Sun-Moon-Earth, windmills

Systems Items

Systems scenarios developed for these assessments are to conform to the following considerations. Systems items ask students to **apply** their conceptual understanding in the following manners:

1. Identify the parts or components of a system.
2. Describe interconnections within and/or between systems.
3. Extract a component of a system, describe its properties/characteristics and/or explain its function.
4. Describe inputs, transfers, and/or outputs of matter, information, and/or energy through a system including the order of transfer.
5. Describe energy transformations (changing forms) within a system.
6. Describe changes in matter throughout a system.
7. Explain the interactions and interdependencies between parts of a system.
8. Determine the orders or sequences of a system based upon evidence over time.
9. Compare one part of the system to another part of the system or to a part in a similar system in terms of their properties, characteristics, and/or function.
10. Compare the system to another, similar system.
11. Describe the forces acting between parts of a system and/or acting upon the whole system.
12. Predict changes within a system based on patterns of interactions within a system and explain your prediction.
13. Predict what would happen if a part of a system changed and explain your prediction.
14. Predict what would happen if a part of a system were to be changed from outside the system and explain your prediction.
15. Predict what would happen if the input to a system changes and explain your prediction.
16. Predict what could cause an output of a system to change in a particular way.
17. Create a model of a system correlating the model's parts and connections to the real system.

Problem Solving Scenarios

Problem solving scenarios developed for these assessments are to conform to the following considerations. These considerations include, but are not limited to, the following:

To Be Developed

Problem Solving Items

Problem solving items developed for these assessments are to conform to the following considerations. These considerations include, but are not limited to, the following:

To Be Developed

VI. ITEM DEVELOPMENT RULES

All Types of Item Rules

1. Each item begins with a stem that asks a question or poses a clear problem. A stem will seldom include an incomplete sentence.
2. All items must clearly indicate what is expected in a response and must help students focus their response. That is, items will clearly state the criteria by which the response will be evaluated, so that students understand what they are expected to do (e.g. create a table, provide a written explanation, etc.). General directions that allow the student more freedom in response format may read as follows: "Use words, labeled pictures, and/or labeled diagrams to show or explain your response."
3. All stems will be positively worded—no use of the word "not" in any form.
4. A stimulus that gives information must precede a question or a set of questions (see rules for scenarios and other stimulus materials).
5. To the extent possible, no stimulus, stem, or response for one item will serve as a clue to the correct response for another item.
6. Reading will be kept to a minimum to help make items clear and precise.
7. Assessment items will be independent in the sense that the answer for any assessment item does not depend on knowing the correct answer to another item, so items are not "linked."
8. If a question is stated in terms of one measurement system, all response options should be given in terms of the same measurement system. Units do not have to be included in the stem, but they should appear in every distractors or response when appropriate.
9. All items, scenarios, and other stimuli materials will be framed in terms of the metric system unless the situation lends itself to another system (e.g. Standard, psi).

Multiple Choice Item Rules

1. Each multiple choice item will have a stem (question, statement, or incomplete statement) and three answer (or completion) options, only one of which is correct.
2. Multiple choice item stems will present a complete problem so that students will know what to do before looking at the answer choices. Students should **not** need to read all answer choices before knowing what is expected.
3. Multiple choice item stems will be short, about 25 words or two lines.
4. All multiple choice answer choices will be similar in length, semantic complexity, and syntax. Students should not be able to rule out a wrong answer or identify a correct response by virtue of it looking or sounding different.
5. Distractors must present plausible alternatives. They should be created so that students *think* their way to the correct answer instead of identifying incorrect answers by virtue of their inappropriate nature.
6. Incorrect answer choices (distractors) will include "common errors" or less-sophisticated understanding so that they are attractive to students with emerging understanding.
7. Distractors should always be plausible (but, of course, incorrect) in the context of the item stem and the stimulus materials. The responses or distracters will be arranged in a logical order (i.e. numerical or chronological order or according to the length of the distracters).
8. Distractors will NOT be partially correct or "trick" students into choosing an incorrect response.
9. Correct responses will be approximately equally distributed among *A*s, *B*s, and *C*s.

Multiple-Choice Item Rules (continued)

10. The responses "Both of the above", "All of the above", "None of the above", and "Neither of the above" will not be used.
11. Some items should include graphics for answer choices.

Short Answer and Extended Response Item Rules

1. Each short answer or extended response item will give clear indications, bulleted when appropriate, of what is required of students (e.g. if two examples are required, the stem will indicate this).
2. Anything required by the scoring rule will be asked for in the item stem.
3. Short answer and extended response item stems will be short and succinct with simple syntax and familiar words. Item stems will contain no more than three sentences (about 45 words): two to set up the situation and one to prompt or question.
4. Short answer and extended response items should need a full thought or sentence, more than one word, for a correct response.
5. All short answer items and extended response items will be developed with accompanying scoring guides.
6. The structure of items should give students a set of information; specific requirements should be bulleted and key words will be bold-faced in order to draw attention to key requirements of the item or task.
7. Any item that requires the student to use information from a scenario will specifically ask for the information from the scenario that was needed to respond (e.g. "Support your response with specific data (details, etc.) from the . . . ").
8. Graphic organizers (boxes with labels or minimal directions) may be used to assist students to frame their responses.

Short Answer Only Item Rules

1. Short answer items should require a limited response that may range from a few words; one or two sentences; completion of a table, graph, or chart; construction of a diagram; a brief comparison or a brief contrast; a brief justification of a choice; or a brief conclusion.
2. Short answer items will involve justifying a multiple choice response, listing examples, explaining a simple concept or principle, making a prediction with supportive evidence, drawing a conclusion with supportive evidence, making an inference with supportive evidence.

Extended Response Only Item Rules

1. Item stems for extended response items should contain no more than three sentences: two to set up the situation and one to prompt or question.
2. Extended response items will require responses that range in length from lists of words or data to diagrams, graphs, tables, and/or charts to extended explanations, justifications, comparisons, and contrasts that include sufficient detail to show clear understanding.

Rules for Developing Scoring Guides

1. An item specific scoring guide will be developed for each short answer and extended response item.
2. Scoring Guides must specifically reflect the intended learning target by using language from the EALR in the full point description.
3. Information from the pilot will be used to refine these scoring guides for use with the final items.
4. Scoring guides generally follow an "analytical" model in which score points are well defined by the bulleted statements in the item stem.
5. Scoring guides may follow a "focused holistic" model in which the score for the response is based on overall quality, but it also results from focusing on several important features of the student's performance.
6. Scoring guides for each item will follow from the scoring criteria given on pages 53 through 57.
7. Scoring guides for conceptual understanding will focus on level of conceptual development or (emerging) understanding.
8. Scoring guides for processes will focus on effectiveness in use of inquiry processes, effectiveness of application, reasonableness of justification, selection of useful information to support claims, degree to which responses are viable and follow from the stimulus materials, etc.
9. Scoring guides for investigation design items must follow the "Generic Scoring Guide for Investigation Design Extended Response Items" on page 58.
10. Short answer items will be scored with a three level scoring guide (0–2); students may receive full credit, partial credit, or no credit.
11. Extended response items will be scored with a five level scoring guide (0–4); the levels may be summarized:
    - 4 Thorough, accurate, effective, shows accurate understanding, clear communication.
    - 3 Mostly complete/mostly accurate, reasonable, mostly clear.
    - 2 Somewhat complete/accurate, partially supported, somewhat clear.
    - 1 Attempted/minimal accuracy, little support, problematic communication.
    - 0 Shows little or no understanding of the concepts or processes being assessed.

VII. ITEM DEVELOPMENT GUIDE for the PROPERTIES and CHARACTERISTIC STRAND

Red

PC Strand Properties and Characteristics of Systems

Use properties to identify, describe, and categorize substances, materials, and objects, and use characteristics to categorize living things.

PCO1 Physical Science Properties

Demonstrates an understanding of how to use properties to identify, describe, and categorize physical substances and objects.

Item Format

Multiple choice and short answer items may be used to assess this learning target.

Stimulus Attributes

- All stimuli must be age and grade appropriate situations or phenomena

Stimuli may include:

- The periodic table of elements.
- Common elements and compounds described in words and conventional symbols (e.g. CO_2, H_20, NaCl).
- Two-dimensional time/distance grids that represent relative positions, motions, and speed of objects.
- Graphics of tools, such as rulers, balances, spring scales, and thermometers, to measure length, area, mass, weight, density and volume.
- Situations and phenomena in which experiences with sound and light are described or visually represented.
- Situations describing and graphics of wave behavior.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:

absorption	family of elements	proton	scattering
amplitude	interference	radiation	solubility
atomic number	neutron	refract	solute
electron shell	periodic table	refraction	solvent

- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under other learning targets at this and all previous grade levels apply to Properties and Characteristics.

PC01 1.1.1 Properties of Substances Red

Examine the basis for the structure and use of the periodic table

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate system, items may ask students to:

a) Use the periodic table to identify or name elements that have the same properties as a given element.
b) Describe what atomic change causes atomic number to increase.
c) Describe the properties shared by elements in a given vertical column (groups or families) of the periodic table.
d) Predict the properties of elements based on their vertical location (groups or families) on the periodic table.

PC01 1.1.2 Motion of Objects

Describe the average speed, direction of motion and acceleration of objects.

Item Characteristics

Given a graph, picture, table, or description of movement over time in a straight line, items may ask students to:

a) Determine the average speed for a given unit of time.
b) Determine the direction of motion for a specific interval of time.
c) Determine the average acceleration of the object for a specific interval of time.

PC01 1.1.3 Wave Behavior

Describe relations between wavelength, speed, and frequency for water waves; describe ways in which water waves, waves on springs, and the phenomena of sound and light exhibit wave-like behavior.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate system, items may ask students to:

a) Identify or describe what happens to sound or light as the frequency of wavelengths increases over time when given a picture of a sound or light wave pattern.
b) Identify or describe what happens to the speed, frequency, or direction of wavelengths in different mediums.
c) Identify or describe the relationship between speed, amplitude, and frequency of wavelengths and energy.
d) Identify or describe similarities and/or differences between light, sound, and water waves.

PC02 Earth and Space Science Properties Red

Demonstrates an understanding of how to use properties to identify, describe, and categorize Earth/space substances.

Item Format

Multiple choice and short answer items may be used to assess this learning target.

Stimulus/Scenario Attributes

- All stimuli must be age and grade appropriate situations or phenomena.

Stimuli may include:

- Situations in which other students observe and examine the physical and chemical properties of Earth materials such as rocks, soil, and water.
- Tables or charts that describe the chemical composition of Earth materials, including rocks, minerals, soils, water, and atmospheric gases.
- Descriptions of situations wherein humans interact with and/or use of Earth materials.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used: wind current
- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under other learning targets at this and all previous grade levels apply to Properties and Characteristics.

PC02 1.1.4 Nature and Properties of Earth Materials

Correlate the chemical composition of Earth materials – rocks, soils, water, gases of the atmosphere – with properties that determine their use to humans.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate system, items may ask students to:

a) Identify or describe why the total amount of a specific element remains constant in Earth's system when given a situation in which one or more elements undergo a change of state (e.g. burning of wood).
b) How and/or why resources are useful to humans when given these Earth resources (e.g. fossil fuel, metal, mineral, gems) with distinctive physical and chemical properties.

PC03 Life Characteristics Red

Demonstrates an understanding of how to use characteristics to categorize living things.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target.

Stimulus Attributes

- Stimuli must be age and grade appropriate situations or phenomena
- Stimuli may include descriptions, charts, and graphics of the structural, cellular, biochemical or genetic characteristics of plants and animals.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:

abiotic	endocrine system	reproductive system	spore
biotic	neurological system	respiratory system	
circulatory system	ova	skeletal system	
digestive system	photosynthesis	sperm	

- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under other learning targets at this and all previous grade levels apply to Properties and Characteristics.

PC03 1.1.5 Basis of Biological Diversity

Classify organisms into distinct groups according to structural, cellular, biochemical, and genetic characteristics

Item Characteristics

Given background information as to the evolutionary histories of several currently living species, items may ask students to:

a) Identify related organisms.
b) Explain why different organisms are related.
c) Classify organisms based on their shared physical characteristics, reproductive processes, cellular characteristics, and/or functional processes (respiratory, circulatory, endocrine, digestive, etc.) systems when given background information about different species.

VIII. ITEM DEVELOPMENT GUIDE for the SYSTEMS and INTERCONNECTIONS STRAND

Orange

SI Strand Systems and Interconnections within and among them

Recognize the components, structure, and organization of systems and the interconnections within and among them.

SI01 Systems

Recognize the components, structure, and organization of systems not explicitly expressed in other learning targets and the interconnections within and among them.

Item Format

Refer to item format under each discipline's section.

Stimulus/Scenario Attributes

Refer to stimulus/scenario attributes under each discipline's section.

Scientific Vocabulary and Terms

Refer to scientific vocabulary and terms under each discipline's section.

SI01 1.2.1 Physical Systems

Analyze physical systems, including inputs and outputs of a system and its subsystems. *

SI02 1.2.1 Earth and Space Systems

Analyze Earth and space systems, including inputs and outputs of a system and its subsystems. *

SI03 1.2.1 Living Systems

Analyze living systems, including inputs and outputs of a system and its subsystems. *

SI04 1.2.1 Integrated Systems

Analyze physical, Earth, space, and/or living systems, including inputs and outputs of a system and its subsystems. *

*Other than the systems described in other SI learning targets

Item Characteristics

Given a description, diagram, or drawing of a simple physical, mechanical, electrical or biological system, items may ask students to:

a) Describe the parts or components of a system.
b) Describe a subsystem within a system.
c) Analyze the interconnections between the parts of a system.
d) Describe the inputs, and outputs of a system.
e) Analyze the transfers and/or transformations within a system.

SI01 Physical Systems Orange

Recognize the components, structure, and organization of physical systems and the interconnections within and among them.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target. Extended response items may be used only when students are asked to describe parts of a system and analyze how the parts of the system interact and/or depend upon one another.

Stimulus/Scenario Attributes

- Stimuli must be age and grade appropriate situations and phenomena.

Stimuli may include:

- Graphics that show interactions between different physical systems including subsystems.
- Pictures or descriptions of objects or matter in different energy states.
- Pictures or diagrams that show transfer of heat energy.
- Diagrams of matter in different forms (e.g. puddles of water, ice cubes, steam)
- Simple diagrams of atomic structures including electrons, neutrons, and protons.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:

contraction	mechanical energy	potential energy	thermal energy
diffusion	nuclear energy	state	transformation
kinetic energy	phase change	state of matter	work

- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under other learning targets at this and all previous grade levels apply to Systems and Interconnections

SI01 1.2.2 Energy Sources and Kinds

Understand many forms of energy as they are found in common situations on Earth and in the universe.

Item Characteristics

Given a description, picture, or diagram of interactions among different physical systems, items may ask students to:

a) Describe the kinetic or potential energy of the parts of a system.
b) Describe the thermal (heat) energy of a system, subsystems, or parts of a system.
c) Describe the work done to or by a system.

SI01 1.2.3 Energy Transfer and Transformation Orange

Understand that total energy is energy is conserved: analyze decreases and increases in energy during transfers in terms of total energy conservation.

Item Characteristics

Given a labeled picture or labeled diagram of a physical system (mechanical, electrical, magnetic, thermal (heat), nuclear, chemical, light, sound, etc.) its parts and subsystems, items may ask students to:

a) Describe or explain conditions likely to increase or decrease the amount of potential or kinetic energy of the parts of a system.
b) Describe or explain conditions likely to increase or decrease the amount of thermal (heat) energy of the parts or subsystems of a system.
c) Identify or describe how chemical or nuclear reactions give off energy in a system.
d) Describe how transformations result in thermal energy and how thermal energy is transferred within and among systems.
e) Identify or describe what happens to the system's total energy as it moves from one part of the system to another.
f) Determine whether the system is an open or closed system.
g) Describe how electrical charge or energy moves through a system.
h) Describe how a wave's energy (sound, light, etc.) moves through and between systems.

SI01 1.2.4 Structure of Matter

Relate the structural characteristics of atoms to the principles of atomic bonding.

Item Characteristics

Given a labeled picture or labeled diagram of an atom or molecule, items may ask students to:

a) Describe the role of the electrons, neutrons, and/or protons in the atom or between atoms.
b) Describe the characteristics of electrons, neutrons, and/or protons.
c) Identify or describe what occurs at the electron level during atomic bonding.
d) Identify or describe what conditions are necessary for the given molecule to be stable.
e) Describe the cause of the decay.

SI01 1.2.5 Physical and Chemical Changes Orange

Analyze and explain the factors that affect physical and chemical changes and how matter and energy are conserved in a closed system.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate system, items may ask students to:

a) Describe whether the system is an open or closed system.
b) Describe the effect of different factors (pressure, temperature, nuclear stability, surface area) upon a rate of change.
c) Describe what changes take place at the molecular level during a phase change.
d) Describe the effects of different factors (atmospheric pressure, temperature, nuclear stability) on physical change, chemical change, or nuclear change.
e) Determine whether the change is a physical change, chemical change, or nuclear change.
f) Identify or describe why the total mass and/or the total atomic weight remains the same.

SI02 Earth and Space Systems and Interactions

Orange

Recognize the components, structure, and organization of Earth and space systems and the interconnections within and among them.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target. Extended response items may be used only when students are asked to describe parts of a system and analyze how the parts of the system interact and/or depend upon one another.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate situations and phenomena.

Stimuli may include:

- Graphics that show parts of Earth's subsystems (a landmass and its topography, vegetation, and bodies of water **or** oceans and landmasses, including landmass topography, and bodies of water **or** a side-view of Earth's core, landforms, and atmosphere).
- Graphics that show Earth in relation to the Sun, the Moon, or both.
- Graphics or data that show Earth in relation to other planets in the solar system.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:

atmospheric	expansion	hydrosphere	topography
celestial	galaxy	spherical	

- Terms that may be used with definitions or examples: lithosphere
- Terms that may not be used:
- All terms allowed and restricted under other learning targets at this and all previous grade levels apply to Systems and Interconnections

SI02 1.2.6 Components and Patterns of Earth Systems

Explain how natural processes determine patterns and arrangements of continents, landforms, and oceans; explain how the theory of plate tectonics accounts for movement of continents, landforms, and oceans over time.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate Earth system, items may ask students to:

a) Describe the interactions among the parts of Earth's system(s), such as the atmosphere and the hydrosphere (weather) or the hydrosphere and the lithosphere (plate tectonics/rock cycle).
b) Identify or describe sources of Earth's internal or external thermal energy.
c) Identify or describe the processes that cause the movement of material on Earth's surface.

SI02 1.2.7 Components of the Solar Systems and Beyond Orange

Understand the solar system as part of a galaxy as part of an expanding universe composed of immense numbers of stars, galaxies, and celestial bodies.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate space system, items may ask students to:

a) Describe role of gravity in interactions among parts of the solar system.
b) Identify or describe how the Big Bang theory explains formation of stars and planets.
c) Identify factors that are thought to be common among all stars or factors that are unique to different stars.
d) Identify or describe stages of the life cycle of a star.
e) Identify or describe the next or proceeding stage of a star's life cycle when given one stage.
f) Identify or describe what changes occur as the star moves from one stage of its life cycle to another.

SI03 Living Systems Orange

Recognize the components, structure, and organization of living systems and the interconnections within and among them

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target. Extended response items may be used only when students are asked to describe parts of a system and analyze how the parts of the system interact and/or depend upon one another.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate situations and phenomena

Stimuli may include:

- Diagrams or pictures of parts of plant subsystems (e.g. flower, leaf, stem; stamen, pistils, and ova).
- Diagrams or pictures of human body subsystems (e.g. lungs, windpipe, mouth and nose; heart, veins and arteries; brain, spinal cord, and nerves; skin; mouth, teeth, esophagus, stomach, intestines).
- Descriptions and graphics that show an offspring and its parent(s).
- Descriptions and graphics that describe genetic information.
- Descriptions, charts, and graphics that describe an organism's characteristics that have been influenced by its environment.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:

asexual	hormone	reproduction	stamen
cell membrane	offspring	reproductive system	
cell nucleus	pistil	sexual	
cell wall	reproduce	spinal chord	

- Terms that may be used with definitions or examples: esophagus
- Terms that may not be used:
- All terms allowed and restricted under other learning targets at this and all previous grade levels apply to Systems and Interconnections

SI02 1.2.8 Structure and Organization of Living Systems

Understand that specific genes regulate the functions performed by structures within the cells of multi-cellular organisms.

Item Characteristics

Given a labeled picture or labeled diagram of a living system (or cell), items may ask students to:

a) Identify or describe how specialization of cells defines different functions of the parts of living systems.
b) Identify or describe different cell processes controlled by the parts of the cell.

SI02 1.2.9 Molecular Basis of Heredity Orange

Describe how genetic information (DNA) in the cell is controlled at the molecular level and provides genetic continuity between generations.

Item Characteristics

Given a labeled picture or labeled diagram of a living system (or cell), items may ask students to:

a) Identify or describe how specialization of cells defines different functions of the parts of living systems.
b) Identify or describe how genes influence specialization of cells.
c) Identify or describe how genes are combined from egg and sperm to create offspring.
d) Identify or describe the role of chromosomes in determining the sex of an offspring.
e) Identify or describe the relationship between genes and chromosomes.
f) Identify or describe an example of how gene combinations can lead to positive or negative outcomes for an organism.

SI02 1.2.10 Human Biology

Compare and contrast the specialized structural and functional systems that regulate and maintain human growth and development, and maintain health.

Item Characteristics

Given a labeled picture or labeled diagram of a human body system, items may ask students to:

a) Describe how the system helps maintain human health.
b) Identify or describe the role of the systems in human growth and development.
c) Identify or describe the role of hormones in regulating the processes of the system.
d) Items may ask students to identify the major functions of the pituitary, hypothalamus, or thyroid glands in supporting human growth, development, or health.
e) Identify or explain the role of the immune system in fighting disease when given a human illness caused by microorganisms.
f) Identify or explain the role of the immune system in causing the illness when given a human illness caused by a breakdown of the immune system.
g) Identify or describe the functions of the nervous system that are critical to human survival.
h) Identify or describe the role of the nervous system in maintaining human body systems.
i) Identify or predict the potential effects of the drug mimicking or blocking neurotransmitters brain function.
j) Explain how environmental factors can affect normal embryo development.

IX. ITEM DEVELOPMENT GUIDE for the CHANGES in MATTER and ENERGY STRAND

Yellow

CH Strand Change in Matter and Energy in and among Systems

Understand how interactions within and among systems cause changes in matter and energy.

CH01 Changes in Matter and Energy in Physical Systems

Understand how interactions within and among physical systems cause changes in matter and energy.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate situations and phenomena.

Stimuli may include:

- Graphics that show various forces, the direction of a force, or the effects of a force.
- Graphics showing magnetic forces, electrical forces, or forces from colliding or moving objects

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:

electrical charge	frictional force	magnetic pole
electrical force	gravitational force	nuclear force

- Terms that may be used with examples or definitions:
- Terms that may not be used: normal force

CH01 1.3.1 Nature of Forces

Identify various forces and their relative magnitudes; explain everyday situations in terms of force.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate physical system, items may ask students to:

a) Identify or describe the forces acting on an object.
b) Describe the sum of all forces acting on an object.
c) Describe the effect of the direction and magnitude of force acting on an object.
d) Identify, describe, or predict the forces between electrical charges.
e) Identify, describe, or predict the forces between magnetic poles.

CH01 1.3.2 Forces to Explain Motion Yellow

Explain the effects of unbalanced forces in changing the direction of motion.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate physical system, items may ask students to:

a) Identify or describe the magnitude and direction of a force needed to speed up an object with a given mass in a given distance or time.
b) Identify or describe the magnitude and direction of a force needed stop an object within a given distance or time.
c) Describe the forces acting on an object traveling a constant speed in a straight line.
d) Describe the forces acting on an object traveling a constant speed in a circular path or orbit.
e) Identify or describe the magnitude and direction of a force needed turn an object given the mass of the object and the desired turning arc or orbit.

CH02 Changes in Matter and Energy in Earth and Space Systems Yellow

Understand how interactions within and among Earth and space systems cause changes in matter and energy.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate situations and phenomena

Stimuli may include:

- Simplified graphics that show landforms of Earth.
- Pictures, charts and graphics showing or representing changes that occur to the surface of Earth.
- Pictures or descriptions of situations that show plant and/or animal fossils.
- Charts, graphs, or tables showing evidence of weather patterns (precipitation, snowfall, temperatures, wind directions, wind speed).
- Pictures, diagrams or descriptions of nebulae, a "Big Bang", stars, and other celestial events.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:
  meteorology nuclear fission nuclear fusion thermal
- Terms that may be used with examples or definitions: biosphere, hydrosphere, lithosphere
- Terms that may not be used:

CH02 1.3.3 Processes and Interactions in Earth Systems

Understand that patterns of movement in the plates that comprise Earth's surface are the result of outward transfer of Earth's internal heat and that historical patterns of movement can be identified from clues in rock formations; describe how volcanoes and Earthquakes in Washington State occur because of this interaction.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate Earth system, items may ask students to:

a) Identify the likely causes of a change in Earth's surface.
b) Describe the likely outcome of a geologic event (Earthquakes, volcanoes, mountain ranges, islands, etc.) based on the location of the event (undersea or on land).
c) Identify or describe the body waves [primary (P), secondary (S)] and surface waves that occur during the Earthquake.
d) Identify or describe the source of matter (magma) and energy (thermal) of a volcano.

CH02 1.3.4 History and Evolution of Earth Yellow

Understand how fossils and radioactive elements are used to correlate and determine the sequence of geological events.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate Earth system, items may ask students to:

a) Identify or describe how decay rates of radioactive isotopes in rock layers are used to estimate the age of fossil remains or the time of geological events.
b) Determine the sequence of geologic events given ages of fossils in rock layers.

CH02 1.3.5 Hydrosphere and Atmosphere

Correlate global climate with energy transfer by the Sun, cloud cover Earth's rotation, positions of mountain ranges, and positions of oceans.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate Earth system, items may ask students to:

a) Identify, describe, or explain how heat transfer between the atmosphere, hydrosphere, and lithosphere affect climate or weather patterns.
b) Identify, describe, or explain how the gravity working on the density of the atmosphere and hydrosphere affect climate or weather patterns.
c) Identify, describe, or explain how Earth's rotation affect climate or weather patterns.
d) Identify, describe, or explain how the stationary nature of landforms and bodies of water affect climate or weather patterns.
e) Identify, describe, or explain how the gases in the atmosphere affect climate or weather patterns.

CH02 1.3.6 Interactions in the Solar System and Beyond

Understand that Earth, planets, Sun, and the rest of the celestial bodies in the universe are continuing to evolve because of the interactions between matter and forces of nature.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate space system, items may ask students to:

a) Identify or describe how gravity worked on celestial matter in a nebular cloud to form the solar system according to the "Big Bang" theory.
b) Identify or describe how the nuclear fusion of hydrogen to helium is the source of energy of a star.
c) Identify or describe how helium, generated through nuclear fusion, could undergo other nuclear reactions that generate other elements.

CH03 Changes in Matter and Energy in Living Systems Yellow

Understand how interactions within and among living systems cause changes in matter and energy.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate situations and phenomena

Stimuli may include:

- Charts and graphics that show matter and energy (food, light, water) being transferred from one organism to another.
- Graphics that show how matter and energy (food, light, water) are exchanged between organisms and their physical environment.
- Situations and graphics where energy is changed from one form to another in an organism
- Charts with pictures show plant and/or animal fossils in rocks from different time periods or timelines with pictures of fossils.
- Descriptions, charts, and graphics that show a change in an organism over time.
- Descriptions or graphics that describe or show an organism's ability to adapt to its environment, such as camouflage.
- Descriptions of how a species has become extinct.
- Descriptions and graphics that show organisms in competitive relationships.
- Descriptions and graphics that show organisms in mutually beneficial relationships.
- Descriptions, charts, and graphics that show humans and other living things using natural resources.
- Descriptions, charts, and graphics that describe how living things can cause changes in their environment.
- Descriptions, charts, and graphics that describe how resources are recycled.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:

diversity	host	relationship	succession
energy chain	parasite	scavenger	

- Terms that may be used with definitions or examples: biome, community, speciation
- Terms that may not be used:

CH03 1.3.7 Life Processes and the Flow of Matter and Energy Yellow

Explain how organisms can sustain life by obtaining, transporting, transforming, releasing, and eliminating matter and energy.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate living system, items may ask students to:

a) Identify or describe, at a conceptual level, the matter and energy inputs and outputs of photosynthesis.
b) Identify or describe, at a conceptual level, how chemical reactions in the cell create energy.
c) Identify or describe, at a conceptual level, the matter and energy inputs and outputs of animals.
d) Identify or describe how changes in certain factors (water, oxygen, carbon dioxide, minerals, energy, recycling of dead organic materials) can support or diminish life.

CH03 1.3.8 Biological Evolution

Investigate and examine scientific evidence used to develop theories of evolution, speciation, adaptation, and biological diversity.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate living system, items may ask students to:

a) Explain how molecular and anatomical similarities and differences among organisms is used to determine common ancestry.
b) Create a lineage that shows evolution over time based upon molecular and anatomical similarities and differences among organisms.
c) Predict the likely impact on survival and/or extinction of certain organisms based upon the principles of natural selection as environmental conditions change over time.
d) Identify or provide an explanation for the benefits of speciation in the survival of organisms as environmental conditions change over time.
e) Identify or describe the characteristics of organisms that are likely to be heritable and/or those that are likely to be the effect of environmental conditions.
f) Identify or describe characteristics that are inherited and those that are learned.
g) Identify or describe how the physical characteristics may help one organism to adapt to environmental conditions better than another organism.
h) Discriminate between adaptations that help organisms survive widely varying environmental conditions and those that limit adaptation.

CH03 1.3.9 Interdependence of Life

Compare and contrast the complex factors (biotic and abiotic) that affect living organisms' interactions in biomes, ecosystems, communities, and populations.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate ecosystem system, items may ask students to:

a) Identify, describe, or explain the directional flow of energy through the system.
b) Identify or describe how the change of one factor can affect organisms in an ecosystem.

CH03 1.3.10 Environmental and Resource Issues Yellow

Analyze the effects of natural events and human activities on the Earth's capacity to sustain biological diversity.

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate ecosystem system including humans, items may ask students to:

a) Discriminate between normal fluctuations in populations and fluctuations in populations that could lead to extinction, overpopulation or both.
b) Give specific predictions of potential consequences of overuse of resources in an ecosystem.
c) Discriminate between renewable and non-renewable resources in an ecosystem.
d) Explain how carrying capacity of an ecosystem can be affected by factors such as population growth, technological advancements, disease, recycling, resource management, and/or other factors.
e) Identify or explain how major environmental shifts (e.g. global warming, el Nino, volcanoes, Earthquakes) can threaten human survival.

X. ITEM DEVELOPMENT GUIDE for the SKILLS and PROCESSES STRAND

Green

IP Strand Inquiry and Problem Solving in Science and Technology

Develop abilities necessary to do scientific inquiry and apply science knowledge and skills to solve problems or meet challenges.

IP01 2.1.1 Questioning

Identify and formulate questions and related concepts that guide scientific investigations

Item Format

Multiple choice and short answer items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigations.
- All formal or controlled investigations must include a hypothesis, materials, procedure, and data section.
- All tables, charts, and/or graphs must have informative titles, appropriate labels, units, and appropriate scales.
- Tables, graphs, and charts will NOT include irrelevant data or data designed to 'trick' students into giving an incorrect response

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used: experimental control, infer, inference, investigative control, investigative question
- Terms that may be used with definitions or examples: dependent variable, independent variable,
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Questioning.

Item Characteristics

Given a description of a scientific investigation and the results of the investigation, items may ask students to:

Identify the investigative question.

Select a new investigative question that can be answered using the same materials described in the original investigation.

IP02 2.1.2 Designing and Conducting Investigations Green

Design, conduct, and evaluate systematic and complex scientific investigations, using appropriate technology, multiple-measures, and safe approaches.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigations.
- All formal or controlled investigations must include a hypothesis, materials, procedure, and data section.
- All tables, charts, and/or graphs must have informative titles, appropriate labels, units, and appropriate scales.
- Tables, graphs, and charts will NOT include irrelevant data or data designed to 'trick' students into giving an incorrect response.
- Stimuli must include a brief description of background information about a scientific issue or phenomenon related to the investigation.
- Stimuli may include diagrams or pictures of objects used in a scientific investigation.
- Stimuli may include descriptions, charts, and graphics that show a repeated or related scientific investigation that includes the results and conclusions.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used: controlled variable, experiment, hypothesis, logical, manipulated variable, responding variable
- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Designing and Conducting Investigations.

Item Characteristics

Given a description of a scientific investigation and the results of the investigation, items may ask students to:

a) Identify the investigative control.
b) Design a second investigation for a different investigative question that can be answered using a similar design.
c) Identify possible sources of error in the investigation.
d) Identify the manipulated (independent) variable.
e) Identify two controlled variables.
f) Identify the responding (dependent) variable.
g) Identify or describe safety requirements that would be needed in the investigation.
h) Select an appropriate tool to gather data for the investigation.
i) Identify or describe how one or more variables affected the responding (dependent) variable.
j) Identify or describe how a specific change in one variable might affect the responding (dependent) variable.
k) Identify or describe the causes of unexpected variability in results.
l) Identify or describe one or more strategies for improving the quality of the investigation.

IP03 2.1.3 Explanation Green

Formulate and revise scientific explanations and models using logic and evidence; recognize and analyze alternative explanations and predictions.

Item Format

Short answer and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigations.
- All formal or controlled investigations must include a hypothesis, materials, procedure, and data section.
- All tables, charts, and/or graphs must have informative titles, appropriate labels, units, and appropriate scales.
- Tables, graphs, and charts will NOT include irrelevant data or data designed to 'trick' students into giving an incorrect response.
- Stimuli must include a brief description of background information about a scientific issue or phenomenon related to the investigation.
- Stimuli may include diagrams or pictures of objects used in a scientific investigation.
- Stimuli may include descriptions, charts, and graphics that show a repeated or related scientific investigation that includes the results and conclusions.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:
- Terms that may be used with definitions or examples: phenomenon
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Explanation.

Item Characteristics

Given a completed investigation, items may ask students to:

a) Write a conclusion. A standard item reads as follows:
   Write a conclusion to the investigation.
   Be sure to:
   - Answer the investigative question.

   OR
   - Explain whether or not the hypothesis is supported by the data.

   AND
   - Give data from the table to support your conclusion.

b) Identify or describe a scientific interpretation based on the results of an investigation.
c) Compare the results drawn from repeated or two related investigations.
d) Identify or generate an interpretation based on results *and* support that interpretation with specific data.
e) Identify or give a rationale for a given conclusion or interpretation using evidence from the investigation.
f) Compare the results drawn from repeated or two related investigations.
g) Determine whether a given conclusion supports a given hypothesis.
h) Identify evidence that supports a conclusion or interpretation.
i) Identify ways to improve the quality of the investigation to obtain clearer results.
j) Predict what logically might happen if the investigation lasted longer.

IP04 2.1.4 Modeling Green

Use mathematics, computers, and/or related technology to model the behavior of objects, events, or processes.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigations.
- Stimuli must include a brief description of background information about a scientific issue or phenomenon related to the investigation.
- Stimuli may include diagrams or pictures of a scientific phenomenon.
- Stimuli may include diagrams or graphics that show a model of a scientific phenomenon.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used: metaphor
- Terms that may be used with definitions or examples: analogy, conceptual, construct
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Modeling.

Item Characteristics:

a) Items may ask students to identify a mathematical model to represent results from an investigation.
b) Given possible phenomena for which is it efficient and effective to represent using mathematical models, items may ask students to identify or describe a specific example of the phenomenon.
c) Given a mathematical model for a phenomenon, items may ask students identify or describe how the model fits the observations.

IP05 2.1.5 Communication Green

Research, interpret, and defend scientific investigations, conclusions, or arguments; use data, logic, and analytical thinking as investigative tools; express ideas through oral, written, and mathematical expressions.

Item Format

Short answer and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigations.
- All formal or controlled investigations must include a hypothesis, materials, procedure, and data section.
- All tables, charts, and/or graphs must have informative titles, appropriate labels, units, and appropriate scales.
- Tables, graphs, and charts will NOT include irrelevant data or data designed to 'trick' students into giving an incorrect response
- Stimuli must include a brief description of background information about a scientific issue or phenomenon related to the investigation.

Stimuli may include:

- Diagrams or pictures of objects used in a scientific investigation.
- Descriptions, charts, and graphics that show a repeated or related scientific investigation that includes the results and conclusions.
- Summaries of previous studies on a given scientific issue or question.
- Diagrams or graphics that show a model of a scientific phenomenon.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:
- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Communication.

Item Characteristics

Given a description of an investigation and the results, items may ask students to:

a) Write a summary of the data of an investigation. A standard item is as follows:
   Write a summary of the data from the investigation.
   - Use your own words to report the data.
   - Give data for all conditions investigated
b) Identify or give a rationale for one or more steps in the investigation.
c) Write a summary of an investigative procedure.
d) Identify or describe patterns found in results using words, numbers, symbols, graphics, and tables.
e) Use the scientific information to support a position on a scientific issue (e.g. dangers of smoking, problems with nuclear power plants, need for widening riparian zones near streams and rivers).

IP06 2.2.1 Identifying Problem Green

Study and analyze challenges or problems from local, regional, national or global contexts in which science/technology can or has been used to design a solution.

Item Format

Multiple choice and short answer items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigations.
- Stimuli may include descriptions, charts, and/or graphics that include background information about a social/environmental problem related to scientific phenomena.
- Stimuli may include familiar objects or tools that have been invented through science/technology.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:
- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Identifying Problems.

Item Characteristics

Given a social/environmental problem, items may ask students to:

a) Define the parts of the problem that can be addressed through scientific research/investigation.

Given a technological problem, items may ask students to:

b) Define the problem including constraints or restrictions.

Given a familiar object or tool, items may ask students to:

c) Identify or describe a change that could improve the tool or technology.

d) Identify what scientific concept is at work as they function (e.g. a stretched spring in terms of push/pull forces)

IP07 2.2.2 Designing and Testing Solutions Green

Research, model, simulate, and test alternative solutions to a problem.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigations.

Stimuli may include:

- Descriptions, charts, and/or graphics that include background information about a social/environmental problem related to scientific phenomena.
- Scientific details on at least two proposed solutions to a social/environmental problem related to scientific phenomena.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:
- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Designing and Testing Solutions.

Item Characteristics

Given a problem and a proposed scientific solution, items may ask students to:

a) Identify the constraints to implementing the proposed solution.
b) Identify the trade-offs for the alternative solutions.
c) Identify the risks for implementing the proposed solution.
d) Analyze the effectiveness of proposed solutions to a problem using a simple model.

IP08 2.2.3 Evaluating Potential Solutions Green

Propose, revise, and evaluate the possible constraints, applications, and consequences of solutions to a problem or challenge.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigations.

Stimuli may include:

- Descriptions, charts, and/or graphics that include background information about a social/environmental problem related to scientific phenomena.
- A set of criteria upon which a solution is to be evaluated.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used: constraint, criteria
- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Evaluating Potential Solutions.

Item Characteristics

Given a problem, two attempted solution, results, and criteria for evaluation, items may ask students to:

a) Compare the two solutions in terms of their effectiveness in solving the problem.
b) Compare the two solutions in terms of their cost effectiveness, safety, human factors, and sustainability.

Given a problem, attempted solution, unsuccessful or partially successful results, and criteria for evaluation, items may ask students to:

c) Use scientific concepts or processes to modify the design or product to improve its effectiveness.

Given a problem and the technological product intended to solve the problem, items may ask students how to:

d) Use scientific principles to improve the technological product.

XI. ITEM DEVELOPMENT GUIDE for the NATURE and CONTEXT STRAND

Blue

NC Strand Nature and Context of Science and Technology

Understand the nature of scientific inquiry and know that science and technology are human endeavors, interrelated to each other, to society, and to the workplace.

NC01 3.1.1 Intellectual Honesty

Analyze and explain why curiosity, honesty, openness, and skepticism are integral to scientific inquiry.

Item Format

Multiple choice and short answer items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigation results

Stimuli may include:

- A situation in which charts and graphics contain unexpected results from an investigation.
- An investigation wherein unavoidable events interfered with the controls in the investigation.
- Two identical investigations that have different results.
- A situation in which the researcher is placed in a situation where others' results differ substantially from hers or his.
- A situation in which a person must decide whether to give credit for a discovery to the person who first made the discovery but didn't report it.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used: honesty, inconsistent, investigative design, skeptical
- Terms that may be used with definitions and examples: plagiarize
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Intellectual Honesty.

Item Characteristics

Given a description of a scientific investigation and results, items may ask students to:

a) Identify an appropriate response when results are inconsistent with established theories.
b) Describe or identify an intellectually honest response to questionable research results.
c) Identify an appropriate response when unavoidable factors disturbed an investigative control or controlled variables.

Given two identical studies with different results, items may ask students to:

d) Write an appropriate summary for the diverse results.

Given a replication of a scientific investigation and results, items may ask to:

e) Identify an appropriate scientific response when the first researcher has not published the results.

NC02 3.1.2 Limitations of Science and Technology Blue

Identify and analyze factors that limit the extent of a scientific investigation.

Item Format

Multiple choice and short answer items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate situations.

Stimuli may include:

- Descriptions of situations that contain a question that may or may not lead to a scientific investigation.
- Descriptions of investigations that may or may not be appropriate for the domain of investigation.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used: impact
- Terms that may be used with definitions and examples:
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Limitations of Science and Technology.

Item Characteristics

Given a clear description of the question or phenomenon, items may ask students to:

a) Identify reasons for replicating the investigation.
b) Identify an appropriate scientific response when given two competing theories (e.g. construct investigations to test competing explanations).
c) Identify what kind of evidence is needed to support a given hypothesis.
d) Determine whether a conclusion logically follows from the results of a given investigation.
e) Explain whether a given hypothesis is testable and why.

NC03 3.1.3 Dealing with Inconsistencies Blue

Compare, contrast, and critique divergent results from scientific investigations based on scientific arguments and explanations.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigations.
- All formal or controlled investigations must include a hypothesis, materials, procedure, and data section.
- All tables, charts, and/or graphs must have informative titles, appropriate labels, units, and appropriate scales.
- Tables, graphs, and charts will NOT include irrelevant data or data designed to 'trick' students into giving an incorrect response
- Stimuli must include a brief description of background information about a scientific issue or phenomenon related to the investigation.

Stimuli may include:

- Diagrams or pictures of objects used in a scientific investigation.
- Descriptions, charts, and graphics that show a repeated or related scientific investigation that includes the results and conclusions.
- The procedure, results, and conclusions for two investigations or studies about the same phenomenon.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:
- Terms that may be used with definitions and examples:
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Dealing with Inconsistencies.

Item Characteristics

Given an investigation, results, and conclusions, items may ask students to:

a) Evaluate the overall quality of the investigation procedures, quality of the evidence, or soundness of reasoning.
b) Identify or explain why the results from a single investigation are not conclusive about a phenomenon.
c) Identify an alternative explanation of the results.
d) Identify or describe data that support alternative explanation of the results.
e) Determine whether data support the conclusions.

Given a description of an event or phenomenon, items may ask students to:

f) Defend or refute explanations for the event or phenomena using evidence.

NC04 3.1.4 Evaluating Methods of Investigation Blue

Analyze and evaluate the quality and standards of investigative design, processes, and procedures.

Item Format

Short answer and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate investigations.
- All formal or controlled investigations must include a hypothesis, materials, procedure, and data section.
- All tables, charts, and/or graphs must have informative titles, appropriate labels, units, and appropriate scales.
- Tables, graphs, and charts will NOT include irrelevant data or data designed to 'trick' students into giving an incorrect response.
- Stimuli must include a brief description of background information about a scientific issue or phenomenon related to the investigation.

Stimuli may include:

- Diagrams or pictures of objects used in a scientific investigation.
- Descriptions, charts, and graphics that show a repeated or related scientific investigation that includes the results and conclusions.
- Charts and graphics that show the results of a flawed scientific investigation; flaws may include design flaws (design doesn't fit with question; obvious flaws in converting observations to data tables, graphs, charts).

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used: logical
- Terms that may be used with definitions and examples:
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Evaluating Methods of Investigation.

Item Characteristics

Given an investigation, results, and conclusions, items may ask students to:

a) Evaluate the appropriateness of tools used in the research.
b) Determine whether the design of the investigation was appropriate for the investigative question.

Given a research question and two proposed investigative designs (one observational and one experimental), items may ask students to:

c) Determine which design is most appropriate for the research question and why.

NC05 3.1.5 Evolution of Scientific Ideas Blue

Know why science involves testing, revising and occasionally discarding theories; understand how scientific inquiry and investigation lead to a better understanding of the natural world and not to absolute truth.

Item Format

Multiple choice and short answer items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli may include age and grade appropriate investigations.

Stimuli may include:

- Descriptions of situations, charts, or graphics that contain background information regarding history of a scientific idea.
- Descriptions of situations in which scientific evidence is used to support a theory or explain an phenomenon.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used: law, principle, theory
- Terms that may be used with definitions and examples:
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Evolution of Scientific Ideas.

Item Characteristics

Given an investigation or idea, items may ask students to:

a) Identify or explain why multiple tests are needed before accepting a scientific idea.
b) Identify likely reasons for rejecting a previous theory when given the currently accepted theory.
c) Identify an appropriate scientific response with surprising but pleasing results (e.g. teeth kept in a cola drink have stronger enamel than teeth kept in water).

Given a description of a theory and some related principles or laws, items may ask students to:

d) Explain whether or not the laws or principles apply to location or situation different from one location or situation in which the research was conducted.
e) Determine whether the principles or laws are logically consistent.
f) Determine whether the principles or laws can be verified through empirical evidence.

Given results of an investigation and two written conclusions, one that is empirically verifiable and one that makes large leaps in logic, items may ask students to:

g) Select the more appropriate conclusion and explain why it is more appropriate.

NC06 3.2.1 All People Contribute to Science and Technology Blue

Analyze how scientific knowledge and technological advances discovered and developed by individuals and communities in all cultures of the world contribute to changes in societies.

Classroom-based Assessment Only

NC07 3.2.2 Relationship of Science and Technology

Analyze how the scientific enterprise and technological advances influence and are influenced by human activity, for example societal, environmental, economical, political, or ethical considerations.

Item Format

Multiple choice, short answer, and extended response items may be used to assess this learning target.

Stimulus/Scenario Attributes

- Stimuli must include age and grade appropriate situations.

Stimuli may include:

- Descriptions of situations, charts and graphics that show technological development supporting science and/or science supporting technological development.
- Descriptions of situations, charts, and graphics that depict a social or environmental problem.
- Descriptions of situations wherein technology and/or science have been used to support social or economic development.
- An investigation with flaws in procedures that lead to questionable scientific results.

Scientific Vocabulary and Terms (in addition to fifth and eighth grade vocabulary and terms)

- Terms that may be used:
- Terms that may be used with definitions and examples:
- Terms that may not be used:
- All terms allowed and restricted under the other learning targets apply to Relationship of Science and Technology.

Item Characteristics

Items may ask students to:

a) Identify or describe how science and/or technology have led to a given social or economic development.
b) Identify an appropriate scientific response to the problems associated investigations that could place living things at risk.
c) Identify the limits of scientific research in solving the given social, environmental, and/or economic problems.

NC08 3.2.3 Careers and Occupations Using Science, Mathematics, and Technology

Investigate the scientific, mathematical, and technological knowledge, training, and experience needed for occupational/career areas of interest.

Classroom-based Assessment Only

XII. SCORING CRITERIA

General Scoring Criteria for Short Answer Science Items

Science Conceptual Understanding

2 A 2-point response shows complex understanding (e.g. elaborated explanation) of the concept or task, as well as use of applicable information and/or procedures.

1 A 1-point response shows simple understanding (e.g. names or defines) of the concept or task. There may be minor errors in the use of applicable information and/or procedures.

0 A 0-point response shows little or no understanding (e.g. restates task or event) of the concept.

Science Application of Concepts

2 A 2-point response shows an effective, simple analysis or application of the concept to a given situation.

1 A 1-point response shows a partially effective application or rote analysis of the concept to a given situation.

0 A 0-point response shows little or no understanding of the concept or no understanding of how to apply the concept in the given situation (e.g. describes or restates task or event).

Scientific Inquiry: investigations and problem solving (analyses, interpretations, predictions, evaluations, comparison & contrast)

2 A 2-point response shows effective analysis, interpretation, evaluation, prediction from, comparison and/or contrast of scientific information from a given investigation or problem situation; reasonable claims; support of claims with appropriate evidence.

1 A 1-point response shows weak or minimal analysis, interpretation, evaluation, prediction from, comparison and/or contrast of scientific information from a given investigation or problem situation; claims that are related to but not necessarily supported by information given in the investigation or problem situation; and/or only partial support of claims with evidence.

0 A 0-point response shows little or no understanding of how to analyze, interpret, evaluate, predict from, compare and/or contrast scientific information from a given investigation or problem situation.

Scientific Inquiry: communication (communication, arguments, and representations)

2 A 2-point response shows skill in effectively and clearly organizing and representing information from a given investigation; writing clear explanations and justifications; preparing effective, systematic, and clear arguments and rationales.

1 A 1-point response shows limited skill in organizing and representing information from a given investigation; writing explanations and justifications; preparing arguments.

0 A 0-point response shows little or no skill in organizing and representing information from a given investigation; writing explanations and justifications; preparing arguments.

Nature of Science and Science, Technology & Society (analyses, evaluations, comparison & contrasts, critique)

2 A 2-point response shows effective analysis, comparison and/or contrast of results from one or more given investigations; critique and evaluation of procedures and claims; analysis of influences.

1 A 1-point response shows weak or limited analysis, comparison and/or contrast of results from one or more given investigations; critique and evaluation procedures and claims; analysis influences.

0 A 0-point response shows no analysis, comparison and/or contrast of results from one or more given investigations; no attempt at critique or evaluation of procedures and claims; no analysis of influences.

General Scoring Criteria for Extended Response Science Items

Science Conceptual Understanding:

4 Meets all relevant criteria
- response is thorough and addresses all aspects of the task
- sophisticated and generalizable understanding of the relevant concept(s)
- effective and appropriate use of applicable information
- all supporting information and details provided give support for the response

3 Meets most relevant criteria
- response is thorough and addresses most aspects of the task
- solid understanding of the relevant concept(s)
- appropriate use of applicable information
- most supporting information and details provided give support for the response

2 Meets some relevant criteria
- response addresses many aspects of the task
- simple or one-dimensional understanding of the concept (s) (e.g. gives definitions)
- use of applicable information may show conceptual confusion
- some information and details provided give support for the response

1 Meets few relevant criteria
- response addresses few aspects of the task
- rote or limited understanding of the concept(s) (e.g. gives names or labels)
- use of applicable information shows conceptual confusion
- little or no information and details provided give support for the response

Science Application of Concepts:

4 Meets all relevant criteria
- response is thorough and addresses all aspects of the task
- sophisticated and generalizable understanding of the relevant concept(s)
- effective and appropriate application of the concept(s) to the given situation
- all supporting information and details provided given support for the response

3 Meets most relevant criteria
- response is thorough and addresses most aspects of the task
- solid understand of the relevant concept(s)
- appropriate application of the concept(s) to the given situation
- most supporting information and details provided given support for the response

Science Application of Concepts: (continued)

2 Meets some relevant criteria
- response addresses many aspects of the task
- simple or one-dimensional understanding of the concept (s) (e.g. gives definitions)
- shows difficulties with application of the concept(s) to the given situation
- some supporting information and details provided given support for the response

1 Meets few relevant criteria
- response addresses few aspects of the task
- rote or limited understanding of the concept(s) (e.g. gives names or labels)
- attempt to apply the concept(s) to the given situation may be ineffective
- little or no supporting information and details provided given support for the response

Scientific Inquiry: investigations and problem solving (analyses, interpretations, predictions, evaluations, comparison & contrasts)

4 Meets all relevant criteria
- response thoroughly addresses all aspects of the task
- gives insightful, detailed, and complete analysis, interpretation, evaluation, prediction from, comparison and/or contrast of scientific information from a given investigation or problem situation
- makes reasonable claims
- all claims supported with appropriate, well-chosen, specific evidence

3 Meets most relevant criteria
- response is thorough and addresses most aspects of the task
- gives expected, detailed, and complete analysis, interpretation, evaluation, prediction from, comparison and/or contrast of scientific information from a given investigation or problem situation
- makes reasonable claims
- most claims supported with appropriate, well-chosen, specific evidence

2 Meets some relevant criteria
- response addresses many aspects of the task
- gives general but reasonable analysis, interpretation, evaluation, prediction from, comparison and/or contrast of scientific information from a given investigation or problem situation
- makes plausible claims
- claims supported with appropriate but limited evidence

1 Meets few relevant criteria
- response addresses few aspects of the task
- gives general analysis, interpretation, evaluation, prediction from, comparison and/or contrast of scientific information from a given investigation or problem situation, although response may have serious flaws in thinking
- claims, if given, may not be supportable
- attempts at support use generalities rather than evidence

Scientific Inquiry: communication (communication, arguments, and representations)

4 Meets all relevant criteria:
- effectively and clearly organizes information and/or data from a given investigation
- clearly, completely, and accurately represents ideas in words, diagrams, charts, graphs, tables, visual models, using appropriate scientific and mathematical terms, symbols, and conventions
- clearly and systematically presents support for explanations and justifications
- effectively, systematically, and clearly presents arguments and rationales

3 Meets most relevant criteria:
- organizes information and/or data from a given investigation in an acceptable and understandable manner; there may be minor errors in transfer of information
- completely, and accurately represents ideas and/or data in words, diagrams, charts, graphs, tables, visual models, using scientific and mathematical terms, symbols; there may be minor errors in conventions, terms, or symbols
- supports for explanations and justifications are evident but not always clear
- understandably presents arguments and rationales

2 Meets some relevant criteria:
- organizes information and/or data from a given investigation in a confusing manner
- representations of ideas and/or data in words, diagrams, charts, graphs, tables, visual models have several problems with incorrect or missing conventions, symbols, and/or incorrectly used terms
- supports for explanations and justifications are difficult to ascertain
- arguments and rationales are unclear

1 Meets few relevant criteria:
- information and/or data from a given investigation is given but disorganized or only partially complete
- representations of ideas and/or data in words, diagrams, charts, graphs, tables, visual models are confusing, incomplete, and/or have many problems with incorrect or missing conventions, symbols, and/or incorrectly used terms
- supports for explanations and justifications are missing
- arguments and rationales are vague or missing

Nature of Science and Science, Technology & Society (analyses, evaluations, comparison & contrasts, critique)

4 Meets all relevant criteria
- response thoroughly addresses all aspects of the task
- gives insightful, detailed, and complete analysis, comparison and/or contrast of results from one or more given investigations
- gives effective and detailed critique and/or evaluation of procedures and claims
- accurate and detailed analysis of influences on outcomes
- all ideas supported with appropriate, well-chosen, specific evidence

3 Meets most relevant criteria
- response is thorough and addresses most aspects of the task
- gives expected, detailed, and complete analysis, comparison and/or contrast of results from one or more given investigations
- gives expected critique and/or evaluation of procedures and claims
- detailed analysis of influences on outcomes is mostly accurate
- most ideas supported with appropriate, well-chosen, specific evidence

2 Meets some relevant criteria
- response addresses many aspects of the task
- gives general but reasonable analysis, comparison and/or contrast of results from one or more given investigations
- gives expected critique and/or evaluation of procedures and claims with minor flaws
- analysis of influences on outcomes is partially accurate
- claims supported with appropriate but limited evidence

1 Meets few relevant criteria
- response addresses few aspects of the task
- gives general analysis, comparison and/or contrast of results from one or more given investigations, although response may have serious flaws in thinking
- gives vague or general critique and/or evaluation of procedures and claims with significant flaws
- analysis of influences on outcomes is has significant errors attempts at support use generalities rather than evidence

Generic 10th Grade Scoring Guide for Investigation Design Extended Response Items

All inquiry scenarios will have an investigation that models the areas awarded the value points of the scoring guide described below.

A **4-point response**: The student shows the ability to design a complex scientific investigation. The student designs an investigation that earns Q value points for a four-point response.

Question: (0-2 value points)

Hypothesis: (1-2 value points)

Materials: (1-2 value points)

Procedure: (up to 8 value points, 1 per bulleted feature)

- The steps of the investigation are logical.
- An investigative control is identified or implied.
- At least two variables are identified or implied as controlled, kept the same, or constant.
- A variable is identified or implied as manipulated, independent, or changed.
- A variable is identified or implied as responding or dependent.
- Measurements are repeated, more than trail is planned.
- Measurements are recorded in an organized manner periodically throughout the investigation.
- Validity measures are identified or implied.

Note: If a student makes up a new, different question than the one(s) given, points may be awarded for an accurate design for the student's question.

A **3-point response**: The student designs an investigation that earns R value points.

A **2-point response**: The student designs an investigation that earns S value points.

A **1-point response**: The student designs an investigation that earns T value points.

A **0-point response**: The student designs an investigation that earns U value points.

Note: Q, R, S, T, and U are ranges of value points depending upon the weight of a section in a particular item.

XIII. SCIENTIFIC VOCABULARY SUMMARY

The following terms are a summary of the vocabulary that may be used on the science WASL at each grade level without definitions. More terms may be used with definitions or examples as noted in the item specifications. The plural form of all these words is assumed useable. However, other forms of these are not accepted unless specified. Every word from a lower grade level may be used at a higher grade level.

This list of scientific vocabulary identifies concepts and processes described in the science EALRs that all students should know without explanation at these grade levels. These are not meant to be exclusive terms used in the science curriculum. The science curriculum should build in-depth understanding of these concepts and processes using many instructional activities and other supporting terms.

A

10th Grade	8th Grade	5th Grade
abiotic	acceleration	acquired
absorption	accuracy	air
amplitude	adaptation	amount
asexual	affect	amount of time
atmospheric	applied force	
atomic number	artery	
	atmosphere	
	attract	

B

10th Grade	8th Grade	5th Grade
biotic	blood vessel	balance scale
	body of water	bone
		brain

C

10th Grade	8th Grade	5th Grade
celestial	camouflage	cause
cell membrane	carbon dioxide	cell
cell nucleus	cell	centimeter (cm)
cell wall	charge	characteristic
circulatory system	chemical	chart
constraint	circuit	classify
contraction	cold-blooded	climate
controlled variable	compare	color
criteria	conduction	conclude
	contrast	conclusion
	controlled variable (kept the same)	condensation
	convection	condense
	conversion	consumer
	core	continent
	crust	cycle

D

10th Grade	8th Grade	5th Grade
diffusion	density	data
digestive system	description	decomposer
diversity		depend
		describe
		design
		diagram
		direction

E

10th Grade	8th Grade	5th Grade
electrical charge	electron	Earth
electrical force	ecosystem	earthquake
electron shell	electrical force	echo
endocrine system	environment	effect
energy chain	evidence	egg
expansion	evolution	electrical
experiment		electricity
experimental control		energy
		energy of motion
		erosion
		eruption
		evaporate
		evaporation
		event
		explain
		explanation

F

10th Grade	8th Grade	5th Grade
family of elements	frequency	fair test
frictional force	friction	feet
	factor	flower
		food
		food chain
		force
		forest
		fossil remains
		fossil
		freeze
		function

G

10th Grade	8th Grade	5th Grade
galaxy	genetic	gas
gravitational force	groundwater	glacier
		gram
		graph
		grassland
		gravity

H

10th Grade	8th Grade	5th Grade
honesty	heat	hand lens
hormone		hardness
host		heart
hydrosphere		heat energy
hypothesis		

I

10th Grade	8th Grade	5th Grade
impact	igneous	identify
inconsistent	image	inch (in)
infer	interpret	inclined plane
inference	interpretation	invent
interference	intestine	invention
investigative control	issue	investigate
investigative design		investigation
investigative question		inherited

K

10th Grade	8th Grade	5th Grade
kinetic energy		kilogram (kg)
		kilometer (km)

L

10th Grade	8th Grade	5th Grade
law	landslide	lake
logical	landmass	leaf
		lever
		liquid
		liter (L)
		living
		lung

M

10th Grade	8th Grade	5th Grade
magnetic pole	magnetic force	machine
manipulated variable	magnetism	magnetic
mechanical energy	manipulated variable (changed)	magnifying glass
metaphor	mantle	material
meteorology	mass	melt
	matter	meter (m)
	metamorphic	mile (mi)
	meter stick	milliliter (mL)
	microscope	model
	millimeter (mm)	molecule
	minerals	Moon
	mixture	mountain
		muscle

N

10th Grade	8th Grade	5th Grade
neurological system	natural selection	nonliving
neutron	nitrogen	nutrient
nuclear energy	nucleus	
nuclear fission		
nuclear force		
nuclear fusion		

O

10th Grade	8th Grade	5th Grade
offspring	opinion	object
ova	organ	observe
		observation
		ocean
		orbit (revolve)
		orbit (revolution)
		organism
		organize
		ounce
		oxygen

P

10th Grade	8th Grade	5th Grade
parasite	particle	part
periodic table	pattern	pattern
phase change	predator	picture
photosynthesis	prediction (hypothesis)	pitch
pistil	prey	plan
potential energy	property	planet
principle		pound
proton		precipitation
		predict
		prediction
		problem
		procedure
		process
		producer
		property
		pull
		pulley
		push

Q

10th Grade	8th Grade	5th Grade
		question

R

10th Grade	8th Grade	5th Grade
radiation	recycle	rate
refract	reflect	report
refraction	reflection	reproduce
relationship	relationship	reproduction
reproduce	relative position	result
reproduction	relative speed	river
reproductive system	repel	root
research question	report	
respiratory system	resource	
responding variable	responding variable (measured)	
	river system	
	rock cycle	

S

10th Grade	8th Grade	5th Grade
scattering	scientist	sea
scavenger	sedimentary	seed
sexual	solar system	shape
skeletal system	solution	size
skeptical	specialized	skeleton
solubility	sphere	soil
solute	stomach	solid
solvent	stored energy	solve
sperm	subsystem	sort
spherical	summarize	sound
spinal cord		special
spore		speed
stamen		spin (rotate)
state		spring scale
state of matter		sprout
succession		stem
		stored energy
		stream
		strength
		structure
		substance
		summary
		Sun
		system

T

10th Grade	8th Grade	5th Grade
theory	telescope	table
thermal	tissue	temperature
thermal energy	transfer	texture
topography	transmit	thaw
transformation		thermometer
transmission		tool

U

10th Grade	8th Grade	5th Grade
	unexpected	

V

10th Grade	8th Grade	5th Grade
validate	valid	vapor
validity	vein	variable
	volume	variable changed (manipulated)
		variable kept the same (controlled)
		vibration
		volcano

W

10th Grade	8th Grade	5th Grade
wind direction	warm-blooded	waste
wind speed	water table	water
wind current	wavelength	weather
work	weathering	weight
	wind direction	wind
	wind speed	

X

10th Grade	8th Grade	5th Grade

Y

10th Grade	8th Grade	5th Grade
		yard

Z

10th Grade	8th Grade	5th Grade