Washington Assessment of Student Learning

A Component of the Washington State Assessment Program

Science

Test and Item Specifications

Grade 8

September 17, 2002

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

I. PURPOSE of ASSESSMENT TOOL

The purpose of this assessment tool is to measure Washington eighth grade students' level of proficiency in Benchmark 2 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
CH01 1.3.1	Nature of Forces	
CH01 1.3.2	Forces to Explain Motion	
CH02 1.3.3	Processes & Interactions in Earth Systems	
CH02 1.3.4	History & Evolution of Earth	
CH02 1.3.5	Hydrosphere/Atmosphere	
CH02 1.3.6	Interactions in the Solar System & Beyond	
CH03 1.3.7	Life Processes & the Flow of Matter & Energy	
CH03 1.3.8	Biological Evolution	
CH03 1.3.9	Interdependence of Life	
CH03 1.3.10	Environmental & Resource Issues	
IP Strand	**Inquiry and Problem Solving in Science and Technology**	Green
IP01 2.1.1	Questioning	
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	
IP08 2.2.3	Evaluating Potential Solutions	
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 eighth grade science test will consist of 45 items, resulting in 66 points per form. Items will be written at a reading level appropriate for an eighth 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 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:

Item Code: a number for tracking purpose
Item Order in Scenario
Scenario Title or Stand Alone Item name indicating content description
EALR Code: strand and learning target (i.e. PC01 1.1.1)
Item Characteristic: letter of characteristic (i.e. PC01 1.1.1 a)
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)
Grade Level: 10, 8, or 5
Cognitive Level: (Category I or II)
Item Type: (MC, SA, ER)
Keyed Correct Answer Key
Word count and reading level from Microsoft Word
Latest Revision Date
Pilot Year and Form
Data Review Date
Fairness Review Date
Content Review Date
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 and 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 200 words.
5. Scenarios will **not** be a reading burden, written at sixth 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 30 (i.e. 3x10, 5x6).
    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: 5**		
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 eighth 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, Prediction (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 Prediction (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 six steps.
9. Procedures should state or imply the following variables: controlled (kept constant), manipulated (changed), responding (measured).
10. 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 (kept constant), manipulated (changed), and responding (measured).
5. Explain how an investigation is a fair test of a hypothesis or a cause-effect relationship.
6. Describe the technology (measurement tools, electronics, computers, etc.) needed to do scientific inquiry.
7. 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.

8. Identify safety precautions in investigations.
9. Identify sources of error in measurement or describe how to improve measurement error.
10. Summarize an investigation to describe the data or results. This summary is different than a conclusion.
11. Design tests to answer questions such as, “What chemical is in a container?”
12. Describe how a model (physical and/or mathematical) can be used to represent a system.
13. Compare the design of a different investigation of the same investigative question.
14. 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 3-level scoring guide (0–2); students may receive full credit, partial credit, or no credit.
11. Extended response items will be scored with a 5-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 Properties and Characteristics Strand

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/Scenario Attributes

- All stimuli will be age and grade appropriate situations or phenomena.
- Stimuli may be two-dimensional time/distance grids that represent relative positions, motions, and speed of objects. Grids will only be in the first quadrant of the Cartesian plane.

Stimuli may include:

- Phenomena, situations, diagrams, or charts with information about physical and chemical properties of objects and materials.
- Graphics of tools, such as rulers, balances, spring scales, and thermometers, to measure length, area, mass, weight, density, volume, and temperature.
- 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 grade vocabulary and terms)

- Terms that may be used:

density	magnetic force	reflect	water table
description	mass	reflection	wavelength
electron	millimeter (mm)	relative speed	
frequency	nucleus	transmit	
groundwater	property	volume	

- Terms that may be used with definitions or examples: aquifer, interference, refraction
- Terms that may **not** be used:
- All terms allowed and restricted under other learning targets apply to Properties and Characteristics.

PC01 1.1.1 Properties of Substances Red

Use physical and chemical properties to sort and identify substances; for example, density, boiling point, and solubility.

Item Characteristics

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

a) Use physical properties, including density, boiling point, freezing point, and solubility to identify, categorize, or describe the substances.
b) Use chemical properties, including pH to describe substances.
c) Measure and use length, area, and volume to describe objects.
d) Differentiate between methods used to obtain measures of mass, weight, and density.

PC01 1.1.2 Motion of Objects

Describe the positions, relative speeds, and changes in speed of objects**.**

Item Characteristics:

Given a position or speed and time graph or table, items may ask students to:

a) Describe the relative speeds of objects during a given amount of time.
b) Determine whether an object is speeding up, slowing down, or moving with constant speed during a given interval of time.
c) Determine whether an object is speeding up, slowing down, or moving with constant speed at a given instant of time.

PC01 1.1.3 Wave Behavior

Describe sound, water waves, and light, using wave properties such as wavelength, reflection, refraction, transmission, absorption, scattering, and interference

Item Characteristics

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

a) Differentiate between the motion of a wave and the motion of the particles in the medium along which the wave is traveling.
b) Identify examples of situations that demonstrate that the speed of light is greater than the speed of sound and that sound has a speed.
c) Identify or describe changes in speed or direction as a wave goes from one medium into another.
d) Identify or describe the behavior of light waves when they hit clear, translucent, opaque, or absorbing substances.
e) Identify or describe the behavior of sound waves when they hit reflecting or absorbing surfaces.
f) Identify or describe what happens when two waves collide.

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 will 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.
- Charts or diagrams that include the properties of soil, such as color, texture, capacity to retain water, and ability to support the growth of many plants.
- Descriptions of situations that describe rocks in different stages of the rock cycle.

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

- Terms that may be used:

atmosphere	metamorphic	rock cycle
igneous	mineral	sedimentary

- Terms that may be used with definitions or examples:
- Terms that may not be used: wind current
- All terms allowed and restricted under other learning targets apply to Properties and Characteristics

PC02 1.1.4 Nature and Properties of Earth Materials

Classify rocks and soils into groups based on their chemical and physical properties; describe the processes by which rocks and soils are formed.

Item Characteristics

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

a) Identify or describe the processes that create different types of rocks.
b) Identify or describe the properties of soils, such as chemical composition and texture.
c) Identify or describe processes that contribute to the composition of soil (e.g., weathering rock, decomposition via decomposers).

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/Scenario Attributes

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

Stimuli may include:

- Diagrams or charts that include living organisms and nonliving objects.
- Descriptions, charts, and graphics of the physical characteristics or internal structures of plants and animals.

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

- Terms that may be used: cold-blooded, warm-blooded
- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under other learning targets apply to Properties and Characteristics.

PC03 1.1.5 Basis of Biological Diversity

Categorize plants and animals into groups according to how they accomplish life processes and by similarities and differences in external and internal structures.

Item Characteristics

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

a) Categorize plants and/or animals into groups according to how they accomplish life processes such as food production or consumption and reproduction.
b) Categorize plants and/or animals into groups by similarities and differences in physical characteristics, functional characteristics, and/or internal and external structures.
c) Assess whether animals or plants have a biological relationship or common ancestry based on given characteristics.

VIII. ITEM DEVELOPMENT GUIDE for the SYSTEMS and INTERCONNECTIONS STRAND

Orange

SI Systems and Interconnections Strand

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

Describe how the parts of a physical system interact and influence each other. *

SI02 1.2.1 Earth and Space Systems

Describe how the parts of Earth's and/or space systems interact and influence each other. *

SI03 1.2.1 Living Systems

Describe how the parts of living systems interact and influence each other. *

SI04 1.2.1 Integrated Systems

Describe how the parts of physical, Earth, space, and/or living systems interact and influence each other. *

*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 living system, items may ask students to:

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

SI01 Physical Systems and Interconnections 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 identify parts of a system and describe how the parts of the system interact and/or depend upon one another.

Stimulus/Scenario Attributes

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

Stimuli may include:

- Graphics that show parts of a physical system, including subsystems.
- Pictures or diagrams that show objects in different energy states (potential, kinetic).
- Pictures or diagrams that show transfer of heat energy.
- Diagrams of matter in different forms (e.g. puddles of water, ice cubes, steam).

Scientific Vocabulary and Terms

- Terms that may be used:

chemical	conversion	particle	transfer
circuit	heat	solution	
conduction	matter	stored energy	
convection	mixture	subsystem	

- Terms that may be used with definitions or examples: potential (stored energy), kinetic (energy of motion), thermal (heat), diffusion.
- Terms that may not be used: elastic potential energy.
- All terms allowed and restricted under other learning targets apply to Systems and Interconnections.

SI01 1.2.2 Energy Sources and Kinds

Understand that energy is a property of substances and systems and comes in many forms, including stored energy, energy of motion, heat energy, and other forms of energy.

Item Characteristics

Given a diagram, drawing, or description of one or more objects, items may ask students to:

a) Compare the sources of stored (potential) energy for different objects (e.g. springs, batteries, fuel, ball held up from floor, catapult).
b) Compare the energy of motion (kinetic) at various locations or times.
c) Describe heat energy sources such as light, electrical, mechanical, sound, nuclear, and chemical.

SI01 1.2.3 Energy Transfer and Transformation Orange

Determine factors that affect rate and amount of energy transfer; associate a decrease in one form of energy with an increase in another.

Item Characteristics

Given a labeled diagram, drawing, or description of a simple system, items may ask students to:

a) Identify or describe the transfer of energy of motion (kinetic) from one object to another.
b) Identify or describe the physical characteristics of an object that determine the amount of energy of motion that will be transferred to another object.
c) Identify or describe where energy is transformed from stored energy to energy of motion or vice versa.
d) Identify or explain the processes by which heat is transferred from one object to another.
e) Identify or describe the motion of the particles of a substance as heat increases.
f) Identify or describe the direction heat will flow and what will happen to the final temperature of the two objects.
g) Identify or provide examples of materials that are heat conductors and materials that are heat insulators.
h) Describe the role of waves in the transfer of energy.
i) Explain what happens to the total amount of energy in a given situation.

SI01 1.2.4 Structure of Matter

Understand that all matter is made up of atoms, which may be combined in various kinds, ways, and numbers.

Item Characteristics

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

a) Identify, describe, or diagram what happens as atoms form compounds when given a diagram involving atoms that may form compounds.
b) Discriminate between the characteristics of a compound, a mixture, and a solution when given a situation involving mixtures, compounds and solutions.
c) Explain why one solution has greater concentration than another when given a situation involving solutions.

SI01 1.2.5 Physical and Chemical Changes Orange

Understand physical and chemical changes at the particle level; know that matter is conserved. *

* Water cycle in physical, non-Earth, systems

Item Characteristics

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

a) Identify or describe the differences in the motion of the particles of the substance when given a substance in different states of matter.
b) Identify or describe how the movement of particles accounts for the pressure of the gas on the walls of the container when given a substance in the gas state within a container (closed system).
c) Distinguish between physical changes and chemical changes when given substances undergoing changes.
d) Identify or describe how chemical changes produce matter with different properties and characteristics form the original.
e) Explain that matter is neither created nor destroyed during a change when given substances undergoing (non-nuclear) physical and/or chemical changes.
f) Describe how some chemical changes can decompose materials (e.g. burning, rusting, acid/base reactions).

SI02 Earth/Space Systems and System Interactions — Orange

Recognize the components, structure, and organization of Earth/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 identify parts of a system and describe how the parts of the system interact and/or depend upon one another.

Stimulus/Scenario Attributes

- All stimuli must include age and grade appropriate situations and phenomena.

Stimuli may include:

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

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

- Terms that may be used:

body of water	landmass	river system
crust	mantle	sphere
core	relative position	solar system

- Terms that may be used with definitions or examples: hydrosphere, topography (shape or contour)
- Terms that may not be used: metallic, spherical
- All terms allowed and restricted under other learning targets apply to Systems and Interconnections.

SI02 1.2.6 Components and Patterns of Earth Systems

Describe the components and relationships of the Earth system, including the solid earth (crust, hot convecting mantle, and dense metallic core), the hydrosphere (oceans, seas, lakes, rivers, and streams), and the atmosphere (a mixture of gases)

Item Characteristics

Given a labeled picture or labeled diagram of an appropriate 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) Describe each of the components of the Earth's system.

SI02 1.2.7 Components of the Solar System and Beyond Orange

Describe the relationship of the Earth to the Sun, the Moon, the other planets and their moons, and smaller objects such as asteroids and comets.

Item Characteristics

Given a diagram of the solar system or Earth and Moon system, items may ask students to:

a) Describe the interactions among the components of the solar system, such as Earth and the Sun (an eclipse) or Earth and the Moon (tides).
b) Identify or describe how one part of the system affects or impacts another part of the system.
c) Identify or describe the interactions of asteroids and comets with other components of the solar system.

SI03 Living Systems and Interactions 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 identify parts of a system and describe how the parts of the system interact and/or depend upon one another.

Stimulus/Scenario Attributes

- All stimuli may 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, and intestines).
- Descriptions and graphics of living organisms that reproduce.
- Descriptions and graphics that show an offspring and its parent(s).
- Descriptions and graphics that describe genetic information.
- Descriptions, charts, and graphics that describe how an organism's characteristics have been influenced by its environment.

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

- Terms that may be used:

artery	cell	genetic	specialized
asexual	ecosystem	intestine	stomach
blood vessel	environment	nitrogen	tissue
carbon dioxide	factor	organ	vein

- Terms that may be used with definitions and examples: esophagus, ova, pistil, stamen
- Terms that may not be used:
- All terms allowed and restricted under other learning targets apply to Systems and Interconnections.

SI03 1.2.8 Structure and Organization of Living Systems

Know that specialized cells within multi-cellular organisms form different kinds of tissues, organs, and organ systems to carry out life functions

Item Characteristics

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

a) Identify or describe the role of cell division in plant and animal growth and health.
b) Identify or describe the early and later stages of fetal development.

SI03 1.2.9 Molecular Basis of Heredity Orange

Understand that all living things reproduce and pass on genetic information and that an organism's characteristics are determined by both genetic and environmental influences.

Item Characteristics

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

a) Identify or describe the role of reproduction in the survival and maintenance of a species.
b) Identify or describe how genes, obtained from parents, are combined in their offspring.
c) Identify or describe the relationship between genes and chromosomes.
d) Identify or describe how physical traits of living things can be affected by genetic information and by interactions with the environment (e.g., nutrition, disease, sanitation).
e) Identify or describe the role of sperm and egg in reproduction.

SI03 1.2.10 Human Biology

Identify and describe human life functions and the interconnecting systems necessary to maintain human life, such as digestion, respiration, reproduction, circulation, excretion, movement, disease prevention, control, and coordination.

Item Characteristics

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

a) Identify or describe the relationships between or among the systems in accomplishing a process necessary for human life when given a picture or diagram of two or more human body systems.
b) Identify or describe the components and steps necessary for human body processes (e.g. digestion, reproduction, respiration, elimination of waste, circulation) to function properly.
c) Discriminate between diseases caused by microorganisms and those caused by a breakdown of an organ or body system.
d) Identify or describe the function of hormones in the functioning of human systems and processes.
e) Identify or describe the role of the senses in human survival.
f) Identify or describe the role of the nervous system in maintaining human body systems.

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

Yellow

CH Changes in Matter and Energy Strand

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

CH01 Physical Changes in Matter and Energy

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

- All 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.
- Scenarios or graphics describing magnetic forces, electrical forces, or forces from colliding or moving objects.

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

- Terms that may be used:

acceleration	attract	electrical force	magnetism
applied force	charge	friction	repel

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

CH01 1.3.1 Nature of Forces

Know the factors that determine the strength of various forces.

Item Characteristics

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

a) Identify or describe the interaction among the forces when given a situation involving two or more forces.
b) Identify or describe the affects of distance and strength of the magnet on the strength of the magnetic forces when given a situation involving magnetic forces.
c) Identify or describe the effects of distance and charge on the strength of the electrical forces when given a situation involving electrical forces.
d) Identify or describe the effects of distance and mass on the strength of the gravitational forces when given a situation involving gravitational forces.
e) Identify or describe the effects of distance and current on the strength of the magnetic force when given a situation involving electrical currents and magnets.

CH01 1.3.2 Forces to Explain Motion Yellow

Understand the effects of balanced and unbalanced forces on the motion of objects along a straight line.

Item Characteristics

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

a) Identify or describe the effects of an unbalanced force on an object moving in a straight line.
b) Identify or describe how unbalanced forces can change the speed of an object or how mass can affect the speed of an object.
c) Describe the effect a change in force on an object has on the object's motion.
d) Describe the effect a change in the mass of an object has on the object's motion when an unbalanced force is applied.
e) Identify or describe the characteristics of a situation involving balanced forces.

CH02 Earth and Space Changes in Matter and Energy Yellow

Understand how interactions within and among Earth's 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

- All 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 the Earth.
- Pictures or descriptions of situations that show plant and/or animal fossils.
- Diagrams of the Earth-Moon-Sun system with indications of motion.
- Charts, graphs, or tables indicating locations of the Sun (from the Earth's perspective) at different times of the year **or** of the Moon (from the Earth's perspective) at different times of the month.
- Charts, graphs, or tables showing evidence of weather patterns (precipitation, snowfall, temperatures, wind directions, wind speed).

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

- Terms that may be used:
  landslide weathering wind direction wind speed
- Terms that may be used with definitions or examples: revolution (orbit), rotation (spin)
- Terms that may not be used: biosphere, glaciology, hydrosphere, lithosphere, meteorology
- All terms allowed and restricted under other learning targets apply to Changes in Matter and Energy

CH02 1.3.3 Processes and Interactions in Earth Systems

Describe constructive and destructive processes at work and how they continually change landforms on Earth.

Item Characteristics

Given a description or picture of a change in the Earth's surface, items may ask students to:

a) Differentiate between changes that happened quickly and those that have occurred over a long period of time.
b) Identify or describe a change that occurred rapidly (e.g. a mountain created by a volcano).
c) Identify or describe a change that occurred slowly (e.g. a glacial meadow).
d) Identify or describe the effects of volcanic eruptions on landforms and/or the atmosphere.
e) Identify or describe how heat flow and movement beneath the Earth's crust causes earthquakes and volcanoes.
f) Identify or describe how rocks change in form, composition, and location during the rock cycle.
g) Identify or describe how human activities cause changes in landforms, bodies of water, and the atmosphere.

CH02 1.3.4 History and Evolution of Earth Yellow

Know the importance of fossils in documenting life and environmental changes over time.

Item Characteristics

Given examples of fossil evidence, items may ask students to:

a) Identify or describe how the evidence can be used to document past life on Earth.
b) Identify or describe how the evidence can be used to document environmental changes, extinction, evolution, and major climatic changes.

CH02 1.3.5 Hydrosphere and Atmosphere

Relate global atmospheric movement and the formation of ocean currents to weather and climate.

Item Characteristics

Given a diagram, drawing, or description of one or more objects, items may ask students to:

a) Describe the role of oceans in cooling the Earth's surface.
b) Identify the role of heat from the Sun in winds, ocean currents, and the water cycle.
c) Describe the relationship between landforms, the water cycle, and climate.
d) Identify or describe how major changes in the Earth's surface (e.g. volcanic ash, dust created by meteors) can cause climatic changes.

CH02 1.3.6 Interactions in the Solar System and Beyond

Describe how the regular and predictable motions of most objects in the solar system account for such phenomena as the day, year, and phases of the Moon, eclipses, seasons, and ocean tides.

Item Characteristics

Given a diagram, drawing, or description of one or more objects, items may ask students to:

a) Describe how the tilt of the Earth causes seasonal changes on Earth.
b) Identify or describe why seasonal change differs at different latitudes on the Earth.
c) Identify or describe the causes of the phases of the Moon or the location of the Sun, Earth, and Moon during different phases of the Moon.
d) Identify or describe the causes of lunar or solar eclipses **or** the location of the Sun, Earth, and Moon during lunar or solar eclipses.
e) Identify or explain the role of gravity on life on Earth.
f) Identify or explain the role of Moon's gravity on tidal movements.

CH03 Changes in Matter and Energy of 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

- All 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 shows 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 that 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 organisms using natural resources.
- Descriptions, charts, and graphics that describe how living organisms can cause changes in their environment.
- Descriptions, charts, and graphics that describe how resources are recycled.

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

- Terms that may be used:

adaptation	evolution	natural selection	recycle
affect	host	predator	resource
camouflage	impact	prey	

- Terms that may be used with definitions or examples: thermal (heat), mimicry.
- Terms that may not be used:
- All terms allowed and restricted under other learning targets apply to Changes in Matter and Energy.

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

Understand that individual organisms use matter and energy processes; understand the mechanisms that accomplish these processes are complex, integrated, and regulated.

Item Characteristics

Given the fact that the total amount of energy in a system does not change, items may ask students to:

a) Identify or describe how energy is transformed into energy or food for the growth of an organism.
b) Identify or describe how energy is transferred from organism to organism within a food chain.
c) Identify or describe the role of the Sun in energy for a food chain.
d) Identify or describe all of the places energy goes as it moves through a food chain.
e) Identify or describe the process of how nutrients are cycled through a food chain.

CH03 1.3.8 Biological Evolution

Describe how biological evolution accounts for species diversity, adaptation, natural selection, extinction, and change in organisms over time.

Item Characteristics

Given a diagram, drawing, or description of one or more objects, items may ask students to:

a) Identify or explain how natural selection could lead to a change in species when given a major environmental change.
b) Explain how the species could evolve from the same ancestor hen given similarities in physical structures among different species.
c) Identify or explain how the change could lead to the extinction of one species or the presence of a new species given a major environmental change.
d) Identify or describe the role of the fossil record in helping us track the evolution of species.

CH03 1.3.9 Interdependence of Life

Explain how organisms interact with their environment and with other organisms to acquire energy, cycle matter, influence behavior, and establish competitive or mutually beneficial relationships.

Item Characteristics

Given a description or picture of an ecosystem and some of the species in it, items may ask students to:

a) Identify or describe how various factors sustain the health of the ecosystem.
b) Identify or describe how increases or decreases in the population of one species in an ecosystem can affect other species in the ecosystem.
c) Identify or describe how competition among species can affect the population of one or the other species in an ecosystem.
d) Identify or describe one or more mutually beneficial relationship among species in an ecosystem.

CH03 1.3.10 Environmental and Resource Issues Yellow

Understand how human societies' use of natural resources affects the quality of life and the health of ecosystems.

Item Characteristics

Given a description of the interplay between natural and human systems, items may ask students to:

a) Identify or describe how and why various human activities (e.g. consumption of natural resources, waste management, urban growth, land use decisions, pesticide, herbicide, or fertilizer use) can affect the health of the system.

X. ITEM DEVELOPMENT GUIDE for the SKILLS and PROCESSES STRANDS

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

Generate questions that can be answered through scientific investigations

Item Format

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

Stimulus/Scenario Attributes

- All stimuli must include age- and grade-appropriate investigations.
- All formal or controlled investigations must include a prediction (hypothesis), materials, procedure, and data section.

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

- Terms that may be used:

controlled variable (kept the same)
responding variable (measured)
manipulated variable (changed)
valid
prediction (hypothesis)

- Terms that may be used with definitions or examples: infer, inference
- 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 an investigation, items may ask students to:

a) Identify the investigative question.
b) 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 scientific investigations, using appropriate equipment, mathematics, and safety procedures.

Item Format

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

Stimulus/Scenario Attributes

- All stimuli may include age and grade appropriate investigations.
- All formal or controlled investigations must include a prediction (hypothesis), materials, procedure, and data section.
- All descriptions of scientific investigations must have either a clearly stated question that guides the investigation **or** indication that the investigation was guided by a question.
- 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.
- Charts and graphics that show the results of a scientific investigation.
- Descriptions, charts, and graphics that show a repeated or related scientific investigation that includes the results and conclusions.
- Diagrams or pictures of objects used in a scientific investigation.

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

- Terms that may be used: microscope, meter stick, telescope
- 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 complete description of an investigation, items may ask students to:

a) Design a second investigation involving a minimal change.
b) Identify possible sources of error in the investigation.
c) Identify the manipulated (changed) variable.
d) Identify one controlled variable (kept the same).
e) Items may ask students to identify the responding variable (measured).
f) Items may ask students to identify safety requirements that would be needed in the investigation.

IP03 2.1.3 Explanation Green

Use evidence from scientific investigations to think critically and logically to develop descriptions, explanations, and predictions.

Item Format

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

Stimulus/Scenario Attributes

- All stimuli may include age and grade appropriate investigations.
- All descriptions of scientific investigations must have either a clearly stated question that guides the investigation **or** indication that the investigation was guided by a question.
- All descriptions of investigations must include the materials, procedure, and data.
- All tables, charts, and/or graphs must have informative titles, appropriate labels, units, and appropriate scales.
- Stimuli may include charts and graphics that show the results of 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 grade vocabulary and terms)

- Terms that may be used:

compare	evidence	interpretation	relationship
contrast	interpret	opinion	

- Terms that may be used with definitions or examples:
- Terms that may not be used:
- All terms allowed and restricted under 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 prediction 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) Predict what logically might occur if the investigation lasted longer.

IP04 2.1.4 Modeling Green

Correlate models of behavior of objects, events, or processes to the behavior of actual things under investigation; test models by predicting and observing actual behaviors or processes.

Item Format

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

Stimulus/Scenario Attributes

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

Stimuli may include:

- Background information about a scientific issue or phenomena.
- A description of a scientific phenomenon.
- Diagrams or graphics that show a model of a scientific phenomenon.

Scientific Vocabulary and Terms

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

Item Characteristics

Given an appropriate phenomena or model for a phenomena, items may ask students to:

a) Identify or describe how a model can be used to investigate the phenomenon.
b) Describe how manipulating a model is an effective way to investigate the phenomena (i.e. an Earth-Moon-Sun model to investigate phases of the Moon or eclipses).
c) Identify or describe how to modify the model to investigate predicted changes in a system.
d) Use geometric figures, number sequences, graphs, diagrams, number lines, or maps to make a model of scientific systems, events, and processes in the real world.
e) Identify or describe similarities/difference between a model and the actual phenomena.

IP05 2.1.5 Communication Green

Communicate scientific procedures, investigations, and explanations orally, in writing, with computer-based technology, and in the language of mathematics.

Item Format

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

Stimulus/Scenario Attributes

- All stimuli must include age- and grade-appropriate investigations.
- All descriptions of scientific investigations must have either a clearly stated question that guides the investigation **or** indication that the investigation was guided by a question.
- All descriptions of investigations must include the prediction (hypothesis), materials, procedure, and data.
- All tables, charts, and/or graphs must have informative titles, appropriate labels, units, and appropriate scales.
- Stimuli may include summaries of previous studies on a given scientific issue or question.
- Stimuli may include charts and graphics that show the results of a scientific investigation in numeric and/or descriptive form.
- Stimuli may descriptions, charts, and graphics that show a repeated or related scientific investigation that includes the results.
- All grids to be used for student-generated graphs must include an informative title, scale(s), and labels for axes.

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

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

Item Characteristics

Items may ask students to:

a) Write a summary of the data of an investigation. A standard item reads 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 describe limitations to a given investigation.
c) Describe connections between the results, prediction (hypothesis), and phenomenon.
d) Explain the purpose of each step in a given investigation.
e) Identify or describe patterns found in results of an investigation.

IP06 2.2.1 Identifying Problems Green

Identify and examine common, everyday challenges or problems in which science and/or technology can be or have been used to design solutions.

Item Format

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

Stimulus/Scenario Attributes

- All stimuli must include age and grade appropriate situations.

Stimuli may include:

- Descriptions, charts, and/or graphics that include background information about a social/environmental problem related to scientific phenomena.
- Familiar objects or tools that have been invented through science and technology.

Scientific Vocabulary and Terms (in addition to fifth 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 other learning targets apply to Identifying Problems.

Item Characteristics

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

a) Define the parts of the problem.
b) Identify or describe the criteria for an acceptable solution to the problem.

Given a familiar tool or process developed through science, items may ask students to:

c) Determine how they help to solve problems **or** what kinds of problems they can be used to solve.
d) Identify or describe what scientific process or principle is used in their design (e.g. identify a pry bar as a lever).
e) Identify what scientific process or principle 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

Identify, design, and test alternative solutions to a challenge or problem.

Item Format

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

Stimulus/Scenario Attributes

- All stimuli must include age and grade appropriate situations.

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 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 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 proposed alternative solutions to a challenge or problem.
b) Draw simple models of proposed solutions to a social/environmental problem.
c) Identify or describe a solution to a challenge or problem using engineering or technological design processes.

IP08 2.2.3 Evaluating Potential Solutions Green

Compare and contrast multiple solutions to a problem.

Item Format

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

Stimulus/Scenario Attributes

- All stimuli must include age and grade appropriate situations.

Stimuli may include:

- Descriptions, charts, and graphics that include background information about a social/environmental problem, a design or product that has been used to solve the problem, and the results of the design or product.
- A set of criteria upon which a solution is to be evaluated.

Scientific Vocabulary and Terms (in addition to fifth 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 other learning targets apply to Evaluating Potential Solutions.

Item Characteristics

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

a) Identify the reason why the design or product has **or** has not been successful in solving the problem.
b) Determine which solution was most effective using criteria for evaluation and results.
c) Use scientific concepts or processes to modify the design or product to improve its effectiveness.

Given a problem and the technology or design intended to solve the problem, items may ask students how to:

d) Use scientific principles to improve the technology or design.

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
Understand the operational and ethical traditions of science and technology such as skepticism, cooperation, intellectual honesty, and proprietary discovery.

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

Stimulus/Scenario Attributes
- All 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.
- Two investigations: one well developed and one with flaws, including results and conclusions.
- A situation in which the researcher draws conclusions before results are obtained.
- 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 grade vocabulary and terms)
- Terms that may be used: honesty, issue, unexpected
- Terms that may be used with definitions and examples:
- Terms that may not be used:
- All terms allowed and restricted under 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 intellectually honest response to questionable research results.
b) Identify a flaw in a scientific response to the research based on limited data or a flawed conclusion.
c) Differentiate between proof of and evidence for a theory or prediction (hypothesis) when given a scientific situation.

NC02 3.1.1 Limitations of Science and Technology Blue

Understand that scientific investigation is limited to the natural world.

Item Format

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

Stimulus/Scenario Attributes

- All 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 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 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 the relationship between a question and the type of research.
b) Identify the relationship between the domain of research and the methods used to investigate questions (e.g. for astronomy, modeling is used to investigate questions).

NC03 3.1.3 Dealing with Inconsistencies Blue

Provide more than one explanation for events or phenomena; defend or refute the explanations using evidence.

Item Format

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

Stimulus/Scenario Attributes

- All stimuli must include age and grade appropriate investigations.
- All descriptions of scientific investigations must have either a clearly stated question that guides the investigation **or** indication that the investigation was guided by a question.
- All descriptions of investigations must include the materials, procedure, and data.
- All tables, charts, and/or graphs must have informative titles, appropriate labels, units, and appropriate scales.

Stimuli must include:

- Background information about a scientific issue or phenomenon related to the investigation.
- Charts and graphics that show the results of a scientific investigation.
- Descriptions, charts, and graphics that show a repeated or related scientific investigation that includes the results and conclusions.
- The procedure, data, and conclusions for two investigations or studies about the same phenomenon.

Scientific Vocabulary and Terms (in addition to fifth 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 other learning targets apply to Dealing with Inconsistencies.

Item Characteristics

Given a complete investigation, items may ask students to:

a) Determine whether the conclusion is supported by the evidence and explain why, even when the conclusions are inconsistent with prevailing views.
b) Identify or explain why the results from a single investigation are not conclusive about a phenomenon.
c) Decide whether an investigation is valid and explain why.
d) Identify or describe inconsistencies in the results from a second investigation.
e) Identify an alternative explanation of the results.
f) Identify or describe data that support alternative explanation of the results.

Given an appropriate diagram of an event or phenomena, items may ask students to:

g) Defend or refute explanations for the event or phenomenon, using evidence.

NC04 3.1.4 Evaluating Methods of Investigation Blue

Describe how methods of investigation relate to the validity of scientific experiments, observations, theoretical models, and explanation.

Item Format

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

Stimulus/Scenario Attributes

- All stimuli must include age and grade appropriate investigations.
- All descriptions of scientific investigations must have either a clearly stated question that guides the investigation **or** indication that the investigation was guided by a question.
- All descriptions of investigations must include the prediction (hypothesis), materials, procedure, and data.
- All tables, charts, and/or graphs must have informative titles, appropriate labels, units, and appropriate scales.
- Stimuli must include background information about a scientific issue or phenomenon related to the investigation.

Stimuli may include:

- Charts and graphics that show the results of a flawed scientific investigation; flaws may include design flaws (e.g. design doesn't fit with question; obvious flaws in converting observations to data tables, graphs, charts).
- Descriptions of an investigation with results that are inconsistent with previous findings.

Scientific Vocabulary and Terms (in addition to fifth 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 other learning targets apply to Evaluating Methods of Investigation.

Item Characteristics

Given a complete investigation, items may ask students to:

a) Identify or explain whether the data supports the given conclusion when given a complete investigation.
b) Identify faulty reasoning in the conclusions or explanations (e.g. opinions, unrelated evidence, lack of controls, lack of randomness in assignment during experiments) when given conclusions or explanations made about a scientific phenomenon.

NC05 3.1.5 Evolution of Scientific Ideas Blue

Explain how scientific theory, prediction (hypothesis), generation, experimentation, and observation are interrelated and may lead to changing ideas.

Item Format

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

Stimulus/Scenario Attributes

- All stimuli must include age and grade appropriate situations.

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 a phenomenon.

Scientific Vocabulary and Terms (in addition to fifth 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 other learning targets apply to Evolution of Scientific Ideas.

Item Characteristics

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

a) Identify why multiple tests are needed before accepting a scientific idea.
b) Evaluate whether sufficient evidence is provided to support a scientific prediction (hypothesis) when given a description of an investigation.
c) Identify an appropriate response when given a description of an accepted scientific explanation supported by substantial evidence that is contradicted by new evidence.

NC06 3.2.1 All People Contribute to Science and Technology Blue

Know that science and technology have been developed, used, and affected by many diverse individuals, cultures, and societies throughout human history.

Classroom-based Assessment Only

NC07 3.2.2 Relationship of Science and Technology

Compare and contrast scientific inquiry and technological design in terms of activities, results, and influence on individuals and society; know that science supports technological development and vice versa.

Item Format

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

Stimulus/Scenario Attributes

- All 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.
- Stimuli may include descriptions of situations, charts, and graphics that depict a social or environmental problem.

Scientific Vocabulary and Terms (in addition to fifth 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 other learning targets apply to Relationship of Science and Technology.

Item Characteristics

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

a) Identify or describe an example of the different purposes of technology and research given an appropriate description of the area of focus.
b) Describe the similarities and differences between technological design and scientific inquiry in terms of their ultimate purposes.
c) Identify or describe how technology supports scientific investigations.
d) Identify or describe how scientific research supports technology in specific fields of work (e.g. architecture, engineering, medicine, agriculture, manufacturing, creating energy).
e) Explain how both science and technology influence solutions to problems in the world (e.g. medicine, agriculture, energy shortages).

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

Investigate the use of science, mathematics, and technology within 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 general understanding (e.g. a simple explanation) of the concept or task, as well as use of applicable information and/or procedures.

1 A 1-point response shows rote 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 appropriate, simple analysis or application of the concept to a given situation.

1 A 1-point response shows a flawed 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
- complex and detailed 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
- general 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

Application of Science Concepts:

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

Application of Science 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 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)
- attempt to apply the concept(s) to the given situation may be ineffective
- little or no supporting information and details provided give 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 has significant errors
- attempts at support use generalities rather than evidence

Generic 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 scientific investigation. The student designs an investigation that earns Q value points for a four-point response.

Question: (0-2 value point)

Prediction (Hypothesis): (1-2 value points)

Materials: (1-2 value points)

Procedure: (up to 6 value points, 1 per bulleted feature)

- The steps of the investigation are logical.
- At least one variable is identified or implied 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 periodically throughout the investigation.

Note: If a student makes up a new, different question than the ones 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