Assessment Guide for Educators

Science

October 2020

GED Testing Service®

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Note on the March 2016 Edition

GED Testing Service has published the March 2016 Edition of the Assessment Guide for Educators to include the following:

1. Updated performance level information to reflect the new performance levels: Below Passing, Pass/High School Equivalency, GED® College Ready, and GED® College Ready + Credit
2. Updated information on the Social Studies test to reflect the elimination of the Social Studies Extended Response question
3. Streamlining and simplification of the guide, based on adult educator feedback, to make the guide more user-friendly and to eliminate redundancies

Note on the October 2020 Edition

GED Testing Service has enhanced the Science Practices to include subskills.

CHAPTER 1

Assessment Targets

Assessment Targets for Science

The GED® test has three main purposes–to provide candidates with

1. A path to a high school credential
2. Evidence of their readiness to enter workforce training programs or postsecondary education
3. Information about their strengths and weaknesses in key academic areas

The philosophy underlying the GED® test is that there is a core of academic skills and content knowledge that must be acquired in order for an adult to be prepared to enter a job, a training program, or an entry-level, credit-bearing postsecondary course. This core of knowledge and skills is reflected in the career- and college-readiness standards now adopted in some form by the majority of states.

Content Specifications for the GED® Science Test

The GED® Science test focuses on the fundamentals of scientific reasoning, balancing (1) deeper conceptual understanding, (2) procedural skill and fluency, and (3) the application of these fundamentals in realistic situations. In order to stay true to this intention, each item on the Science test aligns with one *Science Practice and one Content Topic*.

The Science Practices are skills that are key to scientific reasoning in both textual and quantitative contexts. The science practices are derived from both the career- and college-readiness standards as well as in the National Research Council's Framework for K-12 Science Education.

The Science test focuses on three major content domains: (1) life science, (2) physical science, and (3) Earth and space science. The science content topics are drawn from these three domains. They provide context for measuring a test-taker's abilities to apply the reasoning skills described in the practices. The content topics focus on science that reflects both what is taught in many high school-level science courses and what is most relevant and useful to an adult population. To measure this content at a range of levels of complexity, the following item types are used in the test: multiple choice, short answer, drag-and-drop, hot spot, and fill-in-the-blank.

The Science Assessment Targets are divided into two sections: the practices and the content topics. The science practices describe skills necessary for reasoning in a scientific context, while the content topics describe a body of knowledge typical of what is taught in American high schools. Each item on the GED® Science test aligns with one Science Practice and one Content Topic.

The following specifications guide the GED® Science test:

1. Approximately 40 percent of the test focuses on life science, 40 percent on physical science, and 20 percent on Earth and space science
2. The test includes items that test textual analysis and understanding, data representation and inference skills, as well as problem solving with science content
3. Each item on the Science test aligns with both one Science Practice and one Content Topic
4. Each item also reflects one Depth of Knowledge level of cognitive complexity, based on the appropriate alignment to a science practice
5. Approximately 60 percent of the items reflect a Depth of Knowledge level of 2 or 3
6. The contexts within which problem solving skills are measured are taken from both academic and workforce contexts
7. Approximately 50 percent of the items are in scenarios, in which two to three items are based on a single stimulus (textual, graphic, or a combination of both), and 50 percent are standalone items

Each science practice in the Science Assessment Targets correspond with standards from Common Core State Standards (CCSS) for Literacy in Science & Technical Subjects, and mathematics and/or practices from *A Framework for K-12 Science Education*. For example, R.1 corresponds with CCSS Reading Anchor Standard 1m and 8.SP refers to skills introduced in the CCSS Grade 8 Statistics and Probability mathematics domain. Practices 1-8, however, are drawn from the scientific practices in *A Framework for K-12 Science Education.*

Scientific Practices in A Framework for K-12 Science Education

References to Common Core State Standards and Framework for K-12 Science Education[1]	Science Practices	Range of Depth of Knowledge (DOK) levels[2]
SP.1 Comprehending Scientific Presentations		
R2, R8, P8, M2, M6	SP.1.a Understand and explain textual scientific presentations • Identify summaries and central ideas of passages. • Recognize restatements of research or experimental findings. • Recognize comparisons between scientific processes, theories and trends.	1-3
R4, L4, P8,M2, M4, M6	SP.1.b Determine the meaning of symbols, terms and phrases as they are used in scientific presentations • Distinguish between multiple meanings of an academic vocabulary term used in context. • Determine the meaning of symbols as they are used in scientific presentations	2
S-ID, 8.SP, P8, M2, M4, M6	SP.1.c Understand and explain a non-textual scientific presentations • Interpret scientific results and information in graphs, tables and various scientific diagrams.	2
SP.2 Investigation Design (Experimental and Observational)		
R8, P3, P4, M4	SP.2.a Identify possible sources of error and alter the design of an investigation to ameliorate that error • Identify the source of error using discrepant results. • Redesign an experiment to reduce sources of error.	2-3
R2, R5, W5, P1, P8. M, M4, M8	SP.2.b Identify and refine hypotheses for scientific investigations • Identify the hypothesis in a scientific investigation. • Refine the hypothesis in a scientific investigation.	2-3
R8, R9, P2, P5, M3, M4	SP.2.c Identify the strength and weaknesses of one or more scientific investigation (i.e. experimental or observational) designs • Identify the strengths or weaknesses of a single experimental design. • Compare experimental designs to identify strengths or weaknesses.	2-3
W7, 3.MD, P3, P5, M4, M8	SP.2.d Design a scientific investigation • Identify the correct order of steps in a scientific experiment. • Identify proper measurement tools or appropriate units for a scientific experiment.	1-3
R5, P2, P4, M4	SP.2.e Identify and interpret independent and dependent variables in scientific investigations • Identify the independent and dependent variables in a scientific experiment. • Interpret the relationship between the independent and dependent variables in a scientific experiment.	2-3

References to Common Core State Standards and Framework for K-12 Science Education[1]	Science Practices	Range of Depth of Knowledge (DOK) levels[2]
SP.3 Reasoning from Data		
R1, P7	SP.3.a Cite specific textual evidence to support a finding or conclusion • Identify quotations and text from passages that support conclusions. • Identify numerical data that supports conclusions.	2-3
R1, R2, R3, P1, P6, P7, M3, M4, M7, M8	SP.3.b Reason from data or evidence to a conclusion • Identify if scientific evidence from stimulus supports a conclusion. • Determine which conclusion is supported by evidence in the stimulus.	2-3
R1, R3, P4, M3, M4, M7, M8	SP.3.c Make a prediction based upon data or evidence • Identify how a scientific variable changes as a result of another variable. • Make a prediction or extend a trend from results or data presented.	2-3
S-CP, 7.SP, P4, P5, M4, M7, M8	SP.3.d Using sampling techniques to answer scientific questions • Use a subset of data presented in a stimulus to draw conclusions about a larger set of data. • Identify the correct sampling strategy for a given scientific investigation. • Identify strengths and weaknesses of sampling techniques.	2-3
SP.4 Evaluating Conclusions with Evidence		
R8, P4, P6, M3, M7, M8	SP.4.a Evaluate whether a conclusion or theory is supported or challenged by particular data or evidence • Determine if specific evidence supports or challenges the proposed claim or solution. • Determine which model (hypothesized set of relationships or experiment) is weakened by new evidence. • Identify which data supports the theory or hypothesis.	2-3
SP.5 Working with Findings		
R9, P2, P4, P6, M3, M7	SP.5.a Reconcile multiple findings, conclusions or theories. • Identify the reason(s) a particular finding or theory is superior to another. • Identify the reason(s) two particular findings or theories are both correct.	2-3
SP.6 Expressing Scientific Information		
R7, W2, P8, M2, M4, M6	SP.6.a Express scientific information or findings visually • Translate information presented numerically or verbally into a visual representation.	2
R7, W2, P5, P8, M2, M4, M6	SP.6.b Express scientific information or findings numerically or symbolically. • Translate information presented visually or verbally into a numerical representation.	1-2
R7, W2, P8, M2, M6	SP.6.c Express scientific information or findings verbally • Translate information presented visually or numerically into a verbal representation.	2-3

References to Common Core State Standards and Framework for K-12 Science Education[1]	Science Practices	Range of Depth of Knowledge (DOK) levels[2]
SP.7 Scientific Theories		
R3, R5, L3, P1, P2, P7, M2, M4	SP.7.a Understand and apply scientific models, theories and processes • Identify a correct answer by applying commonly known scientific models, theories, and processes. • Analyze relationship among concepts in a stimulus.	2-3
P2, P5, M2, M4, M8	SP.7.b Apply formulas from scientific theories • Solve for an unknown variable by applying concepts and information provided in a stimulus.	2
SP.8 Probability & Statistics		
S-MD, S-ID, P4, P5, M4, M6	SP.8.a Describe a data set statistically • Calculate the mean, median, and mode of a data set.	1-2
7.SP, P5, M4, M6	SP.8.b Use counting and permutations to solve scientific problems • Determine the number of combinations to solve a scientific problem.	1-2
7.SP, S-CP, P5, M4, M6	SP.8.c Determine the probability of events • Determine simple probabilities. • Determine compound probabilities of two independent events. • Determine offspring ratios using a Punnett square.	2

1 The GED® Science Practices (SP#) are derived from The Common Core State Standards for ELA and Literacy (R#) (L#) (W#)(2010), The Common Core State Standards for Mathematics (M#) (2010), and the National Research Council's A Framework for K-12 Science Education: Practices, Crosscutting Concepts and Core Ideas (P#) (forthcoming).

2 26 The Depth of Knowledge (DOK) levels correspond to Norman Webb's (University of Wisconsin) Depth of Knowledge model of cognitive complexity.

GED® Science Test Content Topics

The primary focus of the GED® test - Science is the measurement of essential reasoning skills (e.g., analysis, evaluation, and inference) applied in scientific context. The science content topics describe key concepts that are widely taught in a variety of high school-level courses and are relevant to the lives of GED® test-takers. The content topics provide context for measuring the skills outlined in the science practices.

Test-takers should be broadly and generally familiar with each of the concepts in the science content topics and subtopics: they should be able to recognize and understand, in context, each of the terms listed there, rather than having an in-depth and comprehensive knowledge of each subtopic. The stimuli used in the GED® test - Science provide necessary details about scientific graphic elements, formulas, and other key principles.

		Science Content Topics		
		Life Science (L) (40%)	**Physical Science (P) (40%)**	**Earth and Space Science (ES) (20%)**
Focusing Themes	**Human Health and Living Systems**	a. Human body and health b. Organization of life (structure and function of life) c. Molecular basis for heredity d. Evolution	a. Chemical Properties and Reactions Related to Human Systems	a. Interactions between Earth's systems and living things
	Energy and Related Systems	e. Relationships between life functions and energy intake f. Energy flows in ecologic networks (ecosystems)	b. Conservation, transformation, and flow of energy c. Work, motion, and forces	b. Earth and its system components and interactions c. Structure and organization of the cosmos

For example, a question may include answer options and stimuli that contain specific terms drawn from the content subtopics; however, test-takers will never be asked to formulate their own definition of a scientific term.

Focusing Themes

The two focusing themes ensure that the test covers a wide range of important scientific topics while focusing on a distinct subset of ideas within each content topic. Items from any of the three content domains of life science, physical science, and Earth and space science can pertain to one of these two themes, but content that falls outside the spheres of these themes will not appear on the Science test.

The theme of **Human Health and Living Systems** pertains to material that is vital for the health and safety of all living things on the planet. Topics relating to this theme include (but are not limited to)

- the physical body
- characteristics of humans and other living things
- systems of living organisms and related topics (e.g. diseases, evolution, and heredity)
- the mechanisms for how the human body works on chemical and physical levels
- how the environment affects living things and human society
- how humans and other organisms affect the environment

The theme of **Energy and Related Systems** deals with a fundamental part of the universe, and includes (but is not limited to) topics such as

- sources of energy
- transformations of energy
- uses of energy
- how energy flows through organisms and ecosystems
- Earth's geochemical systems
- how humans gain energy in their bodies
- the results of the use of the energy used in the human body

The Science Content Topics Matrix below identifies the major topics in science and shows the relationship between each content topic and each focusing theme.

The Science Content Topics And Subtopics tables on the following pages break down each content topic into greater detail. Individual test items will be drawn from the subtopics.

Science Content Topics and Subtopics[3]

Life Science
L.a Human Body and Health
L.a.1 Body systems (e.g. muscular, endocrine, nervous systems) and how they work together to perform a function (e.g. muscular and skeletal work to move the body)
L.a.2 Homeostasis, feedback methods that maintain homeostasis (e.g. sweating to maintain internal temperature), and effects of changes in the external environment on living things (e.g. hypothermia, injury)
L.a.3 Sources of nutrients (e.g. foods, symbiotic organisms) and concepts in nutrition (e.g. calories, vitamins, minerals)
L.a.4 Transmission of disease and pathogens (e.g. airborne, bloodborne), effects of disease or pathogens on populations (e.g. demographics change, extinction), and disease prevention methods (e.g. vaccination, sanitation)
L.b Relationship Between Life Functions and Energy Intake
L.b.1 Energy for life functions (e.g. photosynthesis, respiration, fermentation)
L.c Energy Flows in Ecologic Networks (Ecosystems)
L.c.1 Flow of energy in ecosystems (e.g. energy pyramids), conservation of energy in an ecosystem (e.g. energy lost as heat, energy passed on to other organisms) and sources of energy (e.g. sunlight, producers, lower level consumer)
L.c.2 Flow of matter in ecosystems (e.g. food webs and chains, positions of organisms in the web or chain) and the effects of change in communities or environment on food webs
L.c.3 Carrying capacity, changes in carrying capacity based on changes in populations and environmental effects and limiting resources to necessary for growth
L.c.4 Symbiosis (e.g. mutualism, parasitism, commensalism) and predator/prey relationships (e.g. changes in one population affecting another population)
L.c.5 Disruption of ecosystems (e.g. invasive species, flooding, habitat destruction, desertification) and extinction (e.g. causes [human and natural] and effects)
L.d Organization of Life (Structure and Function of Life)
L.d.1 Essential functions of life (e.g. chemical reactions, reproduction, metabolism) and cellular components that assist the functions of life (e.g. cell membranes, enzymes, energy)
L.d.2 Cell theory (e.g. cells come from cells, cells are the smallest unit of living things), specialized cells and tissues (e.g. muscles, nerve, etc.) and cellular levels of organization (e.g. cells, tissues, organs, systems)
L.d.3 Mitosis, meiosis (e.g. process and purpose)
L.e Molecular Basis for Heredity
L.e.1 Central dogma of molecular biology, the mechanism of inheritance (e.g. DNA) and chromosomes (e.g. description, chromosome splitting during Meiosis)
L.e.2 Genotypes, phenotypes and the probability of traits in close relatives (e.g. Punnett squares, pedigree charts)
L.e.3 New alleles, assortment of alleles (e.g. mutations, crossing over), environmental altering of traits, and expression of traits (e.g. epigenetics, color-points of Siamese cats)
L.f Evolution
L.f.1 Common ancestry (e.g. evidence) and cladograms (e.g. drawing, creating, interpreting)
L.f.2 Selection (e.g. natural selection, artificial selection, evidence) and the requirements for selection (e.g. variation in traits, differential survivability)
L.f.3 Adaptation, selection pressure, and speciation

Physical Science

P.a Conservation, Transformation, and Flow of Energy

P.a.1 Heat, temperature, the flow of heat results in work and the transfer of heat (e.g. conduction, convection)

P.a.2 Endothermic and exothermic reactions

P.a.3 Types of energy (e.g. kinetic, chemical, mechanical) and transformations between types of energy (e.g. chemical energy [sugar] to kinetic energy [motion of a body])

P.a.4 Sources of energy (e.g. sun, fossil fuels, nuclear) and the relationships between different sources (e.g. levels of pollutions, amount of energy produced)

P.a.5 Types of waves, parts of waves (e.g. frequency, wavelength), types of electromagnetic radiation, transfer of energy by waves, and the uses and dangers of electromagnetic radiation (e.g. radio transmission, UV light and sunburns)

P.b Work, Motion, and Forces

P.b.1 Speed, velocity, acceleration, momentum, and collisions (e.g. inertia in a car accident, momentum transfer between two objects)

P.b.2 Force, Newton's Laws, gravity, acceleration due to Gravity (e.g. freefall, law of gravitational attraction), mass and weight

P.b.3 Work, simple machines (types and functions), mechanical advantages (force, distance, and simple machines), and power

P.c Chemical Properties and Reactions Related to Living Systems

P.c.1 Structure of matter

P.c.2 Physical and chemical properties, changes of state, and density

P.c.3 Balancing chemical equations and different types of chemical equations, conservation of mass in balanced chemical equations and limiting reactants

P.c.4 Parts in solutions, general rules of solubility (e.g. hotter solvents allow more solute to dissolve), saturation and the differences between weak and strong solutions

Earth and Space Science

ES.a Interactions between Earth's Systems and Living Things

ES.a.1 Interactions of matter between living and non-living things (e.g. cycles of matter) and the location, uses and dangers of fossil fuels

ES.a.2 Natural Hazards (e.g. earthquakes, hurricanes, etc.) their effects (e.g. frequency, severity, and short- and long-term effects), and mitigation thereof (e.g. dikes, storm shelters, building practices)

ES.a.3 Extraction and use of natural resources, renewable vs. non-renewable resources and sustainability

ES.b Earth and its System Components and Interactions

ES.b.1 Characteristics of the atmosphere, including its layers, gases and their effects on the Earth and its organisms, including climate change

ES.b.2 Characteristics of the oceans (e.g. salt water, currents, coral reefs) and their effects on Earth and organisms

ES.b.3 Interactions between Earth's systems (e.g. weathering caused by wind or water on rock, wind caused by high/low pressure and Earth rotation, etc.)

ES.b.4 Interior structure of the Earth (e.g. core, mantle, crust, tectonic plates) and its effects (e.g. volcanoes, earth quakes, etc.) and major landforms of the Earth (e.g. mountains, ocean basins, continental shelves, etc.)

ES.c Structures and Organization of the Cosmos

ES.c.1 Structures in the universe (e.g. galaxies, stars, constellations, solar systems), the age and development of the universe, and the age and development of Stars (e.g. main sequence, stellar development, deaths of stars [black hole, white dwarf])

ES.c.2 Sun, planets, and moons (e.g. types of planets, comets, asteroids), the motion of the Earth's motion and the interactions within the Earth's solar system (e.g. tides, eclipses)

ES.c.3 The age of the Earth, including radiometrics, fossils, and landforms

3 The GED® Science Content Topics are informed by the National Research Council's A Framework for K-12 Science Education: Practices, Crosscutting Concepts and Core Ideas 2011.

CHAPTER 2

Item Types & Layouts

Item Types in Science

The GED® test now uses a variety of item types, made possible through computer-based testing. The computer-based testing platform allows the opportunity to use interactive item types that are not possible on a pencil-and-paper test.

The Science test includes:

- Multiple choice items
- Fill-in-the-blank items (Technology-enhanced)
- Drag-and-drop items (Technology-enhanced)
- Drop-down items (Technology-enhanced)
- Hot Spot items (Technology-enhanced)
- Short answer items

Technology-Enhanced Items

In Technology-enhanced (TE) items, test-takers interact with the content in a more authentic way. Test-takers may be asked to select blocks of text, select multiple answers from a list, drag an answer to a location, or manipulate symbols or other graphics.

These items assess the full depth and breadth of skills outlined in the GED® Science Assessment Targets. Employing a variety of item types allows us to assess the targeted content at a number of DOK levels. Each item type provides opportunities for test-takers to apply different cognitive strategies to demonstrate proficiency with Science practices and content knowledge *(See Assessment Guide for Educators Introduction: Depth of Knowledge Summary for more information)*. Each item type on the Science test is presented either as a stand-alone item or as part of an item scenario in which two or three items pertain to a single stimulus. Stimulus materials include brief text, graphs, tables, or other graphic representations of data or scientific concepts. The Science

test stimuli reflect the focusing theme of either "Human Health and Living Systems" or "Energy and Related Systems" as identified in the GED® Science Assessment Targets. (See Chapter Three: Assessment Targets: Science for more information.)

Multiple choice (MC)

Multiple choice (MC) items consist of a question accompanied by several possible answer choices. This item type is used to assess aspects of every Science Practice and Content Topic listed in the GED® Science Assessment Targets. Multiple choice items continue to be a reliable method for measuring skills and knowledge at a range of cognitive levels in a standardized manner. MC items on the GED® test have four answer options.

Fill-in-the-blank (FIB)

Fill-in-the-blank (FIB) items consist of a sentence with one or more blanks for the test-taker to complete. These items give test-takers the opportunity to construct a very brief response, like a single word or a short phrase, when potential answers have little variability. For example, this item type is used when an item calls for a response to a specific calculation or the identification of a specific quantity from a graphic representation of data.

Drag-and-drop

Drag-and-drop items are interactive tasks that require test-takers to move images or words to designated "drop targets" on a computer screen. On the Science test, this item type is used to measure a test-taker's skills with regard to assembling data or comparing and classifying information. For instance, an item could ask test-takers to place organisms in specific locations on a food web. Other examples of tasks well-suited to drag-and-drop items are ones in which test-takers place labels on a graph or chart, fill in a Venn diagram with data from a brief textual stimulus, order steps in a scientific experiment, or place data points from a given context into a chart, table, or graphical model.

Drop-down

Drop-down items have a drop-down menu embedded within a brief text. They are used to give test-takers opportunities to choose the correct response to complete statements. Test-takers are given the advantage of seeing the complete statements they create in an interactive manner on screen. These items measure many of the

same skills that fill-in-the-blank items can, though they provide a selection of possible responses from which test-takers can choose. This item type is especially effective for the purposes of assessing how well a test-taker can identify a logical conclusion drawn from text-based evidence or even make a generalization based on an author's argument.

Hot spot

Hot spot items consist of a graphic image or block of text with virtual "sensors" placed strategically within it. The test-taker selects a portion of the text or part of the graphic by clicking on the designated sensor. This item type is used to measure a test-taker's understanding of relationships between data points cited from a textual or graphic stimulus. For example, a hot spot item could contain a pedigree chart requiring test-takers to select offspring with a particular trait in order demonstrate their understanding of heredity. Other items might ask test-takers to select data or points in a graph, chart, or table that support or refute a given conclusion or to select parts of a specific model given some selection criteria (e.g. a model of the human body, a cladogram [i.e., a diagram showing the relationships between organisms], or a matter-cycle diagram).

Short answer (SA)

Short answer (SA) are items that require test-takers to compose their own brief responses to the wide range of content outlined in the GED® Science Assessment Targets. This item type is used to provide a test-taker the opportunity to create a valid summary of a passage or model, create and successfully communicate a valid conclusion or hypothesis, or derive evidence from a textual or graphic stimulus that supports particular conclusion.

Science Practice and Content Topic:

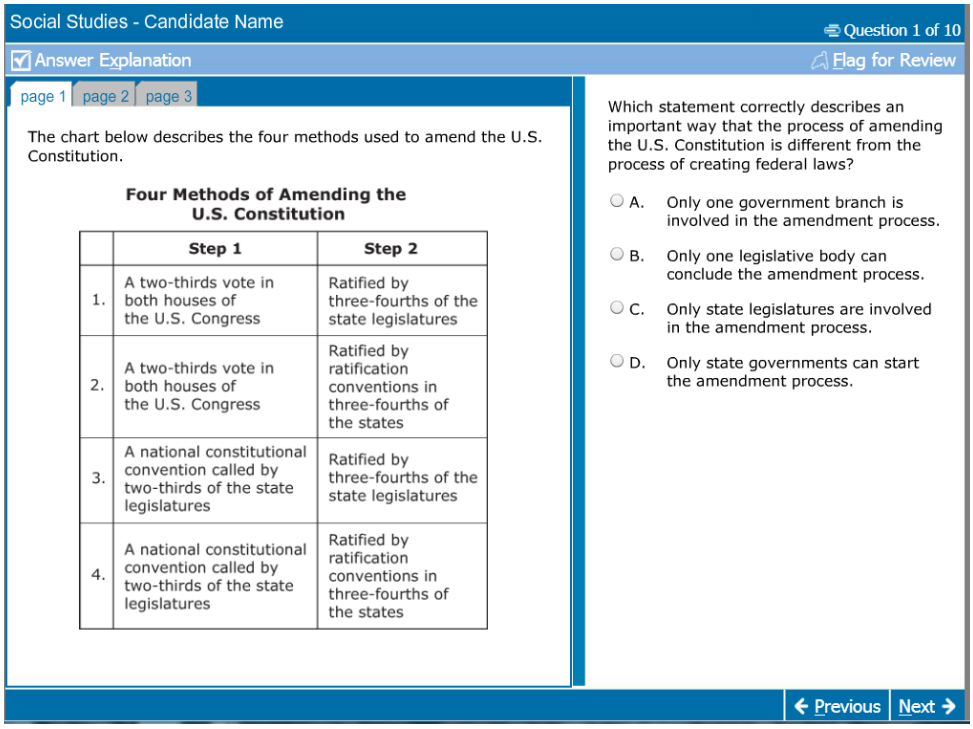
The Science Assessment Targets represent a "two-layer" system. The top layer is the science practices and the second layer is the content topics. Every item is aligned to one practice and one content topic.

Item Layouts in Science

Item layouts are shown to highlight the structure of each item type described in the previous section. The content in the item layouts shown in this guide is not representative of the GED® test and is merely included to illustrate test item functionality rather than content.

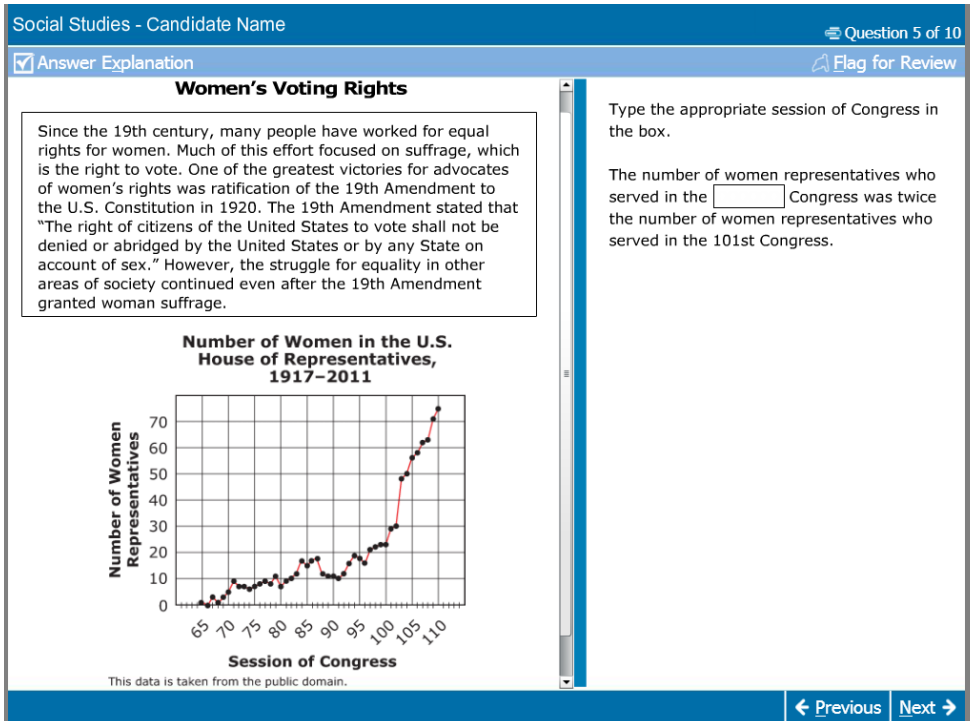
Multiple Choice Item and a Passage

This layout allows the test-takers to see the stimulus—whether it be textual or graphic or both—and item simultaneously. For Science, this layout is used when two or three items will pertain to a single, brief text or graphic.



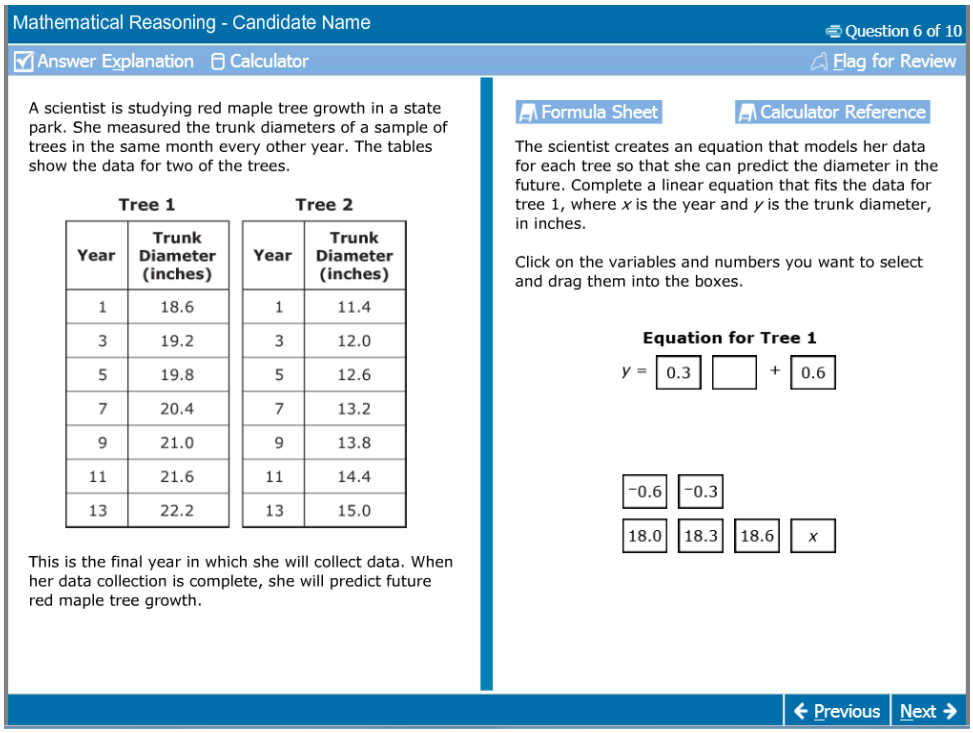
Fill-in-the-blank

This item type (shown below using Social Studies content) requires test-takers to fill in a single blank.



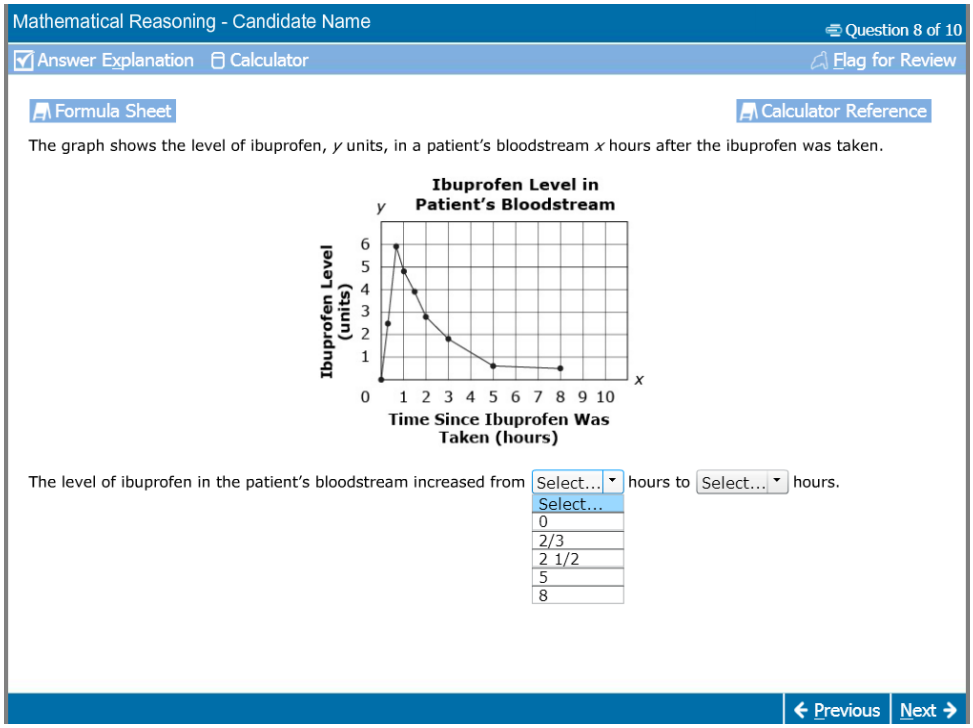
Drag-and-drop Item

This example using math content shows six elements of an equation (boxed numbers and boxed letter x), three of which would be selected and dragged to one of the drop targets in the equation boxes next to "y =." In items that use this layout, the appearance and number of the drag tokens and the drop targets may vary, but all drag-and-drop items allow test-takers to interact with the material as they move objects around on the screen.



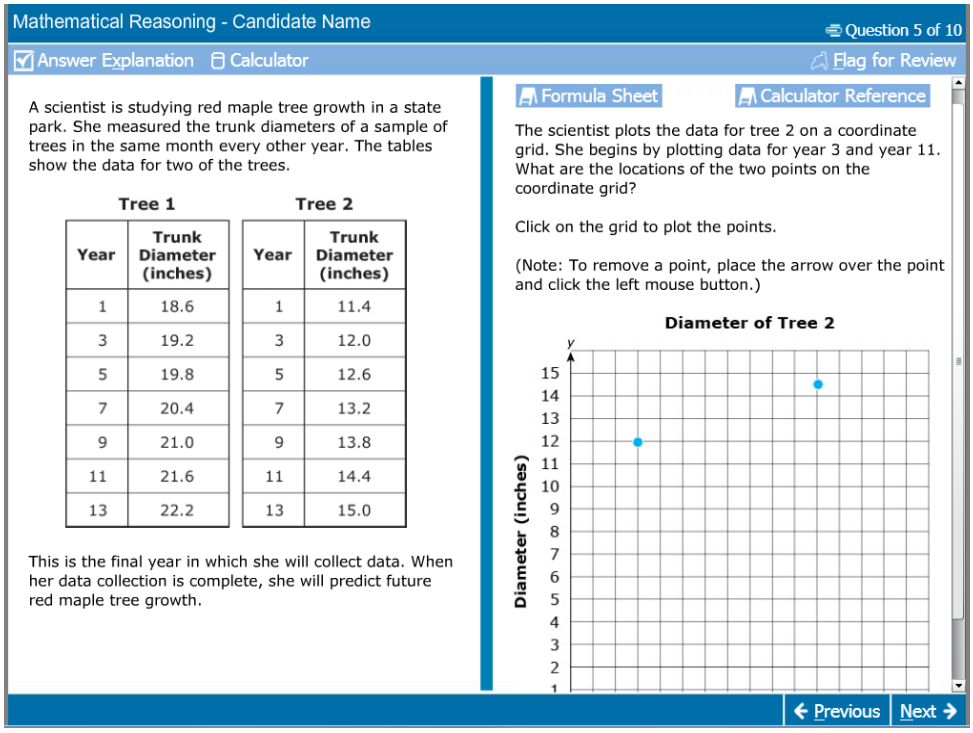
Drop-down Item

In this item type, test-takers choose their answers from a drop-down menu that appears embedded within text.



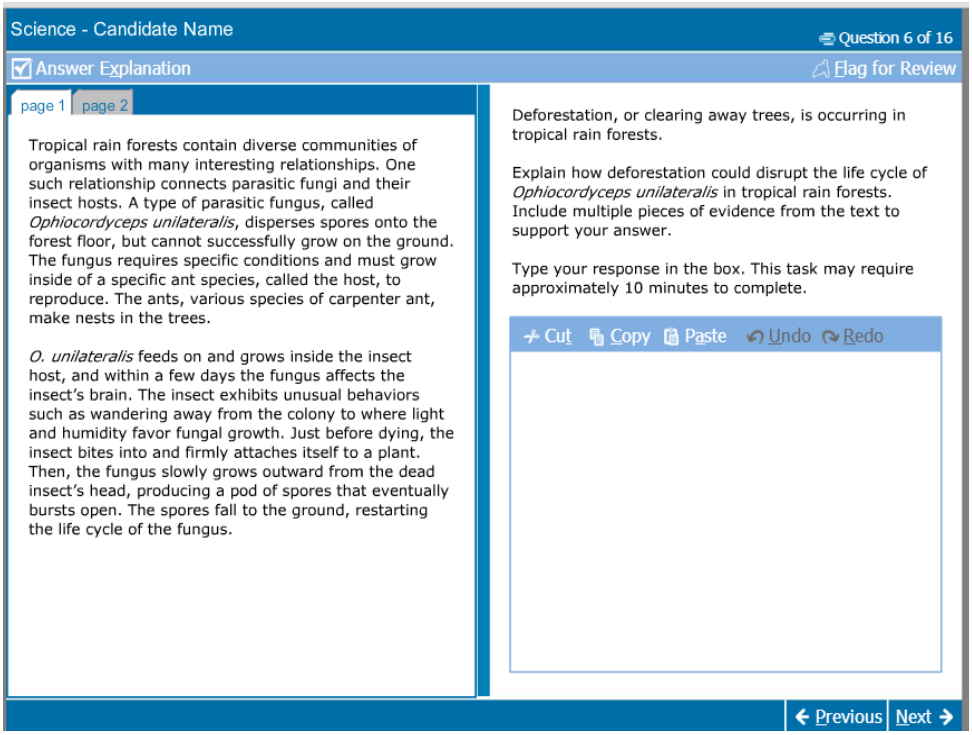
Hot Spot Item

This item layout shows a brief stimulus placed in a split screen with a number line graphic. The graphic contains one or more "sensor" regions, or "hot spots," on which the test-takers can click in order to provide responses to the question. In this example, the green circles represent the test-taker's answer to this item.



Short Answer Box

This item layout requires test-takers to answer one or more questions in a brief written paragraph. This item type is used only on the Science test.



CHAPTER 3

The Development Cycle of a Short Answer Item

The Development Cycle of a Short Answer Item

The GED® test features a variety of item types that allow us to measure the full breadth and depth of the assessment targets. Short answer (SA) items appear on only the Science test. SA items allow us to measure a wide range of skills identified in the assessment targets at a higher cognitive level than traditional multiple choice (MC) items. This chapter focuses on the SA item development and scoring processes.

Measuring Complex Content Through Short Answer Items

The tasks that appear in SA items are much more like problems the GED® test-takers encounter in their daily lives, whether writing papers or reports in a postsecondary program or solving problems in the workplace.

Although MC items continue to be a proven, reliable method for obtaining information about a test-taker's mastery of various skills, SA items allow us to observe how test-takers apply a wider variety of cognitive strategies to the same content in a more authentic, real-world application, as shown in the example below.

Science Test Example

Science Test MC Item	Science Test SA Item
Which step [out of four listed] would produce a particular outcome in a scientific process?	Design an experiment to test the hypothesis [which is given in the stimulus]. Be sure to include descriptions of your data collection process and data analysis in your response.
Advantage: SA items allow test developers to access a higher level of cognitive complexity because they require test-takers to express a response in their own words.	

Developing Short Answer Scoring Guides

Each SA item on the GED® test - Science is scored on a three-point scale. For some items, the three points are accumulated when the test-takers identify or analyze up to three specific details or correct answers. This type of SA can be scored analytically, meaning that one point is given for each correct part in a test-taker's response. Other items are scored holistically. In these holistic items, each score point reflects a range of possible test-taker responses, with varying levels of correctness. This style of SA is particularly effective at measuring a test-taker's skills with regard to summarizing or synthesizing information.

Because each item has its own rules for scoring, scoring guides are developed alongside the item itself in two stages. The completed guides contain as broad a selection of responses as necessary to convey the types of answers that can receive full and partial credit. In the first stage of scoring guide development, test developers list possible correct answers that reflect the content target that the item intends to measure. For instance, if the SA item asks test-takers to identify three textual details that support a main idea in a passage, the preliminary scoring guide will list as many relevant phrases or sentences from the passage as necessary.

The second stage of SA scoring guide development takes place during the **rangefinding process**. The primary purpose of rangefinding is to select exemplars at each score point level from a representative sample of responses. An exemplar is an optimal sample response for each score point. These exemplars, which are drawn from the pool of responses created when the items are field tested, serve to help train both human scorers and the automated scoring engine. Because test-takers can be both creative and insightful, they may come up with correct responses to a given SA item that the test developers did not anticipate when drafting the preliminary scoring guides. Therefore, SA scoring guides are often updated and completed during the rangefinding process, incorporating answers or common phrasings that have been directly observed in test-taker responses during the field test.

Scoring guides broadly represent the variety of answers found in the sample pool. After finalization, the scoring guides are used with the exemplars to train human scorers. Once all items from field testing have been scored by humans, the scoring guides and exemplars are used to train the automated scoring engine. The

automated engine replicates human scoring and is then used to score items on the operational tests, ensuring that test-takers are not only measured on their demonstration of higher-order thinking skills, but that they also receive feedback on their test scores as quickly as possible.

Short Answer Scoring Process

1. **First Stage: Scoring Guide Development**
   - Test developers create a scoring guide for each item which lists all the possible correct answers
2. **Second Stage: Rangefinding**
   - Exemplars, or optimal sample responses for each score point, are pulled from the pool of test-taker responses from field-testing
   - The SA scoring guides may be updated to incorporate additional answers or common phrasings based on the test-taker responses during the field test
   - The scoring guides are used with the exemplars to train human scorers
   - The scoring guides and exemplars are used to train the automated scoring engine

CHAPTER 4

Performance Level Descriptors

Performance Level Descriptors

Performance Level Descriptors explain the skills a test-taker generally demonstrates in order to score into one of four performance levels on the GED® test and the skills they need to develop to advance their score to the next performance level.

The four performance levels for the GED® Science Test are Performance Level 1 - Below Passing, Performance Level 2 – Pass/ High School Equivalency, Performance Level 3 – GED® College Ready, and Performance Level 4 – GED® College Ready + Credit.

Performance Level 1: Below Passing Level

Test-takers who score at this level typically have a **limited but developing proficiency** demonstrating the skills in the following categories: examining scientific text, understanding and applying scientific methods and concepts, and interpreting scientific data using numeric reasoning.

Test-takers at the Below Passing level typically demonstrate the following skills:

Analyze Scientific and Technical Arguments, Evidence, and Text-Based Information

- Cite specific textual evidence to support a finding or conclusion at a limited and/or inconsistent level

Applying Scientific Processes and Procedural Concepts

- Identify and refine hypotheses for scientific investigations at a limited and/or inconsistent level
- Reason from data or evidence to a conclusion at a limited and/or inconsistent level
- Identify the strength and weaknesses of one or more scientific investigations (i.e. experimental or observational) designs at a limited and/or inconsistent level

Reasoning Quantitatively and Interpreting Data in Scientific Contexts

- Describe a data set statistically at a limited and/or inconsistent level
- Understand and explain non-textual scientific presentations at a limited and/or inconsistent level
- Express scientific information or findings numerically or symbolically at a limited and/or inconsistent level
- Express scientific information or findings visually at a limited and/or inconsistent level

In order to progress to the Pass/High School Equivalency level, test-takers need to:

1. continue to **strengthen** the skills listed in the Below Passing Level, including:
   - Cite specific textual evidence to support a finding or conclusion
   - Express scientific information or findings verbally
   - Identify and refine hypotheses for scientific investigations
   - Understand and explain non-textual scientific presentations

and

2. **develop** the following additional skills:
   - Understand and explain textual scientific presentations
   - Identify possible sources of error and alter the design of an investigation to ameliorate that error
   - Identify and interpret independent and dependent variables in scientific investigations
   - Understand and apply scientific models, theories, and processes
   - Apply formulas from scientific theories

Performance Level 2 - Pass/High School Equivalence

Test-takers who score at this level typically have a **satisfactory** proficiency in demonstrating skills in the following categories: examining scientific text, understanding and applying scientific methods and concepts, and interpreting scientific data using numeric reasoning.

Test-takers are generally able to demonstrate knowledge of and ability with the skills identified in the Below Passing level at a satisfactory level as well as the following skills:

Analyze Scientific and Technical Arguments, Evidence, and Text-Based Information

- Understand and explain textual scientific presentations at a satisfactory level
- Express scientific information or findings verbally at a satisfactory level
- Determine the meaning of symbols, terms, and phrases as they are used in scientific presentations at a satisfactory level
- Reconcile multiple findings, conclusions, or theories at a satisfactory level

Applying Scientific Processes and Procedural Concepts

- Make a prediction based on data or evidence at a satisfactory level
- Identify possible sources of error and alter the design of an investigation to ameliorate that error at a satisfactory level
- Identify and interpret independent and dependent variables in scientific investigations at a satisfactory level
- Understand and apply scientific models, theories, and processes at a satisfactory level
- Design a scientific investigation at a satisfactory level
- Evaluate whether a conclusion or theory is supported or challenged by particular data or evidence at a satisfactory level

Reasoning Quantitatively and Interpreting Data in Scientific Contexts

- Apply formulas from scientific theories at a satisfactory level

- Determine the probability of events at a satisfactory level
- Use counting and permutations to solve scientific problems at a satisfactory level

In order to progress to the **GED® College Ready** level, test-takers need to continue to **strengthen** the skills listed in the Below Passing level and the skills listed in the Pass/ High School Equivalency level, including:

- Understand and apply scientific models, theories, and processes
- Design a scientific investigation
- Apply formulas from scientific theories
- Determine probability of events
- Identify possible sources of error and alter the design of an investigation to ameliorate that error
- Evaluate whether a conclusion or theory is supported or challenged by particular data or evidence
- Reconcile multiple findings, conclusions, or theories
- Make a prediction based on data or evidence

Performance Level 3 - GED® College Ready

Test-takers who score at this level typically have a strong proficiency in demonstrating skills in the following categories: examining scientific text, understanding and applying scientific methods and concepts, and interpreting scientific data using numeric reasoning.

Test-takers are generally able to demonstrate strong knowledge of and ability with the skills identified in the Below Passing and the Pass/High School Equivalency levels, including:

Analyze Scientific and Technical Arguments, Evidence, and Text-Based Information

- Reconcile multiple findings, conclusions, or theories at a strong level

Applying Scientific Processes and Procedural Concepts

- Apply formulas from scientific theories at a strong level
- Identify possible sources of error and alter the design of an investigation to ameliorate that error at a strong level
- Make a prediction based on data or evidence at a strong level
- Design a scientific investigation at a strong level
- Understand and apply scientific models, theories, and processes at a strong level
- Evaluate whether a conclusion or theory is supported or challenged by particular data or evidence at a strong level

Reasoning Quantitatively and Interpreting Data in Scientific Contexts

- Determine probability of events at a strong level

In order to progress to the **GED® College Ready + Credit** level, test-takers need to continue to **strengthen** the skills listed in the previous levels including:

- Reconcile multiple findings, conclusions, or theories
- Design a scientific investigation
- Evaluate whether a conclusion or theory is supported or challenged by particular data or evidence
- Understand and apply scientific models, theories, and processes
- Determine probability of events

Performance Level 4 - GED® College Ready + Credit

Some institutions may confer three (3) semester hours, lower division credits in introductory physical science (survey, without laboratory) on students who score at this level. Test-takers who score at this level typically have an outstanding proficiency in demonstrating skills in the following categories: examining scientific text, understanding and applying scientific methods and concepts, and interpreting scientific data using numeric reasoning.

Test-takers are generally able to demonstrate knowledge of and ability with the skills identified in the previous levels, plus the following:

Analyze Scientific and Technical Arguments, Evidence, and Text-Based Information

- Reconcile multiple findings, conclusions, or theories at an outstanding level

Applying Scientific Processes and Procedural Concepts

- Design a scientific investigation at an outstanding level
- Evaluate whether a conclusion or theory is supported or challenged by particular data or evidence at an outstanding level
- Understand and apply scientific models, theories, and processes at an outstanding level

Reasoning Quantitatively and Interpreting Data in Scientific Contexts

- Determine probability of events at an outstanding level

Appendix A

The GED® Test - Science: A Content Comparison Between 2002 and the Current Test

Note: Codes in the Current Test column refer to the Current GED® Assessment Targets and Indicators as outlined in Chapter 1. The codes may not appear in numerical order, as the goal of the table below is to show areas of correspondence between the 2002 content and the Current content.

Science Practices	
2002	**Current Test**
Understand unifying concepts and processes, including • systems • order and organization • evidence • models and explanations • change, constancy and measurement • evolution • equilibrium	SP.1.a Understand and explain textual scientific presentations. SP.1.b Determine the meaning of symbols, terms and phrases as they are used in scientific presentations. SP.1.c Understand and explain a non-textual scientific presentations. SP.7.a Understand and apply scientific models, theories and processes. SP.7.b Apply formulas from scientific theories.

Science Practices	
2002	**Current Test**
Use science as inquiry, including • identifying questions and concepts that guide scientific investigations • designing and conducting scientific investigations • using appropriate tools and techniques to gather data • thinking critically and logically about • relationships between evidence and explanations • analyzing alternative explanations • communicating scientific arguments • understanding scientific inquiry	SP.2.a Identify possible sources of error and alter the design of an investigation to ameliorate that error. SP.2.b Identify and refine hypotheses for scientific investigations. SP.2.c Identify the strength and weaknesses of one or more scientific investigation (i.e. experimental or observational) designs. SP.2.d Design a scientific investigation. SP.2.e Identify and interpret independent and dependent variables in scientific investigations. SP.3.a Cite specific textual evidence to support a finding or conclusion. SP.3.b Reason from data or evidence to a conclusion. SP.3.c Make a prediction based upon data or evidence. SP.3.d Using sampling techniques to answer scientific questions. SP.4.a Evaluate whether a conclusion or theory is supported or challenged by particular data or evidence. SP.5.a Reconcile multiple findings, conclusions or theories. SP.6.a Express scientific information or findings visually. SP.6.b Express scientific information or findings numerically or symbolically. SP.6.c Express scientific information or findings verbally. SP.8.a Describe a data set statistically. SP.8.b Use counting and permutations to solve scientific problems. SP.8.c Determine the probability of events.
Understand the links between science and technology to • Identify, change, or improve a piece of technology or technique • Make decisions in regards to identifying and stating new problems or needs • Designing, implementing, and evaluating a solution. Use science in social and personal perspectives to make decisions about personal and social issues, including • personal and community health • population growth • natural resources • environmental quality • natural and human-induced hazards • science and technology in local, national, and global challenges.	**[Science and technology and science in social and personal perspectives are not separately assessed on the 2014 test. These overall concepts are integrated into the other relevant areas on the current test.]**

Science Content Topics

Physical Science	
2002	**Current Test**
• structure of atoms	P.a Conservation, Transformation, and Flow of Energy
• structure and properties of matter	P.b Work, Motion, and Forces
• chemical reactions	P.c Chemical Properties and Reactions Related to Living Systems
• motions and forces	
• conservation of energy and increase in disorder	
• interactions of energy and matter	

Life Science	
2002	**Current Test**
• the cell	L.a Human Body and Health
• molecular basis of heredity	L.b Relationship Between Life Functions and Energy Intake
• biological evolution	L.c Energy Flows in Ecologic Networks (Ecosystems)
• interdependence of organisms	L.d Organization of Life (Structure and Function of Life)
• matter	L.e Molecular Basis for Heredity
• energy	L.f Evolution
• organization in living systems	

Earth and Space Science	
2002	**Current Test**
• energy in the Earth system	ES.a Interactions between Earth's Systems and Living Things
• geochemical cycles	ES.b Earth and its System Components and Interactions
• origin and evolution of the Earth system	ES.c Structures and Organization of the Cosmos
• origin and evolution of the universe	

What's different on the Current Science Test?

Many of the science reasoning skills that were assessed on the 2002 test continue to be assessed on the current test. However, in the current Science Practices, these skills are articulated in greater detail and with greater focus.

The current Science Practices focus on test-takers' ability to glean information from scientific texts, reason with data representations and statistics, and apply key scientific models, theories and processes. The intent of the Science Practices is to provide clearer and more specific information to both test developers and educators about the skills that will be assessed.

Similarly, the content of the Current Science test continues to be drawn from the three major content domains of Physical Science, Life Science and Earth and Space Science. However, instead of the broad and open-ended categories that appeared in the 2002 content specifications, the Content Topics in the Current Science Assessment Targets are broken down into the Subtopics, which give much greater detail so as to narrow the scope of the content that is "fair game" for being featured in test questions. The content topics are also further filtered by the focusing themes. Content of each item must pertain to one of these two themes:

- Human Health and Living Systems
- Energy and Related Systems

Test-takers should be *broadly and generally familiar* with each of the basic concepts enumerated in the Science Content Topics and Subtopics, and they should be able to recognize and understand, in context, each of the *terms* listed therein. Test-takers are not expected to have an in- depth and comprehensive knowledge of each subtopic. Rather, the stimuli about which each question pertains will provide necessary details about scientific figures, formulas, and other key principles. For example, a question may include answer options and stimuli that contain specific terms drawn from the content subtopics; however, test-takers will never be asked to formulate their own definition a term without the item providing sufficient contextual support for such a task.

For more information on the science content topics and subtopics and the focusing themes, see the Science Assessment Targets in Chapter 1.

Appendix B

Science Reporting Categories

The GED® Science Test focuses on the fundamentals of science reasoning, striking a balance of deeper conceptual understanding, procedural skill and fluency, and the ability to apply these fundamentals in realistic situations.

The Science reporting categories are organized according to the Science Practices, rather than the Science content indicators. This organization has been chosen because the Science Practices are integrated into every item on the Science test and represent thinking and reasoning skills that are critical for adults to master. Although the content Topics and Subtopics are also reflected in all items, the Science content areas are too numerous for the test to be able to provide reliable and meaningful reporting data on them. Test-takers, however, will be receiving much more detailed information both on the skills they possess and on those they need to develop than ever before. With this additional information, adult educators will be in a position to focus their work with test-takers on critical skill development needs.

The reporting information provided by the GED® test is one of the most important elements of the assessment system. Gaining a firm understanding of the reporting categories on the GED® test will help adult educators in planning how they can best help adult learners to gain the skills they will need to be successful both on the test and in the future pathway they ultimately pursue.

Reporting Category 1: Analyzing scientific and technical arguments, evidence and text-based information		**30%**
SP.1.a	Understand and explain a textual scientific presentations	
SP.1.b	Determine the meaning of symbols, terms and phrases as they are used in scientific presentations	
SP.3.a	Cite specific textual evidence to support a finding or conclusion	
SP.5.a	Reconcile multiple findings, conclusions or theories.	
SP.6.c	Express scientific information or findings verbally	
Reporting Category 2: Applying scientific processes and procedural concepts		**40%**
SP.2.a	Identify possible sources of error and alter the design of an investigation to ameliorate that error	
SP.2.b	Identify and refine hypotheses for scientific investigations	
SP.2.c	Identify the strength and weaknesses of one or more scientific investigation (i.e. experimental or observational) designs	
SP.2.d	Design a scientific investigation	
SP.2.e	Identify and interpret independent and dependent variables in scientific investigations	
SP.3.b	Reason from data or evidence to a conclusion	
SP.3.c	Make a prediction based upon data or evidence	
SP.4.a	Evaluate whether a conclusion or theory is supported or challenged by particular data or evidence	
SP.7.a	Understand and apply scientific models, theories and processes	
Reporting Category 3: Reasoning quantitatively and interpreting data in scientific contexts		**30%**
SP.1.c	Understand and explain a non-textual scientific presentations	
SP.3.d	Using sampling techniques to answer scientific questions	
SP.6.a	Express scientific information or findings visually	
SP.6.b	Express scientific information or findings numerically	
SP.7.b	Apply formulas from scientific theories	
SP.8.a	Describe a data set statistically	
SP.8.b	Use counting and permutations to solve scientific problems	
SP.8.c	Determine the probability of events	

Appendix C

Reference Codes for Science Practices in the Assessment Targets

Appendix C gives the reference for each code identified in the "References" column in the Science Practices section of the Science Assessment Targets.

Numerical/Letter Symbol	Science Standards Document Reference
The Reading, Writing, and Language Master Standards are found in the Common Core State Standards for English Language Arts 6-12.	
R1, R2, R3, R4, R5, R7, R8, R9	Common Core State Standards for English Language Arts & Literacy Reading Master Standards
L3, L4	Common Core State Standards for English Language Arts & Literacy Language Master Standards
W2, W5, W7	Common Core State Standards for English Language Arts & Literacy Writing Master Standards
The Standards for Mathematical Practice are found in the Common Core State Standards for Mathematics.	
M2, M3, M4, M6, M7	Common Core State Standards for Mathematics Standards for Mathematical Practice
The Science Practices are found in Dimension 1 of the Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas	
P1, P2, P3, P4, P5, P6, P7, P8	A Framework for K-12 Science Education: Practices, Crosscutting Concepts and Core Ideas Science Practices
This domain comes from the K-8 section of the Common Core State Standards for Mathematics. The numbers in parentheses represent the grade levels of that domain that served as the basis for creating GED® mathematical reasoning indicators.	
SP (7, 8)	Common Core State Standards for Mathematics Statistics and Probability

Numerical/Letter Symbol	Science Standards Document Reference
These domains come from the High School section of the Common Core State Standards for Mathematics. The letter before the hyphen represents the conceptual category, while the letter(s) after the hyphen represent(s) the domain.	
S-ID	Common Core State Standards for Mathematics Statistics and Probability Interpreting Categorical and Quantitative Data
S-CP	Common Core State Standards for Mathematics Statistics and Probability Conditional Probability and the Rules of Probability
S-MD	Common Core State Standards for Mathematics Statistics and Probability
Using Probability to Make Decisions	

Appendix D

Glossary of Key Terms for the Science Test

Analysis/analyze (do not substitute *infer, summarize*): to examine critically in order to determine meaning and to understand the essential elements of [a text or other stimulus]

Application/apply (do not substitute *interpret, infer, summarize, conclude, calculate, solve, predict*): to use or employ an already established skill or piece of information in a new situation

Argument (do not substitute *claim, stance, argumentation*): a process or line of reasoning. For our purposes, arguments can be made either persuasively (i.e., to convince an audience of something) or rhetorically (i.e., to lay out a logical progression of ideas in support of a central stance).

Argumentation (do not substitute *argument, claim, stance, point of view*): the presentation of a line (or lines) of reasoning (i.e., the way in which something is argued, not the line of reasoning itself)

Assumption (do not substitute *premise, conclusion*): something taken for granted; a supposition

Author's credibility (do not substitute *author's point of view, meaning, bias, propaganda*): the degree to which an author can be believed or trusted

Author's point of view (do not substitute *author's purpose, meaning, author's credibility*): the author's attitude or outlook with which information, events, etc. are presented

Author's purpose/intent (do not substitute *meaning, summary, author's point of view, perspective*): the reason an author composes a text or other document (e.g., to convince an audience to use reusable bags rather than paper, to explain Lincoln's stance on abolition of slavery)

Bias (do not substitute *propaganda, author's credibility*): a particular tendency (of an author or a group), especially ones that prevents unprejudiced consideration

Claim (do not substitute *stance, argument author's purpose, author's point of view, hypothesis, position, perspective*): an assertion of something as fact

Compute/computation/calculate/calculation: to determine by mathematical methods (for our purposes, arithmetically or algebraically)

Conclusion/conclude (do not substitute *generalization, hypothesis, inference, application, summarize, predict*): a statement that follows logically from another or others in an argument (Note: arguments may be text-based, mathematical, scientific, etc.)

Create (do not substitute *apply, analyze, synthesize*): to originate or invent (e.g., an original line of reasoning)

Data (do not substitute *information*): individual facts, statistics, or pieces of information (can be qualitative or quantitative). See **information** for disambiguation.

Dependent variable: the variable that may change as a result of the independent variable

Detail (do not substitute *idea*): a small part than can be considered individually

Evaluate (do not substitute interpret, infer, summarize, analyze): to make a judgment about the significance, worth, validity, or quality of something.

Evidence (do not substitute *detail, reasoning*): that which tends to prove or disprove something; grounds for belief

Finding (do not substitute *conclusion, evidence, assumption*): that which is discovered through research or study (See conclusion for disambiguation— these concepts are closely related)

Format (do not substitute *genre*): general appearance, style, arrangement (e.g., of a text)

Generalization (do not substitute *summary, conclusion, hypothesis*): a principle, theory, or idea that can be applied in many instances

Hypothesis (do not substitute *generalization, conclusion, claim, stance, position, assumption, inference*): a proposition or set of propositions set forth as an explanation for a group of facts or phenomena; conjecture that is a guide for investigation

Idea (do not substitute *theme, detail*): any conception resulting from mental understanding, awareness, or activity

Independent variable: the variable deliberately manipulated in an experiment

Inference/infer (do not substitute *interpret, summarize, analyze, hypothesize*): to conclude by reasoning from evidence that which is not explicitly stated

Information (do not substitute *data*): knowledge gained through experience or study. More abstract and general than "data."

Interpret (do not substitute *infer, summarize, analyze*): to provide the meaning of, or explain, that which is explicitly stated or displayed graphically or symbolically

Justify (do not substitute *support*): to show a claim or statement to be writing, especially using evidence

Main idea (do not substitute *theme, summary, topic, idea*): the most important central thought in a paragraph or longer informational text

Meaning (do not substitute *tone, voice*): what is or is intended to be expressed

Permutations: an arrangement of a set or number of objects, without repetition, where order is a factor

Premise (do not substitute *conclusion, assumption, hypothesis*): a basis, stated or assumed, on which reasoning proceeds

Prediction (do not substitute *conclusion, assumption, reasoning, premise, hypothesis*): A statement of something in advance of occurrence, especially on a reasoned or evidentiary basis

Reasoning (do not substitute *evidence, meaning, conclusion*): the process of forming conclusions, judgments, or inferences from evidence

Sample: a subset of individuals (or in this case, data) chosen from a larger set (a population)

Sampling techniques: a method used to gather data on a small portion of a larger population. Sampling is used to obtain a representative, statistically valid sample of the larger set.

Scientific model (do not substitute *scientific presentation, theory*): An interpretative description of a phenomenon or system that facilitates access to that phenomenon. May be expressed in a diagram, a set of equations and/or a textual description, though none of those expressions are the model itself. Rather, the expressions represent or communicate the model.

Scientific presentation (do not substitute *scientific model, theory*): any medium through with scientific data or information is conveyed, including text, graphs, tables, diagrams, etc.

Sequence of events (do not substitute *plot, structure*): the order in which events (often historical) occur. Most often conveyed chronologically, but may also be conveyed procedurally, non-literally, etc. Typically, we use "sequence of events" to describe historical events and we use "plot" to describe the events that occur in fictional works.

Stance (do not substitute *claim, argument, argumentation*): the position on which an author bases an argument (e.g., pro or con)

Structure (do not substitute *sequence of events*): the relationships among and/or organization of component parts of a text or other medium (e.g., Q&A or cause-effect)

Summarize (do not substitute *interpret, analyze*): a brief account that gives the main points of something

Support (do not substitute *justify*): to establish by providing appropriate facts and evidence (either quantitative or textual

Synthesis/synthesize (do not substitute *apply, summarize, analyze*): to combine elements or ideas from multiple materials into a unified, if complex, whole

Theory (do not substitute *scientific presentation, scientific model*): a set of principles that explain or predict phenomena

Tone (do not substitute *meaning, voice*): the author's attitude toward the subject and/or audience (e.g., informal, playful, serious, condescending, etc.)

Topic (do not substitute *idea, theme, main idea, summary*) the subject of a discussion or work (typically more concrete than a theme (e.g., sedimentary rocks (topic) vs. rebirth (theme))) in an informational text