



## COGNITIVE COMPLEXITY CLASSIFICATION OF FCAT SSS TEST ITEMS

The benchmarks in the Sunshine State Standards (SSS) identify knowledge and skills students are expected to acquire at each grade level, with the underlying expectation that students also demonstrate critical thinking. Goal 3, Standard 4, of Florida’s System of School Improvement and Accountability makes this expectation clear:

“Florida students use creative thinking skills to generate new ideas, make the best decisions, recognize and solve problems through reasoning, interpret symbolic data, and develop efficient techniques for lifelong learning.”

Florida Comprehensive Assessment Test® SSS (FCAT SSS) test items, while assessing Sunshine State Standards benchmarks, must also reflect this goal and standard. It is important to develop items that elicit the complexity of knowledge and skills required to meet these objectives.

The degree of challenge of FCAT items is currently categorized in two ways: **item difficulty** and **cognitive complexity**. Item difficulty has two meanings, depending on the stage of item development. Before testing, item difficulty is a prediction of the percentage of students who will choose the correct answer.

After testing, item difficulty refers to the percentage of students who actually chose the correct answer. Items for which the correct answer is chosen by more than 70 percent of the students are considered easy. Items for which the correct answer is chosen by 40–70 percent of the students are considered average. Items for which the correct answer is chosen by less than 40 percent of the students are considered challenging.

Cognitive complexity refers to the cognitive demand associated with an item. Since the inception of the FCAT, Bloom’s Taxonomy<sup>1</sup> has been used for this purpose; however, Bloom’s Taxonomy is difficult to use because it requires an inference about the skill, knowledge, and background of the students responding to the item. Beginning in 2004, a new cognitive classification system is being used that is based largely upon Dr. Norman L. Webb’s work with “Depth of Knowledge”<sup>2</sup> levels. The rationale for classifying items by their level of complexity is to focus on the expectations of the item, not the ability of the student. The demands on thinking that an item makes—what the item requires the student to recall, understand, analyze, and do—are made with the assumption that the student is familiar with the basic concepts of the task. Items are chosen for the FCAT based on the Sunshine State Standards and their grade-level appropriateness, but the complexity of the items remains independent of the particular curriculum a student has experienced. The cognitive complexity of a multiple-choice item is generally NOT dependent on the distractors (answer choices). These answer choice options may affect the difficulty of the item, but not the complexity of the item.

The categories—low complexity, moderate complexity, and high complexity—form an ordered description of the demands an item may make on a student. For example, low complexity items may require a student to solve a one-step problem. Moderate complexity items may require multiple steps. High complexity items may require a student to analyze and synthesize information. The distinctions made in item complexity ensure that items will assess the depth of student knowledge at each benchmark. The intent of the item writer weighs heavily in determining the complexity of an item.

The pages that follow illustrate some, but not all, of the varying complexity demands that items might make at each level. Note that an item may fit one or more descriptions but should be classified in the highest level of complexity demanded by the item. The next four pages illustrate the complexity levels for the different content areas of reading, mathematics, science, and writing. The last page breaks down the percentages of points by cognitive complexity level for each content area.

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<sup>1</sup> Bloom, B.S., et al. *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain*. New York: McKay, 1956.

<sup>2</sup> Webb, N.L., 1999, *Alignment Between Standards and Assessment*, University of Wisconsin Center for Educational Research.

## FCAT SSS Reading

### Low Complexity

This category requires students to recall, observe, question, or represent basic facts. For a low complexity item, the student would be expected to demonstrate simple skills or abilities. A low complexity item requires only a basic understanding of text—often verbatim recall from text or simple understanding of a single word or phrase. Skills required to respond correctly to low complexity items include

- identifying the correct meanings of grade-appropriate words;
- locating details in a text;
- locating details on a graph, chart, or diagram;
- recognizing the correct order of events in a text; or
- identifying figurative language in a text.

### Moderate Complexity

Items may require a two-step process: first, comprehension, and then subsequent processing of text. Students are expected to make simple inferences within the text and may encounter items that include words such as *summarize*, *infer*, *classify*, *gather*, *organize*, *compare*, and *display*. Depending on the objective of a particular moderate level item, students may also be required to explain, describe, or interpret. Skills required to respond correctly to moderate complexity items include

- using context clues to identify the meanings of unfamiliar words;
- determining how details support the main idea;
- interpreting the information in graphs, charts, and diagrams;
- identifying cause-and-effect relationships;
- determining an author's main purpose or point of view;
- identifying similarities and differences;
- demonstrating an understanding of plot development;
- recognizing elements of plot;
- recognizing patterns of organization;
- summarizing the major points of a text; or
- comparing word meanings.

### High Complexity

High complexity items make heavy demands on student thinking. Students may be encouraged to explain, generalize, or make multiple connections. High complexity items require several steps involving abstract reasoning and planning. Students must be able to support their thinking. Items may involve identifying theme and implicit main idea and making complex inferences within or across text. Students may also be asked to take information from at least one portion of the text and apply this information to a new task. They may be asked to perform complex analyses of the connections among texts. Skills required to respond correctly to high complexity items include

- analyzing the use of figurative language in a text;
- showing how graphs, charts, and diagrams contribute to a text;
- determining an author's purpose and/or point of view and describing how it affects the text;
- evaluating strong vs. weak arguments in a text;
- analyzing similarities and differences;
- describing and analyzing the characteristics of various types of literature;
- describing and illustrating how common themes are found across texts; or
- analyzing cause-and-effect relationships.

## FCAT SSS Mathematics

### Low Complexity

This category relies heavily on the recall and recognition of previously learned concepts and principles. Items typically specify what the student is to do, which is often to carry out some procedure that can be performed mechanically. It is not left to the student to come up with a low complexity original method or solution. Skills required to respond to low complexity items include

- solving a one-step problem;
- computing a sum, difference, product, or quotient;
- evaluating a variable expression, given specific values for the variables;
- recognizing or constructing an equivalent representation;
- recalling or recognizing a fact, term, or property;
- retrieving information from a graph, table, or figure;
- identifying appropriate units or tools for common measurements; or
- performing a single-unit conversion.

### Moderate Complexity

Items in the moderate complexity category involve more flexible thinking and choice among alternatives than low complexity items. They require a response that goes beyond the habitual, is not specified, and ordinarily has more than a single step. The student is expected to decide what to do—using informal methods of reasoning and problem-solving strategies—and to bring together skill and knowledge from various domains. Skills required to respond to moderate complexity items include

- solving a problem requiring multiple operations;
- solving a problem involving spatial visualization and/or reasoning;
- selecting and/or using different representations, depending on situation and purpose;
- retrieving information from a graph, table, or figure and using it to solve a problem;
- determining a reasonable estimate;
- extending an algebraic or geometric pattern;
- providing a justification for steps in a solution process;
- comparing figures or statements;
- representing a situation mathematically in more than one way; or
- formulating a routine problem, given data and conditions.

### High Complexity

High complexity items make heavy demands on student thinking. Students must engage in more abstract reasoning, planning, analysis, judgment, and creative thought. The high-complexity item requires that the student think in an abstract and sophisticated way. Skills required to respond correctly to high complexity items include

- performing a procedure having multiple steps and multiple decision points;
- solving a non-routine problem (as determined by grade-level appropriateness);
- solving a problem in more than one way;
- describing how different representations can be used for different purposes;
- generalizing an algebraic or geometric pattern;
- explaining and justifying a solution to a problem;
- describing, comparing, and contrasting solution methods;
- providing a mathematical justification;
- analyzing similarities and differences between procedures and concepts;
- formulating an original problem, given a situation;
- formulating a mathematical model for a complex situation; or
- analyzing or producing a deductive argument.

## FCAT SSS Science

### Low Complexity

This category relies heavily on the recall and recognition of previously learned concepts and principles. Items typically specify what the student is to do, which is often to carry out some procedure that can be performed mechanically. It is not left to the student to come up with an original method or solution. Skills required to respond to low complexity items may include but are not limited to

- identifying a common example or recognizing a concept;
- retrieving information from a chart, table, diagram, or graph;
- recognizing a standard scientific representation of a simple phenomenon; or
- calculating or completing a familiar single-step procedure or equation using a reference sheet.

### Moderate Complexity

Items in the moderate complexity category involve more flexible thinking and choice among alternatives than low complexity items. They require a response that goes beyond the habitual, is not specified, and ordinarily has more than a single step or thought process. The student is expected to decide what to do—using informal methods of reasoning and problem-solving strategies—and to bring together skill and knowledge from various domains.

Skills required to respond to moderate complexity items may include but are not limited to

- applying or inferring relationships among facts, terms, properties, or variables;
- describing examples and nonexamples of scientific processes or concepts;
- predicting or determining the logical next step or outcome;
- comparing or contrasting structures or functions of different organisms or systems;
- choosing the appropriate formula or equation to solve a problem and then solving it; or
- applying and using concepts from a standard scientific model or theory.

### High Complexity

High complexity items make heavy demands on student thinking. Students must engage in more abstract reasoning, planning, analysis, judgment, and creative thought. The items require that the student think in an abstract and sophisticated way often involving multiple steps. Skills required to respond to high complexity items may include but are not limited to

- constructing models for research;
- generalizing or drawing conclusions;
- designing an experiment, given data and conditions;
- explaining or solving a problem in more than one way;
- providing a justification for steps in a solution or process;
- analyzing an experiment to identify a flaw and propose a method for correcting it;
- interpreting, explaining, or solving a problem involving spatial relationships; or
- predicting a long-term effect, outcome, or result of a change within a system.

## FCAT SSS Writing+

### Low Complexity

This category relies heavily on the recall and recognition of previously learned concepts and principles. Demonstrating knowledge of writing at this level does not include complex synthesis or analysis but involves understanding of simple facts. Low complexity items require the recognition of traits that distinguish something as a member of a category. For a low complexity item, the student would be expected to demonstrate simple skills or abilities. The item might involve the prewriting process of grouping ideas or words (as in a brainstorming activity), simple spelling or vocabulary tasks, or composing simple sentences. Low complexity items require students to perform familiar, mechanical tasks and require a basic understanding of the writing process. Some of the skills required for low complexity items include, but are not limited to, the following:

- categorizing information;
- inserting end punctuation in a sentence; and
- adding an *-s* to change a word from the singular to the plural form.

### Moderate Complexity

Items in this category move beyond simple recall and involve more flexibility of thinking and choice among alternatives. They require a response that goes beyond the habitual and is not specified. The student is expected to decide what to do. Moderate complexity multiple-choice items may include the assessment of students' ability to apply knowledge about the elements of writing by asking students to process and manipulate text. Some of the skills required for moderately complex items include, but are not limited to, the following:

- determining the relevance, placement, or quality of detail;
- applying the purpose for writing to the task; and
- applying knowledge of conventions.

### High Complexity

This category makes heavy demands on students thinking. Students may be encouraged to explain, generalize, or make multiple connections. Standards and items of high complexity often involve abstract reasoning and planning. These items require students to consider the elements of focus, organization, support, and conventions to demonstrate understanding of the writing situation—including the intended audience, occasion, or purpose—as a prerequisite to recognizing and producing effective writing. Inherent in such items is the expectation that students demonstrate knowledge of writing that is insightful and involved with the subject. Items at this level often ask students to apply skills to accomplish a new task, such as a demand writing situation in which the prompt or stimulus for writing is unknown to the student beforehand and cannot be read to or interpreted for the student. These items require students to support their thinking as they engage in developing compositions. Such writing tasks call for a mature command of language and complex sentence structures, showing synthesis and analysis. The tasks also necessitate the integration and evaluation of appropriate compositional elements.

Items may involve analyzing the presentation and maintenance of a central theme, topic, or unifying point and making a complex inference within or across compositions. The standard at this level may be an extended activity, with additional time provided for completing it; however, the extended time period is not a distinguishing factor if the work is only repetitive and does not require the application of significant conceptual understanding and higher-order thinking. Some of the skills required for high complexity items include, but are not limited to, the following:

- evaluating the effectiveness of a written response according to audience and purpose;
- developing a composition using the writing process; and
- analyzing and applying complex conventions.

## COGNITIVE COMPLEXITY CLASSIFICATION OF FCAT SSS TEST ITEMS

The tables below show the target range for the percentage of points by cognitive complexity level on each FCAT SSS test by content area.

### Percentage of Points by Cognitive Complexity Level for FCAT SSS Reading

Grades	Low Level	Moderate Level	High Level
3	25–35	50–70	5–15
4*	20–30	50–70	10–20
5–7	15–25	50–70	15–25
8*	10–20	50–70	20–30
9	10–20	50–70	20–30
10*	10–20	45–65	25–35

### Percentage of Points by Cognitive Complexity Level for FCAT SSS Mathematics

Grades	Low Level	Moderate Level	High Level
3–4	25–35	50–70	5–15
5*	10–20	50–70	20–30
6–7	10–20	60–80	10–20
8*	10–20	50–70	20–30
9	10–20	60–80	10–20
10*	10–20	50–70	20–30

### Percentage of Points by Cognitive Complexity Level for FCAT SSS Science

Grades	Low Level	Moderate Level	High Level
5*	15–25	40–60	25–35
8*	15–25	40–60	25–35
11*	15–25	40–60	25–35

\*These grades have a greater percentage of high complexity points due to the nature of performance tasks.

The prompt portion of FCAT SSS Writing+ is a high cognitive complexity task. The table below represents the multiple-choice items only.

### Percentage of Points by Cognitive Complexity Level for FCAT SSS Writing+ (Multiple-Choice)

Grades	Low Level	Moderate Level	High Level
4	10–30	40–60	15–30
8	10–30	40–60	15–30
10	10–30	40–60	15–30