South Carolina
Alternate Assessment (SC-Alt)

High School Biology Extended Standards

Office of Assessment
South Carolina Department of Education

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Introduction

The *South Carolina Alternate Assessment (SC-Alt): High School Biology Extended Standards* was developed to provide guidance to teachers for including students with significant cognitive disabilities in challenging academic instruction. This document is intended to make the general education indicators and the extended standards useful for classroom instruction and assessment test development.

In 2005, the *South Carolina Science Academic Standards* (*SCSAS*) was published. That document, which sets forth the state's academic standards for general education in biology, served as the basis for the state's alternate assessment standards in high school biology. All of the academic standards and indicator statements that appear in this document have been selected—and are cited verbatim—from the original 2005 standards document. The extended standards and indicators preserve the essence of the grade-level expectations but may be restricted in scope or complexity or may take the form of introductory or prerequisite skills to the grade-level standards and indicators. Access to the extended indicators is broken down into the three levels of symbolic communication used by students with significant cognitive disabilities. The intended purpose of this organizational structure is to guide special education teachers in linking their classroom instruction to the state academic standards and to provide specific content to developers of the South Carolina Alternate Assessment (SC-Alt), the state assessment designed for administration for these students.

All of the general education indicators, which are taken directly from the 2005 state standards document, appear in tables in this extended standards document. Each of these tables is prefaced by two statements: the original general education standard and the extended standard. The tables themselves contain five columns:

- **Indicator—**the general education indicator

- **Extended Indicator—**a statement describing the essence of the expectations of the grade-level general education indicator

- **Communication Levels**—descriptions of the three levels of symbol usage that students with significant cognitive disabilities use to communicate and that therefore impact the ways that academic content may be presented, taught, and assessed:

  Abstract Symbolic. Students who use *abstract symbolic* communication are those who typically use a vocabulary of pictures, picture symbols, and words to communicate. They recognize some sight words and numbers and understand abstract concepts such as yesterday and happy or sad.

  Concrete Symbolic. Students at the *concrete* level of communication are beginning to use pictures or other symbols to communicate. They primarily use *concrete symbols* (e.g., eat, drink, play, "more").

Pre-Symbolic. Students at the *pre-symbolic* level may not yet have a consistent system of communication. They may use gestures, eye gaze, and purposeful movement toward objects and sounds to indicate wants or needs. For example, students may point to or hold up a cup to indicate they are thirsty. Some students at the *pre-symbolic* level of communication may still be at the awareness level of communication and may communicate by crying or vocalizing but they may not yet demonstrate purposeful communication.

Format of the Extended Biology Standards for High School

These are the first **general education standard** (cited verbatim from the 2005 *SCSAS*) and the **extended standard** for high school biology.

Standard B-1

Standard B-1: The student will demonstrate an understanding of how scientific inquiry and technological desig analysis, can be used appropriately to pose questions, seek answers, and develop solutions.

Extended Standard: The student will demonstrate an understanding of how scientific inquiry can be used to as and develop solutions.

This is the third indicator for standard B-1 (cited verbatim from the 2005 *SCSAS*).

		Communication Levels		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	
B-1.3 Use scientific instruments to record measurement data in appropriate metric units that reflect the precision and accuracy of each particular instrument.	Identify and record measurement data using scientific instruments (e.g., scales, balances, rulers, thermometers).	Use scientific instruments nt its.	Use scientific instruments to identify and record data.	Ide instru colle (e.g., balan

These are the three levels of symbolic communication—**abstract symbolic**, **concrete symbolic**, and **pre-symbolic**—that guide access to the expectations of the general education indicators.

This is the extended indicator for standard B-1—the required subject-matter focus of the third indicator.

Standard B-1

Standard B-1: The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions.

Extended Standard: The student will demonstrate an understanding of how scientific inquiry can be used to ask questions, seek answers, and develop solutions.

		COMMUNICATION LEVELS		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-1.1 Generate hypotheses based on credible, accurate, and relevant sources of scientific information.	Generate hypotheses (predictions) based on credible, accurate, and relevant sources of scientific information.	Generate a hypothesis based on credible and relevant sources of scientific information (in the form of verbal and adapted text with object symbols).	Predict the outcome of an investigation on the basis of credible and relevant sources of scientific information (in the form of verbal and adapted text with object symbols).	Recognize a hypothesis as an "If . . . then" statement that is derived from a testable question.
B-1.2 Use appropriate laboratory apparatuses, technology, and techniques safely and accurately when conducting a scientific investigation.	Use laboratory tools (e.g., magnifying glass, microscope) safely and appropriately when conducting a simple controlled scientific experiment.	Select (by means of pictures or picture symbols paired with words) the correct tools for a simple controlled scientific experiment or use such tools when conducting an experiment.	Identify (by means of pictures or picture symbols or by pointing to the actual tools) the correct tools to use when conducting a simple controlled scientific experiment.	Identify the correct tool to use when conducting a simple controlled scientific experiment.
B-1.3 Use scientific instruments to record measurement data in appropriate metric units that reflect the precision and accuracy of each particular instrument.	Identify and record measurement data using scientific instruments (e.g., scales, balances, rulers, thermometers).	Use scientific instruments to record measurement data in appropriate units.	Use scientific instruments to identify and record data.	Identify scientific instruments used to collect measurement data (e.g., thermometers, balances, rulers).

		COMMUNICATION LEVELS		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-1.4 Design a scientific investigation with appropriate methods of control to test a hypothesis (including independent and dependent variables), and evaluate the designs of sample investigations.	Design a simple scientific investigation to answer a question about the relationship between two variables in a predicted cause-effect relationship (i.e., hypothesis). In an investigation, the *independent variable* is the factor that is being manipulated or changed, and the *dependent variable* is the factor that is responding. All other variables must be controlled. A controlled scientific investigation includes the following steps: 1. Identify a question. 2. State a prediction that answers the question. 3. Design a procedure that includes changing only one factor. 4. Record the data in tables, charts, diagrams, or graphs.	Plan a simple controlled scientific investigation or evaluate an experimental design based on the steps required for a scientific controlled investigation.	Summarize some of the steps of a controlled scientific investigation.	Identify some of the components of a controlled scientific investigation.

		COMMUNICATION LEVELS		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-1.5 Organize and interpret the data from a controlled scientific investigation by using mathematics, graphs, models, and/or technology.	Organize and interpret the data from a simple controlled scientific investigation by using bar graphs, line graphs, circle graphs, or models.	Organize (place on a graph) and interpret given data from a simple controlled scientific investigation.	Organize (use a pictograph) and interpret given data from a simple controlled scientific investigation.	Identify what was measured or manipulated in a simple controlled scientific investigation and interpret the results.
B-1.6 Evaluate the results of a controlled scientific investigation in terms of whether they refute or verify the hypothesis.	Explain that the analysis of the results of a controlled scientific investigation will either refute or verify the hypothesis (prediction of results).	Explain whether the results of a controlled scientific investigation (dependent or responding variable) has supported or refuted the hypothesis.	Interpret investigation results and compare them to the hypothesis.	Identify the results (dependent or responding variable) of a simple controlled scientific investigation.
B-1.7 Evaluate a technological design or product on the basis of designated criteria (including cost, time, and materials).	NA	NA	NA	NA
B-1.8 Compare the processes of scientific investigation and technological design.	NA	NA	NA	NA
B-1.9 Use appropriate safety procedures when conducting investigations.	Use appropriate safety procedures when conducting investigations.	Classify safe and unsafe procedures or practices in conducting investigations, and conduct investigations using safe procedures.	Use safety procedures and practices when conducting investigations.	Identify a safety procedure that must be followed when conducting investigations.

Standard B-2

Standard B-2: The student will demonstrate an understanding of the structure and function of cells and their organelles.
Extended Standard: The student will demonstrate an understanding of the structure and function of cells and some of their parts.

		COMMUNICATION LEVELS		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-2.1 Recall the three major tenets of cell theory (all living things are composed of one or more cells; cells are the basic units of structure and function in living things; and all presently existing cells arose from previously existing cells).	Recall that all living things are composed of cells and that cells are the basic unit of structure and function in all living things.	Identify objects as cellular or noncellular, and recall that cells are the basic units of structure and function in living things.	Identify objects (living or once alive) as cellular.	Identify an object as cellular (i.e., living and made of cells).
B-2.2 Summarize the structures and functions of organelles found in a eukaryotic cell (including the nucleus, mitochondria, chloroplasts, lysosomes, vacuoles, ribosomes, endoplasmic reticulum [ER], Golgi apparatus, cilia, flagella, cell membrane, nuclear membrane, cell wall, and cytoplasm).	Summarize the structure and function of organelles found in a eukaryotic cell (including the nucleus, chloroplasts, vacuoles, cell wall, nuclear membrane, cytoplasm, cilia, flagella, and cell membrane).	Identify the parts of a eukaryotic cell (including the nucleus, cell membrane, cytoplasm, vacuoles, cilia, flagella and [in plant cells] the cell wall and chloroplasts) and recall their function.	Identify the parts of a eukaryotic cell (including the nucleus, cell membrane, cytoplasm [internal material of a cell], vacuoles, and [in plant cells] the cell wall and chloroplasts) through the use of pictures, picture symbols, or concrete objects.	Recognize that a cell has a nucleus and a cell membrane (outer enclosure of the cell).

		COMMUNICATION LEVELS		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-2.3 Compare the structures and organelles of prokaryotic and eukaryotic cells.	NA	NA	NA	NA
B-2.4 Explain the process of cell differentiation as the basis for the hierarchical organization of organisms (including cells, tissues, organs, and organ systems).	Identify forms of cell differentiation that are the basis for the hierarchical organization of organisms (including cells, tissues, organs, and organ systems).	Identify several different cell types, tissues, major organs, and organ systems.	Identify different types of cells (e.g., blood, nerve, muscle) and associated organs in the body.	Recognize similar cell types that make up different tissues (e.g., blood cells make up blood, muscle cells make up muscle tissue).
B-2.5 Explain how active, passive, and facilitated transport serve to maintain the homeostasis of the cell.	NA	NA	NA	NA
B-2.6 Summarize the characteristics of the cell cycle: interphase (called G1, S, G2); the phases of mitosis (called prophase, metaphase, anaphase, and telophase); and plant and animal cytokinesis.	Identify the process of mitosis (i.e., cell division).	Recall the process of cell division (*mitosis*) where one entire cell reproduces itself to form two cells.	Identify mitosis as cell division: one cell divides to form two cells.	Recognize that a cell can divide to become two identical cells.

		COMMUNICATION LEVELS		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-2.7 Summarize how cell regulation controls and coordinates cell growth and division and allows cells to respond to the environment, and recognize the consequences of uncontrolled cell division.	NA	NA	NA	NA
B-2.8 Explain the factors that affect the rates of biochemical reactions (including pH, temperature, and the role of enzymes as catalysts).	NA	NA	NA	NA

Standard B-3

Standard B-3: The student will demonstrate an understanding of the flow of energy within and between living systems.

Extended Standard: The student will demonstrate the understanding that energy from the Sun transfers to plants through photosynthesis and then can flow to other organisms (living things).

		Communication Levels		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-3.1 Summarize the overall process by which photosynthesis converts solar energy into chemical energy and interpret the chemical equation for the process.	Summarize the process of photosynthesis (i.e., the process by which green plants make their own food [*glucose*] using air, water, and light energy from the Sun).	Summarize the overall process of photosynthesis by using words or picture symbols, and explain why the process is important to the plant.	Summarize the process of photosynthesis by using picture symbols or objects.	Identify a specific component of the overall process of photosynthesis by using pictures or objects (e.g., recognize the Sun as a source of energy).
B-3.2 Summarize the basic aerobic and anaerobic processes of cellular respiration, and interpret the chemical equation for cellular respiration.	Identify cellular respiration as the process by which cells (organisms) are provided with energy.	Identify sugar (carbohydrate) and air (oxygen) as the basic requirements of the process of respiration, which provides the organism with energy for survival.	Recognize an organism's need for food (carbohydrate) and air (oxygen) to provide it with energy.	Recognize an organism's need for energy to carry out all its life processes.
B-3.3 Recognize the overall structure of adenosine triphosphate (ATP)—namely, adenine, the sugar ribose, and three phosphate groups—and summarize its function (including the ATP-ADP [adenosine diphosphate] cycle).	NA	NA	NA	NA

		Communication Levels		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-3.4 Summarize how the structures of organic molecules (including proteins, carbohydrates, and fats) are related to their relative caloric values.	Classify foods as proteins, carbohydrates, or fats.	Classify foods as proteins, carbohydrates, or fats.	Exemplify proteins, carbohydrates, and fats.	Identify types of foods on a food chart as proteins, carbohydrates, or fats.
B-3.5 Summarize the functions of proteins, carbohydrates, and fats in the human body.	Summarize the roles of proteins, carbohydrates, and fats in the body.	Summarize the roles of proteins, carbohydrates, and fats in the body.	Match types of foods to their role in the body (e.g., protein for growth of muscle, carbohydrates for immediate energy, fats for energy storage).	Identify food items that are used for immediate energy (i.e., carbohydrates).
B-3.6 Illustrate the flow of energy through ecosystems (including food chains, food webs, energy pyramids, number pyramids, and biomass pyramids).	Illustrate the flow of energy through an ecosystem.	Illustrate the flow of energy through an energy pyramid.	Illustrate the flow of energy in a simple food web.	Identify organisms that are producers and those that are consumers in a simple food chain.

Standard B-4

Standard B-4: The student will demonstrate an understanding of the molecular basis of heredity.

Extended Standard: The student will demonstrate an understanding of heredity as the passing of traits (characteristics) from parents to offspring.

		COMMUNICATION LEVELS		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-4.1 Compare DNA and RNA in terms of structure, nucleotides, and base pairs.	NA	NA	NA	NA
B-4.2 Summarize the relationship among DNA, genes, and chromosomes.	Identify the relationship among DNA, genes, and chromosomes.	Identify a chromosome as being made of DNA and recognize that genes are specific locations on the DNA.	Recognize that DNA and genes (specific parts of DNA) of parents pass on traits to their offspring.	Recognize the structure of DNA.
B-4.3 Explain how DNA functions as the code of life and the blueprint for proteins.	Summarize that DNA functions as the code of life and the blueprint for proteins.	Summarize that DNA is responsible for traits being passed on from parent to offspring because DNA has the code for all an organism's traits.	Identify traits passed on from parent to offspring and recognize that DNA is responsible for these traits (e.g., an acorn will grow to be an oak tree like its parent tree).	Recognize that an organism's DNA determines all its traits (characteristics).
B-4.4 Summarize the basic processes involved in protein synthesis (including transcription and translation).	NA	NA	NA	NA
B-4.5 Summarize the characteristics of the phases of meiosis I and II.	NA	NA	NA	NA

		Communication Levels		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-4.6 Predict inherited traits by using the principles of Mendelian genetics (including segregation, independent assortment, and dominance).	Predict inherited traits on the basis of the principle of dominance.	Predict physical traits of offspring on the basis of dominant physical traits of parents.	Match parent and offspring organisms on the basis of two dominant traits.	Match offspring and parent organisms on the basis of one dominant trait. (e.g., fur color, flower shape).
B-4.7 Summarize the chromosome theory of inheritance and relate that theory to Gregor Mendel's principles of genetics.	NA	NA	NA	NA
B-4.8 Compare the consequences of mutations in body cells with those in gametes.	NA	NA	NA	NA
B-4.9 Exemplify ways that introduce new genetic characteristics into an organism or a population by applying the principles of modern genetics.	NA	NA	NA	NA

Standard B-5

Standard B-5: The student will demonstrate an understanding of biological evolution and the diversity of life.

Extended Standard: The student will demonstrate an understanding that organisms change over time and that there are many different types of organisms.

		Communication Levels		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-5.1 Summarize the process of natural selection.	Summarize the main principles of natural selection.	Summarize the following principles of natural selection: variation of traits, adaptation to a particular environment, overproduction of offspring.	Exemplify how variation of traits may enhance an organism's possibility to survive and reproduce in its environment (e.g., the deer that runs the fastest will evade predators, a giraffe with the longest neck will reach the most leaves in a tree).	Identify a trait that would give an organism a greater chance of survival (e.g., bright colors in flowers, echolocation in bats, white fur in polar bears).
B-5.2 Explain how genetic processes result in the continuity of life-forms over time.	Summarize how the continuity of life-forms results from the passing of genes from parent to offspring.	Summarize how the passing of genes from one generation to the next results in life-forms that are similar to one another (e.g., today's elephant resembles the extinct mastodon).	Identify parent-offspring pairs that are identical (the result of asexual reproduction—i.e., one parent) as opposed to those with some variability (the result of sexual reproduction—i.e., two parents).	Identify various parent-offspring pairs on the basis of common traits.

		Communication Levels		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-5.3 Explain how diversity within a species increases the chances of its survival.	Exemplify favorable traits (characteristics) that ensure the survival of a species.	Illustrate the traits of an organism that would be favorable to the survival of that species (e.g., a zebra's stripes acting as camouflage, a tall tree getting the sunlight).	Identify a characteristic that would be favorable to the survival of a particular species in a specific environment (e.g., beak size, neck length).	Identify a species that would survive in a particular environment (e.g., fish in water, squirrel in tree, cactus in desert).
B-5.4 Explain how genetic variability and environmental factors lead to biological evolution.	NA	NA	NA	NA
B-5.5 Exemplify scientific evidence in the fields of anatomy, embryology, biochemistry, and paleontology that underlies the theory of biological evolution.	Explain how paleontology (the study of fossils) shows the ways that organisms have changed over time.	Compare the differences between organisms found as fossils and those that are alive today.	Match a fossil with its living counterpart through the use of pictures, picture symbols, or concrete objects.	Identify a fossil as an organism that lived a long time ago.
B-5.6 Summarize ways that scientists use data from a variety of sources to investigate and critically analyze aspects of evolutionary theory.	NA	NA	NA	NA

		Communication Levels		
Indicator	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-5.7 Use a phylogenetic tree to identify the evolutionary relationships among different groups of organisms.	Use a simple phylogenetic tree to identify the evolutionary relationships among different groups of organisms.	Use a simple phylogenetic tree to identify the closest connections among different species.	Use a simple phylogenetic tree to identify the closest connection between two species.	NA

Standard B-6

Standard B-6: The student will demonstrate an understanding of the interrelationships among organisms and the biotic and abiotic components of their environments.

Extended Standard: The student will demonstrate an understanding of how organisms interact with one another and with the living and nonliving environment.

		COMMUNICATION LEVELS		
INDICATOR	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-6.1 Explain how the interrelationships among organisms (including predation, competition, parasitism, mutualism, and commensalism) generate stability within ecosystems.	Exemplify relationships such as predation, mutualism, and competition among organisms in an ecosystem.	Classify interrelationships among organisms (including predation, mutualism, and competition).	Identify predator and prey relationships (e.g., lion chases and kills a zebra for food).	Identify a predator or prey.
B-6.2 Explain how populations are affected by limiting factors (including density-dependent, density-independent, abiotic, and biotic factors).	Summarize how populations are affected by changes in nonliving factors (e.g., sunlight, precipitation, soil, water, temperature) in their environment.	Summarize how a change in a nonliving factor can affect the environment and can, in turn, affect the populations living in that environment.	Identify the effect that a change in a nonliving environmental factor could have on particular populations (e.g., too little rain would not allow most plants to grow and animals would have to leave the environment to find water).	Identify a nonliving environmental factor (e.g., water) that could change (e.g., flooding) and affect a population (e.g., organisms would have to seek a new environment).
B-6.3 Illustrate the processes of succession in ecosystems.	Illustrate the series of changes in an ecosystem that occurs in the process of succession.	Illustrate the sequence of changes in an ecosystem that occurs in the process of succession (e.g., sequence pictures to show the succession from bare rock to soil).	Identify a change in an ecosystem that occurs in the process of succession (e.g., from barren rock to moss, from grass to shrubs to trees).	Identify the first organisms to populate a barren area (primary succession).

		COMMUNICATION LEVELS		
INDICATOR	**Extended Indicator**	**Abstract Symbolic**	**Concrete Symbolic**	**Pre-Symbolic**
B-6.4 Exemplify the role of organisms in the geochemical cycles (including the cycles of carbon, nitrogen, and water).	NA	NA	NA	NA
B-6.5 Explain how ecosystems maintain themselves through naturally occurring processes (including maintaining the quality of the atmosphere, generating soils, controlling the hydrologic cycle, disposing of wastes, and recycling nutrients).	Summarize how ecosystems are maintained through naturally occurring processes (including the water cycle).	Summarize the steps of the water cycle and explain how it may help maintain pure water on Earth.	Recognize that the processes of evaporation and precipitation act to clean our air and water.	Identify evaporation (e.g., puddles drying up) and precipitation as parts of the water cycle.
B-6.6 Explain how human activities (including population growth, technology, and consumption of resources) affect the physical and chemical cycles and processes of Earth.	Explain how human activities (including population growth, technology, and consumption of resources) affect Earth.	Categorize human activities as positive or negative on the basis of their effect on Earth.	Match human activities with their effect on Earth.	Identify human activities that can affect Earth (e.g., cutting trees can eliminate habitats, recycling can save resources).

Appendix A

Revised Bloom's Taxonomy

In 1956, Benjamin Bloom and his colleagues published the *Taxonomy of Educational Objectives: The Classification of Educational Goals*, a groundbreaking book that classified educational goals according to the cognitive processes that learners must use in order to attain those goals. The work, which was enthusiastically received, was utilized by teachers to analyze learning in the classroom for nearly fifty years.

However, research during that time span generated new ideas and information about how learners learn and how teachers teach. Education practice is very different today. Even the measurement of achievement has changed; teachers now live in a standards-based world defined by state accountability systems.

In order to reflect the new data and insights about teaching and learning that the past forty-five years of research have yielded—and to refocus educators' attention on the value of the original Bloom's taxonomy—Lorin Anderson and David Krathwohl led a team of colleagues in revising and enhancing that system to make it more usable for aligning standards, instruction, and assessment in today's schools. The results of their work were published in 2001 as *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives* (New York: Allyn and Bacon)—a book that is important to educators because it provides the common understanding of expectations that is critical for improving student achievement in all subjects.

The revised taxonomy is two-dimensional, identifying both the kind of knowledge to be learned (knowledge dimension) and the kind of learning expected from students (cognitive processes) to help teachers and administrators improve alignment and rigor in the classroom. This taxonomy will assist educators to improve instruction, to ensure that their lessons and assessments are aligned with one another and with the state standards, that their lessons are cognitively rich, and that instructional opportunities are not missed.

Science goes well beyond simple recognition and the memorization of facts that many people mistake for scientific literacy. Therefore, many of the main verbs in the indicators of the South Carolina science standards reflect the cognitive processes described in the revised Bloom's taxonomy under the category *understand*. This category requires *interpreting, exemplifying, classifying, summarizing, inferring, comparing*, and *explaining* from students—understanding rather than rote memorization of materials. Students might have to *compare* two organisms or *explain* how variations in habitats affect the survival of an organism. Several indicators require students to demonstrate two even higher categories of cognitive processes—*analyze* and *evaluate*—by *organizing* and *critiquing* data and/or the results of scientific investigation, for example.

Tables 1 and 2 on the following pages are reproduced from Anderson and Krathwohl's *Taxonomy for Learning, Teaching, and Assessing*, pages 46 and 67, respectively. Table 3, "A Taxonomy for Teaching, Learning, and Assessing," describes both dimensions of the taxonomy: types and subtypes of knowledge described in table 1 and the cognitive categories and processes described in table 2. This matrix is provided as a template for teachers to use in analyzing their instruction as they seek to align standards, units/lessons/activities, and assessments. Examples and more information about specific uses of the matrix can be found in the *Taxonomy for Learning*.

Table 1: The Knowledge Dimension		
MAJOR TYPES AND		**EXAMPLES**
A. FACTUAL KNOWLEDGE—The basic elements students must know to be acquainted with a discipline or solve problems in it		
AA.	Knowledge of terminology	Technical vocabulary, musical symbols
AB.	Knowledge of specific details and elements	Major natural resources, reliable sources of information
B. CONCEPTUAL KNOWLEDGE—The interrelationships among the basic elements within a larger structure that enable them to function together		
BA.	Knowledge of classifications and categories	Periods of geological time, forms of business ownership
BB.	Knowledge of principles and generalizations	Pythagorean theorem, law of supply and demand
BC.	Knowledge of theories, models, and structures	Theory of evolution, structure of Congress
C. PROCEDURAL KNOWLEDGE—How to do something, methods and inquiry, and criteria for using skills, algorithms, techniques, and methods		
CA.	Knowledge of subject-specific skills and algorithms	Skills used in painting with watercolors, whole-number division algorithm
CB.	Knowledge of subject-specific techniques and methods	Interviewing techniques, scientific method
CC.	Knowledge of criteria for determining when to use appropriate procedures	Criteria used to determine when to apply a procedure involving Newton's second law, criteria used to judge the feasibility of using a particular method to estimate business costs
D. METACOGNITIVE KNOWLEDGE—Knowledge of cognition in general as well as awareness and knowledge of one's own cognition		
DA.	Strategic knowledge	Knowledge of outlining as a means of capturing the structure of a unit of subject matter in a textbook, knowledge of the use of heuristics
DB.	Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge	Knowledge of the types of tests particular teachers administer, knowledge of the cognitive demands of different tasks
DC.	Self-knowledge	Knowledge that critiquing essays is a personal strength, whereas writing essays is a personal weakness; awareness of one's own knowledge level

From Lorin W. Anderson and David R. Krathwohl, *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Educational Objectives*, © 2001. Psublished by Allyn and Bacon, Boston, MA. © 2001 by Pearson Education. Reprinted by permission of the publisher.

Table 2: The Cognitive Process Dimension		
CATEGORIES & COGNITIVE PROCESSES	**ALTERNATIVE NAMES**	**DEFINITIONS AND EXAMPLES**
1. REMEMBER—Retrieve relevant knowledge from long-term memory		
1.1 RECOGNIZING	Identifying	Locating knowledge in long-term memory that is consistent with presented material (e.g., Recognize the dates of important events in United States history)
1.2 RECALLING	Retrieving	Retrieving relevant knowledge from long-term memory (e.g., Recall the dates of important events in United States history)
2. UNDERSTAND—Construct meaning from instructional messages, including oral, written, and graphic communication		
2.1 INTERPRETING	Clarifying, paraphrasing, representing, translating	Changing from one form of representation (e.g., numerical) to another (e.g., verbal) (e.g., Paraphrase important speeches and documents)
2.2 EXEMPLIFYING	Illustrating, instantiating	Finding a specific example or illustration of a concept or principle (e.g., Give examples of various artistic painting styles)
2.3 CLASSIFYING	Categorizing, subsuming	Determining that something belongs to a category (e.g., Classify observed or described cases of mental disorders)
2.4 SUMMARIZING	Abstracting, generalizing	Abstracting a general theme or major point(s) (e.g., Write a short summary of events portrayed on a videotape)
2.5 INFERRING	Concluding, extrapolating, interpolating, predicting	Drawing a logical conclusion from presented information (e.g., In learning a foreign language, infer grammatical principles from examples)
2.6 COMPARING	Contrasting, mapping, matching	Detecting correspondences between two ideas, objects, and the like (e.g., Compare historical events to contemporary situations)
2.7 EXPLAINING	Constructing models	Constructing a cause-and-effect model of a system (e.g., Explain the causes of important 18th Century events in France)
3. APPLY—Carry out or use a procedure in a given situation		
3.1 EXECUTING	Carrying out	Applying a procedure to a familiar task (e.g., Divide one whole number by another whole number, both with multiple digits)
3.2 IMPLEMENTING	Using	Applying a procedure to an unfamiliar task (e.g., Use Newton's Second Law in situations in which it is appropriate)

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Table 3: A Taxonomy for Teaching, Learning, and Assessing

THE KNOWLEDGE DIMENSION	THE COGNITIVE PROCESS DIMENSION					
	1. Remember— Retrieve relevant knowledge from long-term memory 1.1 Recognizing 1.2 Recalling	**2. Understand—** Construct meaning from instructional messages including oral, written, and graphic communication 2.1 Interpreting 2.2 Exemplifying 2.3 Classifying 2.4 Summarizing 2.5 Inferring 2.6 Comparing 2.7 Explaining	**3. Apply—**Carry out or use a procedure in a given situation 3.1 Executing 3.2 Implementing	**4. Analyze—**Break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose 4.1 Differentiating 4.2 Organizing 4.3 Attributing	**5. Evaluate—**Make judgments based on criteria and standards 5.1 Checking 5.2 Critiquing	**6. Create—**Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure 6.1 Generating 6.2 Planning 6.3 Producing
A. Factual Knowledge—The basic elements that students must know to be acquainted with a discipline or solve problems in it AA. Knowledge of terminology AB. Knowledge of specific details and elements						
B. Conceptual Knowledge—The interrelationships among the basic elements within a larger structure that enable them to function together BA. Knowledge of classifications and categories BB. Knowledge of principles and generalizations BC. Knowledge of theories, models, and structures						
C. Procedural Knowledge—How to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods CA. Knowledge of subject-specific skills and algorithms CB. Knowledge of subject-specific techniques and methods CC. Knowledge of criteria for determining when to use appropriate procedures						
D. Metacognitive Knowledge—Knowledge of cognition in general as well as awareness of one's own cognition DA. Strategic knowledge DB. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge DC. Self-knowledge						

Appendix B

Students with Significant Cognitive Disabilities: Three Levels of Symbolic Communication

Presymbolic

- Has not yet acquired the skills to discriminate between pictures or other symbols (and does not use symbols to communicate). May or may not use objects to communicate. May or may not use idiosyncratic gestures, sounds/vocalizations, and movements/touch to communicate with others.
- Students may use motor initiation to communicate their wants/needs (e.g., going to the kitchen when hungry, going to the door when playing outside is desired).
- A direct and immediate relationship between a routine activity and the student's response may or may not be apparent. The student may have the capacity to sort very different objects, may be trial and error. Mouthing and manipulation of objects leads to knowledge of how objects are used. May combine objects (e.g., place one block on another).

Concrete Symbolic

- May use some symbols to communicate (e.g., pictures, logos, objects). Beginning to acquire symbols as part of a communication system.
- May have limited emerging functional academic skills. Identification of neutral items may be emerging, but representations will probably need to be related to the student's immediate environment (e.g., digital picture of Walmart for community based instruction) and needs (e.g., hand a picture from schedule for lunch when hungry).

Abstract Symbolic

- Communicates with symbols (e.g., pictures, numbers) or words (e.g., spoken words, assistive technology, ASL, home signs). May have emerging or basic functional academic skills. Emerging writing or graphic representation for the purpose of conveying meaning through writing, drawing, or computer keying.

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