

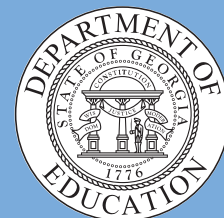
Georgia  
**Milestones**  
Assessment System



**Assessment Guide**  
**Biology**



**Assessment Guide**



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## **THE GEORGIA MILESTONES ASSESSMENT SYSTEM**

The purpose of the Georgia Student Assessment Program is to measure student achievement of the state-adopted content standards and inform efforts to improve teaching and learning. Results of the assessment program are utilized to identify students failing to achieve mastery of content, to provide educators with feedback about instructional practice, and to assist school districts in identifying strengths and weaknesses in order to establish priorities in planning educational programs.

The State Board of Education is required by Georgia law (O.C.G.A. §20-2-281) to adopt assessments designed to measure student achievement relative to the knowledge and skills set forth in the state-adopted content standards. The Georgia Milestones Assessment System (Georgia Milestones) fulfills this requirement and, as a key component of Georgia's Student Assessment Program, is a comprehensive summative assessment program spanning Grade 3 through high school. Georgia Milestones measures how well students have learned the knowledge and skills outlined in the state-adopted content standards in Language Arts, Mathematics, Science, and Social Studies. Students in Grades 3–8 take an end-of-grade assessment in each content area, while high school students take an end-of-course assessment for each of the ten courses designated by the State Board of Education. In accordance with State Board Rule, Georgia Milestones end-of-course measures serve as the final exams for the specified high school courses.

The main purpose of Georgia Milestones is to inform efforts to improve student achievement by assessing student performance on the standards specific to each course or subject/grade tested. Specifically, Georgia Milestones is designed to provide students and their parents with critical information about the students' achievement and, importantly, their preparedness for the next educational level. The assessment system is a critical informant of the state's accountability measure, the College and Career Ready Performance Index (CCRPI), providing an important gauge about the quality of the educational services and opportunities provided throughout the state. The ultimate goal of Georgia's assessment and accountability system is to ensure that all students are provided the opportunity to engage with high-quality content standards, receive high-quality instruction predicated upon those standards, and are positioned to meet high academic expectations.

Features of the Georgia Milestones Assessment System include:

- open-ended (constructed-response) items in Language Arts and Mathematics (all grades and courses);
- a writing component (in response to passages read by students) at every grade level and course within the Language Arts assessment;
- norm-referenced items in all content areas and courses to complement the criterion-referenced information and to provide a national comparison; and
- a transition to online administration over time, with online administration considered the primary mode of administration and paper/pencil as a backup until the transition is complete.

The primary mode of administration for the Georgia Milestones program is online, with the goal of completing the transition from paper/pencil within five years after the inaugural administration (i.e., the 2014–2015 school year). Paper/pencil test materials (such as Braille) will remain available for students with disabilities who may require them in order to access the assessment.

Georgia Milestones follows guiding principles to help ensure that the assessment system:

- is sufficiently challenging to ensure Georgia students are well positioned to compete with other students across the United States and internationally;
- is intentionally designed across grade levels to send a clear signal of student academic progress and preparedness for the next level, whether it is the next grade level, course, or college or career;
- is accessible to all students, including those with disabilities or limited English proficiency, at all achievement levels;
- supports and informs the state’s educator-effectiveness initiatives, ensuring items and forms are appropriately sensitive to quality instructional practices; and
- accelerates the transition to online administration, allowing—over time—for the inclusion of innovative technology-enhanced items.

## **GEORGIA MILESTONES END-OF-COURSE (EOC) ASSESSMENTS**

As previously mentioned, Georgia law (§20-2-281) mandates that the State Board of Education adopt EOC assessments for core courses to be determined by the Board. An EOC assessment serves as a student’s final exam in the associated course. With educator input and State Board approval, the Georgia Milestones EOC assessments measure student achievement in the following courses: Ninth Grade Literature and Composition, American Literature and Composition, Algebra I, Geometry, Coordinate Algebra, Analytic Geometry, Physical Science, Biology, United States History, and Economics/Business/Free Enterprise.

Any student enrolled in and/or receiving credit for one of the above-mentioned courses, regardless of grade level, is required to take the Georgia Milestones EOC assessment upon completion of that course. This includes middle school students completing a course associated with a Georgia Milestones EOC assessment, regardless of whether they are receiving high school credit. Students enrolling from non-accredited programs are required to take and pass the Georgia Milestones EOC assessment prior to receiving credit for the course.

A student’s final grade in the course will be calculated using the Georgia Milestones EOC assessment as follows (State Board Rule 160-4-2-.13):

- For students enrolled in Grade 9 for the first time before July 1, 2011, the EOC assessment counts as 15% of the final grade.
- For students enrolled in Grade 9 for the first time on or after July 1, 2011, the EOC assessment counts as 20% of the final grade.

Results of the EOC assessments, according to the legislated and identified purposes, must:

- provide a valid measure of student achievement of the state content standards across the full achievement continuum;
- serve as the final exam for each course, contributing 15% or 20% to the student's final course grade;
- provide a clear signal of each student's preparedness for the next course and ultimately post-secondary endeavors (college and career);
- allow for the detection of the academic progress made by each student from one assessed course to the next;
- support and inform educator-effectiveness measures; and
- inform state and federal accountability measures at the school, district, and state levels.

Additional uses of the EOC assessments include: (1) certifying student proficiency prior to the awarding of credit for students enrolling from non-accredited private schools, home study programs, or other non-traditional educational centers and (2) allowing eligible students to demonstrate competency without taking the course and earn course credit (e.g., "test out"). In both cases, students are allotted *one* administration.

## ASSESSMENT GUIDE

The Georgia Milestones Biology EOC Assessment Guide is provided to acquaint Georgia educators and other stakeholders with the structure of and content assessed by the test. Importantly, this guide is not intended to inform instructional planning. It is essential to note that there are a small number of content standards that are better suited for classroom or individual assessment than for large-scale summative assessment. While those standards are not included in the tests and therefore are not included in this Assessment Guide, the knowledge, concepts, and skills inherent in those standards are often required for the mastery of the standards that are assessed. Failure to attend to all content standards within a course can limit a student's opportunity to learn and show what he or she knows and can do on the assessment.

The Georgia Milestones Biology EOC Assessment Guide is in *no way* intended to substitute for the state-mandated content standards; it is provided to help educators better understand the structure and content of the assessment, *but it is not all-encompassing of the knowledge, concepts, and skills covered in the course or assessed on the test*. The state-adopted content standards and associated standards-based instructional resources, such as the Content Frameworks, should be used to plan instruction. This Assessment Guide can serve as a *supplement* to those resources, in addition to any locally developed resources, **but should not be used in isolation**. In principle, the Assessment Guide is intended to be descriptive of the assessment program and should not be considered all-inclusive. The state-adopted content standards are located at [www.georgiastandards.org](http://www.georgiastandards.org).

## TESTING SCHEDULE

The Georgia Milestones Biology EOC assessment is offered during three Main Administrations. Main Administrations are primarily intended to provide an opportunity to assess student achievement at the completion of a course and to serve as the final exam for the associated course as required by State Board Rule. As a result, the EOC assessment should occur as close to the conclusion of the course as possible. Main Administrations can also be utilized to verify credit from a non-accredited school or home schooling. In addition to the Main Administrations, Mid-Month Administrations are provided in order to allow students additional testing opportunities for the various reasons noted below.

Purpose for EOC Assessment	Winter & Spring Main Administrations	Mid-Month Administrations	Summer Main Administration
Completion of Course	Yes	Yes	Yes
Makeup from Previous Administration	Yes	Yes	Yes
Retest	No*	Yes	Yes
Test Out	No	Yes**	Yes
Validation of Credit	Yes	Yes	Yes

\*Winter and Spring Main Administrations cannot be used for the purpose of a retest.

\*\*August, September, and March Mid-Month Administrations as well as the Summer Main Administration can be used for the purpose of a test out.

**Note:** Each district determines a local testing window within the state-designated testing window.

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## TEST STRUCTURE

### DESCRIPTION OF TEST FORMAT AND ORGANIZATION

The Georgia Milestones Biology EOC assessment is primarily a criterion-referenced test designed to provide information about how well a student has mastered the state-adopted content standards within the course. Each student will receive one of four Achievement Level designations, depending on how well the student has mastered the course content standards. The four Achievement Level designations are Beginning Learner, Developing Learner, Proficient Learner, and Distinguished Learner. In addition to criterion-referenced information, the Georgia Milestones measures will also include a limited sample of nationally norm-referenced items to provide a signal of how Georgia students are achieving relative to their peers nationally. The norm-referenced information provided is supplementary to the criterion-referenced Achievement Level designation and will not be utilized in any manner other than to serve as a barometer of national comparison. Only the criterion-referenced scores and Achievement Level designations will be utilized in the accountability metrics associated with the assessment program (such as student course grades, student growth measures, educator-effectiveness measures, and the CCRPI).

The Biology EOC assessment consists of a total of 75 selected-response items, 66 of which are operational items (and contribute to a student's criterion-referenced and/or norm-referenced score) and 9 of which are field test items (newly written items that are being tried out and do not contribute to the student's scores). The criterion-referenced score, as well as the Achievement Level designation, is based on 55 items, for a total of 55 points. Of the 66 operational items, 20 will be norm-referenced and will provide a national comparison in the form of a national percentile rank. Nine of the items have been verified as aligned to the course content standards by Georgia educators and will therefore contribute to the criterion-referenced Achievement Level designation. The other 11 items will contribute only to the national percentile rank and be provided as supplemental information. Only items that are aligned to the state-adopted content standards will be utilized to inform the criterion-referenced score.

With the inclusion of the norm-referenced items, students may encounter items for which they have not received direct instruction. These items will not contribute to the students' criterion-referenced Achievement Level designation; only items that align to the course content standards will contribute to the criterion-referenced score. Students should be instructed to try their best should they ask about an item that is not aligned to the content they have learned as part of the course.

### Biology EOC Assessment Design

Description	Number of Items	Points for CR <sup>1</sup> Score	Points for NRT <sup>2</sup> Feedback
CR Selected-Response Items	46	46	0
NRT Selected-Response Items	20 <sup>3</sup>	9 <sup>4</sup>	20
CR Field Test Items	9	0	0
<b>Total Items/Points<sup>5</sup></b>	<b>75</b>	<b>55</b>	<b>20</b>

<sup>1</sup>CR—Criterion-Referenced: items aligned to state-adopted content standards

<sup>2</sup>NRT—Norm-Referenced Test: items that will yield a national comparison; may or may not be aligned to state-adopted content standards

<sup>3</sup>Of these items, 9 will contribute to both the CR scores and NRT feedback. The other 11 of these items will contribute to NRT feedback only and will not impact the student's Achievement Level designation, scale score, or grade conversion.

<sup>4</sup>Alignment of national NRT items to course content standards was verified by a committee of Georgia educators. Only approved, aligned NRT items will contribute to a student's CR Achievement Level designation, scale score, and grade conversion score.

<sup>5</sup>Total number of items contributing to CR score: 55; total points: 55; total number of items contributing to NRT feedback: 20; total points: 20

The test will be given in two sections. Students may have up to 70 minutes per section to complete Sections 1 and 2. The total estimated testing time for the Biology EOC assessment ranges from approximately 90 to 140 minutes. Total testing time describes the amount of time students have to complete the assessment. It does not take into account the time required for the test examiner to complete pre-administration and post-administration activities (such as reading the standardized directions to students). Sections 1 and 2 may be administered on the same day or across two consecutive days based on the district's testing protocols for the EOC measures (in keeping with state guidance).

## CONTENT MEASURED

The Biology EOC assessment will measure the Biology standards that are described at [www.georgiastandards.org](http://www.georgiastandards.org).

The content of the assessment is organized into five groupings, or domains, of standards for the purposes of providing feedback on student performance. A content domain is a reporting category that *broadly* describes and defines the content of the course, as measured by the EOC assessment. The standards for Biology are grouped into five domains: Cells, Genetics, Organisms, Ecology, and Evolution. Each domain was created by organizing standards that share similar content characteristics. The content standards describe the level of expertise that Biology educators should strive to develop in their students. Educators should refer to the content standards for a full understanding of the knowledge, concepts, and skills subject to be assessed on the EOC assessment.



The approximate proportional number of points associated with each domain is shown in the following table. A range of cognitive levels will be represented on the Biology EOC assessment. Educators should always use the content standards when planning instruction.

### Biology: Domain Structures and Content Weights

Domain	Standard	Approximate Weight
Cells	SB1 (a, b, c, d)	18%
Genetics	SB2 (a, b, c, d, e, f)	25%
Organisms	SB3 (a, b, c, d)	17%
Ecology	SB4 (a, b, c, d, e, f)	25%
Evolution	SB5 (a, b, c, d, e)	15%

## ITEM TYPES

The Biology EOC assessment consists of selected-response items only.

A selected-response item, sometimes called a multiple-choice item, is defined as a question, problem, or statement that appears on a test followed by several answer choices, sometimes called options or response choices. The incorrect choices, called distractors, usually reflect common errors. The student's task is to choose, from the alternatives provided, the best answer to the question posed in the stem (the question). The Biology selected-response items will have four answer choices.

## DEPTH OF KNOWLEDGE DESCRIPTORS

Items found on the Georgia Milestones assessments, including the Biology EOC assessment, are developed with a particular emphasis on cognitive complexity or Depth of Knowledge (DOK). DOK is measured on a scale of 1 to 4 and refers to the level of cognitive demand required to complete a task (or in this case, an assessment item). The higher the level, the *more complex* the item; however, higher levels do not necessarily mean *more difficult* items. For instance, a question can have a low DOK but a medium or even high difficulty level. Conversely, a DOK 4 question may have a low difficulty level but still require a great deal of cognitive thinking (e.g., analyzing and synthesizing information instead of just recalling it). The following descriptions and table show the expectations of the four DOK levels in greater detail.

**Level 1** (Recall of Information) generally requires students to identify, list, or define, often asking them to recall who, what, when, and where. Consequently, this level usually asks students to recall facts, terms, concepts, and trends and may ask them to identify specific information contained in documents, excerpts, quotations, maps, charts, tables, graphs, or illustrations. Items that require students to “describe” and/or “explain” could be classified at Level 1 or Level 2, depending on what is to be described and/or explained. A Level 1 “describe” and/or “explain” would require students to recall, recite, or reproduce information.

**Level 2** (Basic Reasoning) includes the engagement of some mental processing beyond recalling or reproducing a response. A Level 2 “describe” and/or “explain” would require students to go beyond a description or explanation of recalled information to describe and/or explain a result or “how” or “why.”

**Level 3** (Complex Reasoning) requires reasoning, using evidence, and thinking on a higher and more abstract level than Level 1 and Level 2. Students will go beyond explaining or describing “how and why” to justifying the “how and why” through application and evidence. Level 3 questions often involve making connections across time and place to explain a concept or “big idea.”

**Level 4** (Extended Reasoning) requires the complex reasoning of Level 3 with the addition of planning, investigating, applying significant conceptual understanding, and/or developing that will most likely require an extended period of time. Students should be required to connect and relate ideas and concepts *within* the content area or *among* content areas in order to be at this highest level. The distinguishing factor for Level 4 would be a show of evidence (through a task, a product, or an extended response) that the cognitive demands have been met.

The following table identifies skills that students will need to demonstrate at each DOK level, along with question cues appropriate for each level.

Level	Skills Demonstrated	Question Cues
<p style="text-align: center;">Level 1 Recall of Information</p>	<ul style="list-style-type: none"> <li>• Make observations</li> <li>• Recall information</li> <li>• Recognize properties, patterns, processes</li> <li>• Know vocabulary, definitions</li> <li>• Know basic concepts</li> <li>• Perform one-step processes</li> <li>• Translate from one representation to another</li> <li>• Identify relationships</li> </ul>	<ul style="list-style-type: none"> <li>• Tell what, when, or where</li> <li>• Find</li> <li>• List</li> <li>• Define</li> <li>• Identify; label; name</li> <li>• Choose; select</li> <li>• Compute; estimate</li> <li>• Express</li> <li>• Read from data displays</li> <li>• Order</li> </ul>
<p style="text-align: center;">Level 2 Basic Reasoning</p>	<ul style="list-style-type: none"> <li>• Apply learned information to abstract and real-life situations</li> <li>• Use methods, concepts, theories in abstract and real-life situations</li> <li>• Perform multi-step processes</li> <li>• Solve problems using required skills or knowledge (requires more than habitual response)</li> <li>• Make a decision about how to proceed</li> <li>• Identify and organize components of a whole</li> <li>• Extend patterns</li> <li>• Identify/describe cause and effect</li> <li>• Recognize unstated assumptions, make inferences</li> <li>• Interpret facts</li> <li>• Compare or contrast simple concepts/ideas</li> </ul>	<ul style="list-style-type: none"> <li>• Apply</li> <li>• Complete</li> <li>• Describe</li> <li>• Explain how; demonstrate</li> <li>• Construct data displays</li> <li>• Construct; draw</li> <li>• Analyze</li> <li>• Extend</li> <li>• Connect</li> <li>• Classify</li> <li>• Arrange</li> <li>• Compare; contrast</li> </ul>

Level	Skills Demonstrated	Question Cues
<p style="text-align: center;">Level 3 Complex Reasoning</p>	<ul style="list-style-type: none"> <li>• Solve an open-ended problem with more than one correct answer</li> <li>• Create a pattern</li> <li>• Generalize from given facts</li> <li>• Relate knowledge from several sources</li> <li>• Draw conclusions</li> <li>• Make predictions</li> <li>• Translate knowledge into new contexts</li> <li>• Compare and discriminate between ideas</li> <li>• Assess value of methods, concepts, theories, processes, formulas</li> <li>• Make choices based on a reasoned argument</li> <li>• Verify the value of evidence, information, numbers, data</li> </ul>	<ul style="list-style-type: none"> <li>• Plan; prepare</li> <li>• Predict</li> <li>• Create; design</li> <li>• Ask “what if?” questions</li> <li>• Generalize</li> <li>• Justify; explain why; support; convince</li> <li>• Assess</li> <li>• Rank; grade</li> <li>• Test; judge</li> <li>• Recommend</li> <li>• Select</li> <li>• Conclude</li> </ul>
<p style="text-align: center;">Level 4 Extended Reasoning</p>	<ul style="list-style-type: none"> <li>• Analyze and synthesize information from multiple sources</li> <li>• Examine and explain alternative perspectives across a variety of sources</li> <li>• Combine and synthesize ideas into new concepts</li> </ul>	<ul style="list-style-type: none"> <li>• Design</li> <li>• Connect</li> <li>• Synthesize</li> <li>• Apply concepts</li> <li>• Critique</li> <li>• Analyze</li> <li>• Create</li> <li>• Prove</li> </ul>

## SCORES

Selected-response items are machine scored. The Biology EOC assessment consists of only selected-response items.

Students will receive a scale score and an Achievement Level designation based on total test performance. In addition, students will receive information on how well they performed at the domain level. Students will also receive a norm-referenced score based on a set of norm-referenced items included within the test; this score will allow comparison to a national norming group of students.

## EXAMPLE ITEMS

Example items, which are representative of the applicable DOK levels across various Biology content domains, are provided.

**All example and sample items contained in this guide are the property of the Georgia Department of Education.**

### Example Item 1

**DOK Level 1:**

**Biology Content Domain:** Organisms

**Standard:** SB3d. Compare and contrast viruses with living organisms.

**Does the presence of DNA help scientists classify disease-causing agents as bacteria or viruses?**

- A. Yes, viruses contain DNA but bacteria do not.
- B. Yes, bacteria contain DNA but viruses do not.
- C. No, neither bacteria nor viruses contain DNA.
- D. No, both bacteria and some viruses contain DNA.

**Correct Answer:** D

**Explanation of Correct Answer:** The correct answer is choice (D) No, both bacteria and some viruses contain DNA. Choices (A) and (C) are incorrect because all bacteria contain DNA. Choice (B) is incorrect because some viruses contain DNA.

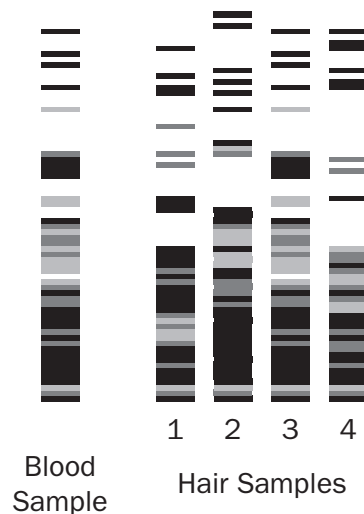
## Example Item 2

**DOK Level 2:**

**Biology Content Domain:** Genetics

**Standard:** SB2f. Examine the use of DNA technology in forensics, medicine, and agriculture.

The diagram shows the DNA fingerprints from a blood sample and four different hair samples.



Based on the DNA fingerprints, which hair sample came from the same organism as the blood sample?

- A. Hair Sample 1
- B. Hair Sample 2
- C. Hair Sample 3
- D. Hair Sample 4

**Correct Answer:** C

**Explanation of Correct Answer:** The correct answer is choice (C) Hair Sample 3. The pattern of dark and light bands in this hair sample exactly matches the pattern in the blood sample. Choices (A), (B), and (D) are incorrect because each of these hair samples has a different pattern of dark and light bands that does not match the pattern in the blood sample.

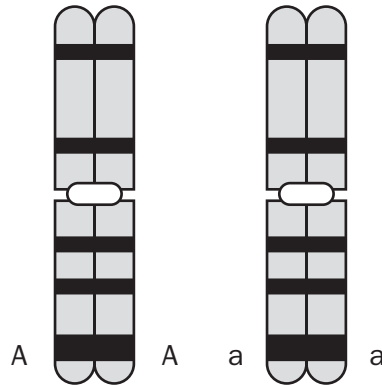
### Example Item 3

**DOK Level 2:**

**Biology Content Domain:** Evolution

**Standard:** SB5a. Trace the history of the theory.

The diagram shows a pair of homologous chromosomes in a cell prior to the first division of meiosis.



After completing meiosis, what percentage of the male sex cells would contain a chromosome with the dominant allele “A”?

- A. 0%
- B. 25%
- C. 50%
- D. 100%

**Correct Answer:** C

**Explanation of Correct Answer:** The correct answer is choice (C) 50%. Each of the four sex cells (gametes) that result from meiosis of a single cell have an equal probability of containing one of the four chromatids in the original homologous pair of chromosome. Since two of the four chromatids contained a dominant “A” allele, 50% of the sex cells will contain that dominant “A” allele. Choices (A), (B), and (D) are incorrect because they are values other than 50%.



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**Example Item 4****DOK Level 3:****Biology Content Domain:** Ecology**Standard:** SB4a. Investigate the relationships among organisms, populations, communities, ecosystems, and biomes.

**Population density is found by dividing the number of organisms in an ecosystem by the total area of the ecosystem. If 50 square meters of an ecosystem are surveyed and 5 rabbits are sighted, what is the estimated population density of the rabbits?**

- A. 1 rabbit per 5 square meters
- B. 1 rabbit per 10 square meters
- C. 0.5 rabbit per square meter
- D. 0.1 rabbit per 5 square meters

**Correct Answer:** B

**Explanation of Correct Answer:** The correct answer is choice (B) 1 rabbit per 10 square meters. There are 5 rabbits per 50 square meters; simplifying this ratio results in 1 rabbit per 10 square meters. To check this answer, note that both 5 divided by 50 and 1 divided by 10 equal 0.1 (a reduction to 0.1 rabbits per square meter). Choices (A), (C), and (D) are incorrect because the ratios of rabbits to total area have not been properly reduced. In choice (A), dividing 1 by 5 equals 0.2, not 0.1. In choice (C), dividing 0.5 by 1 equals 0.5, not 0.1. In choice (D), dividing 0.1 by 5 equals 0.02, not 0.1.

### Example Item 5

**DOK Level 3:**

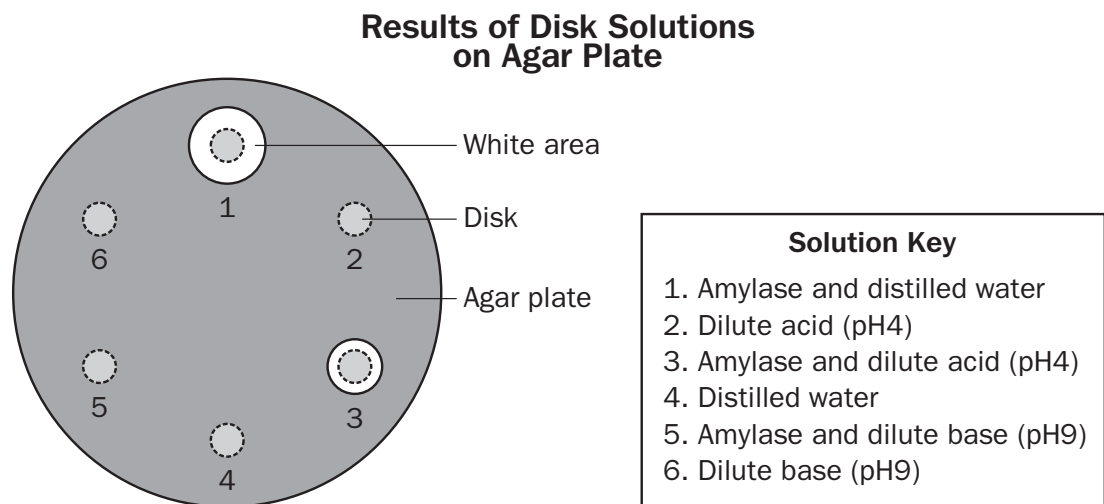
**Biology Content Domain:** Cells

**Standard:** SB1b. Explain how enzymes function as catalysts.

A student investigated the effects of the enzyme amylase on starch digestion. The student followed this procedure:

- Soak a different paper disk in one of six solutions.
- Place the disks on an agar plate containing starch.
- Store the agar plate at 37°C for one hour.
- Flood the agar plate with iodine and then drain.
- Observe the results.

A white area around a disk indicates starch digestion. The student's results are shown in this diagram.



**Which conclusion about the enzyme amylase do the student's results support?**

- A. Iodine destroys amylase.
- B. Amylase does not digest starch.
- C. Amylase works best in basic solutions.
- D. The action of amylase is sensitive to pH.

**Correct Answer:** D

**Explanation of Correct Answer:** The correct answer is choice (D) The action of amylase is sensitive to pH. The solution key indicates that both disk 1 and disk 3 were soaked in a solution that contained amylase. In addition, the pH of the solution was either neutral or acidic. The area of the agar plate indicated that starch digestion did occur in the area of both disks. Disk 5, which was soaked in a solution that also contained amylase but had a basic pH, did not show similar results. Indicating that pH does have an effect on the action of amylase. Choice (A) is incorrect because the diagram does not give any evidence to support that iodine destroys amylase. If that were the case, then disk 1 and disk 3 would have no impact on starch digestion. Choice (B) is incorrect because disk 1 and disk 3 were both soaked in solutions that contained amylase, and starch digestion did occur in the area of both disks. Choice (C) is incorrect because the results for disk 1 indicate that amylase actually works best in neutral solutions.

## ADDITIONAL SAMPLE ITEMS

This section has two parts. The first part is a set of 10 sample items for Biology. The second part contains a table that shows for each item the standard assessed, the DOK level, the correct answer (key), and a rationale/explanation about the key and distractors. The sample items can be utilized as a mini-test to familiarize students with the item formats found on the assessment.

**All example and sample items contained in this guide are the property of the Georgia Department of Education.**

**Item 1**

**What is the role of mitochondria in eukaryotic plant cells?**

- A. to transport materials
- B. to provide a storage area
- C. to produce chemical energy
- D. to control chemical reactions

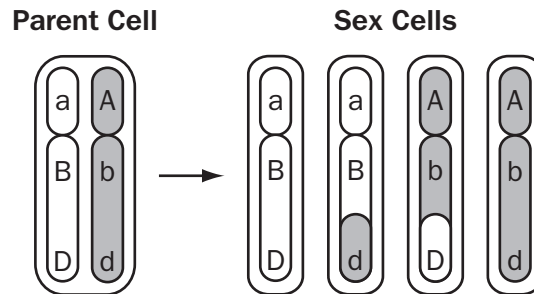
**Item 2**

**Which characteristic does a virus have in common with a eukaryotic cell?**

- A. a cell wall
- B. a mitochondrion
- C. a nucleic acid
- D. a ribosome

### Item 3

The diagram shows the results of meiosis. The parent cell has one pair of chromosomes. The locations of three genes are shown on each chromosome.



Why are the chromosomes in two of the sex cells different from the chromosomes in the parent cell?

- A. crossing over occurred in the chromosome
- B. an insertion mutation occurred during replication
- C. some of the genes were damaged during replication
- D. the chromosomes from another parent cell were introduced

### Item 4

A plant species growing in a certain location has one variety that grows best in wet soil and another variety that grows best in dry soil. Which outcome is MOST LIKELY to occur at the end of an extended drought at that location?

- A. The variety that prefers dry soil will show an increase in population.
- B. The variety that prefers wet soil will show an increase in population.
- C. Both varieties will compete for space, so the size of both populations will remain the same.
- D. Both varieties will adapt to the new conditions, so the size of both populations will remain the same.

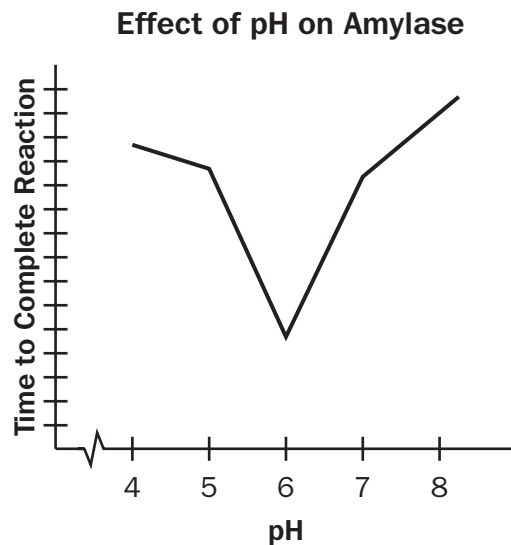
**Item 5**

In prairies around the world, grass species provide food for many different prairie animals. Based on the titles, in which book would a student find the MOST information about relationships between specific plants and animals of the prairie?

- A. *The Prairie Community*
- B. *The Biomes of the Prairie*
- C. *The Ecosystems of the Prairie*
- D. *The Abiotic Factors of a Prairie*

**Item 6**

Amylase is an enzyme in saliva that catalyzes the digestion of starch.



Based on the graph, what is the optimal pH for amylase?

- A. 5
- B. 6
- C. 7
- D. 8

### Item 7

Which of the following supported the change in the classification system from five kingdoms to six kingdoms?

- A. parasites on deep sea fish
- B. new viral diseases in people
- C. molecular differences among bacteria
- D. new insect species in tropical rain forests

### Item 8

Use this information to answer the question.

Alleles and Traits in Pea Plants	
R – round seeds	Y – yellow seeds
r – wrinkled seeds	y – green seeds

Plants with the genotype RrYy are crossed with plants with the genotype rryy. What is the probability of an offspring with round, yellow seeds?

- A. 10%
- B. 25%
- C. 50%
- D. 100%



## Item 9

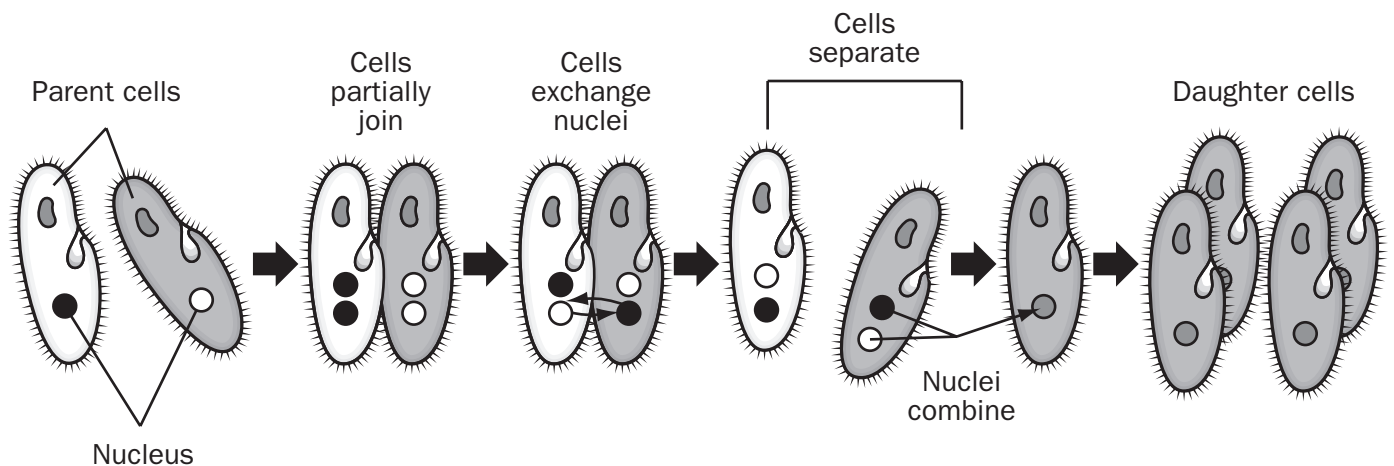
The human body contains nitrogen ( $N_2$ ) as part of amino acids, ATP, DNA, and RNA. The atmosphere is about 79% nitrogen, but humans cannot use nitrogen in its atmospheric form.

How is atmospheric nitrogen made available for use in the human body?

- A. Plants absorb nitrogen after it is changed to useable compounds by the radiant energy of the Sun.
- B. Rainwater dissolves the nitrogen gas in the air and makes it available to plants and animals.
- C. Humans have special enzymes in their lungs to make nitrogen gas useable.
- D. Bacteria change nitrogen gas to useable compounds that can be absorbed by plants.

## Item 10

This diagram shows a form of reproduction in *Paramecium*.



What is the advantage of this type of reproduction in *Paramecium*?

- A. a greater number of offspring are produced
- B. the genetic variability in offspring is increased
- C. a more accurate form of DNA replication occurs
- D. the exchange of genetic information is decreased

**ADDITIONAL SAMPLE ITEM KEYS**

Item	Standard/ Element	Characteristics of Science Standard/ Element	DOK Level	Correct Answer	Explanation
1	SB1a	n/a	1	C	The correct answer is choice (C) to produce chemical energy. Mitochondria convert the energy stored in food into energy forms that the cell can use. Choice (A) is incorrect because organelles such as vesicles transport materials within cells. Choice (B) is incorrect because organelles such as vacuoles are storage areas for cells. Choice (D) is incorrect because substances such as enzymes control chemical reactions within cells.
2	SB3d	SCSh7a	2	C	The correct answer is (C) a nucleic acid. Both viruses and eukaryotic cells contain genetic material, DNA and RNA, which are nucleic acids. Choices (A), (B), and (D) are incorrect because viruses do not contain cell organelles.
3	SB2d1	SCSh3e	2	A	The correct answer is choice (A) crossing over occurred in the chromosome. During the process of crossing over, chromosomes exchange alleles to produce new combinations. Choices (B) and (C) are incorrect because replication happens before meiosis takes place. Choice (D) is incorrect because meiosis does not involve an additional parent cell.

Item	Standard/ Element	Characteristics of Science Standard/ Element	DOK Level	Correct Answer	Explanation
4	SB5d	SCSh3	2	A	<p>The correct answer is choice (A) The variety that prefers dry soil will show an increase in population. An extended drought will cause the soil in the location to dry out. This will give a competitive advantage to the variety that prefers dry soil. Choices (B) and (C) are incorrect because the variety that prefers wet soil will have a competitive disadvantage; it will likely struggle to obtain resources and experience a population decrease. Choice (D) is incorrect because, although it is possible that the variety that prefers wet soil will adapt to the new conditions, this will require many generations; in the meantime, the variety that prefers dry soil will likely thrive and experience a population increase.</p>
5	SB4a	SCSh7a	2	A	<p>The correct answer is choice (A) <i>The Prairie Community</i>. A book focused on the organisms in a prairie community will have more detailed information about the relationships between the organisms than books about other aspects of a prairie. Choices (B) and (C) are incorrect because they would likely focus on other content that goes beyond the relationships between the organisms in the prairie. Choice (D) is incorrect because it focuses on the non-living factors that affect the prairie community.</p>

Item	Standard/ Element	Characteristics of Science Standard/ Element	DOK Level	Correct Answer	Explanation
6	SB1b	SCSh3d	2	B	The correct answer is choice (B) 6. The graph shows that when the pH is 6, amylase catalyzes the digestion of starch in the least amount of time. Choices (A), (C), and (D) are incorrect because the graph shows that when pH is greater or less than 6, amylase requires more time to catalyze the digestion of starch.
7	SB3c	SCSh7c	2	C	The correct answer is choice (C) molecular differences among bacteria. These differences led scientists to divide what had been a single kingdom, Monera, into two kingdoms, Eubacteria and Archaeobacteria. Choice (A) is incorrect because parasites may belong to the Plantae or Animalia kingdoms. Choice (B) is incorrect because viruses are not organisms and therefore do not belong to a kingdom. Choice (D) is incorrect because insects belong to the Animalia kingdom.
8	SB2c	SCSh5e	3	B	The correct answer is choice (B) 25%. Crossing these genotypes produces 16 possible combinations of alleles. Of these combinations, 4 have both the allele for round seeds (R) and the allele for yellow seeds (Y). Choices (A), (C), and (D) are incorrect because 4 out of 16 equals 25%, not 10%, 50%, or 100%.

Item	Standard/ Element	Characteristics of Science Standard/ Element	DOK Level	Correct Answer	Explanation
9	SB4b	SCSh7b	3	D	The correct answer is choice (D) Bacteria change nitrogen gas to useable compounds that can be absorbed by plants. Animals, including humans, then absorb this nitrogen when they eat plants. Choices (A), (B), and (C) are incorrect because they do not accurately describe natural processes.
10	SB2e	SCSh3f	3	B	The correct answer is choice (B) the genetic variability in offspring is increased. This diagram shows conjugation, a sexual process through which organisms such as <i>Paramecium</i> , which typically reproduce asexually, temporarily conjoin and exchange nuclear material. Choices (A) and (C) are incorrect because these are not effects of conjugation. Choice (D) is incorrect because the opposite happens: the exchange of genetic information within a population increases.

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