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Introduction

_Louisiana Believes_ embraces the principle that all children can achieve at high levels. _Louisiana Believes_ also promotes the idea that Louisiana’s educators should be empowered to make decisions to support the success of their students. In keeping with these values, the Department has created documents with sample test items to help prepare teachers and students for the EOC tests. These documents reflect the State’s commitment to consistent and rigorous assessments and provide educators and families with clear information about expectations for student performance.

**Purpose of this Document**

Teachers are encouraged to use the sample items presented in this document in a variety of ways to gauge student learning and to guide instruction and development of classroom assessments. The document includes multiple-choice items and a task set that includes two multiple-choice items and an extended-response item. These items exemplify what students scoring at specified achievement levels should know and be able to do. A discussion of each item highlights the knowledge and skills the item is intended to measure.

As you review the items, it is important to remember that a student’s achievement level is based on his or her total test score (cumulative score for all questions in the test), not on one particular item or session, and that the sample items included in this document represent a portion of the body of knowledge and skills measured by the EOC test.

**Biology Administration**

The Biology EOC test is administered to students who have completed the following course:

- Biology: course code 150301
EOC Achievement Levels

Student scores for the Biology EOC test are reported at four achievement levels: Excellent, Good, Fair, and Needs Improvement. General definitions of the EOC achievement levels are shown below.

EOC Achievement-Level Definitions

<table>
<thead>
<tr>
<th><strong>Excellent:</strong> A student at this achievement level has demonstrated mastery of course content beyond Good.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Good:</strong> A student at this achievement level has demonstrated mastery of course content and is well prepared for the next level of coursework in the subject area.</td>
</tr>
<tr>
<td><strong>Fair:</strong> A student at this achievement level has demonstrated only the fundamental knowledge and skills needed for the next level of coursework in the subject area.</td>
</tr>
<tr>
<td><strong>Needs Improvement:</strong> A student at this achievement level has not demonstrated the fundamental knowledge and skills needed for the next level of coursework in the subject area.</td>
</tr>
</tbody>
</table>

The Biology EOC test contains forty-six multiple-choice items and one task set that includes multiple-choice items and an extended-response item. In addition, some field test items are embedded so that new forms can be developed for future use.

Multiple-choice items assess knowledge, conceptual understanding, and application of skills. They consist of an interrogatory stem followed by four answer options and are scored as correct or incorrect.

The task consists of two multiple-choice items and one extended-response item. The items are based on one or two stimulus materials. The extended-response portion of the task requires students to provide a written response in which they incorporate science content knowledge with evidence from the stimulus materials. The Biology EOC extended-response item is scored on a scale of 0 to 4 points. The general extended-response scoring rubric, shown on page 3, provides descriptors for each score point.
### Scoring Rubric

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
</table>
| **4** | • The student’s response demonstrates an in-depth understanding of the relevant content and/or procedures.  
• The student completes all key components of the task accurately and communicates ideas effectively.  
• The student’s response is extensively supported by relevant evidence in the form of data and/or examples.  
• Where appropriate, the student uses a higher level of reasoning skills that may include applications, procedures, etc.  
• The response contains no errors. |
| **3** | • The student’s response demonstrates a good understanding of major concepts, although less important ideas or details may be overlooked or misunderstood.  
• The student completes most important aspects of the task accurately and communicates clearly.  
• The student’s response is sufficiently supported by relevant evidence.  
• The student’s logic and reasoning may contain minor flaws.  
• The response contains minor errors. |
| **2** | • The student’s response demonstrates a limited understanding of major concepts (gaps in conceptual understanding).  
• The student completes some parts of the task successfully.  
• The student’s response is not sufficiently supported by relevant evidence.  
• The response contains errors. |
| **1** | • The student’s response demonstrates a basic understanding of major concepts.  
• The student completes only a small portion of the task.  
• The student’s response contains little or no support of relevant evidence.  
• The student response contains major errors. |
| **0** | • The student’s response is incorrect, irrelevant, too brief to evaluate, or blank. |

Prior to December 2013, it was possible for a student to earn a total of 50 points on the Biology EOC test. This will increase to 52 points in the December 2013 and May 2014 administrations when two additional multiple-choice items associated with the task will be added to Session 2. The number of raw-score points that a student has to achieve in order to reach each achievement level varies slightly, given the difficulty of a particular form of the test. The table on page 4 shows the raw-score ranges for the forms that were administered in spring 2013.
Raw-Score Ranges for the Spring 2013 Biology EOC Test

<table>
<thead>
<tr>
<th>Achievement Level</th>
<th>Raw-Score Range*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>41–50</td>
</tr>
<tr>
<td>Good</td>
<td>30–40</td>
</tr>
<tr>
<td>Fair</td>
<td>21–29</td>
</tr>
<tr>
<td>Needs Improvement</td>
<td>0–20</td>
</tr>
</tbody>
</table>

* For December 2013 and May 2014, the total possible points will increase to 52.

Testing Materials

Students taking the Biology EOC test have access to scratch paper and pencils provided by test administrators. These materials can be used by students during all three sessions of the Biology EOC test.
Multiple-Choice Items

This section presents six multiple-choice items selected to illustrate the type of skills and knowledge students would need to perform at three of the four achievement levels used to report EOC results—Excellent, Good, and Fair. Examples of Needs Improvement work are not included; by definition, work classified as Needs Improvement exhibits a narrower range of knowledge and skills than work classified as Fair. Information shown for each item includes

- the strand,
- the GLE each item measures,
- the achievement level,
- the correct answer, and
- commentary on the skills and knowledge measured by the item.
Use the diagrams to answer the question.

The diagram shows the concentration of different molecules across a lipid bilayer. Which numbered diagram or diagrams represent active transport?

A. 1 only
B. 2 and 3
C. 1 and 3
D. 3 only

*correct answer

This item would most likely be answered correctly by students who score at the Excellent level. This item requires students to identify key features of active transport.

Option A illustrates diffusion from a high concentration to a lower concentration. Option B refers to two diagrams: one (diagram 2) shows diffusion from a high concentration to a lower concentration while the other (diagram 3) shows active transport. Option C also refers to two diagrams: one (diagram 1) illustrates diffusion from a high concentration to a low concentration and the other (diagram 3) shows active transport.

Option D is the correct answer. The key attribute of active transport shown in diagram 3 is that energy is used by a carrier protein to move a molecule from an area of low concentration to one with a higher concentration of that type of molecule.
Use the flowchart to answer the question.

Human Immune System

1  antigen

2  macrophage presents antigen

3  helper T cells activated
   memory helper T cells
   killer T cells

Which statement identifies the stage of the human immune response shown at each number?

A. 1 is detection, 2 is defense, and 3 is invasion.
B. 1 is defense, 2 is detection, and 3 is invasion.
*C. 1 is invasion, 2 is detection, and 3 is defense.
D. 1 is invasion, 2 is defense, and 3 is detection.

*correct answer

This item would most likely be answered correctly by students who score at the Excellent level. This item requires students to interpret a three-stage diagram that shows how a macrophage helps activate T cells to attack an antigen such as a virus.
Option A represents an incorrect order of events; invasion has to occur before detection. Option B shows an incorrect order of events; invasion and detection have to happen before defense. Option D refers to an incorrect order of events; detection needs to occur before a defense can be initiated.

Option C is the correct answer. First an invasion occurs and is then detected by macrophages which then stimulate a defense reaction by the T cells.
Scientists introduce ten male pheasants and thirty female pheasants to an island on which pheasants have not previously lived. The island has a natural food source and no predators of pheasants.

Which graph **best** predicts the number of pheasants on the island 50 years after their introduction to the island?

A. *Number of Pheasants over Time*

B. *Number of Pheasants over Time*

C. *Number of Pheasants over Time*

D. *Number of Pheasants over Time*

*correct answer

This item would most likely be answered correctly by students who score at the **Good** level and above. This item requires students to interpret the population dynamics for a newly introduced species with no predators or established diseases.
Option A represents a population that grows very quickly, followed by a rapid decrease. Options B illustrates a jagged pattern, suggesting seasonal peaks and valleys for the population. Option C shows an exponential decay in the population, represented by the rapid decrease in the curve.

Option D is the correct answer. The pheasant population increases rapidly, and then levels off and fluctuates around the carrying capacity for the environment.
**Strand:** Earth and Space Science—The Origin and Evolution of the Earth System

**Biology GLE ESS 18:** Use data from radioactive dating techniques to estimate the age of earth materials (ESS-H-C2)

**Achievement Level:** Good

---

**Use the graph to answer the question.**

![Graph: Radioactive Decay of Carbon-14](image)

The half-life of carbon-14 is approximately 5,700 years. A fish fossil is found in a rock layer that has 25% of its original carbon-14 remaining. Which is the best approximation of the age of the fish fossil?

A. 2,850 years  
B. 5,700 years  
C. 8,550 years  
D. 11,400 years

*correct answer

This item would most likely be answered correctly by students who score at the Good level and above. This item requires students to use the radioactive decay graph of carbon-14 to determine the age of a fossil.

Option A represents half of 5,700 years, implying that more than 50% of the carbon-14 should be remaining. Option B represents one half-life, implying that 50% of the carbon-14 should be remaining. Option C represents an age that is more than one half-life but less than two half-lives. If true, there would be more than 25% of the carbon-14 remaining.

Option D is the correct answer. If a rock layer has 25% of its carbon-14 left, then two half-lives have passed, which is 11,400 years.
Use the model to answer the question.

Which characteristics do X and Y most likely represent in this model?

A. X represents increasing temperature, and Y represents increasing moisture.
B. X represents increasing temperature, and Y represents decreasing moisture.
*C. X represents decreasing temperature, and Y represents increasing moisture.
D. X represents decreasing temperature, and Y represents decreasing moisture.

*correct answer
This item would most likely be answered correctly by students who score at the *Good* level and above. This item requires students to interpret a model listing some common biomes in terms of average temperature and the amount of precipitation. For example, tundra is much colder than a dry desert, while a tropical rain forest is much wetter than any kind of desert.

Option A lists the correct value for Y but provides the opposite value for X. Option B lists the opposite values for both X and Y. Option D lists the correct value for X but provides the opposite value for Y.

Option C is the correct answer. The changes in biomes in the direction indicated by X show a series of dry environments, each colder on average as you move up the chart. At the same time, the changes in the direction indicated by Y show a steady increase in the moisture level in the biome.
**Strand:** Life Science—Biological Evolution  
**Biology GLE LS 15:** Compare the embryological development of animals in different phyla (LS-H-C1) (LS-H-A3)  
**Achievement Level:** Fair

Use the illustration to answer the question.

![Embryos](image)

The illustration shows four embryos at the same stage of early development. These embryos will develop into four very different organisms. In which way are these embryos similar?

A. They are genetically identical.  
B. They are beginning to form a head and backbone.  
C. They contain the same number of cells.  
D. They will mature at the same rate.

*correct answer

This item would most likely be answered correctly by students who score at the Fair level and above. This item requires students to realize that these embryos all represent chordates that have a brain case and a spinal cord encased in a backbone.

Option A represents a scenario in which all the embryos are not only the same species, but also identical twins. Option C could apply during the first few rounds of cell division, but not after the cells have started to differentiate. Option D describes what could happen if all the embryos were the same species. Option B is the correct answer. Each embryo is following its own path but with similarities to other chordates. At this stage, the head and backbone are beginning to form.
Task

This section presents a task set that includes two multiple-choice questions and an extended-response item, information used to score the task, and samples of student responses. Items in the sample task are aligned to GLE 04 in the Science and the Environment strand, which is not eligible for assessment on the Biology EOC test. This item set is intended to provide a model of the format and rigor of a CCSS-aligned task and to be useful as a classroom assessment tool. This section also includes the Biology Extended-Response Checklist and the Biology Typing Help, an online tool that describes how to enter special characters, symbols, and formatting into typed responses.

**Strand:** Science and the Environment

**Biology GLE SE 04:** Determine the effects of limiting factors on a population and describe the concept of carrying capacity (SE-H-A3)
Task Introduction

You are asked to read an unfinished laboratory report about the growth of duckweed and then answer two multiple-choice questions and one extended-response question.

Some biology students conducted an experiment on the growth of duckweed. They are writing a laboratory report about their experiment. The introduction, methods, and results sections of their report are shown. They have not yet written the discussion section.

Read and study the unfinished laboratory report. Then answer questions 1 through 3.

Factors Affecting the Growth of Duckweed

Introduction

Duckweed (*Lemna minor*) is a very small plant that floats on top of water in ponds, marshes, and puddles. It has green leaf-like structures called thalli. Duckweed can grow very quickly, reproducing through the breaking off of smaller thalli from larger plants.

![Duckweed plants with thalli](image)

Although duckweed can grow very rapidly, sometimes it does not. Our investigation was designed to explore the effects of light, nutrients, and available space on the growth of duckweed. We hypothesized that duckweed would grow fastest in high-light and high-nutrient conditions, and that the duckweed population would then use up all the available space.
**Methods**

We placed duckweed plants in beakers representing the different conditions. We used an initial population of 10 plants in each beaker. We counted the total number of plants present in each of the beakers each week for 6 weeks. Plants were counted as live only when they were green. White, clear, or brown plants were not counted. When plants were very close together, it was sometimes necessary to make our best estimate of the number of individual plants present.

We used identical small beakers for each test population. Beakers were filled with distilled water (no nutrients—group 1), pond water (low nutrients—group 2), or pond water with a small amount of commercial plant fertilizer (high nutrients—group 3). As evaporation occurred, all beakers were refilled with distilled water. In addition, we used a screen over some high-nutrient beakers (group 4) to create a low-light condition. All beakers were kept under plant lights at room temperature for the entire experiment.

We used a total of 12 beakers in 4 different treatment groups. The table shows our experimental design.

<table>
<thead>
<tr>
<th>Group</th>
<th>Nutrients</th>
<th>Light</th>
<th>Number of Beakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>group 1</td>
<td>no nutrients</td>
<td>high light</td>
<td>3</td>
</tr>
<tr>
<td>group 2</td>
<td>low nutrients</td>
<td>high light</td>
<td>3</td>
</tr>
<tr>
<td>group 3</td>
<td>high nutrients</td>
<td>high light</td>
<td>3</td>
</tr>
<tr>
<td>group 4</td>
<td>high nutrients</td>
<td>low light</td>
<td>3</td>
</tr>
</tbody>
</table>
**Results**

We recorded the number of live plants in each of the 3 beakers in each group each week. Then we calculated the average number of live plants each week within each treatment group. We graphed these average values in the line graph shown.
Study the information in the Duckweed Experiment before answering the questions.

1. Based on the information in the graph, which statement best explains whether the duckweed population in group 3 reached its carrying capacity during the 6 weeks of the experiment?

   *A. After about 3 weeks, the population reached its carrying capacity of about 250 plants.

   B. After about 4 weeks, the population reached its carrying capacity of about 225 plants.

   C. The population did not reach its carrying capacity because it was still slowly increasing.

   D. The population did not reach its carrying capacity because it was declining at the end of the experiment.

Type the letter of the correct response (A, B, C, or D) in the box.

* correct answer

2. Which statement best evaluates the students’ decision to use 3 beakers in each treatment group?

   A. Using 3 beakers made the experiment worse because it required the students to find average data.

   B. Using 3 beakers made the experiment worse because it introduced more sources of error.

   *C. Using 3 beakers improved the experiment by showing that the results that occurred could be reproduced.

   D. Using 3 beakers improved the experiment by allowing more experimental conditions to be tested.

Type the letter of the correct response (A, B, C, or D) in the box.

* correct answer
The following question requires you to write an extended response that combines information from the source with your knowledge of science.

3. The students’ laboratory report is not finished. Write a discussion section to complete the laboratory report. In your discussion section, be sure to:
   - Evaluate whether the results shown in the graph support the hypothesis.
   - Discuss the effects of nutrient levels, light, and space availability on a population of duckweed.
   - Use the terms *limiting factor* and *carrying capacity*.

For help composing your response, click on the Extended-Response Checklist button for further instructions on what to include and how to organize the response.

*(student enters response in text box)*
Biology Extended-Response Checklist

As you write your response, remember these important points:

- Show an in-depth understanding of the topic.
- Support your ideas thoroughly with data, facts, and details from the source(s). Use facts from your own knowledge of the topic (beyond what is given in the source information) as well.
- Communicate your ideas clearly.
- Compose a response that is long enough to fully answer the question; this will usually require more than one paragraph.

Follow the steps below to help you write a successful extended response.

Step 1: Planning

☐ Read the question carefully.
☐ Review the source information and take notes that will help you create your response.
☐ Think about what you want to write before you begin.
☐ Use the paper provided by your test administrator for planning your response and/or writing a rough draft.

Step 2: Drafting

☐ Type your response in the space provided.
☐ Use the Enter key to begin a paragraph, and then use the Tab key or the space bar to indent the paragraph.
☐ Include evidence from the source(s) as well as your own knowledge of the topic to support your ideas.
☐ Present your ideas in an organized manner.

Step 3: Revising and Proofreading

☐ Review your response to be sure you have included the important points listed above.
☐ Add more detail to your response if necessary.
☐ Rearrange ideas or change words to make your meaning clearer.
☐ Reread your response and correct any errors you find.
Scoring Information

Rubric

Exemplary Response

We hypothesized that with high light and high nutrients, duckweed would reproduce rapidly until it was limited by the available growing space in the beaker. The results from group 3 confirmed our hypothesis. The duckweed population increased quickly from week 0 through week 3, but then stabilized at around 250 plants. This suggests that the carrying capacity for a small beaker of duckweed under these conditions is around 250.

Our data show that duckweed must have some nutrients and does respond to increased nutrient levels. Group 1, duckweed grown in distilled water with no nutrients, died quickly. Group 2 had the nutrients present in pond water, but no added nutrients. This group grew a little bit more slowly than the high-nutrient group, but it also reached a carrying capacity of between 200 and 250 plants. This suggests that pond water has sufficient nutrients even without added fertilizer so that nutrient availability was not a major limiting factor for these plants. Group 3 did grow more quickly than group 2, which shows that duckweed does grow more quickly with more nutrients in the water.

Group 4, the plants grown in high nutrients but low light showed that low light dramatically limited their ability to grow and reproduce. Since these plants had the same nutrients as group 3, we know that nutrients could not have limited their growth; therefore, the low-light conditions must have been the limiting factor causing their very slow growth.

Overall, we concluded that our hypothesis is correct. When nutrients and light are not limiting factors for duckweed, space constraints eventually force their population to stabilize at carrying capacity.
<table>
<thead>
<tr>
<th>Score</th>
<th>Duckweed Experiment Rubric</th>
</tr>
</thead>
</table>
| 4     | • The student’s response demonstrates an in-depth understanding of population dynamics such as carrying capacity and limiting factors.  
      | • The student completes all key components of the task accurately and communicates ideas effectively.  
      | • Explains that the results shown in the graph confirm the original hypothesis by noting that group 3 grew the fastest and did reach the carrying capacity of the beaker.  
      | • Compares the effect of nutrient levels by describing the differences in groups 1–3. The student should note that lower levels of nutrients turned out to not be a limiting factor (although growth was slowed) except that nutrients were required for the plants to survive (group 1 did not survive).  
      | • Compares the effect of light intensity by at least comparing groups 3 and 4. The student should note that low light intensity dramatically slowed the overall growth rate.  
      | • Uses the terms limiting factor and carrying capacity correctly.  
      | • The student’s response is extensively supported by relevant evidence in the form of data and/or examples.  
      | • The student uses a higher level of reasoning skills and shows a strong grasp of how to write a discussion section of a laboratory report.  
      | • The response contains no errors.  
| 3     | • The student’s response demonstrates a good understanding of population dynamics, although less important ideas or details may be overlooked or misunderstood.  
      | • The student completes most important aspects of the task accurately and communicates clearly.  
      | • The student’s response is sufficiently supported by relevant evidence.  
      | • The student’s logic and reasoning may contain minor flaws.  
      | • The response contains minor errors.  
| 2     | • The student’s response demonstrates a limited understanding of population dynamics (gaps in conceptual understanding).  
      | • The student completes some parts of the task successfully.  
      | • The student’s response is not sufficiently supported by relevant evidence.  
      | • The response contains errors.  
| 1     | • The student’s response demonstrates a basic understanding of population dynamics.  
      | • The student completes only a small portion of the task.  
      | • The student’s response contains little or no support of relevant evidence.  
      | • The student’s response contains major errors.  
| 0     | • The response attempts to address the prompt, but is mostly or entirely incorrect or contains some correct work that is irrelevant to the skill or concept being measured.  

Sample Student Responses

Score Point 4

The following authentic student responses show the work of two students who received a score of 4 for their responses. A score of 4 is given when a student completes all required components of the task and communicates his or her ideas effectively. The response should demonstrate in-depth understanding of the content objectives, and all required components of the task should be complete.

Student 1

Discussion
Once we were finished with our experiment, we concluded that the results did support our hypothesis that the duckweed would grow fastest in high-light and high-nutrient conditions, and that the duckweed population would then use up all the available space. When we look at our line graph, it shows that group 3 which had the beakers filled with pond water with a small amount of commercial plant fertilizer had a high amount of nutrients and also had a high amount of light allowed the duckweed plant to grow very rapidly and abundantly. Within 3 weeks, the plant had reached its carrying capacity of about 250 living plants. This means that the duckweed population had used up all the available space. With high-nutrient and high-light conditions, the duckweed population grew faster than duckweed with only a high-nutrient or a high-light condition. However, duckweed in high-light conditions and in a low-nutrient condition was still able to grow fast but not as fast as it would under conditions with both high nutrients and light. This means that the limiting factor is the amount of sunlight available to the duckweed plant. This will determine how fast the duckweed will grow.

The student response is thorough and correct. The student correctly identifies the results of each combination of light and nutrients, and explains the concept of carrying capacity in this situation. The student also observes the different results due to low light and a lower level of nutrients, and reaches the correct conclusion that light is more of a limiting factor in the growth of duckweed.
**Student 2**

In the experiment, the student was testing the growth of duckweed. It can grow very fast. It also reproduces by breaking off into its own plant. The experiment is to test the effect of light, nutrients, and available space on duckweed growth. Their hypothesis was that duckweed would grow faster in high-light and high-nutrient conditions. They also said that duckweed population would then use up all the available space. The students used the same beakers for every plant. They used about 10 plants per beaker. Every week, for 6 weeks, the number of plants present were counted. Only live ones were counted. Group 1 was distiller water which has no nutrients. Group 2 was pond water which has low nutrients. Group 3 was pond water with a small amount of commercial plant fertilizer. Group 4 was with a screen that caused low-light.

In the end, group 3 did the best. It reached its carrying capacity within the first 3 weeks. Group 2 also did well. It just reached its carrying capacity at the end of 6 weeks. Group 1 did the worse. They died off after 1 week. Group 4 only got up to about a population of 50.

The hypothesis was correct in the end. The graph matched exactly what the students said would happen. Duckweed grows best in high nutrients and high-light. They have to have light to grow. They die without it, even if they have high nutrients. A duckweed with no nutrients dies right away. Low nutrients can supply for a duckweed but not to a high extent. The students conducted a very accurate experiment.

The student correctly interprets the results in each of the four groups and the conclusion that light is a limiting factor. Although this student does not assign a number to the carrying capacity for the beakers, the response does explain what carrying capacity is in this situation.
Score Point 3

The following authentic student responses show the work of two students who received a score of 3 for their responses. A score of 3 is given when a student response meets nearly all the criteria for full credit but either contains a mistake or does not provide adequate reasoning for the conclusions.

Student 1

Duckweed can reproduce very rapidly but sometimes it does not. In an experiment we conducted, we tested four groups under different conditions. What made each group different was the amount of nutrients and light they received throughout the experiment. The results in the graph show that the group of plants with high light and high nutrition reached its carrying capacity within three weeks. The group with low nutrients and high light reached its carrying capacity at the end of the six weeks. The group with high nutrients and low light never reached its carrying capacity but did increase in population. The group with no nutrients and high light decreased in population. The limiting factor in this population is that it received no nutrients.

The student response does a good job of summarizing the four groups and the meaning of carrying capacity in this context. This response received only a score of 3 because it does not identify light as a limiting factor and only indirectly compares the rate of growth in each group.

Student 2

The results in the graph support the hypothesis because the duckweed with the high nutrients and high light did grow fastest and take up the most space. By week three more than 250 duckweed plants had grown, which was more than any other group. The no nutrients and high light group grew no duckweed in six weeks. The low nutrients high light group grew 200 by week 3 and 250 by week 6. The high nutrients high light group grew more than 250 by week 3 which was more than any other group, so it was best. The high nutrients low light group only made about 50 plants by week 6. The effects of light and nutrients on the plants were very high because the higher it was, the faster it grew and the more it grew. The limiting factor was the availability of space. The carrying capacity of the beakers was what the plants could grow in the environment it was given.

The student response correctly defines carrying capacity and identifies space as the limiting factor. The response lacks clear explanation of the effects of light. The response does not provide any comparison between the high nutrient, high light (group 3) and the high nutrient, low light (group 4) test groups. The student uses some evidence from the data to support his or her claims.
**Score Point 2**

The following authentic student responses show the work of three students who received a score of 2 for their responses. A score of 2 is given when a student response addresses some but not all of the points required for full credit. The response may also contain errors.

**Student 1**

I find that the results in the graph support the hypothesis very well. Not only does one of the graphs support this, but both of the graphs do. Duckweed needs high or large amount of light to grow fastest. for the plants nutrient conditions, that needs to be high as well. being that the duckweed population can get large, it can use up all of the available space. If the following all goes well, then these should be some quite healthy duckweed.

Carrying capacity is the maximum number of individuals of a given species that an area’s resource can withhold. The duckweed’s carrying capacity is a little past 250. A limiting factor are plants that exceed past the maximum tolerable level for the species. This is bad for the duckweed being that they all will not get all of their required needs.

The student response is almost sufficient to receive a score of 3. The student clearly understands carrying capacity, but misses the concept of a limiting factor in terms of the growth rate. The response also does not adequately discuss the effect of the conditions in group 1 or group 2 in terms of growth.

**Student 2**

Our hypothesis was correct. The results show that the beaker with high light and high nutrients took up all of the available space. Duckweed can grow very quickly, although sometimes it does not. Duckweed, in order for it to grow fast, need high light, but does not necessarily high nutrients. Our graph shows that group 2 and group 3 end up having about the same population of Duckweed. The limiting factor of our experiment is the light because high light is better than low light. The carrying capacity is the nutrients, because you need nutrients but not too much.

The student correctly identifies that light is more of a limiting factor than the level of nutrients in this investigation. The response is incomplete in that there is no mention of group 1 (no nutrients) and incorrect in stating “The carrying capacity is the nutrients...”.
**Student 3**

The results in the graph do support the hypothesis. They hypothesized that the Duckweed would grow the best in high light and high nutrient conditions. In the graph, the plant that grew the fastest and the most was the plant that were in these conditions. Plants that had no light or nutrients did not grow at all. Plants with low nutrients and high light grew the second to best. Plants with high nutrients and low light did not grow very much. The carrying capacity of the beakers were 10 duckweed plants.

The student response is barely sufficient to earn a score of 2. The response correctly summarizes the results of the four groups. However, the response does not discuss the concept of a limiting factor and provides an incorrect value for the carrying capacity.

**Score Point 1**

The following authentic student responses show the work of three students who received a score of 1 for their responses. A score of 1 is given when a student correctly addresses some but not all aspects of the item or demonstrates at least minimal understanding of the key concepts. According to the rubric, the responses can contain major errors.

**Student 1**

The hypothesis was that the duckweed would reach max of about 250 duckweed. The graph shows valid information about the duckweed growth. Nutrients play a very important roll in this experiment. Groups 2/3 shows you on the graph. That highlight is needed for the duckweed to grow. Group 1 with no nutrients didnt grow. Which shows that nutrients is needed in order duckweed to grow. The group used 12 beakers in all. They made 4 groups of plants for the duckweed experiment.

The student response does a reasonable job discussing the effect of nutrients on growth and identifies the maximum number of duckweed plants. However, the response misstates the hypothesis, barely mentions the role of light, and does not use the terms *carrying capacity* and *limiting factor*. 


**Student 2**

The Students concluded that with no nutrients and high light, Group 1 plants did not grow. With low nutrients and high light, group 2 plants thrived. With high nutrients and high light, the plants thrived higher than group 2. The 3rd plants did better than expected. But group 4 didn’t do as well. But still did better than group 1, because of the high nutrients they added.

The student correctly identifies the relative growth rates for the four groups but confuses the concept of the hypothesis with the data resulting from the experiment. This response also does not discuss carrying capacity or limiting factors.

**Student 3**

The carrying capacity of the duckweed plant is 250 plants in one group. The limiting factor is the beaker that the plants are put in. The hypothesis of the students were that the group with high-light and high-nutrient contents would grow the fastest and then the duckweed population would use up all of the available space. Half of the hypothesis was correct. Group 3 had the highest amount of light and nutrient contents and grew the fastest but did not fill the carrying capacity in the end.

The student response provides a good working definition of carrying capacity and identifies the number of plants at carrying capacity. The student also correctly describes the hypothesis. However, the student does not address light and nutrients as possible limiting factors and does not realize that the population will fluctuate around the carrying capacity. The response is also lacking any comparison of the four groups.
Score Point 0

The following authentic student responses show the work of two students who received a score of 0 for their responses. A score of 0 is given when a student response is incorrect, irrelevant, too brief to evaluate, or blank.

Student 1

The students were on something good when they were testing this hypothesis. But they were wrong. The reason of this is because they said that group 4 would produce the most when it was really group 3 that produced the most. If you have different portions of nutrients and light, then you won’t see as much results as you would if you had the nutrients and light at a same level. And as a result of them doing so group 3 reached its carrying capacity faster than the others.

This response is close to receiving a score of 1. The student has the beginning of a good response in the last sentence but provides no support other than that group 3 “produced the most.” This response also misunderstands the hypothesis, does not compare the groups adequately, and errs in stating that nutrients and light need to be at the “same level” for growth.

Student 2

They can do the test over and see if they would get the same results that they had in the first test. If they don’t they would might have to do the whole thing over again. Because they didn’t get the same result that they have already done on the first on. You got to always keep testing you results until you get the same thing that you had when you have first started with.

The student has focused on an aspect of the scientific method but does not provide any details about this investigation.
Biology EOC Typing Help

On the constructed-response portion of the Biology EOC test, students may need to use the following keystrokes to enter special symbols within their responses. The table below shows the shortcuts that students will have available for their use during the Biology EOC test.

Keystrokes for Special Symbols

<table>
<thead>
<tr>
<th>1. If the Response Includes:</th>
<th>2. Type this Instead:</th>
<th>3. Example:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na(^+) superscript</td>
<td>^</td>
<td>Na(^+)</td>
</tr>
<tr>
<td>H(_2)O subscript</td>
<td>2 number</td>
<td>H2O</td>
</tr>
<tr>
<td>20°C degree symbol</td>
<td>degrees the word “degrees”</td>
<td>20 degrees C</td>
</tr>
<tr>
<td>Bb × Bb cross</td>
<td>x space, letter x, space</td>
<td>Bb x Bb</td>
</tr>
<tr>
<td>→ reaction arrow</td>
<td>-&gt; dash, followed by greater than sign</td>
<td>Na + Cl → NaCl</td>
</tr>
<tr>
<td>⇌ reversible reaction arrows</td>
<td>&lt;=&gt; less than sign, followed by equals sign, followed by greater than sign</td>
<td>H + I ⇌ HI</td>
</tr>
</tbody>
</table>