Resource Materials for Teachers

2012-2013
NMSBA/HIGH SCHOOL GRADUATION ASSESSMENT (HSGA)

Grade 11 SCIENCE Items for Practice
ACKNOWLEDGEMENT

The practice items contained herein are from comprehensive databases of science assessment items released by the New England Common Assessment Program (developed collaboratively by the Rhode Island, Vermont and New Hampshire Departments of Education) and the Massachusetts Department of Education. RDA obtained appropriate licenses for usage and reproduction of these items; however, all rights in and to this material belong exclusively to the respective public education departments.
Resource Materials for Teachers

This teacher resource document accompanies the “NMSBA/HSGA SCIENCE Items for Practice” student booklet; it contains an answer key for practice items and student samples of short answer responses with corresponding scoring guides.

Contents of Student Booklet

The “NMSBA/HSGA SCIENCE Items for Practice” student booklet contains 18 science practice items that are representative of test items that may appear on the spring 2013 graduation exit exam. These practice items are intended to help students prepare for the actual NMSBA/HSGA.

Specifically, the student booklet contains 15 multiple-choice (MC) and 3 constructed response (CR) questions. Each MC question has four possible answers; only one of the four choices is the correct answer. The CR questions require written responses.

Usage of Student Booklet

Teachers are encouraged to use the student booklet with science practice items to help students prepare for the NMSBA/HSGA. Teachers can administer the student booklet in its entirety during one sitting, and then after grading, critically review all item answers with students. Alternatively, teachers can take one passage/poem selection at a time and critically review item answers orally with students in a large group setting. The student booklet and answer sheet (for MC practice items) can be found in Data Director (www.achievedata.com/aps) under Assessments using the following search criteria:

- Subject: Science
- Year: 2012-2013
- Grade Level: 11
- Test Type: District
- Search by Assessment Title: 2012-2013 NMSBA/HSGA Science Practice Items
- Search by Assessment Title: 2012-2013 NMSBA/HSGA Science Practice Items (SPANISH)

Questions?

This teacher resource document is also located in Data Director (use same search criteria as above). If you have any questions about either this document or the “NMSBA/HSGA SCIENCE Items for Practice” student booklet, contact:

- Dr. Donna Navarrete, RDA secondary assessment resource teacher (navarrete_d@aps.edu, 505.872.6866); or
- Dr. Mike Loughrey, RDA assessment manager (loughrey@aps.edu, 505.872.6822).
# Answer Key

<table>
<thead>
<tr>
<th>Item</th>
<th>Assessment Target&lt;sup&gt;1&lt;/sup&gt;</th>
<th>DOK&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Item Type&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Answer</th>
<th>Points Possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PS</td>
<td>2</td>
<td>MC</td>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>PS</td>
<td>2</td>
<td>MC</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>PS</td>
<td>1</td>
<td>MC</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>ESS</td>
<td>2</td>
<td>MC</td>
<td>D</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>ESS</td>
<td>1</td>
<td>MC</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>ESS</td>
<td>2</td>
<td>MC</td>
<td>D</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>LS</td>
<td>2</td>
<td>MC</td>
<td>D</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>LS</td>
<td>1</td>
<td>MC</td>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>LS</td>
<td>2</td>
<td>MC</td>
<td>D</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>LS</td>
<td>2</td>
<td>CR</td>
<td>*</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>ESS</td>
<td>2</td>
<td>CR</td>
<td>*</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>LS</td>
<td>2</td>
<td>MC</td>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>LS</td>
<td>2</td>
<td>MC</td>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>LS</td>
<td>2</td>
<td>MC</td>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>LS</td>
<td>3</td>
<td>CR</td>
<td>*</td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>PS</td>
<td>2</td>
<td>MC</td>
<td>D</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>PS</td>
<td>2</td>
<td>MC</td>
<td>A</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>PS</td>
<td>3</td>
<td>MC</td>
<td>C</td>
<td>1</td>
</tr>
</tbody>
</table>

*Scoring guide for item (with samples of student work) is provided on the following pages.

<sup>1</sup>PS = Physical Science, ESS = Earth and Space Science, LS = Life Science

<sup>2</sup>Depth of Knowledge (DOK): 1 = recall & reproduction, 2 = skills & concepts, 3 = strategic thinking.

<sup>3</sup>Item Type: MC = Multiple Choice, CR = Constructed Response
CONSTRUCTED RESPONSE

The diagram below shows the flow of energy in a temperate deciduous forest.

Oak tree → Squirrel → Hawk

a. Which organism is capable of transforming solar energy into chemical energy? Explain your answer.

b. Which organism is least efficient at capturing energy? Explain your answer.

c. Deforestation is the removal of trees by cutting or burning. How would deforestation affect the flow of energy among the trophic levels represented in the diagram?

Scoring Guide

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Response demonstrates a thorough understanding of ecological relationships and making predictions about how environmental disturbances affect the flow of energy in an ecosystem. Response completes all tasks required by identifying the oak tree as most efficient and explaining why, identifying the hawk as least efficient and explaining why, and stating that energy flow is disrupted after deforestation.</td>
</tr>
<tr>
<td>3</td>
<td>Response demonstrates a general understanding of ecological relationships and making predictions about how environmental disturbances affect the flow of energy in an ecosystem. The response has an error or omission.</td>
</tr>
<tr>
<td>2</td>
<td>Response demonstrates a limited understanding of ecological relationships and makes predictions about how environmental disturbances affect the flow of energy in an ecosystem. The response has errors and omissions.</td>
</tr>
<tr>
<td>1</td>
<td>Response demonstrates a minimal understanding of ecological relationships and makes predictions about how environmental disturbances affect the flow of energy in an ecosystem. The response has several errors and omissions.</td>
</tr>
<tr>
<td>0</td>
<td>Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.</td>
</tr>
<tr>
<td>Blank</td>
<td>No response</td>
</tr>
</tbody>
</table>
Training Notes:

a. The tree is capable of converting solar energy to chemical energy by the process of photosynthesis.

b. • The hawk is the least efficient at capturing energy because only one percent of the energy converted by plants actually reaches the hawk. The energy is used or lost as heat before it reaches the hawk.
   • The hawk uses more energy to capture prey/energy for its use.

c. • Destruction of trees reduces photosynthesis, so energy originally entering the system is lost. Therefore, all organisms (squirrels and hawks) directly or indirectly receiving energy from trees will either die or move to new areas.
   • Organisms will have to find an abundant, different food source.
   • Since most organisms have more than one food source, it may have little effect.

Special Notes:

• Score holistically.
• If part (a) response contains “tree” and part (b) response contains “hawk,” give 1 point total for parts (a) and (b).
• Give full credit in part (a) if response also explains photosynthesis, in part (b) if response explains how energy is reduced at each trophic level and less energy is passed on to the next, and in part (c) if response fully explains how energy lost at the producer level will affect all other levels.
10

a) The oak tree transforms solar energy into chemical energy through photosynthesis. It is a plant, so it uses chlorophyll to photosynthesize the sun's rays.

b) The hawk is least efficient at capturing energy. It can only receive 10% of the energy that the squirrel receives from eating plants, and the squirrel, in turn, only receives 10% of the tree's energy.

c) Deforestation would affect every trophic level. If there were fewer trees, the squirrels would have less food and their population would decrease. As the squirrel population decreased, the hawks would not be able to find food, and its population would be depleted.

The response is complete and includes all required elements. The oak tree is correctly identified as the primary producer, and the response notes that photosynthesis is the process involved. There is strong use of detail. Part (b) receives full credit for identifying the hawk as the least efficient in capturing energy. The response also gives a detailed explanation of energy loss through the trophic levels. Finally, the response gives a thorough, accurate explanation of how the loss of the primary producer could cause a decrease in both squirrel and hawk populations.
The response shows a general understanding of the concepts addressed. Part (a) correctly identifies the oak tree as the primary producer through the function of photosynthesis. Part (b) correctly identifies the hawk as the least efficient in capturing energy. However, the explanation needs to be clearer for full credit. Part (c) provides a correct progression of events but omits some details, such as precisely why deforestation will result in fewer squirrels (less food available); this part is considered general. Both parts (b) and (c) require the reader to infer to complete the response. Overall, this response would need additional details to be considered a score of 4.
A. The squirrel because it eats from the tree, then gets eaten by the hawk. The squirrel takes the energy of the grown food, then the digesting is done chemically.

B. The hawk is least efficient because it could use more energy trying to capture the squirrel.

C. With the removal of trees, there’s less food and homes, meaning the squirrels lose energy, and when the squirrels lose energy, that means the hawks don’t have enough to eat.

The response shows a limited understanding of the concepts addressed. Part (a) is incorrect and receives no credit. Stating that the hawk uses more energy in capturing the squirrel is acceptable for part (b). Part (c) correctly explains the effects on energy flow but does so in general terms.
1-Point Score

The response shows a minimal understanding of the concepts addressed. The response receives credit for correctly identifying the oak tree as the primary producer in part (a) and the hawk as the least efficient at capturing energy in part (b). Omitting explanations for those parts as well as giving a vague, incorrect explanation in part (c) prevent this response from receiving more than 1 point.

0-Point Score

The response does not provide any information relevant to the item and receives no credit.
CONSTRUCTED RESPONSE

The diagram below shows a time line of the Big Bang Theory.

a. Explain two pieces of evidence that support the Big Bang Theory.

b. Explain two forces that contribute to the formation of stars and planets.

You may use information from the diagram in your responses.
Scoring Guide

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Response demonstrates a thorough understanding of the formation of the universe by using data to explain the Big Bang Theory. Response gives the correct conditions before the Big Bang, includes two observations to support the Big Bang Theory, and explains that gravity and nuclear fusion are necessary for the formation of stars and planets. Response includes no errors or omissions.</td>
</tr>
<tr>
<td>3</td>
<td>Response demonstrates a general understanding of the formation of the universe by using data to explain the Big Bang Theory. Response has an error or omission.</td>
</tr>
<tr>
<td>2</td>
<td>Response demonstrates a limited understanding of the formation of the universe by using data to explain the Big Bang Theory. Response has errors and omissions.</td>
</tr>
<tr>
<td>1</td>
<td>Response demonstrates a minimal understanding of the formation of the universe by using data to explain the Big Bang Theory. Response has several errors and omissions.</td>
</tr>
<tr>
<td>0</td>
<td>Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.</td>
</tr>
<tr>
<td>Blank</td>
<td>No response</td>
</tr>
</tbody>
</table>

Training Notes:

a. Support of Big Bang Theory (2 points):
   • Galaxies continue to move apart from one another as the universe expands.
   • Cosmic microwave background radiation is present.
   • An abundance of light elements such as hydrogen, helium, and lithium are present.
   • Temperature cools as the universe expands.
   • The first galaxies formed 500 million to 1 billion years later.
   • Large, stable atoms form as the universe ages.
   • Redshifting galaxy spectra are mentioned.

b. Forces for star and planet formation (2 points):
   • Temperatures of nebulae, clumping due to gravity, pressure pushing objects apart
   • Gravity, hydrogen fuses to form helium, nuclear force (nuclear fusion reactions)→ stars
   • Gravity, collisions of larger and larger particles (planetesimals)→ planets
   • Electromagnetic force, for assembling planets and stars in connection with friction and pressure

Special Notes:
   • Score holistically, with equal weighting for parts (a) and (b).
   • Give a total score of 2 out of 4 possible points if lists are given in both parts.
4-Point Score

11

a) By using orbital telescopes, and spectral lines, we come to the conclusion that since there is a redshift in most of the observed stars and galaxies, the universe is expanding. By using SPITZER (a radio telescope developed by NASA), we can see the spectral emissions released from light-years away, of very old stars. This allows us to determine the composition of stars near the time period of the Big Bang as well as the presence of the first hydrogen/helium stars.

b) First, you would need the raw materials (dust and gas) to form the star. These can usually be found from supernovae. Secondly, you need gravity to pull all of these materials together. After the core temperature rises (through reactions/heat from other stars), nuclear fusion begins. However, if the dust and gas is heated enough, it may form a planet. This can be proven by looking at our solar system. The terrestrial planets (Mars, Venus, Mercury, Earth) are rocky due to their proximity to the sun. The jovian planets (Jupiter, Neptune, Saturn, Uranus) are all gaseous planets. This is because the sun’s heat could not warm them enough for the necessary reactions to occur,

This is a sophisticated response that presents two pieces of evidence—the redshift and the presence of helium/hydrogen atoms—that support the Big Bang Theory. Both pieces of evidence are well explained and supported with appropriate details. The descriptions supporting the evidence for the formation of stars (gravity and nuclear fusion) are detailed and demonstrated through understanding of the subject matter. Supplemental information that is not required is provided (source of evidence). The response received full credit for both parts and is considered a high 4 score.
3-Point Score (Example A)

The response shows a solid but general understanding of the concepts addressed. Part (a) correctly refers to the continued expansion and cooling of the universe as evidence of the Big Bang. The additional statement that the rate of expansion is slowing down is taken as a minor error. In part (b), the response correctly states that gravity pulls particles together but only implies the progression from individual particles to stars and planets. “Nuclear force,” as referred to in the final statement, probably refers to nuclear fusion of hydrogen, but this must be inferred. Also, the explanation refers to a stage later than formation in a star’s life. The response could have achieved a score of 4 if not for the minor error in part (a).
NMSBA/HSGA Grade 11 SCIENCE Practice Items:
Resource Materials for Teachers

3-Point Score (Example B)

The response shows a general understanding of the concepts addressed. Part (a) gives two pieces of evidence—the redshift and the universe's decrease in temperature—to support the Big Bang Theory. These phenomena are given support, with the response citing the Doppler shift and the loss of energy as the universe expands. In part (b), credit is given for noting that gravity aids in the formation of planets. References to friction without further explanation receive no credit. Overall, this response presents some accurate information with some strong supporting details, but the presence of general support in some parts and the lack of support in others prevent this response from receiving a score of 4.
The response shows a limited understanding of the concepts addressed. The response accurately notes that dropping temperatures support the Big Bang Theory. As seen in the item diagram, hydrogen atoms formed, but the response fails to note the abundance of these light elements. Also, the supporting statement citing nuclear fission as the cause of hydrogen formation is not evidence of the Big Bang. Part (b) correctly identifies and explains gravity as a force present during the formation of stars, but the response does not offer a second force. Partial responses are provided for both part (a) and part (b), which earns a score of 2. The score for this response could have been improved by the use of information found in the item diagram.
1-Point Score

11

A) matter and stable atoms
b) gravity, pressure

The response shows a minimal understanding of the concepts addressed. The response correctly
states that gravity is a force present during the formation of stars. However, the balance of the
information presented is inaccurate or too vague for credit.

0-Point Score

11

A)

B) Collision of planets and stars, explosions of stars

Part (a) is not attempted and receives no credit. Part (b) vaguely refers to
events not related to the formation of stars and planets and receives no credit.
CONSTRUCTED RESPONSE

DNA is found in the cells of all organisms. The structure of DNA is directly linked to its function.

a. Describe the function of DNA in organisms.

b. Draw and label a simple model of DNA that includes the sugar/phosphate backbone and nitrogenous bases.

c. Explain how the structure of DNA enables it to perform the function you described in part (a).

Scoring Guide and Sample Student Work

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Response demonstrates a thorough understanding of the basic structure and function of DNA. The response correctly describes the function of DNA, provides a correctly labeled model of DNA, and clearly explains how the structure of DNA enables it to perform its function in organisms.</td>
</tr>
<tr>
<td>3</td>
<td>Response demonstrates a general understanding of the basic structure and function of DNA.</td>
</tr>
<tr>
<td>2</td>
<td>Response demonstrates a limited understanding of the basic structure and function of DNA.</td>
</tr>
<tr>
<td>1</td>
<td>Response demonstrates a minimal understanding of the basic structure and function of DNA.</td>
</tr>
<tr>
<td>0</td>
<td>Response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.</td>
</tr>
</tbody>
</table>

Note: There are 2 sample student responses for Score Point 4.
4-Point Score

A. The function of DNA in organisms is to pass on genetic information from one generation to the next. It allows an organism to pass on its traits to its offspring.

B. P = Phosphate  S = 5-carbon sugar  A, T, C, G = Base

C. DNA's structure allows it to perform its function because each individual has a different sequence of bases that codes for different amino acids. This sequence of bases is determined by the genes given to an individual by their parents. The genetic information from the parents codes for a certain sequence of bases, and this structure organizes the sequence of bases.
A) DNA plays an important role in organisms. DNA is almost like the instruction manual to a device or the recipe to a food. It is what determines how a person will look, operate, what traits they will have, and even how tall or heavy they will be. DNA also splits, allowing it to replicate and produce more of itself, making it important to all organisms.

B) ![Diagram of DNA structure]

This diagram is an example of an unwound DNA segment. DNA in its original form is in a double helix.

C) This structure of the DNA allows it to split easily. By being able to easily split, the DNA can replicate and complete other functions in a more efficient manner. For example, when a DNA segment is going to be used, the nitrogen bases detach but are held together by the phosphate backbone. Now, you have two long segments that can be used to create two of the identical strands of DNA.
3-Point Score

A. The function of DNA is to provide a blueprint for creating proteins in the organism.

B. [Diagram of DNA structure with labels: Phosphate group, Sugar, Nitrogen Bases]

C. The structure of DNA allows the DNA to be transcribed into RNA and then have its nitrogen bases translated into proteins which then create and maintain the functions of the organism.

2-Point Score

A. The function of DNA in an organism is mainly reproduction. DNA is used in mitosis and meiosis.

B. [Diagram of DNA structure with labels: Sugar/phosphate backbone, Nitrogenous bases]

C. The structure of the DNA enables it to split and perform mitosis or meiosis. When it splits, it will reproduce and form two identical DNA strands.
1-Point Score

a. DNA holds the genetic information that makes an organism.

b. sugar, nitrogen base, phosphoester backbone

c. All the information is stored in the parts of DNA.

0-Point Score

A. The function of DNA in organisms is the brain of the cell. It controls the whole cell. It is found in the nucleus.

B. {base} {base} {base} {base} backbone

C. It enables it to perform because it is everything and controls the cell. It is the powerhouse.