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INTRODUCTION

General Introduction

The Department of Education provides districts and schools with tools to assist in delivering focused instructional programs aligned to the state assessment system. These tools include assessment anchor documents, assessment handbooks, and content-based item and scoring samplers. This 2005–2006 Science Item and Scoring Sampler is a useful tool for Pennsylvania educators in the preparation of local instructional programs and the statewide PSSA assessments.

What's Included

This item and scoring sampler contains science multiple-choice items, open-ended items and a science scenario. These items are examples of science items that may be used to assess student performance on the PSSA. These provide an idea of the types of items that will appear on the operational Spring 2008 PSSA. Each item has been through a rigorous review process to ensure alignment with the Assessment Anchors and State Standards, but they have not been reviewed by Pennsylvania teachers or administered in Pennsylvania schools.

Purpose and Uses

The items in this sampler may be used as examples for creating assessment items at the classroom level, and they may also be copied and used as part of a local instructional program.* Classroom teachers may find it beneficial to have students respond to the open-ended items in the sampler. Educators can then use the sampler as a guide to score the responses either independently or together with colleagues within a school or district.

Item Format and Scoring Guidelines

The multiple-choice items have four answer choices. A correct response to each multiple-choice item is worth 1 point.

Each short open-ended (SOE) item is designed to take about ten minutes to complete. Each extended open-ended (EOE) item is designed to take about 20 minutes to complete. However, during an actual testing event students are given additional time as necessary to complete the test items. The open-ended items in science are scored with item-specific scoring guides on a 0–2 or 0–4 scale. The item-specific scoring guides are presented within this sampler and are similar to those which will be used to score open-ended items in future PSSA science assessments.

Also included is the General Description of Scoring Guidelines used to develop the item-specific guides. The General Description of Scoring Guidelines should be used to develop any item-specific scoring guides created for use within local instructional programs.*

* The permission to copy and/or use these materials does not extend to commercial purposes.
GENERAL DESCRIPTION OF 2-POINT SCIENCE SCORING GUIDELINES:

2 – The response demonstrates a thorough understanding of the scientific content, concepts, and procedures required by the task(s).

The response provides a clear, complete, and correct response as required by the task/s. The response may contain a minor blemish or omission in work or explanation that does not detract from demonstrating a thorough understanding.

1 – The response demonstrates a partial understanding of the scientific content, concepts, and procedures required by the task(s).

The response is somewhat correct with partial understanding of the required scientific content, concepts, and/or procedures demonstrated and/or explained. The response may contain some work that is incomplete or unclear.

0 – The response provides insufficient evidence to demonstrate any understanding of the scientific content, concepts, and procedures as required by the task(s) for that grade level.

The response may show only information copied or rephrased from the question or insufficient correct information to receive a score of 1.

Special Categories within zero reported separately:

BLK – Blank, entirely erased, or written refusal to respond
OT – Off task
IL – Illegible
LOE – Response in a language other than English
**GENERAL DESCRIPTION OF 4-POINT SCIENCE SCORING GUIDELINES:**

4 – The response demonstrates a *thorough* understanding of the scientific content, concepts, and procedures required by the task(s).

   The response provides a clear, complete, and correct response as required by the task(s). The response may contain a minor blemish or omission in work or explanation that does not detract from demonstrating a *thorough* understanding.

3 – The response demonstrates a *general* understanding of the scientific content, concepts, and procedures required by the task(s).

   The response is mostly complete and correct as required by the task(s). The response may have minor errors or omissions that do not detract from demonstrating a *general* understanding.

2 – The response demonstrates a *partial* understanding of the scientific content, concepts, and procedures required by the task(s).

   The response is somewhat correct with *partial* understanding of the required scientific content, concepts, and/or procedures demonstrated and/or explained. The response may contain some work that is incomplete or unclear.

1 – The response demonstrates *minimal* understanding of the scientific content, concepts, and procedures as required by the task(s).

0 – The response provides *insufficient* evidence to demonstrate any understanding of the scientific content, concepts, and procedures as required by the task(s) for that grade level.

   The response may show only information copied or rephrased from the question or *insufficient* correct information to receive a score of 1.

*Special Categories within zero reported separately:*

BLK – Blank, entirely erased, or written refusal to respond
OT – Off task
IL – Illegible
LOE – Response in a language other than English
SCIENCE REPORTING CATEGORIES

Science scores are reported in four categories:

A – The Nature of Science
B – Biological Sciences
C – Physical Sciences
D – Earth and Space Sciences

SAMPLE ITEMS

The science stand-alone multiple-choice items begin on page 7. Each item is preceded by the Assessment Anchor and eligible content coding. Answer options A–D are followed by a brief analysis or rationale. The correct answer is indicated by an asterisk (*).

One stand-alone 2-point SOE item follows the multiple-choice items. The SOE item is displayed with an item-specific scoring guide and samples of responses with scores and annotations.

One science scenario follows the stand-alone item; it is composed of four multiple-choice items and one 4-point EOE item. These items are all related to the scenario. The EOE item is displayed with an item-specific scoring guide and samples of responses with scores and annotations.
A.2.1.2, C.2.1.3

Use the table below to answer question 1.

Cube Information

<table>
<thead>
<tr>
<th>Beaker</th>
<th>Cube</th>
<th>Material</th>
<th>Mass (g)</th>
<th>Density (g/cm³)</th>
<th>Specific Heat (joules/g • °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td>aluminum</td>
<td>10</td>
<td>2.7</td>
<td>0.90</td>
</tr>
<tr>
<td>2</td>
<td>Y</td>
<td>iron</td>
<td>10</td>
<td>7.9</td>
<td>0.45</td>
</tr>
</tbody>
</table>

1. Two cubes were heated in an oven until each cube reached 250 degrees Celsius (482°F). The cubes were immediately placed in beakers that contained 50 mL of room-temperature water; cube X was placed in beaker 1 and cube Y was placed in beaker 2. The maximum temperature of the water in each beaker was recorded. Which statement correctly describes the temperature of the water in the beakers?

A. The temperature of the water in each beaker will increase at the same rate.
B. The temperature of the water in each beaker will increase the same amount.
C. The temperature of the water in beaker 1 will increase more than the temperature of the water in beaker 2. *
D. The temperature of the water in beaker 2 will increase more than the temperature of the water in beaker 1.

A. The temperature of the water in each beaker will not increase at the same rate because the specific heats of aluminum and iron are different.
B. The temperature of the water in each beaker will not increase by the same amount because the specific heats of aluminum and iron are different.
C. Key: The temperature of the water in beaker 1 will increase more than the temperature of the water in beaker 2 because the specific heat of aluminum is higher.
D. The temperature of the water in beaker 2 will not increase more than the temperature of the water in beaker 1 because the specific heat of iron is lower.
B.3.2.3

Use the diagram below to answer question 2.

2. Which statement describes how this ecosystem is likely to change after many years of succession?

A. The variety of fish will increase.
B. The number of plants will increase. *
C. The level of the water will increase.
D. The elevation of the hill will increase.

A. After many years of succession, the pond would fill in due to deposition, which would reduce habitat availability for any aquatic species, like fish.
B. Key: After many years of succession, the pond would fill in due to deposition, which would increase habitat availability for a greater variety of plants.
C. After many years of succession, the pond would fill in due to deposition, and water levels would decrease.
D. After many years of succession, the elevation of the hill will likely decrease due to erosion.
A.3.1.1
Use the closed-loop system for an electric oven below to answer question 3.

3. Which part of the oven’s closed-loop system is the process?
A part 1
B part 2 *
C part 3
D part 4

B.1.1.1
4. Which type of cell has the greatest number of mitochondria?
A fat cell
B skin cell
C blood cell
D muscle cell *

A Part 1 regulates the process; it is not the process.
B Key: Part 2, electricity flowing through a circuit and heating coils, is the process in the electric oven system.
C Part 3 is part of the process regulation; it is not the process.
D Part 4 monitors the process; it is not the process.

A A fat cell’s function is to store energy.
B A skin cell’s function is to protect the body from the outside environment.
C A blood cell’s function is to carry oxygen throughout the body.
D Key: A muscle cell’s function is to move body parts, which requires energy converted by mitochondria.
A.2.1.1

Use the graph below to answer question 5.

5. A sunfish population was introduced into a lake 10 years ago. Biologists have been monitoring this population since then. The graph shows their data. What is the estimated carrying capacity for sunfish in this lake?

A  30 sunfish
B  40 sunfish
C  50 sunfish *
D  60 sunfish

A The data in this graph show that the lake can support more than 30 sunfish.
B The data in this graph show that the lake can support more than 40 sunfish.
C Key: The data in this graph show that the lake can support approximately 50 sunfish. Between years 5 and 10, the sunfish population averaged approximately 50 individuals.
D The data in this graph show that the lake cannot support 60 sunfish. Over the 10 years, the population averaged 50 individuals and did not reach 60.
6. Which change most likely caused a decrease in global mean surface temperatures during the time periods shaded on the graph?

A an increase in deforestation
B an increase in the use of fossil fuels
C an increase in volcanic eruption emissions *
D an increase in the population of domesticated livestock

A Deforestation reduces the number of trees available to conduct photosynthesis, which causes an increase in global mean surface temperatures.
B The use of fossil fuels increases the amount of carbon dioxide in the atmosphere, which will result in an increase in global mean surface temperatures.
C Key: An increase in volcanic eruption emissions will decrease global mean surface temperatures by reducing the amount of sunlight reaching Earth’s surface.
D An increase in the population of domesticated livestock will increase the amount of greenhouse gases in Earth’s atmosphere. An increase in greenhouse gas will cause an increase in global mean surface temperatures.
B.2.2.1
Use the diagram below to answer question 7.

A DNA transcription occurs when mRNA makes a complementary strand from the DNA.
B DNA transcription produces mRNA.
C DNA is not translated.
D DNA is not translated.

7. Which statement describes the diagram?
   A DNA transcription is producing messenger RNA. *
   B DNA transcription is producing ribosomal RNA.
   C DNA translation is producing messenger RNA.
   D DNA translation is producing ribosomal RNA.

---

D.3.1.2
8. Which comparison is true?

   A The Sun’s luminosity is less than a white dwarf’s luminosity.
   B The Sun’s surface temperature is higher than a black dwarf’s surface temperature. *
   C The Sun is in a later stage of development than is a red giant.
   D The Sun is more likely to develop into a supernova than is a more massive star.

---

A Even though they have very high surface temperatures, white dwarfs are much dimmer (less luminosity) than the Sun because they are very small and have less surface area radiating energy.
B Key: A black dwarf does not radiate enough energy to make it visible; its surface is cooler than the Sun’s surface.
C The Sun is a mature main sequence star. If they are large enough, main sequence stars may become red giants later, when they expand.
D A more massive star (> 8 solar masses) is more likely to collapse rapidly and explode (supernova) than the less massive Sun.
A.2.1.5
Use the solubility curves in the graph below to answer question 9.

Solubility Curves

9. Which conclusion is supported by the information provided in the graph?

A  At 50°C, KNO₃ is approximately twice as soluble as KCl.
B  At 50°C, NH₄Cl is approximately twice as soluble as NH₃.
C  At 20°C, the maximum amount of KClO₃ that can dissolve in 100 grams of water is 20 grams.
D  At 20°C, the maximum amount of NaNO₃ that can dissolve in 100 grams of water is 45 grams.

Key:
A  At 50°C, KCl has a solubility of approximately 42 grams, and KNO₃ has a solubility of approximately 85 grams, which is more than twice that amount.
B  At 50°C, NH₄Cl has a solubility of approximately 50 grams, and NH₃ has a solubility of approximately 30 grams, which is not twice that amount.
C  At 20°C, the maximum solubility of KClO₃ is approximately 10 grams.
D  At 20°C, the maximum solubility of NaNO₃ is approximately 85 grams.
10. The tectonic plate map shows the boundary between the Eurasian and Indian Plates. Explain how the tectonic processes at this boundary shape Earth during a human’s lifetime (40–80 years) and over geological time frames (millions of years).
Item #10

This item will be reported under Category D, Earth and Space Sciences.

Assessment Anchors:

D.1.1 – Explain and analyze the forces in the lithosphere that continually shape Earth.

Specific Eligible Content addressed by this item:

D.1.1.2 – Explain the processes that take place at plate boundaries and how these processes continue to shape Earth (e.g., volcanic activity, earthquakes, mountain building, mid-ocean ridges, deep-sea trenches, new land being formed).

Scoring Guide:

<table>
<thead>
<tr>
<th>Score</th>
<th>In response to this item, the student—</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>The student has correctly explained how these tectonic processes can shape the Earth over the time frames specified.</td>
</tr>
<tr>
<td>1</td>
<td>The student has correctly explained how these tectonic processes can shape the Earth during a human’s lifetime, but the response contains an error (volcanoes) pertaining to features created over millions of years at the plate boundary specified. Compression forces are caused as continental plates collide producing mountain ranges, such as the Himalaya, but volcanoes are formed at subduction zones where a denser oceanic plate slides under a continental plate producing pockets of molten rock.</td>
</tr>
<tr>
<td>0</td>
<td>The student has incorrectly responded to the question. While the response describes an event caused by plate tectonics, it is vague as to the time frame of the event and the event is not relevant to the collision of two continental plates. BLK – Blank, entirely erased, or written refusal to respond OT – Off task IL – Illegible LOE – Response in a language other than English</td>
</tr>
</tbody>
</table>
Item #10

Top-scoring Response:

```
Earthquakes could cause landslides during someone’s lifetime in this region. Over millions of years pushing together of these plates would change the Earth by creating new or bigger mountains.
```

(2 score points)

2 points for correct explanation.

```
Over 40 to 80 years a new lake could form because of a bad earthquake. It would take millions of years to make volcanoes.
```

(1 score point)

1 point for correct explanation.

```
All the houses and people would be buried by the ash from the exploding volcanoes.
```

(0 score points)

0 points for incorrect explanations.
10. The tectonic plate map shows the boundary between the Eurasian and Indian Plates. Explain how the tectonic processes at this boundary shape Earth during a human’s lifetime (40–80 years) and over geological time frames (millions of years).

Earthquakes could cause landslides during someone’s lifetime in this region. Over millions of years, Earth’s plates would change the Earth by creating new or bigger mountains.

The student’s response is correct.
10. The tectonic plate map shows the boundary between the Eurasian and Indian Plates. Explain how the tectonic processes at this boundary shape Earth during a human’s lifetime (40–80 years) and over geological time frames (millions of years).

The student’s response is partially correct. The student correctly explains how a process occurring in only one of the two time frames shapes Earth. The response for the millions-of-years time frame is incorrect.
10. The tectonic plate map shows the boundary between the Eurasian and Indian Plates. Explain how the tectonic processes at this boundary shape Earth during a human’s lifetime (40–80 years) and over geological time frames (millions of years).

All the houses and people would be buried by the ash from the exploding volcanoes.

The student’s response does not provide a correct response for either time frame.
Grade 11 Science Scenario Begins on the Next Page
Two students have summer internships working with scientists at an environmental center. Their job is to create an exhibit for the center. The exhibit will focus on changes that have occurred during the past 2,000 years in the study area (Diagram 1).

Scientists have collected and dated macrofossils from the study area to document changes there. The students organized the scientists’ data into a graph (Graph 1).
Next, the students prepared tables that compared plants that once lived or are now living in the study area (Tables 1 and 2).

Table 1. Tree Comparison

<table>
<thead>
<tr>
<th>Species</th>
<th>Habitat</th>
<th>Other Characteristics</th>
<th>Energy Output (millions of joules per cord)</th>
<th>Wood Strength</th>
<th>Wood Hardness</th>
<th>Wood Density (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>jack pine</td>
<td>dry with sandy soils</td>
<td>needs fire to germinate</td>
<td>18,041</td>
<td>moderately low</td>
<td>moderately soft</td>
<td>0.53</td>
</tr>
<tr>
<td>white pine</td>
<td>dry with sandy soils</td>
<td>has many uses for humans</td>
<td>14,032</td>
<td>moderately low</td>
<td>moderately soft</td>
<td>0.35</td>
</tr>
<tr>
<td>black spruce</td>
<td>wet with wet organic soils</td>
<td>lives in marshy areas</td>
<td>12,872</td>
<td>high</td>
<td>moderately hard</td>
<td>0.45</td>
</tr>
<tr>
<td>white cedar</td>
<td>wet with moist organic soils</td>
<td>lives on the edges of ponds and lakes</td>
<td>15,298</td>
<td>moderately low</td>
<td>hard</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Table 2. Aquatic Plant Comparison

<table>
<thead>
<tr>
<th>Species</th>
<th>Native Plant?</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>water lily</td>
<td>yes</td>
<td>lives in water less than 1.5 m deep</td>
</tr>
<tr>
<td>aquatic sedge</td>
<td>yes</td>
<td>lives in water less than 1 m deep</td>
</tr>
<tr>
<td>purple loosestrife</td>
<td>no</td>
<td>lives in water less than 1 m deep</td>
</tr>
</tbody>
</table>
The scientists showed the students how tree cross sections also provide information about environmental changes. Diagram 2 shows an example of a tree cross section used to study annular growth rings. Wide rings indicate years of fast growth; narrow rings indicate years of slow growth. The dark spot is a fire scar.

Annual growth rings can also be studied without harming the tree. A narrow core sample can be extracted from a tree using a coring tool. Diagram 3 shows a typical tree coring process. Because the drilling is perpendicular to the trunk, the core that is retrieved will have rings that can be examined much like those in a cross-sectional cut.
A.1.3.1
11. Which statement about people using the forest resources of the study area 400 years before the present is best supported by the data?

A. White pine was a popular wood choice because it was the best wood for building and there was a large supply of it.

B. Black spruce was a popular wood choice because it was the best wood for building and there was a large supply of it. *

C. Jack pine was a popular wood choice because it was the best wood for building and it produced the most energy per cord when burned than the other types of wood.

D. White cedar was a popular wood choice because it was the best wood for building and it produced the most energy per cord when burned than the other types of wood.

A.1.1.4
12. People used the resources of the study area to build boats. Which statement correctly compares boats made from jack pine wood to those made from white pine wood?

A. A boat made from jack pine wood could carry more mass than the same size and type of boat made from white pine wood because the molecules of a jack pine are more massive than the same volume of white pine.

B. A boat made from white pine wood could carry more mass than the same size and type of boat made from jack pine wood because the molecules of a white pine are more massive than the same volume of jack pine.

C. A boat made from jack pine wood could carry more mass than the same size and type of boat made from white pine wood because a set mass of jack pine molecules takes up more volume than the same mass of white pine molecules.

D. A boat made from white pine wood could carry more mass than the same size and type of boat made from jack pine wood because a set mass of white pine molecules takes up more volume than the same mass of jack pine molecules. *

The rationale for questions 11 and 12 are located on page 29.
SCIENCE

Table 3 shows the actual and predicted climatic conditions for the study area.

Table 3. Climatic Conditions in the Study Area

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Average Annual Temperature</th>
<th>Average Annual Rainfall (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>present day (actual)</td>
<td>7°C/45°F</td>
<td>68</td>
</tr>
<tr>
<td>400 years in the future (predicted)</td>
<td>19°C/66°F</td>
<td>117</td>
</tr>
</tbody>
</table>

14. Black spruce and white cedar are found in similar environments. Black spruce trees are predicted to become more abundant in the study area 400 years in the future, while white cedar trees are predicted to remain at present levels. Which limiting factors most likely explain these predictions?

A. more forest fires and limited precipitation
B. greater human use and higher germination rates
C. increased precipitation rates and less human use
D. higher soil moisture and lower germination rates

The rationale for questions 13 and 14 are located on page 29.
A.1.3.1, A.1.3.2, B.3.2.3
This is an EOE question. It is worth 4 points.
The scientists collected core samples from trees in the study area over many years. Diagram 4 shows core samples from two different trees that once lived in the study area. The students matched the tree rings to show where the trees’ lifespans overlapped. The samples have been magnified to more clearly display the tree ring growth patterns. The shaded box represents a specific period of time in the past.

Diagram 4. Core Samples from Two Trees in Study Area

15. A. Compare the study area’s environment during the time period represented by the shaded box to the study area’s present day environment. Describe how the environments of these two time periods are different.

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C. Describe one factor that could limit the accuracy of the information obtained from these tree rings.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
Rationale for questions 11 through 14.

Rationale for question 11
A White pine was not abundant 400 years ago, and it is a moderately soft wood, which makes it poor for building.
B Key: Black spruce was abundant 400 years ago, and it is moderately hard, which makes it good for building.
C Jack pine did not exist in the study area 400 years ago, but it does have the most energy per cord in comparison to other types of wood.
D White cedar did not exist in the study area 400 years ago, and it does not have the most energy per cord in comparison to other types of wood.

Rationale for question 12
A The data provided do not indicate the relative sizes of jack pine or white pine molecules.
B The data provided do not indicate the relative sizes of jack pine or white pine molecules.
C The density of white pine is less than that of jack pine, which allows white pine to carry more mass per unit of volume.
D Key: The density of white pine is less than that of jack pine, which allows white pine to carry more mass per unit of volume.

Rationale for question 13
A Key: Sandy soils are most abundant in the study area; they allow pollutants to infiltrate easily.
B Conifers will not increase an area’s sensitivity to water pollution.
C Little connection exists between layers of fossils and water pollution, except limestone (fossils), which easily erodes, allowing pollutants to reach groundwater quickly. Limestone is not indicated.
D The types of plants will not affect an area’s sensitivity to water pollution.

Rationale for question 14
A Black spruce and white cedar trees require moist organic soils. The climate of the study area is predicted to be wetter in the future, which will reduce fire potential.
B Neither greater human use nor higher germination rates explain the predictions.
C The increase in precipitation rates causes an increase in black spruce populations. The decrease in human use does not affect the white cedar population.
D Key: Black spruce populations would increase due to an increase in average annual rainfall. Since white cedar populations have not existed in the study area in the past 400 years, the current population would likely remain at zero due to lack of seeds.
SCIENCE

Item #15

This item will be reported under Category A, The Nature of Science, and Category B, Biological Sciences.

Assessment Anchors:

A.1.3 – Describe and interpret patterns of change in natural and human-made systems.
B.3.2 – Analyze patterns of change in natural or human-made systems over time.

Specific Eligible Content addressed by this item:

A.1.3.1 – Use appropriate quantitative data to describe or interpret change in systems (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
A.1.3.2 – Describe or interpret dynamic changes to stable systems (e.g., chemical reactions, human body, food webs, tectonics, homeostasis).
B.3.2.3 – Explain how natural processes (e.g., seasonal change, catastrophic events, habitat alterations) impact the environment over time.

Scoring Guide:

<table>
<thead>
<tr>
<th>Score</th>
<th>In response to this item, the student—</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>demonstrates a thorough understanding of how environmental changes affect environments and organisms by comparing past and present environments of the study area; identifying two types of trees that would have lived in the study area at the time specified and explaining why these types of trees would have thrived; and describing one factor that could limit the accuracy of information available from the tree rings. The response to each part of the item is clear, complete, and correct. Each response may contain a minor blemish or omission in work or explanation that does not detract from demonstrating a thorough understanding.</td>
</tr>
<tr>
<td>3</td>
<td>demonstrates a general understanding of how environmental changes affect environments and organisms by providing a combination of answers that totals 3 points, such as correct and complete responses for parts A and C and an identification of one type of tree that thrived and an explanation for why it thrived (partial part B), or correct and complete responses for parts A and C and a general explanation for why some trees would thrive, but no specific tree type listed (partial part B), or correct and complete responses for part B and a complete response for part A or part C. OR The response demonstrates a general understanding of the required scientific content, concepts, and procedures as required by the task(s). No points are given for simply listing one or two tree types. The response may contain some minor errors or omissions that do not detract from demonstrating a general understanding.</td>
</tr>
</tbody>
</table>

Continued on next page.
### In response to this item, the student—

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Demonstrates a partial understanding of how environmental changes affect environments and organisms by providing a combination of answers that totals 2 points, such as correct and complete responses for parts A and C, or a complete answer for part B. OR The response demonstrates a partial understanding of the required scientific content, concepts, and procedures as required by the task(s). No points are given for simply listing one or two tree types. The response may contain some work that is incomplete or unclear.</td>
</tr>
<tr>
<td>1</td>
<td>Demonstrates a minimal understanding of how environmental changes affect environments and organisms by providing a complete response for part A, or part C, or a partial (one tree and explanation) or general discussion for part B. OR The response demonstrates, in general, a minimal understanding of how environmental changes affect environments or organisms. No points are given for simply listing one or two tree types.</td>
</tr>
<tr>
<td>0</td>
<td>Provides insufficient evidence to demonstrate any understanding of how environmental changes affect environments or organisms. No points are given for simply listing one or two tree types. The response may show only information copied or rephrased from the question or insufficient information to receive a score of 1. BLK – Blank, entirely erased, or written refusal to respond OT – Off task IL – Illegible LOE – Response in a language other than English</td>
</tr>
</tbody>
</table>
### Item #15

**Top-scoring Response:**

<table>
<thead>
<tr>
<th>Part A Response</th>
</tr>
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<tbody>
<tr>
<td>The environment in the past was better for tree growth than it is at present.</td>
</tr>
</tbody>
</table>

(1 score point)

1 point for correct description.

<table>
<thead>
<tr>
<th>Part B Response</th>
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</thead>
<tbody>
<tr>
<td>Black spruce and white cedar because they both require wet habitats with moist soils.</td>
</tr>
</tbody>
</table>

(2 score points)

2 points for correct explanation.

<table>
<thead>
<tr>
<th>Part C Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Different levels of competition between trees for nutrients can produce different patterns of growth rings for different trees of the same species during the same time period.</td>
</tr>
</tbody>
</table>

(1 score point)

1 point for correct description.
The scientists collected core samples from trees in the study area over many years. Diagram 4 shows core samples from two different trees that once lived in the study area. The students matched the tree rings to show where the trees' lifespans overlapped. The samples have been magnified to more clearly display the tree ring growth patterns. The shaded box represents a specific period of time in the past.

Diagram 4. Core Samples from Two Trees in Study Area

A. Compare the study area's environment during the time period represented by the shaded box to the study area's present day environment. Describe how the environments of these two time periods are different.

B. The environment in the past was better for tree growth than it is as present.

The student’s description in part A is correct.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.
15. Continued. Please refer to the previous page for graphic and stimulus text.

B. Identify two types of trees that would have thrived during the time period represented by the shaded box. Explain your choices using information from this scenario to support your answer.

Black spruce and white cedar because they both require wet habitats with moist soils.

The student’s identification and explanation in part B is correct.

C. Describe one factor that could limit the accuracy of the information obtained from these tree rings.

Different levels of competition between trees for nutrients can produce different patterns of growth rings for different trees of the same species during the same time period.

The student’s description in part C is correct.
The scientists collected core samples from trees in the study area over many years. Diagram 4 shows core samples from two different trees that once lived in the study area. The students matched the tree rings to show where the trees’ lifespans overlapped. The samples have been magnified to more clearly display the tree ring growth patterns. The shaded box represents a specific period of time in the past.

**Diagram 4. Core Samples from Two Trees in Study Area**

```
center of tree
```

```
tree died many years ago
```

```
tree still living
```

Key:
```
||| = rings
\ = bark
```

A. Compare the study area’s environment during the time period represented by the shaded box to the study area’s present day environment. Describe how the environments of these two time periods are different.

**A. Trees need enough nutrients and water to grow fast.**

The tree grew slowly during the past several years and faster during the shaded period. The environment must have been wetter many years ago than now.

The student’s description in part A is correct.
15. Continued. Please refer to the previous page for graphic and stimulus text.

B. Identify two types of trees that would have thrived during the time period represented by the shaded box. Explain your choices using information from this scenario to support your answer.

   b. Spruce and pine trees. They like wet soils.

   The student’s explanation in part B is partially correct. The student is vague as to the kind of spruce and pine trees.

C. Describe one factor that could limit the accuracy of the information obtained from these tree rings.

   C) Forest fires can affect tree growth and the accuracy of tree ring information.

   The student’s description in part C is correct.
The scientists collected core samples from trees in the study area over many years. Diagram 4 shows core samples from two different trees that once lived in the study area. The students matched the tree rings to show where the trees' lifespans overlapped. The samples have been magnified to more clearly display the tree ring growth patterns. The shaded box represents a specific period of time in the past.

**Diagram 4. Core Samples from Two Trees in Study Area**

The student's description in part A is incorrect; the supporting information indicates that the environment in the past was wet with moist soils.

**A.** Compare the study area’s environment during the time period represented by the shaded box to the study area’s present day environment. Describe how the environments of these two time periods are different.

The student’s description in part A is incorrect; the supporting information indicates that the environment in the past was wet with moist soils.
B. Identify two types of trees that would have thrived during the time period represented by the shaded box. Explain your choices using information from this scenario to support your answer.

**B) they prefer drier soils.**

The student’s explanation in part B is consistent with the response in part A.

C. Describe one factor that could limit the accuracy of the information obtained from these tree rings.

**C) Forest fires can affect tree growth and the accuracy of tree ring information.**

The student’s description in part C is correct.
The scientists collected core samples from trees in the study area over many years. Diagram 4 shows core samples from two different trees that once lived in the study area. The students matched the tree rings to show where the trees' lifespans overlapped. The samples have been magnified to more clearly display the tree ring growth patterns. The shaded box represents a specific period of time in the past.

A. Compare the study area’s environment during the time period represented by the shaded box to the study area’s present day environment. Describe how the environments of these two time periods are different.

A: It used to rain a lot in the past and now it is drier.

The student’s description in part A is correct, but the references to time periods are vague.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.
15. **Continued.** Please refer to the previous page for graphic and stimulus text.

<table>
<thead>
<tr>
<th><strong>Column 1</strong></th>
<th><strong>Column 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B.</strong> Identify two types of trees that would have thrived during the time period represented by the shaded box. Explain your choices using information from this scenario to support your answer.</td>
<td></td>
</tr>
<tr>
<td>B. Oak trees and maple trees because they need water.</td>
<td></td>
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</tbody>
</table>

**The student’s identification and explanation in part B are incorrect.**

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>C.</strong> Describe one factor that could limit the accuracy of the information obtained from these tree rings.</td>
<td></td>
</tr>
<tr>
<td>C. Your eyesight. If you can’t see the rings you can’t count them accurately.</td>
<td></td>
</tr>
</tbody>
</table>

**The student’s description in part C is incorrect.**
The scientists collected core samples from trees in the study area over many years. Diagram 4 shows core samples from two different trees that once lived in the study area. The students matched the tree rings to show where the trees’ lifespans overlapped. The samples have been magnified to more clearly display the tree ring growth patterns. The shaded box represents a specific period of time in the past.

**Diagram 4. Core Samples from Two Trees in Study Area**

center of tree

**Key**

- rings
- bark

A. Compare the study area’s environment during the time period represented by the shaded box to the study area’s present day environment. Describe how the environments of these two time periods are different.

A. In the shaded area the trees are just starting to grow so they are small and now they are very tall so the rings need to be close together to be strong.

The student’s description in part A is incorrect and contains misconceptions about the purpose of studying tree rings.

GO TO THE NEXT PAGE TO FINISH THE QUESTION.
**SCIENCE**

15. **Continued.** Please refer to the previous page for graphic and stimulus text.

**B.** Identify two types of trees that would have thrived during the time period represented by the shaded box. Explain your choices using information from this scenario to support your answer.

   B. All kinds of baby trees could grow back then. It all depends on the kinds of trees people planted. Some may have planted jack trees and others planted white trees and may be some black trees. They didn't plant water lilies because they aren't trees.

   The student's identification and explanation in part B are incorrect.

**C.** Describe one factor that could limit the accuracy of the information obtained from these tree rings.

   C. I don't know anything about tree rings. We were never taught anything about tree rings.

   The student's response in part C is non-responsive to the task.