MEA 2014–15

Science Grade 11

The table below shows the entire eleventh-grade science test design. Scores are based on common items only, half of which are released and can be found in this document.

Test Design

Content Area	Common		Field Test Items		Total Items per Student		Base Testing Time	Points
	MC	CR	MC	CR	MC	CR		
Science	40	4	8	1	48	5	120 min.	56

Each item on the MEA measures a content standard of Maine's 2007 *Learning Results*.

Science Content Standards Assessed on the MEA

D. The Physical Setting
1. Universe and Solar System
2. Earth
3. Matter and Energy
4. Force and Motion

E. The Living Environment
1. Biodiversity
2. Ecosystems
3. Cells
4. Heredity and Reproduction
5. Evolution

Item Information Chart

Please refer to the item information chart on the next page for in-depth information on each science released item. The released item numbers in the chart correspond to item numbers in the practice test and on the MEA Item Analysis Report.

Constructed-Response Scoring Guides

A constructed-response scoring guide includes score point descriptions used to determine the score. Training notes that follow the scoring guide provide in-depth descriptions or particular information also used to determine the score.

Student Work

At least one sample student response is provided for each score point with annotations that explain the reasoning behind the assigned score.

Grade 11 Science Released Item Information

Released Item Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Practice Test Page Number	1	1	1	1	2	2	2	3	3	3	3	3	4	4	4	4	4	4	5	5	6	7
Content Strand (Maine 2007 *Learning Results*)	D3	E3	D4	D1	E2	D3	D3	E3	D2	E2	D3	D1	D3	D4	E4	E2	D1	E4	D3	E3	D2	E5
Depth of Knowledge Code	2	2	2	1	2	1	2	2	2	2	3	2	1	1	2	2	2	1	3	2	3	3
Item Type	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	MC	CR	CR
Possible Points	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	4
Answer Key	A	D	C	A	A	C	C	D	C	B	C	B	A	D	B	B	C	C	C	B		
% Who Chose A or Earned 1 Point	38	6	8	79	50	7	19	10	9	10	45	11	50	8	20	15	28	9	18	18	24	23
% Who Chose B or Earned 2 Points	26	30	4	7	17	11	6	9	10	73	25	62	6	23	52	69	34	15	19	53	17	19
% Who Chose C or Earned 3 Points	23	7	81	5	21	74	68	12	75	11	25	10	7	22	16	7	32	66	47	15	11	12
% Who Chose D or Earned 4 Points	12	56	7	8	11	8	6	69	5	5	4	16	35	46	9	7	5	8	15	13	5	3
Statewide Average Student Score																					1.11	1.07

Content Strands: See "MDOE Regulation 132–*Learning Results: Parameters for Essential Instruction*" at http://www.maine.gov/education/lres/pei/index.html.

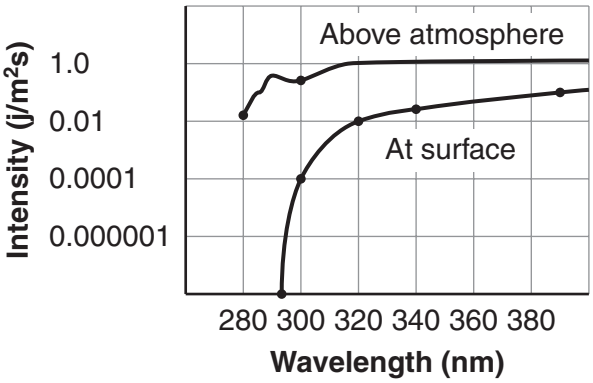
Item Type: MC = multiple choice, CR = constructed response

Answer Key: the letter of the correct answer choice

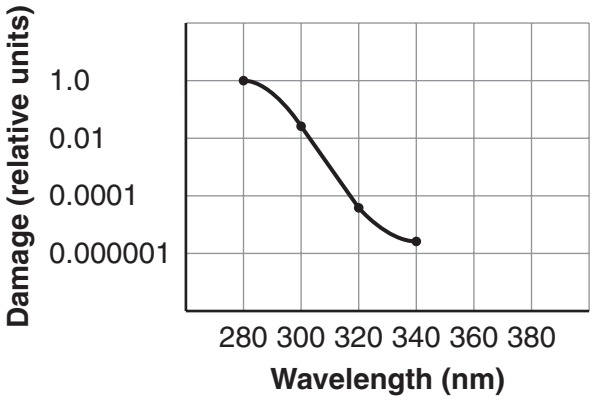
Constructed-Response Item 21

21. Graph 1 below provides information about the intensity of ultraviolet solar energy above Earth's atmosphere and at Earth's surface. Graph 2 provides information regarding DNA sensitivity to ultraviolet energy.

Graph 1: Solar Energy per Ultraviolet Wavelength



Graph 2: DNA Sensitivity per Ultraviolet Wavelength



a. Based on the graphs, estimate the intensity of ultraviolet solar energy that would reach Earth's surface if Earth did not have an atmosphere. Explain your reasoning.

Ultraviolet solar energy below 300 nm is almost completely screened out by ozone and oxygen in the atmosphere and thus does not reach Earth's surface.

b. Describe how an abrupt decrease in atmospheric ozone would most likely affect the habitability of Earth. Use information from <u>both</u> graphs to support your answer.

Scoring Guide for Constructed-Response Item 21

Score	Description
4	The student demonstrates a thorough understanding of the effect solar radiation has on Earth's surface and the habitability of Earth. The response includes an estimate of the amount of solar radiation that would reach Earth's surface if there were no atmosphere and provides reasoning for the estimate. The response also describes how an abrupt decrease in ozone would most likely affect the habitability of Earth and uses information in the graphs to support the description. The response has no errors or omissions.
3	The response demonstrates a general understanding of the effect solar radiation has on Earth's surface and the habitability of Earth. The response has one error/omission overall.
2	The response demonstrates a limited understanding of the effect solar radiation has on Earth's surface and the habitability of Earth. The response has two errors/omissions overall.
1	The response demonstrates a minimal understanding of the effect solar radiation has on Earth's surface and the habitability of Earth. The response has one piece of correct information.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response.

Training Notes for Constructed-Response Item 21

a. Any estimate of intensity greater than 0.01 and less than or equal to 1.0 j/m^2s is acceptable. Earth's atmosphere reflects and absorbs some of the ultraviolet light. Therefore, without an atmosphere, the amount of ultraviolet solar radiation reaching the surface would likely be the current above-atmosphere intensity. Graph 1 shows that the above-atmosphere intensity does not vary greatly as a function of wavelength of ultraviolet light (greater than 0.01 j/m^2s and less than or equal to 1.0 j/m^2s).OR If you take the atmosphere away, then the number would match the above-atmosphere curve. All the ultraviolet wavelengths currently absorbed by the atmosphere would reach Earth's surface.

b. The shorter wavelengths of ultraviolet light that are almost completely screened out by ozone and oxygen as shown in Graph 1 are exactly the wavelengths that Graph 2 shows DNA to be most sensitive to. If there is a decrease in ozone, more ultraviolet light will reach Earth's surface and disrupt DNA. This could make Earth less habitable. (The only organisms that could survive are those that live underground or deep in the ocean, where they are not exposed to the ultraviolet light, or that have a mutation that makes them "immune" to the effects of ultraviolet light.)

The intensity of ultraviolet solar energy that would reach Earth's surface if there was no atmosphere is equal to one J/M^2S. Without an atmosphere, the "At Surface" line on the intensity graph would become equal to the "Above Atmosphere" line because there is no atmosphere to lower the intensity of solar energy.

B) Graph one, and the explanation between questions, state that most ultraviolet energy with a wavelength below 300nm is absorbed by the atmosphere. Graph two however, shows that shorter wavelengths produces more damage to the cells. Going on this information, it can be stated that with a loss of atmosphere, energy with shorter wavelengths will be present on the earth's surface, causing more damage and making Earth less hospitable

Summary annotation statement:

This response accurately answers both parts of the prompt. In part (a), the response identifies a reasonable estimate of the energy intensity and explains how this value was determined. In part (b), the response ties the graph data (specifically regarding the damage shorter wavelengths do to cells) with the loss of atmosphere and correctly discusses the consequences. This response is thorough and receives a score of 4.

a) The intensity would be around 1 j/m^2s because that's the intensity above the atmosphere and if there was no atmosphere there would be nothing to stop the intensity from decreasing when hitting the earth.

b) An abrupt decrease in the ozone layer would be very problematic to the habitally of the earth because it would be a decrease in the atmosphere making the solar rays more harmful to use causing more damage.

Summary annotation statement:

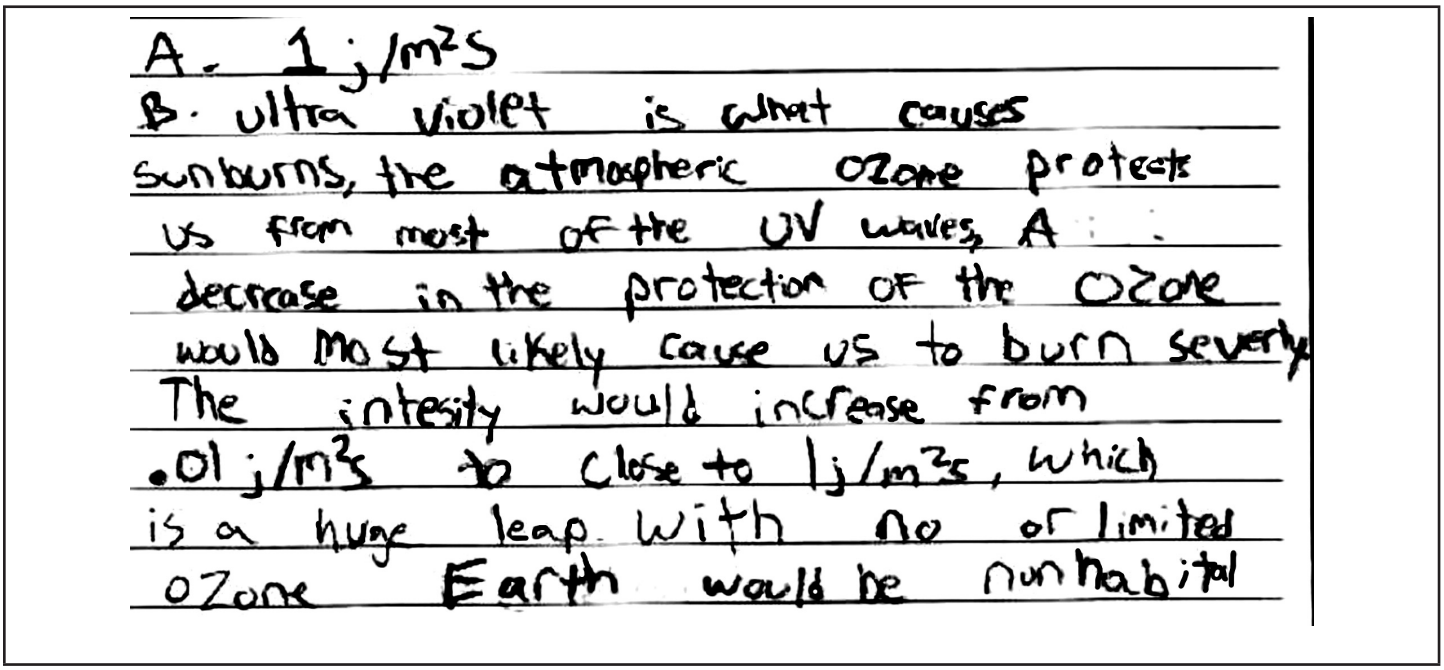
This response identifies a reasonable estimate of the energy intensity and explains the reasoning with support from the graph in part (a). Part (b) is general, correctly identifying that habitability would decrease but not citing any graph evidence to support the claim. This response is general and receives a score of 3.

A The intensity of ultraviolet rays would remain at 1.0 J/m²s, because the graph shows that above our atmosphere, it reaches 1.0 and goes no higher.

B. In an abrupt decrease of the ozone, DNA sensitivity would decrease, because as the solar energy goes up, the sensitivity goes down.

Summary annotation statement:

This response identifies a reasonable estimate of the energy intensity and explains the reasoning with specific support from the graph in part (a). Part (b) uses only the full Wavelength to Damage curve to reach an incorrect conclusion, not identifying that the most damaging wavelengths (below 300nm) would increase with a decrease in ozone; no credit is earned. This response is limited and receives a score of 2.


A. 1 j/m²s
B. ultra violet is what causes sunburns, the atmospheric ozone protects us from most of the UV waves, A decrease in the protection of the ozone would most likely cause us to burn severly The intesity would increase from .01 j/m²s to close to 1 j/m²s, which is a huge leap with no or limited ozone Earth would be nunhabital

Summary annotation statement:

Part (a) identifies a reasonable estimate of the energy intensity but offers no explanation or support from the graphs. Part (b) simply states that the Earth would be non-habitable [not accepted for credit, as underground or undersea creatures would still be able to survive] without using evidence from the graphs to support the claim. This response is minimal and receives a score of 1.

A. The ultraviolet Solar energy can't reach Earth's Surface. It can't because it doesn't have Gravity.

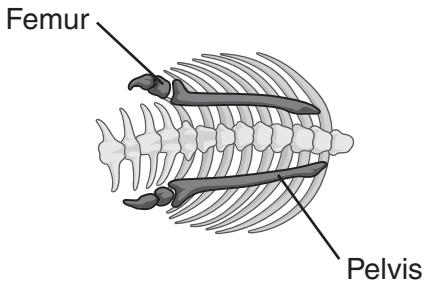
B. Solar energy per Ultraviolet Wavelength is diffesant than DNA Sensitivity per Ultraviolet Wavelength.

Summary annotation statement:

This response uses words from the prompt, but does not address either part of the prompt. Part (a) offers no reasonable estimate of the energy intensity or reasoning. Part (b) does not address the prompt. As a result, this response earns no credit.

Constructed-Response Item 22

22. The diagram below shows a partial skeleton of a snake. The skeleton has small femurs and pelvises. Snakes do not have legs and cannot walk. In many other organisms, the femur and pelvis form a junction that allows legs to move so organisms can walk.



a. Based on the diagram, make a statement about snake evolution.

b. Use evidence from the diagram to support your statement in part a.

c. Describe the general scientific ideas about how new groups of organisms evolve and explain how these ideas connect to your statement in part a.

Scoring Guide for Constructed-Response Item 22

Score	Description
4	The response demonstrates a thorough understanding of why some organisms may have characteristics that have no apparent survival or reproduction advantage. The response makes a statement about snake evolution based on evidence from the snake skeleton and an explanation of how new groups of organisms evolve that connects to the statement.
3	The response demonstrates a general understanding of why some organisms may have characteristics that have no apparent survival or reproduction advantage. The response has an error/omission.
2	The response demonstrates a limited understanding of why some organisms may have characteristics that have no apparent survival or reproduction advantage. The response has errors/omissions.
1	The response demonstrates a minimal understanding of why some organisms may have characteristics that have no apparent survival or reproduction advantage. The response has one piece of correct information.
0	This response has weak statements throughout that lack explanation or any specific details that would earn credit.
Blank	No response.

Training Notes for Constructed-Response Item 22

a. Response must draw a logical conclusion about snake evolution.

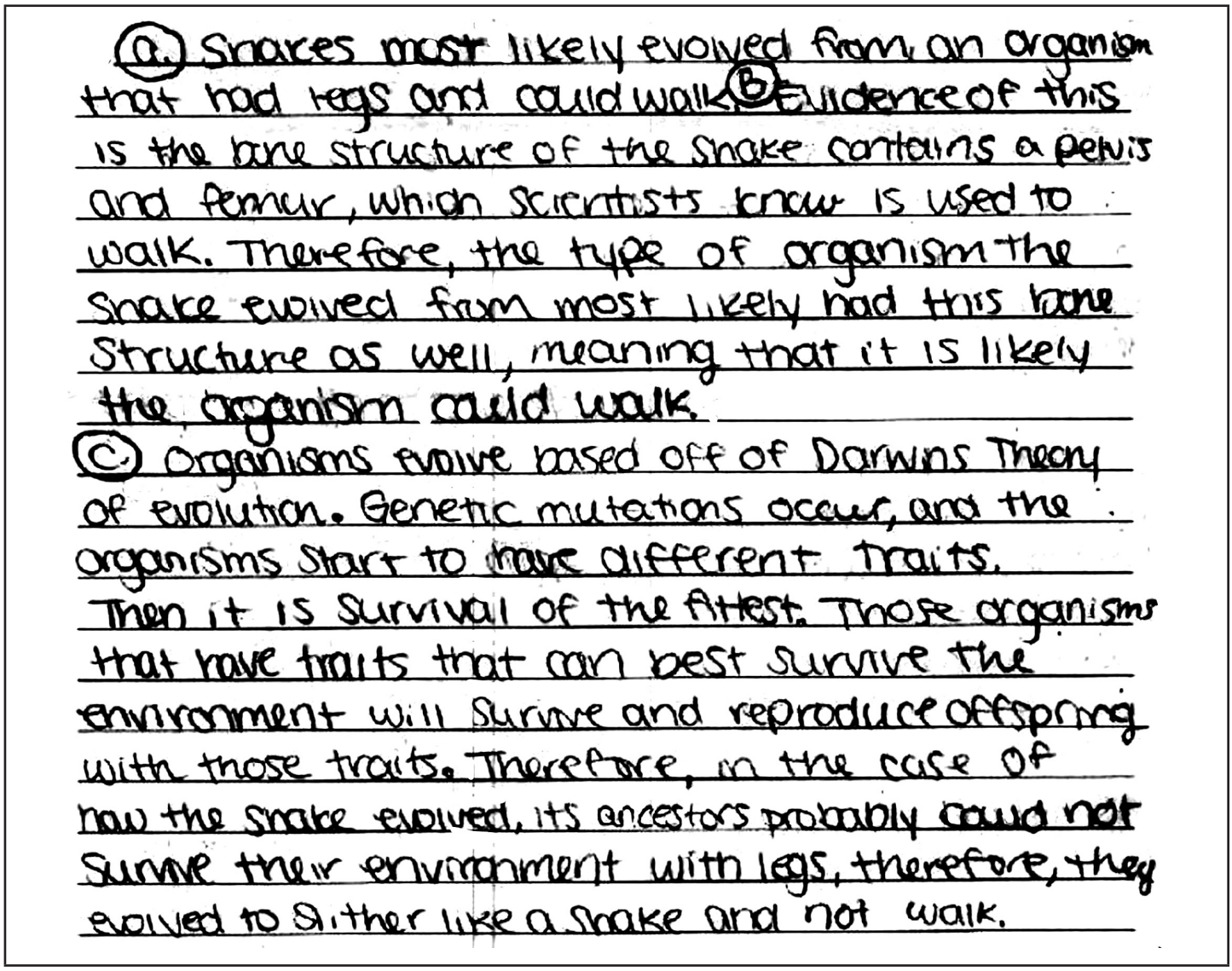
Possible response: Snakes likely evolved from an ancestor that walked on limbs.

b. Response must provide logical evidence from the skeleton.

The snake skeleton shows the presence of bones used for walking (femur and pelvis). These bones are small and would not help the snake survive, so they are most likely left over from an earlier phase of evolution.

c. Response must explain how new groups of organisms evolve and connect to the conclusion.

The process of natural selection allows populations to adapt to changes to their environment. Individuals with traits that help them survive are more likely to reproduce and pass on the genes for those adaptations. The ancestors of the snake may have lived in an environment that favored smaller and smaller limbs. Individuals that lost their limbs entirely and moved by a slithering motion survived at a higher rate than individuals with small limbs. Eventually, the whole population lacked limbs. This group of animals eventually evolved into many species of snakes.


(a) Snakes most likely evolved from an organism that had legs and could walk. (b) Evidence of this is the bone structure of the snake contains a pelvis and femur, which scientists know is used to walk. Therefore, the type of organism the snake evolved from most likely had this bone structure as well, meaning that it is likely the organism could walk.

(c) Organisms evolve based off of Darwins Theory of evolution. Genetic mutations occur, and the organisms start to have different traits. Then it is survival of the fittest. Those organisms that have traits that can best survive the environment will survive and reproduce offspring with those traits. Therefore, in the case of how the snake evolved, its ancestors probably could not survive their environment with legs, therefore, they evolved to slither like a snake and not walk.

Summary annotation statement:

This response clearly and correctly addresses all parts of the prompt. Parts (a) and (b) are correct. Part (c) has a complete discussion of natural selection including a clear connection back to the statement given in part (a).

a) Because of the discovery of the pelvis in the snake it can be inferred that snakes once had legs, but evolved due to their developing mechanism of travelling.
b) The femur and pelvis of a snake can be clearly seen in a skeletal diagram of a snake, but it is strange that it presently does not have legs. Judging by the snake's current anatomy, it is believed it may have evolved into its form today from a creature that had legs, such as a lizard. The femur and pelvis seem relatively useless to present-day snakes, further showing how the legs may have slowly retracted as time went on.
c) When organisms evolved, it is typically because they begin doing things their anatomy was not originally intended for. For instance, a lizard-like creature may have started slithering instead of crawling and using its legs so over time, the legs disappeared and snakes evolved scales on their abdomen that move and help them travel.

Summary annotation statement:

This response is strong overall, but omits a direct discussion of natural selection and its mechanisms. As a result, this response is not considered a demonstration of thorough understanding, so it receives a score of 3.

Sample 2-Point Response with Annotations for Constructed-Response Item 22

a. Snakes used to have legs but evolved so that now they use scales instead of legs.

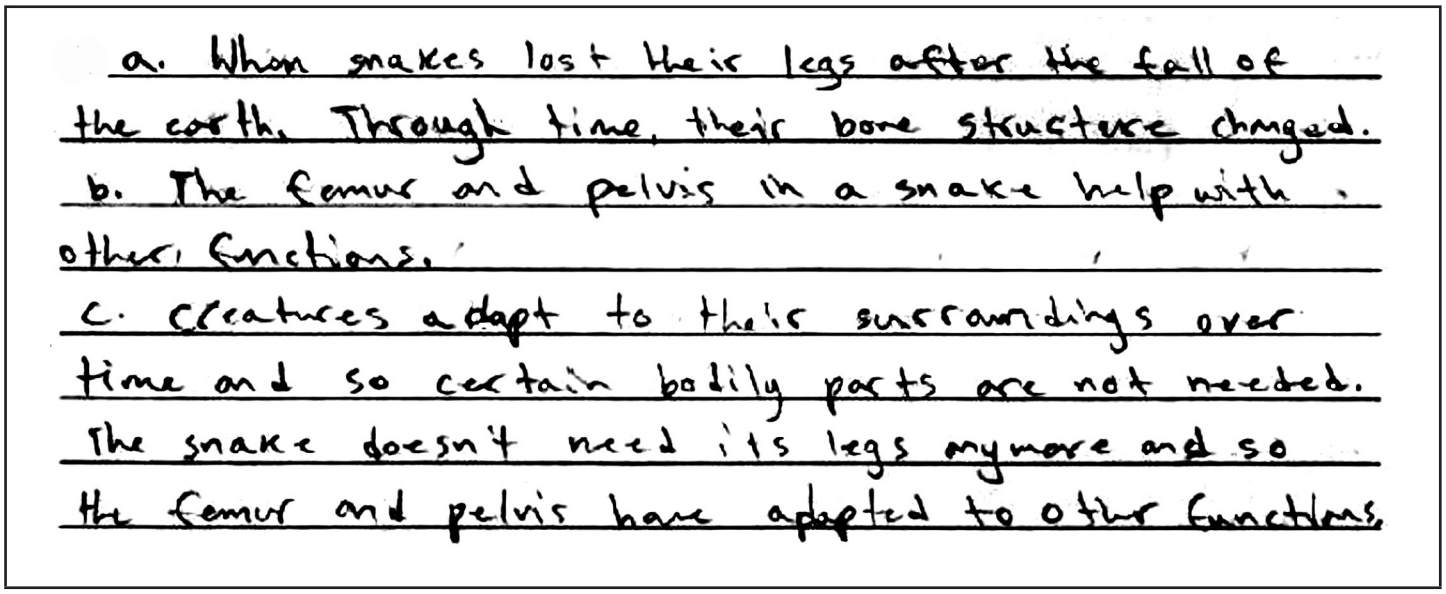
b. The diagram shows that snakes have small femurs and pelvises. This means that snakes used to have legs.

C. Organisms evolve to match whatever environment they are in. Snakes probably used to live in an environment where legs were more necessessary than they are today.

Summary annotation statement:

Each part of this response has correct statements but uses very little support for the statements to justify the conclusions reached. There is no connection between the progression of snake evolution and the mechanism by which this evolution occurs. This response demonstrates limited understanding and receives a score of 2.

Sample 1-Point Response with Annotations for Constructed-Response Item 22


a. When snakes lost their legs after the fall of the earth. Through time, their bone structure changed.
b. The femur and pelvis in a snake help with other functions.
c. Creatures adapt to their surroundings over time and so certain bodily parts are not needed. The snake doesn't need its legs anymore and so the femur and pelvis have adapted to other functions.

Summary annotation statement:

Part (a) implies that snakes once had legs, but is very weak. Part (b) is not creditable. Part (c) refers to adaptation over time, which is acceptable, but is lacking further justification and the connection back to part (a). Overall this response demonstrates minimal understanding for a score of 1.

Sample 0-Point Response with Annotations for Constructed-Response Item 22

A. They advanced over the years.

B. Snakes don't have legs they slether.

C. They matted more and started to change.

Summary annotation statement:

This response has weak statements throughout that lack explanation or any specific details that would earn credit.