Indiana Department of Education
SUPPORTING STUDENT SUCCESS

ISTEP+: Biology I
End-of-Course Assessment
Released Items and Scoring Notes

Introduction

Indiana students enrolled in Biology I participated in the *ISTEP+: Biology I Graduation Examination* End-of-Course Assessment (ECA) during the 2011-2012 test administration windows. The Biology I ECA consists of two item types which contribute to a student's scale score: multiple-choice and constructed-response. It is important to keep in mind that a significant portion of a student's score is calculated from the multiple-choice items on the assessment, which are not addressed within this document.

This document consists of open-ended items from the Spring 2012 administration and includes:

- Sample released open-ended questions
- Rubrics used by trained evaluators to score student responses
- Sample papers used by trained evaluators to distinguish between rubric score point values
- Annotations describing the rationale for scoring student responses

The purpose of this guide is to provide additional Biology I ECA sample items and to model the types of items that are scored using rubrics.

Reporting Category 4: Evolution and Historical Perspective

Question 1

Explain how the fossil record provides evidence for evolution.

Give two reasons why the fossil record is not representative of all evolution on Earth.

Question 1

Key Elements:

Part A

- By looking at younger to older rock layers, the fossil record supports the idea that a variety of different extinct organisms are related to one another and to living organisms.
- Similar structures and features of organisms that are located in different layers (younger and older) of the fossil record.

OR

- The fossil record shows that organisms have evolved from simpler organisms into more complex organisms over time.
- The fossil record shows evidence of extinction events/extinction of species.

Part B

- Not all species are represented in the fossil record because they were not preserved.
- Fossils can be destroyed by geologic processes.
- Some species have left no fossils in the fossil record.

Rubric:

3 points **Correct explanation and two reasons**

2 points **Correct explanation and one reason OR two reasons**

1 point **Correct explanation OR one reason**

0 points **Other**

Question 1, Sample A – 3 points

Fossils can show how the skeletal shape of an organism has changed over millions over years.

Not everything has been fossiled.
It does not show how the animals have changed when it comes to skin, or internal organs.

Notes: Part one of this response describes a valid explanation of how the fossil record provides evidence for evolution. (1 key element) Part two of this response describes two valid reasons why the fossil record is not representative of all evolution. (2 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 1, Sample B – 2 points

The deeper the fossil, the older it is.

1. Not all organisms were fossilized.
2. Some are too deep to be discovered..?

Notes: Part one of this response does not describe how the fossil record provides evidence for evolution. It only describes the general age of fossils as they are found in rock layers. (0 key elements) Part two of this response describes two valid reasons why the fossil record is not representative of all evolution. (2 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 1, Sample C – 1 point

The fossil record provides evidence for evolution by giving you the year of the rock the fossil was found in, therefore telling you how old the organism is.

Some evolution is not represented because some periods in time are not shown because of certain events that left no evidence that things existed. Another reason is that most evolution occured before land was developed.

Notes: Part one of this response does not describe how the fossil record provides evidence for evolution. It only describes how some fossils can be used to determine the ages of rock layers. (0 key elements) Part two of this response describes only one valid reason. The statement that most evolution occurred before land was developed is incorrect. (1 key element)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 1, Sample D – 0 points

It shows that things have been found for long periods of times ago on earth.

Because it is not from now in the present it shows that they found thing in the past and stuff that are in the past.

Notes: Part one of this response does not describe how the fossil record provides evidence for evolution. It only describes that fossils have been found that cover long periods of Earth's history. (0 key elements) Part two of this response does not describe any valid reason why the fossil record is not representative of all evolution on Earth. (0 key elements)

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Reporting Category 3: Genetics

Question 2

Sickle-cell disease occurs when a child is born with two recessive copies of the defective gene.

If neither biological parent has the disease, what are the possible genotypes of the biological parents of a child that has sickle-cell disease?

Explain the mechanism for inheritance of this disorder.

Question 2

Key Elements:

Part A

- Both parents must be carriers of a recessive allele for Sickle-cell disease.
- Both parents are heterozygous.

Part B

- During meiosis, each gamete will receive one allele for each gene. If the allele is dominant, it will be apparent in the offspring. If the allele is recessive, it will only be expressed in offspring that received a like allele (recessive) from the other biological parent.

Rubric:

2 points	**Correctly identifies 2 key elements. Correctly identifies the parents as heterozygotes and explains how offspring get the recessive trait.**
1 point	**Correctly identifies 1 key element. Correctly identifies the parents as heterozygotes OR explains how offspring get the recessive trait.**
0 points	**Does not correctly identify any key elements.**

Question 2, Sample A – 2 points

Both parents would have to be heterozygous for the disease

Both parents contribute one allele to the child and if both had contributed the recessive allele then the child would be homozygous recessive causing him to have the disease

Notes: Part one of this response correctly identifies that both parents are heterozygous. (1 key element. Part two of this response correctly describes the process by which a child could have the disease even if the parents do not. (1 key element)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 2, Sample B – 1 point

Both parents must have been heterozygous for the recessive trait of the defective gene.

Being both parents were heterozygous gave the offspring a greater chance of getting the deffective gene.

Notes: Part one of this response correctly identifies that both parents are heterozygous. (1 key element) Part two of the response does not describe the mechanism for passing the traits on to offspring. This response only states that the offspring have a chance of receiving the recessive allele. (0 key elements)

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Question 2, Sample C – 0 points

The cell could have mutated into the recessive copy and then that would have given the child the disease.

the parent may not know that they carry the recessive copy of the disease but after so many years the trait will pop up and they may not even know that they have it.

Notes: Part one of this response does not describe the genotype of the parents who have a child with sickle-cell disease. (0 key elements) Part two of this response incorrectly describes the mechanism for passing the sickle-cell disease gene to offspring. (0 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Reporting Category 1: Molecules and Cells

Question 3

Identify the elements that make up a molecule of water.

Identify the elements that make up a molecule of glucose.

Identify which of these molecules, water or glucose, provides energy for an organism and briefly explain what happens to the molecule that enables an organism to obtain energy.

Question 3

Key Elements:

- Water – hydrogen and oxygen
- Glucose – carbon, hydrogen, and oxygen
- Organisms obtain energy from glucose as the chemical bonds are broken.
- Glucose is converted to ATP/chemical energy.

Rubric:

3 points	**Correct identification of elements for both compounds and correct description of how glucose is broken down to provide energy.**
2 points	**Correct identification of elements for both compounds OR correct identification of one compound and correct description of how glucose is broken down to provide energy.**
1 point	**Correct identification of element for one of the compounds OR correct description of how glucose is broken down to provide energy.**
0 points	**Other**

Question 3, Sample A – 3 points

Hydrogen and oxygen make up water. Glucose is made up of carbon, hydrogen and oxygen.

Glucose provides energy for an organism. When the bonds of the glucose molecule break energy is released.

Notes: Part one of this response correctly identifies the elements that make up water and glucose. (2 key elements) Part two of this response correctly identifies the molecule that provides energy and how that energy is obtained. (1 key element)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 3, Sample B – 2 points

H2O- 2 parts hydrogen and 1part oxygen make up water.
C6H12O6- 6 parts carbon, 12 parts hydrogen, and 6 parts oxygen make up glucose

glucose provides the organism with energy. the moleule will have enough energy to take out its functions and work properly until the energy is depleted, then the organism will need more

Notes: Part one of this response correctly identifies the elements that make up water and glucose. (2 key elements) Part two of this response correctly identifies the molecule that provides energy but does not state how the body obtains that energy from the glucose molecule. (0 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 3, Sample C – 1 point

hydrogen and oxygen make up water.
sodium oxygen and hydrogen make up glucose.

Water provides engery for an organisim because water refuels the body and quenches the thirst. Water brings oxygen to the body and the blood can pump more freely.

Notes: Part one of this response correctly identifies the elements that make up water only. The elements listed for glucose are incorrect. (1 key element) Part two of the response incorrectly identifies water as the molecule used by the body for energy. (0 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 4, Sample D – 0 points

Elements that make up water is air, liguid and minerals. Glucise is sugar that is made up of minerals and water.

Water provides energy to an organism and if the organism does not have water it will eventuall dehydrate and the body muscles willl not move it will die. Water becomes waste or is used and evaporates.

Notes: Part one of this response incorrectly identifies the elements that make up both water and glucose. (0 key elements) Part two of this response incorrectly identifies water as the molecule used by the body for energy. (0 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Reporting Category 3: Genetics

Question 4

Mendel crossed a pea plant with green pods (GG) and a pea plant with yellow pods (gg).

Explain why only plants with green pods appeared in the F_1 generation.

Mendel crossed offspring of this cross (F_1) with each other and found that both plants with green pods and plants with yellow pods were produced.

Explain why both colors of pea pods appeared in the F_2 generation.

Question 4

Key Elements:

Part A

- Every plant in the F_1 generation inherited a dominant allele for green.

Part B

- Every cross in the F_1 generation involved two heterozygous parents. Therefore, some of the F_2 plants were homozygous recessive.

Rubric:

2 points	**Two key elements**
1 point	**One key element**
0 points	**Other**

Question 4, Sample A – 2 points

Green pods only appeared in the F1 generation because they were dominant and all of the allele possibilities were heterozygous, which means the green pod allele would be covering up the recessive yellow pod allele.

Both colors of pea pods appeared in the F2 generation because not every allele possibility was heterozygous. some were just recessive, gg, and some were heterozygous, Gg. With the recessive gg, the pods would be yellow and with the heterozygous Gg, the pods would be green.

Notes: Part one of this response correctly describes why only green pea pods appeared in the F_1 generation. (1 key element) Part two of the response correctly describes why both color pea pods appeared in the F_2 generation. (1 key element)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 4, Sample B – 1 point

Only green plants showed up because the big G is dominant over the little G.

This happened because the F2 generation was heterozygous and had a different outcome than the F1 generation.

Notes: Part one of this response correctly describes why only green pea pods appeared in the F_1 generation. (1 key element) Part two of this response is incorrect. The F_2 generation will contain homozygous dominant, homozygous recessive, and heterozygous pea plants. (0 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 4, Sample C – 0 points

The yellow pod may hjave been heterozygous in which caused it to have one uppercase letter & a lowercase lwetter that in which changed the phenotype

It all regulated eventually

Notes: Part one of this response does not correctly describe why only green pea pods appeared in the F_1 generation. (0 key elements) Part two of this response does not correctly describe why both yellow and green pea pods appeared in the F_2 generation. (0 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Reporting Category 3: Genetics

Question 5

Below is a sequence of bases that make up a segment of DNA.

A A C T A C A G T C T A C C A T A C

When this segment of DNA is translated into mRNA, how many codons would be represented in this segment?

How are codons used in the process of protein synthesis?

Question 5

Key Elements:

- Six

AND

- Each codon codes for a specific amino acid

OR

- Determining the sequence of amino acids

Rubric:

2 points	**Two key elements**
1 point	**One key elements**
0 points	**Other**

Question 5, Sample A – 2 points

six codons

they code for amino acids that are used to build proteins

Notes: Part one of this response correctly identifies that six codons are represented in the DNA strand. (1 key element) Part two of this response correctly describes the role of codons during protein synthesis. (1 key element)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 5, Sample B – 1 point

6

They are read by 3

Notes: Part one of this response correctly identifies that six codons are represented in the DNA strand. (1 key element) Part two of this response describes how the codons are read instead of the role of codons during protein synthesis. (0 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 5, Sample C – 0 points

18

it tells us how the structure is made

Notes: Part one of this response does not correctly identify the number of codons represented in the DNA strand. (0 key elements) Part two of this response is too vague and does not adequately describe the role of codons in protein synthesis. (0 key elements)

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Reporting Category 4: Evolution and Historical Perspective

Question 6

Describe two pieces of evidence to support the claim that chimpanzees are a close living relative of humans.

Describe one piece of evidence.

Describe another piece of evidence.

Question 6

Key Elements:

- The DNA between chimpanzees and humans is about 98% the same.
- Chimpanzees and humans share similar physical characteristics (with example).
- Chimpanzees and humans share similar social behaviors (with example).
- Chimpanzees and humans have a high degree of amino acid similarity.

Rubric:

2 points	**Two key elements**
1 point	**One key element**
0 points	**Other**

Question 6, Sample A – 2 points

Chimpanzees have simular bone structures as we do.

There genetic make up is very simular to our genetic make up.

Notes: Part one and part two of this response correctly describes two pieces of evidence that support that claim that chimpanzees are close living relatives to humans. (2 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 6, Sample B – 1 point

Humans have many similarities to chimpanzees.

Our DNA and bodily functions are so closely related that humans and chimpanzees have to be closely relative.

Notes: Part one of this response is too vague. While it's true that humans and chimpanzees have many similarities, this student does not provide a specific example of a similarity. (0 key elements) Part two of this response makes an accurate comparison between the DNA of the two organisms. (1 key element)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 6, Sample C – 0 points

We both have the same DNA.

Chimpanzees have common ancestors to us, and are said to have some physical characteristic that are like ours.

Notes: Part one of this response is incorrect. Humans and chimpanzees have very similar, but not the same, DNA. (0 key elements) Part two of this response is not specific enough. A specific similar physical characteristic is needed. (0 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Reporting Category 2: Developmental and Organismal Biology

Question 7

The stomach contains enzymes that aid in digestion and that are active within a small pH range.

Describe what would happen to the enzyme's FUNCTION if the pH was outside this range.

Describe what would happen to the enzyme's STRUCTURE if the pH was outside this range.

Question 7

Key Elements

- The enzyme would stop functioning.
- The enzyme would decrease in activity.
- The enzyme would have no activity.
- The shape of the enzyme changes.
- The structure of the enzyme would fall apart.
- The enzyme would denature.

Rubric:

2 points	**Two key elements**
1 point	**One key element**
0 points	**Other**

Question 7, Sample A – 2 points

The enzyme would lose most of it's function and not be able to do it's job of aiding in digestion.

They enzymes shape would change and it would not be able to grab a hold of the chemical it needs to speed up.

Notes: Parts one and two of the response correctly describe how the enzyme's function and structure would change if the enzyme is in an environment outside of its active pH range. (2 key element)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 7, Sample B – 1 point

They would be damage.

It could ruin the structure.

Notes: Part one of this response is too vague to receive credit. (0 key elements) Part two of the response is vague, but it receives credit because it specifically refers to the structure of the enzyme being changed in an environment outside of its active pH range. (1 key element)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.

Question 7, Sample C – 0 points

The enzyme would act as a catalyst and speed up a chemical reactions if th pH was outside of the range.

The enzyme's structure would change in that it would have to adapt to the new range.

Notes: Part one of this response is incorrect. An enzyme in an environment outside of its active pH range would not be able to function as a catalyst. (0 key elements) Part two of this response is incorrect. This statement implies that an enzyme would adapt to any pH and still be able to function normally. (0 key elements)

Please note that responses are scored for science content only, not for accurate grammar, spelling, or punctuation.