



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 2012-2013 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 2013 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 1: Cellular Structure and Chemistry**

**Question 1**

Cells have specialized structures, including organelles, that carry out the different functions necessary for the growth and survival of the cell.

List three of these specialized structures and/or organelles and describe their functions.

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## Question 1

### Key Elements:

- Chromosomes – holds genetic information necessary for reproduction
- Nuclear membrane – regulates what enters and leaves the nucleus
- Nucleolus – contains RNA for protein synthesis
- Centrioles – involved in cell division
- Chloroplasts – photosynthesis
- Cytoskeleton – supports cell and gives it shape
- Endoplasmic reticulum – part of the transport system for cell materials
- Golgi apparatus – packages proteins
- Lysosome – contains digestive proteins
- Mitochondria – ATP production, powerhouse of the cell
- Ribosomes – synthesize proteins
- Vacuoles – storage sacs
- Cell wall – in plants and bacteria, gives cell shape and structure
- Plasma membrane – regulates what enters and leaves the cell
- Nucleus – stores genetic information, controls cell functions, control center
- Membranes (of organelles) – structural support

### Rubric:

<b>3 points</b>	<b>Three structures, three functions</b>
<b>2 points</b>	<b>Two structures, one function OR two structures, two functions OR three structures, one function OR three structures, two functions</b>
<b>1 point</b>	<b>Two structures OR one structure, one function, OR three structures</b>
<b>0 points</b>	<b>Other</b>

**Question 1, Sample A – 3 points**

1. Nucleus – the nucleus contains all of the genetic information of the cell
2. Ribosome – the ribosomes help to make protein for the cell
3. Lysosome – the lysosomes are in charge of breaking down materials for the cell

*Notes: This response correctly lists three cell structures with the correct function for each of the cell structures.*

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

**Question 1, Sample B – 2 points**

Cell Membrane: Protects the cell and allows substance to pass in and out of the cell

Nucleus: Tells the cell what to do and controls the function of a cell

Lysosomes: protien synithesis

*Notes: This response correctly lists two cell structures with the correct function (cell membrane and nucleus). The response incorrectly lists the function of a lysosome.*

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

**Question 1, Sample C – 1 point**

Mitochondria, cell wall, and golgi appuratus

*Notes: This response correctly lists three cell structures. According to the rubric, this is sufficient to earn one point.*

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

**Question 1, Sample D – 0 points**

Hormones – these stimulate the cells and increase growth

Alleles – alleles control genes

Genes – these give hereditary information to DNA

*Notes: This response incorrectly identifies three cell structures.*

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

**Reporting Category 3: Genetics and the Molecular Basis of Heredity**

**Question 2**

Use the table below to answer the following question.

**Amino Acids and Their Codons**

	U	C	A	G
U	UUU } Phe UUC } UUA } Leu UUG }	UCU } Ser UCC } UCA } UCG }	UAU } Tyr UAC } UAA } Stop UAG }	UGU } Cys UGC } UGA } Stop UGG } Trp
C	CUU } Leu CUC } CUA } CUG }	CCU } Pro CCC } CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } Arg CGC } CGA } CGG }
A	AUU } Ile AUC } AUA } AUG } Met	ACU } Thr ACC } ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }
G	GUU } Val GUC } GUA } GUG }	GCU } Ala GCC } GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } Gly GGC } GGA } GGG }

**What would be the resulting mRNA sequence when this DNA sequence is transcribed?**

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**Using the chart titled "Amino Acids and Their Codons", what would be the resulting amino acids when the mRNA sequence is translated?**

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## Question 2

### Key Elements:

#### Part A

- A G U C G A G G C A U G

#### Part B

- Ser, Arg, Gly, Met

### Rubric:

**2 points**      **Two key elements**

**1 point**      **One key element**

**0 points**      **Other**

**Question 2, Sample A – 2 points**

AGUCGAGGCAUG

Serargglymet

*Part one of this response shows the correct mRNA sequence (1 key element). Part two of this response shows the correct amino acids that would be produced from the mRNA sequence (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**

AGUCGAGGCAUG

Thr, Arg, Gly, Met

*Part one of this response shows the correct mRNA sequence (1 key element). Part two of this response shows an incorrect amino acid, with Thr in place of Ser (0 key elements).*

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

**Question 2, Sample C – 0 points**

UACCUAACUGA

TYR LEU THR STOP

*Part one of this response shows an incorrect mRNA sequence (0 key elements). Part two of this response shows incorrect amino acids based on the mRNA sequence (0 key elements).*

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

**Reporting Category 1: Cellular Structure and Chemistry**

**Question 3**

**Identify two structures or molecules in cells that participate in the process of making proteins.**

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**Explain how each structure plays a role in this process.**

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### Question 3

#### Key Elements:

Part A (Two of the following)

- Nucleus or DNA
- Nucleolus
- Ribosomes
- RNA
- ATP
- Rough Endoplasmic reticulum
- Amino acids
- Enzymes
- mRNA
- tRNA
- Golgi apparatus

**AND**

Part B (correct explanation of all parts identified in Part A)

- Nucleus/DNA: Provides template for transcription, production of mRNA
- Nucleolus: rRNA is synthesized here with proteins from the cytoplasm to form ribosomal subunits (components of ribosomes)
- Ribosomes: Structure/base for translation of mRNA into tRNA and formation of the polypeptide chain
- ATP: provides energy in the process of making proteins
- RNA: Plays integral role in transcribing and translating DNA into polypeptides (via mRNA and tRNA)
- Rough ER: Site for ribosomes to synthesize proteins
- Amino acids: Building blocks of proteins
- Enzymes: Play various important roles in protein synthesis, including assisting DNA replication and formation of amino acids, among others
- mRNA: carries genetic message from the DNA to the protein synthesizing part of the cell
- tRNA: transfers amino acids from cytoplasm to ribosomes
- Golgi apparatus: processes and packages proteins

**Rubric:**

<b>3 points</b>	<b>Two key elements from Part A, two key elements from Part B</b>
<b>2 points</b>	<b>Two key elements from Part A, one key element from Part B</b>
<b>1 point</b>	<b>One key element from Part A, one key element from Part B OR two key elements from Part A</b>
<b>0 points</b>	<b>Other</b>

**Question 3, Sample A – 3 points**

Ribosomes and mRNA (messenger RiboNucleic Acid) participate in protein synthesis, the process of making proteins.

mRNA plays a role in protein synthesis by taking the information from the DNA in the nucleus to the ribosome. This information is a section of the cell's DNA strand and tells the ribosome which protein(s) to make. Ribosomes play a part by building amino acids (brought to the ribosome by tRNA) into protein chains, which the cell can use.

*Notes: Part one of this response correctly identifies two structures/molecules that participate in the process of making proteins (2 key elements). Part two of the response correctly describes how each structure/molecule plays a role in protein making process (2 key elements).*

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

**Question 3, Sample B – 2 points**

ribosomes, nucleolus

The nucleolus contains the information on how to make the protien and the ribosomes create the protien.

*Notes: Part one of this response correctly identifies two structures that participate in the process of making proteins (2 key elements). Part two of the response correctly describes the role of the ribosome but incorrectly describes the role of the nucleolus in the protein making process (1 key element).*

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

**Question 3, Sample C – 1 point**

Ribosomes, Lysosomes

ribosomes- make proteins  
lysosomes- transport proteins

*Notes: Part one of this response correctly identifies one structure that participates in the process of making proteins (1 key elements). Part two of the response correctly describes the role of the ribosome in the protein making process (1 key element).*

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

**Question 3, Sample D – 0 points**

Two molecules that participate in the process of making proteins is adenine and thymine.

They both play a role of base pairing. Adenine and Thymine bond together.

*Notes: Part one of this response incorrectly identifies either a structure or a molecule that participates in the process of making proteins (0 key elements). The response is unable to obtain any key elements from part two if no key elements are earned from part one (0 key elements).*

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

**Reporting Category 3: Genetics and the Molecular Basis of Heredity**

**Question 4**

Round seeds (R) are the dominant seed shape for pea plants; wrinkled (r) is the recessive seed shape for pea plants. A pea plant with round seeds is crossed with a pea plant with wrinkled seeds and all of the offspring have round seeds.

What are the genotypes of the two parent plants in this cross?

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What is the expected phenotypic ratio of seed shape in offspring if a heterozygous plant is crossed with a homozygous recessive plant?

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#### Question 4

##### Key Elements:

##### Part A

- RR and rr or RR and Rr

OR

- Homozygous dominant or homozygous recessive or homozygous dominant and heterozygous

##### Part B

- The phenotypic ratio for offspring is 2 round to 2 wrinkled

##### Rubric:

**2 points**      **Two key elements**

**1 point**        **One key element**

**0 points**       **Other**

**Question 4, Sample A – 2 Points**

The genotypes of the two parents are: RR and rr

The expected phenotypic ration is 2:2. Fifty percent of the seeds will be round and fifty percent of the seeds will be wrinkled.

*Notes: Part one of this response correctly lists two possible genotypes of the two parents (1 key element). Part two of this response correctly identifies the phenotypic ratio (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**

RR\*rr

Rr 4:0

*Notes: Part one of this response correctly lists two possible genotypes of the two parents (1 key element). Part two of this response identifies an incorrect phenotypic ratio (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**

heterozygous & homozygous

round seeds

*Notes: Part one of this response incorrectly lists two possible genotypes of the two parents. The response does have homozygous but does not specify whether it is homozygous dominant or homozygous recessive (0 key elements). Part two of this response does not identify a phenotypic ratio (0 key elements).*

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

**Reporting Category 3: Genetics and the Molecular Basis of Heredity**

**Question 5**

Look at the following DNA segment.

ACC TTA CGG ACT

Rewrite the above DNA segment with a single base insertion mutation that would result in the sequence containing the DNA triplet TAC.

Rewrite the above DNA segment with a single base deletion mutation that would result in the sequence containing the DNA triplet GGA.

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Rewrite the above DNA segment with a single base substitution mutation that would result in the sequence containing the DNA triplet CAG.

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## Question 5

### Key Elements:

- Inserting – ACC TTA CGG TAC T or TAC CTT ACG GAC T
- Deleting – ACC TTA GGA CT (deleted C in CGG) or deletion of any base before the C in the original CGG
- Substitution – ACC TTA CAG ACT

### Rubric:

<b>3 points</b>	<b>Three key elements</b>
<b>2 points</b>	<b>Two key elements</b>
<b>1 point</b>	<b>One key element</b>
<b>0 points</b>	<b>Other</b>

**Question 5, Sample A – 3 Points**

ACC TTA CGG TAC T  
ACT TAC GGA CT

ACC TTA CAG ACT

*Notes: This response correctly rewrites the DNA segment with an insertion, deletion, and substitution mutation (3 key elements).*

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

**Question 5, Sample B – 2 Points**

ACC TTA CGG TAC  
ACC TTA GGA CT

ACC TTA CAG ACT

*Notes: This response correctly rewrites the DNA segment with a deletion and substitution mutation (2 key elements). The response incorrectly rewrites the DNA segment with an insertion mutation.*

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

**Question 5, Sample C – 1 Point**

ACC TTA CGG TAC  
GGA TTA CGG ACT

ACC TTA CAG ACT

*Notes: This response correctly rewrites the DNA segment with a substitution mutation (1 key element). The response incorrectly rewrites the DNA segment with an insertion and deletion mutation.*

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

**Question 5, Sample D – 0 Points**

TGG AAT GCC TGA TAC  
ACC TTA GGA ACT ATG GGA

ACC TTA CAG ACT ATG GGA

*Notes: This response incorrectly rewrites the DNA segment with an insertion, deletion, and substitution mutation (0 key elements).*

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