



Indiana Department of Education  
SUPPORTING STUDENT SUCCESS

*ISTEP+: Biology I*

End-of-Course Assessment

Released Items and Scoring Notes

## Introduction

Indiana students enrolled in Algebra I participated in the *ISTEP+: Biology I Graduation Examination* End-of-Course Assessment (ECA) during the 2009-2010 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 2010 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: Molecules and Cells

### Question 1

List and describe three processes used by cells to control the movement of substances across the cell membrane.


## Question 1

### Key Elements

- Selective permeability is used by the cell membrane to allow certain substances to move across.
- Passive transport occurs when substances move from an area of higher concentration to an area of lower concentration.
- Osmosis is the diffusion of water across the cell membrane.
- Facilitated diffusion occurs when the membrane controls the pathway for a particle to enter or leave a cell.
- Active transport occurs when a cell uses energy to move a substance across the cell membrane, and/or a substance moves from an area of low to high concentration, or against the concentration gradient.
- Pumps are used to move charged particles like sodium and potassium ions through membranes using energy and carrier proteins.
- Membrane-assisted transport occurs when the membrane of the vesicle fuses with the cell membrane forcing large molecules out of the cell as in exocytosis.
- Membrane-assisted transport occurs when molecules are engulfed by the cell membrane as in endocytosis.
- Membrane-assisted transport occurs when vesicles are formed around large molecules as in phagocytosis.
- Membrane-assisted transport occurs when vesicles are formed around liquid droplets as in pinocytosis.
- Protein channels or channel proteins allow for the movement of specific molecules or substances into or out of the cell.

### 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 1, Sample A – 3 Points

**List and describe three processes used by cells to control the movement of substances across the cell membrane.**

- Osmosis is a process in which water travels along a selectively permeable membrane.
- Diffusion is the process a cell uses in which particles move from an area of high concentration to an area of low concentration.
- Active transport is a process in which the cell uses energy to move something from one part of the cell to another.

*Notes:*

*1 point: Osmosis... water travels along a selectively permeable membrane*

*1 point: Diffusion... move from an area of high concentration to an area of low concentration*

*1 point: Active transport... uses energy*

### Question 1, Sample B – 3 Points

**List and describe three processes used by cells to control the movement of substances across the cell membrane.**

Osmosis; The diffusion of water across the cell membrane.

Active transport; Movement across the cell membrane against the concentration gradient.

Passive transport; Movement across the cell membrane without the use of energy.

*Notes:*

*1 point: Osmosis... diffusion of water*

*1 point: Active transport... against the concentration gradient*

*1 point: Passive transport... without the use of energy*

### Question 1, Sample C – 2 Points

**List and describe three processes used by cells to control the movement of substances across the cell membrane.**

The processes that cells use to control the movement of substances across the cell membrane are all types of transports. They can use active transport, facilitated transport, and passive transport. Active transport is when the cell uses energy to move something in or out of the cell. Passive transport is the opposite of active transport as it does not use any energy to control what is entering and leaving the cell. Facilitated transport is when the cell carries the larger things in and out of the cell.

*Notes:*

*1 point: Active transport...cell uses energy*

*1 point: Passive transport...does not use any energy*

*0 points: Facilitated transport...Explanation is incomplete*

### Question 1, Sample D – 1 Point

**List and describe three processes used by cells to control the movement of substances across the cell membrane.**

channel proteins which lets certain things in. Trasport proteins open and close and help transport certain things and diffusion brings things across the membrane.

*Notes:*

*1 point: channel proteins...open and close and help transport certain things and diffusion brings things across the membrane*

### Question 1, Sample F – 0 Points

**List and describe three processes used by cells to control the movement of substances across the cell membrane.**

- 1) OSMOSIS ONLY ALLOWS A CERTIAN AMOUNT OF WATER TO COLLECT IN THE CELL AT ONE TIME.
- 2) SELECTIVE MEMBRANE
- 3) PERREALBLE MEMBRANE

*Notes:*

*0 points: OSMOSIS...Incorrect explanation.*

*0 points: SELECTIVE MEMBRANE...No explanation provided.*

### Reporting Category 3: Genetics

#### Question 2

Use the chart to answer the question.

**Amino Acids and Their Codons**

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

Below is an RNA sequence consisting of three amino acids and a stop codon. Above each amino acid and the stop codon is the list of bases that code for that amino acid.

**Original RNA sequence:**      UUU                      AUG                      ACU                      UGA

**Original amino acid sequence:**    Phe — Met — Thr — Stop

A mutation has occurred. A portion of the new sequence is shown below with the new first and second codons.

**New RNA sequence:**      UUA                      UAU                      ---                      ---

**New amino acid sequence:**    Leu — Tyr —   —

**What will be the fourth codon in the new sequence?**

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**What amino acid will be coded for by the fourth codon in the new sequence?**

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**What name is given to this type of mutation?**

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## Question 2

### Key Elements:

- UUG {resulting from the insertion of a single adenine (A) nucleotide into position 3 of the sequence}

and

- Leu

and

- Frameshift  
Insertion  
Point Mutation

### RUBRIC:

3 points

2 points

1 point

0 points

Three key elements

Two key elements

One key element

Other

**Question 2, Sample A – 3 Points**

**What will be the fourth codon in the new sequence?**

The fourth codon in the new sequence will be UUG.

**What amino acid will be coded for by the fourth codon in the new sequence?**

Leu will be coded for by this codon.

**What name is given to this type of mutation?**

This type of mutation is called insertion.

*Notes:*

*1 point: UUG*

*1 point: Leu*

*1 point: insertion*

**Question 2, Sample B – 2 Points**

**What will be the fourth codon in the new sequence?**

The fourth codon in the new sequence will be UUG.

**What amino acid will be coded for by the fourth codon in the new sequence?**

The amino amino aid that will be coded for by the fourth codon in the new sequence is Leu.

**What name is given to this type of mutation?**

This type of mutation is called a

*Notes:*

*1 point: UUG*

*1 point: Leu*

*0 points:*

**Question 2, Sample C – 2 Points**

**What will be the fourth codon in the new sequence?**

the fourth codon will be UUA.

**What amino acid will be coded for by the fourth codon in the new sequence?**

the sequence for the fourth amino acid will be Leu.

**What name is given to this type of mutation?**

the name given is insertion.

*Notes:*

*0 points: UUA*

*1 point: Leu*

*1 point: insertion*

**Question 2, Sample D – 1 Point**

**What will be the fourth codon in the new sequence?**

UUG.

**What amino acid will be coded for by the fourth codon in the new sequence?**

it will still be a stop codon, because that is its place.

**What name is given to this type of mutation?**

Genetic Displacement

*Notes:*

*1 point: UUG*

*0 points: stop codon*

*0 points: Genetic Displacement*

**Question 2, Sample E – 0 Points**

**What will be the fourth codon in the new sequence?**

UGU

**What amino acid will be coded for by the fourth codon in the new sequence?**

**What name is given to this type of mutation?**

Cys

*Notes:*

*0 points: UGU*

*0 points: Cys*

*0 points:*

### Reporting Category 3: Genetics

#### Question 3

**Starting with mRNA leaving the nucleus, list and describe four major steps involved in protein synthesis.**

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### Question 3

#### Key Elements:

- mRNA exits nucleus via nuclear pore.
- mRNA travels through the cytoplasm to the ribosome or enters the rough endoplasmic reticulum.
- mRNA bases are read in triplets called codons (by rRNA).
- tRNA carrying the complementary (U=A, C+G) anticodon recognizes the complementary codon of the mRNA.
- The corresponding amino acids on the other end of the tRNA are bonded to adjacent tRNA's amino acids.
- A new corresponding amino acid is added to the tRNA.
- Amino acids are linked together to make a protein beginning with a START codon in the P site (initiation).
- Amino acids continue to be linked until a STOP codon is read on the mRNA in the A site (elongation and termination).

#### RUBRIC:

**3 points**

**2 points**

**1 point**

**0 points**

**Four key elements**

**Three key elements**

**One or two key elements**

**Other**

Question 3, Sample A – 3 Points

Starting with mRNA leaving the nucleus, list and describe four major steps involved in protein synthesis.

After mRNA is transcribed in the nucleus, it leaves and goes into the ribosomes. Then the mRNA is paired with its anticodon carried by tRNA connected to an amino acid. As the mRNA gets translated the tRNA breaks off and its amino acid connects with the next tRNA molecule. This continues until there is a long chain of amino acids that forms a polypeptide, or protein.

Notes:

4 Key Elements:

1. "...goes to the ribosome..."
2. "...mRNA is paired with anticodon..."
3. "...mRNA is translated..."
4. "...amino acid connects...forms a polypeptide..."

**Question 3, Sample B – 3 Points**

**Starting with mRNA leaving the nucleus, list and describe four major steps involved in protein synthesis.**

The mRNA moves from the nucleus to ribosomes. Then, tRNA will match anticodons with mRNA codons. The tRNA molecules have amino acids attached to them, so the amino acids are bonded in the same order as the codons instructed. When the mRNA is done translating, the protein is formed.

*Notes:*

*4 Key Elements:*

- 1. "...mRNA...from nucleus to ribosomes..."*
- 2. "...tRNA will match anticodons with mRNA codons..."*
- 3. "...tRNA...amino acids attached to them..."*
- 4. "...amino acids are bonded in the same order as the codons instructed..."*

Question 2, Sample C – 2 Points

Starting with mRNA leaving the nucleus, list and describe four major steps involved in protein synthesis.

mRNA leaves the nucleus, where it joins with tRNA. tRNA reads mRNA, & creates a protein based on the codon that was read. The proteins are continually created until tRNA hits a stop codon. The proteins created are now a protein chain.

Notes:

3 Key Elements:

1. "...tRNA reads mRNA...creates a protein based on the codon that was read..."
2. "...hits a stop codon..."
3. "...proteins created are now in a chain..."

**Question 2, Sample D – 1 Point**

**Starting with mRNA leaving the nucleus, list and describe four major steps involved in protein synthesis.**

- 1) mRNA leaves the nucleus
- 2) mRNA is transcribed
- 3) tRNA brings codons to match with anticodons
- 4) Amino acids are assembled, making proteins

*Notes:*

*2 Key Elements:*

1. "...tRNA brings codons to match with anticodons..."
2. "...amino acids are assembled making proteins..."

**Question 2, Sample E – 0 Points**

Starting with mRNA leaving the nucleus, list and describe four major steps involved in protein synthesis.

- 1) The mRNA connects to the DNA.
- 2) Protein polymerase codes their base pairs.
- 3) Base pairs combine to DNA and mRNA.
- 4) There are 4 copies of DNA.

Notes:

No Key Elements Given

**Question 2, Sample F – 0 Points**

Starting with mRNA leaving the nucleus, list and describe four major steps involved in protein synthesis.

1. mRNA leaves the nucleus
2. mRNA creates amino acids
3. amino acids transcribe tRNA
4. tRNA is used to create proteins

Notes:

No Key Elements Given