COURSE SLO ASSESSMENT REPORT, SCC

Department: Biology Course: Biology 211 – Cellular and Molecular Biology

Year: 2012 Semester: Spring

<table>
<tr><th>1) Outcome to be assessed</th><th>2) Means of assessment and criteria of success</th><th>3) Summary of data collected</th><th>4) Analysis of data</th><th>5) Plan of action/ what to do next</th></tr>
<tr>
<td>Express a coherent understanding of fundamental biological concepts that include cell structure, energy, cell reproduction, and genetics.</td>
<td>A set of 15 multiple choice questions given in the laboratory during the 16th week of the semester prior to a review session for the lecture final exam.

The success of understanding the fundamental biological concepts in each topic area will be assessed by comparison of the actual percentage of correct student responses to the expected percentage.</td>
<td>
<table>
<tr><th>Category</th><th>Question</th><th>Data</th></tr>
<tr><td><u>Topic:</u>
Cell Structure

<u>Difficulty</u>:
Easy</td><td>Which of the following is the primary (most abundant) structural component of Cell Membranes?
a. Triglycerides
b. Fatty Acids
c. Sterols
d. Phospholipids
e. Proteins</td><td>Total # <u>responses</u>
42

Correct <u>responses</u>
39

% Correct <u>responses</u>
92.9%</td></tr>
<tr><td><u>Topic:</u>
Cell Structure

<u>Difficulty</u>:
Moderate</td><td>Which of the following statements is <u>FALSE</u> in comparing the Rough Endoplasmic Reticulum to the Smooth Reticulum?
a. They both function in the synthesis of lipids
b. Detoxification of harmful compounds only occurs in the Smooth ER
c. Protein synthesis occurs in both the Rough ER and the Smooth ER
d. Carbohydrate metabolism only occurs in the Smooth ER
e. None of the above</td><td>Total # <u>responses</u>
42

Correct <u>responses</u>
13

% Correct <u>responses</u>
31%</td></tr>
</table>
</td>
<td>Based on the criteria of success for this assessment, the Spring 2012 combined class was successful in understanding fundamental biological concepts as indicated by 13 out of 15 of the questions having percentages of correct responses greater than the minimum expected for each question.

Two (out of 15) assessment questions had percentages of correct responses that were lower than expected. Question #2 was a moderately difficult</td>
<td>In the Fall semester (2012) I will emphasize the importance of the reading assignments and may modify one or more lecture presentations to include class interaction with the e-text online to emphasize example content and demonstrate good independent note-taking at home. I will also recommend note-taking and reading/study skills workshops available through our student support services.</td>
</tr>
</table>

	"Success" will be defined here as the ability of the class to provide the following expected percentages of correct responses: For "Easy" questions, 80% (or more) is expected. For "Moderate" questions, 50% (or more) is expected. For "Challenging" questions, 20% (or more) is expected.	Topic: Cell Structure/ Energy Difficulty: Moderate	The metabolic reaction pathway known as the Electron Transport Chain occurs specifically: a. On the inner membrane of the mitochondria b. In the Cytosol c. On the outer membrane of the mitochondria d. In the matrix of the mitochondria e. None of the above	**Total # responses 42** **# Correct responses 26** **% Correct responses 61.9%**	question, yet only 31% of the class provided the correct response. This particular question was based on material that was to be learned through a reading assignment. This may indicate that many of the students are relying more on lecture for content than their textbooks even though there is a standing chapter reading assignment for each week of class. Question #6 was a challenging question that only 7.1% of the class were able to answer correctly. The correct response was "None of the above" but a majority of the students selected the distractor containing only half of the correct vocabulary. This indicates that they	
		Topic: Energy Difficulty: Moderate	For every 1 molecule of Glucose that enters the Glycolysis pathway, _____ molecules of _____ are produced at the end of the pathway. a. Three/Oxygen b. Four/Carbon Dioxide c. Two/FADH2 d. Four/Acetyl Co A e. Two/Pyruvate	**Total # responses 42** **# Correct responses 34** **% Correct responses 81.0%**			
		Topic: Cell Structure/ Energy Difficulty: Challenging	Which of the following creates the hydrogen ion concentration gradient, which provides the energy needed for ATP production in a mitochondria? a. The spinning motion of the ATP synthase protein complex embedded in the inner membrane b. The series of oxidation and reduction reactions occurring between cytochromes in the inner membrane c. The transport of electrons to the inner membrane by NADH molecules from the cytoplasm d. The enzymatic conversion of	**Total # responses 42** **# Correct responses 15** **% Correct responses 35.7%**			

			pyruvate molecules into molecules of Acetyl Coenzyme A e. The opening and closing of the large subunits of the catalytic knob of the ATP synthase complex		are not reading the question carefully before answering.	
		Topic: Energy Difficulty: Challenging	In the metabolic pathway known as the Kreb's Cycle, ATP is made by the following process: a. Oxidative phosphorylation b. Electron Transport Chain c. Photophosphorylation d. Oxidation and Reduction e. None of the above	**Total # responses 42** **# Correct responses 3** **% Correct responses 7.1%**		
		Topic: Energy Difficulty: Easy	The general reaction formula for Cellular Respiration is: a. $6\ CO_2 + 6\ H_2O + \text{Energy (ATP)} \rightarrow C_6H_{12}O_6 + 6\ O_2$ b. $C_6H_{12}O_6 + \text{Energy (ATP)} \rightarrow + 6\ CO_2 + 6\ O_2 + 6\ H_2O$ c. $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O + \text{Energy (ATP)}$ d. $C_6H_{12}O_6 + 6\ H_2O + 6\ CO_2 \rightarrow 6\ O_2 + \text{Energy (ATP)}$ e. None of the above	**Total # responses 42** **# Correct responses 36** **% Correct responses 85.7%**		

		Topic: Energy Difficulty: Moderate	The Chlorophyll molecule directly converts light energy from the Sun into: a. Heat energy for increasing molecular collisions to drive covalent bond formation b. Molecular bending of the hydrocarbon tails to increase the diffusion rate within a chloroplast c. Ionic bond formation between oppositely charged molecules d. Electron movement for oxidation/reduction reactions e. None of the above	**Total # responses 42** **# Correct responses 34** **% Correct responses 81.0%**		
		Topic: Cell Reproduction Difficulty: Easy	Starting with a 2n cell, division by Mitosis results in _____ while Meiosis results in _____. a. 2 genetically identical 2n cells, 4 genetically unique 1n cells b. 4 genetically identical 2n cells, 2 genetically unique 1n cells c. 2 genetically identical 2n cells, 2 genetically unique 1n cells d. 4 genetically unique 2n cells, 4 genetically identical 1n cells e. None of the above	**Total # responses 42** **# Correct responses 38** **% Correct responses 90.5%**		
		Topic: Cell Reproduction Difficulty: Moderate	Which statement is **false** in comparing Prophase I of Meiosis with Prophase of Mitosis? a. In both, chromosomes condense b. Homologous chromosomes pair up to form tetrads only in Prophase I of Meiosis c. In both, nuclear membrane breaks down d. The cell in Prophase I of Meiosis is haploid whereas the cell in Prophase of Mitosis is diploid e. None of the above	**Total # responses 42** **# Correct responses 32** **% Correct responses 76.2%**		

		Topic: Cell Reproduction Difficulty: Easy	During Telophase of Mitosis a. Chromosomes line up at the center of the cell b. Sister chromatids separate at their centromeres c. Nuclear membranes begin to form around the chromosomes at opposite ends of the cell d. The nucleoli begin to disappear e. Chromatin begins to condense into chromosome	**Total # responses 42** **# Correct responses 40** **% Correct responses 95.2%**		
		Topic: Genetics Difficulty: Moderate	You mate a green-eyed cat with a blue-eyed cat and they produce 15 kittens. Eight of the kittens are green-eyed and seven are blue-eyed. Assuming this is an example of complete dominance and green eyes is dominant to blue eyes, which of the following may be true? a. The green-eyed cat was homozygous dominant for the eye color trait b. The blue-eyed cat was heterozygous for the eye color trait c. The blue-eyed cat had a mother with green eyes d. The green-eyed cat was female e. None of the above	**Total # responses 42** **# Correct responses 25** **% Correct responses 59.5%**		

		Topic: Genetics Difficulty: Easy	If a template strand of DNA has a base sequence of (3')-CATGGTTCATGGAACACT-(5') then the base sequence of a complementary strand of RNA (5' → 3') must be: a. GUACCAAGUACCUUGUGA b. CTAGGAACTAGGTTCTCA c. UCACAAGGUACUUGGUAC d. TCACAAGGTACTTGGTAC e. None of the above	**Total # responses 42** **# Correct responses 37** **% Correct responses 88.1%**		
		Topic: Genetics Difficulty: Moderate	Which of the following is an example of a Quantitative Character controlled by polygenic inheritance? a. Bell pepper color (Green, Yellow, Orange, Red) b. Four O'clock flowers (Red crossed with White makes pink) c. Sickle Cell Anemia (Normal versus "Sickle" shaped red blood cells) d. Human Blood Type (Types A, B, AB, and O) e. Human Body Height (Range of short to tall)	**Total # responses 42** **# Correct responses 28** **% Correct responses 66.7%**		
		Topic: Genetics Difficulty: Challenging	Which of the following is **TRUE** regarding the expression of a gene? a. It will occur immediately following the process of transcription b. It will not occur if the DNA is condensed to the level of euchromatin in a eukaryotic cell c. It will occur immediately after all of the required transcription factors are present in a eukaryotic cell d. It can only occur if some of the Adenine or Cytosine bases in the template DNA strand are methylated e. None of the above	**Total # responses 42** **# Correct responses 15** **% Correct responses 35.7%**		

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<tr>
<td rowspan="2">Employ the principles of the scientific method to investigate both laboratory and ordinary situations.</td>
<td rowspan="2">A set of 7 multiple choice questions and one rubric evaluated short answer problem were given in the laboratory during the 16th week of the semester prior to a review session for the lecture final exam. These questions were designed to test a student's understanding of the scientific method through evaluation of their</td>
<td>Category</td><td>Question</td><td>Data</td>
<td rowspan="2">Based on the criteria for success for this assessment, the Spring 2012 combined class did not successfully demonstrate an understanding of how to employ the principles of the scientific method to investigate a given research laboratory scenario.

Only 4 out of 8 of the questions</td>
<td rowspan="2">More practice with critical thinking and scenarios of laboratory research will be included in the Spring 2013 in the laboratory.

I will provide more practice in this area through creating a DLA and/or homework on formally expressing hypotheses and predictions.</td>
</tr>
<tr>
<td>Topic:
Limitation of Variables

Difficulty:
Moderate</td>
<td>(See attached sheet for scenario)
In the above-described experiment, which of the following describes a way to limit the factors?
a. Using a random mix of different species of jumping spiders in the experiment
b. Spacing out the data collection throughout the day from morning to evening
c. Allowing each fly and spider to be together in the container for a different length of time
d. Presenting all of the different flies to the same spider during the experiment
e. None of the above</td>
<td>Total # responses 41

Correct responses 29

% Correct responses 70.7%</td>
</tr>
<tr>
<td></td><td></td>
<td>Topic:
Summary of Data</td>
<td>(See attached sheet for scenario)
How would you best summarize the data collected from this experiment?
a. You would create a bar graph
b. You would determine the median</td>
<td>Total # responses 41</td>
<td></td><td></td>
</tr>
</table>

	familiarity with the components of experimental design, data collection, and interpretation of data within a given laboratory research scenario. The success of employing the principles of the scientific method will be assessed by comparison of the actual percentage of correct student responses to the expected percentage in each topic area. Success will be defined here as the ability of the class to provide the following expected percentages of	<u>Difficulty</u>: Easy	values and compare them to the mean values c. You would create a line graph d. You would conduct a regression analysis e. You would conduct a Chi Square analysis	**# Correct <u>responses</u> 36** **% Correct <u>responses</u> 87.8%**	had percentages of correct responses equal or greater than the minimum percentage expected for each question. The 3 multiple choice questions that had less than the minimum expected percentage of correct responses suggest that students have a difficult time recognizing and describing an experimental control and that they are unclear about how to limit the variables in an experiment. The low correct response rate for	
		<u>Topic:</u> Experimental Control <u>Difficulty</u>: Moderate	***(See attached sheet for scenario)*** What is the purpose of presenting a normal housefly to a jumping spider in this study? a. It allows us to determine if jumping spiders are faster than normal houseflies or not b. It allows us to see if a normal housefly has the ability to frighten away a jumping spider c. It shows us the expected result when a fly is incapable of frightening away a jumping spider d. It allows us to measure how frightened a housefly is of a jumping spider e. None of the above	**Total # <u>responses</u> 41** **# Correct <u>responses</u> 18** **% Correct <u>responses</u> 43.9%**			
		<u>Topic:</u> Hypothesis <u>Difficulty</u>: Moderate	***(See attached sheet for scenario)*** In the experiment described on the previous page, which of the following is a possible **<u>hypothesis</u>** as to what characteristic(s) of the *Zonosemata* species of fly causes a jumping spider to retreat away from it? a. The spider may or may not attack the fly depending on how awake or	**Total # <u>responses</u> 41** **# Correct <u>responses</u> 17**			

	correct responses for multiple choice questions: For "Easy" questions, 80% (or more) is expected. For "Moderate" questions, 50% (or more) is expected. For "Challenging" questions, 20% (or more) is expected. Success for the rubric evaluated problem will be defined as a score of 2 or higher (max score = 3). The difficulty level of this question is "challenging."			sleepy the spider is b. The coloration of the fly's body and wings might make it look more like another jumping spider c. The fly might be able to escape from the spider if the spider is too slow d. The spider may not be hungry so the fly can get away e. None of the above	**% Correct responses 41.5%**	the rubric evaluated problem shows an inability to state a formal experimental prediction. Some students left out critical information while others attempted to state a hypothesis instead of a prediction. I was surprised by these results because I thought I had put enough emphasis on the formal steps of the scientific method at the start of the semester. Perhaps more practice is necessary.	
		Topic: Prediction Difficulty: Challenging	***(Rubric evaluated short-answer problem - See attached sheet for scenario)*** Suppose that you want to test the hypothesis that the spider will retreat from a *Zonosemata* species of fly because the sight of the pattern of stripes on the wings alone causes a fear reflex in the spider. Write a formal **prediction** in the space below that would support your hypothesis.	**Total # responses 41** **# of students scoring 3 points 0** **% of students scoring 3 points 0.0%** **# of students scoring 2 points 3**		

					% of students scoring 2 <u>points</u> 7.3% **# of students scoring 1 <u>point</u> 18** **% of students scoring 1 <u>point</u> 43.9%** **# of students scoring 0 <u>points</u> 20** **% of students scoring 0 <u>points</u> 48.8%**		
			<u>Topic:</u> Interpretation of Data <u>Difficulty</u>: Moderate	***(See attached sheet for scenario)*** Which of the following statements is supported based on the results presented above? a. The striped pattern of the Zonosemata's wings alone is a major factor in scaring off the spider	**Total # <u>responses</u> 41** **# Correct <u>responses</u>**		

				b. The spider is not able to eat more than 15 flies per experiment c. The coloration of the Zonosemata's body alone is a major factor in scaring off the spider d. Only untreated Zonosemata flies are able to cause a spider to retreat e. The body coloration and striped wing pattern together is required to scare off the spider	**28** **% Correct responses 68.3%**		
			Topic: Experimental Treatment Difficulty: Moderate	***(See attached sheet for scenario)*** What specifically is the purpose of the treatment described as "A *Zonosemata* fly that has had its own wings cut off and then glued back on to the wing stubs"? a. To isolate the "striped wing pattern" variable so its effectiveness can be measured b. To measure the effects of the "striped wing pattern" and "body coloration" variables together c. To isolate the "body coloration" variable so its effectiveness can be measured d. To measure effect of the wing re-attachment procedure on a fly's "wing waving behavior" e. To isolate the "wing waving behavior" variable so its effectiveness can be measured	**Total # responses 41** **# Correct responses 21** **% Correct responses 51.2%**		
			Topic: Limitation of	***(See attached sheet for scenario)*** The experiment as it is described does not allow for the determination of the	**Total # responses**		

		Variables – Application of concept <u>Difficulty</u>: Challenging	effectiveness of the "wing waving behavior" variable alone in scaring off the spider. Which of the following treatments might you include in the study to obtain measurements of this variable? a. Apply epoxy resin to the wing bases of an untreated *Zonosemata* fly so it cannot move its wings b. Take a *Zonosemata* fly that had its wings cut off and had normal housefly wings glued on it and then paint its body black like a normal housefly c. Apply epoxy resin to the wing bases of an untreated housefly so it cannot move its wings d. Take a housefly that had its wings cut off and had *Zonosemata* fly wings glued on to it and then paint its body with yellow and orange markings so it resembles a *Zonosemata* fly e. Use a dummy fly made of plastic and paint its body and wings to exactly resemble a *Zonosemata* fly	**41** **# Correct <u>responses</u> 7** **% Correct <u>responses</u> 17.1%**			

Course Student Learning Outcome Assessment

Name:	AM PM

SLO #2: Employ the principles of the scientific method to investigate both laboratory and ordinary situations.

BIOLOGY 211 – CELLULAR AND MOLECULAR BIOLOGY – SPRING 2012
Multiple Choice and Short Answer (Rubric Evaluated)

Answer the questions below and on the next page based on the following scenario:

An ecologist observed that a particular species of fly (*Zonosemata*) that has a yellow and black patterned body and black stripes on its clear wings was able to frighten away a species of jumping spider by waving its wings in an intricate pattern when approached by the spider. An experiment was conducted to determine what contribution the fly's body coloration, wing coloration, and/or wing waving behavior had on its ability to scare away the jumping spider. Some flies had their wings cut off and then either the same wings or the wings from another fly glued back onto the remaining stubs. After this treatment, all flies appeared to have full function of their glued-on wings in terms of normal range of motion and the ability to fly.

The experiment involved placing a fly together with a jumping spider in a clear container and observing if the spider eats the fly or is frightened away. The following are presented to the spider in the container:

- A *Zonosemata* fly (unaltered)
- A *Zonosemata* fly that has had its wings cut off and glued back on to the wing stubs
- A *Zonosemata* fly that has had its wings cut off and had normal housefly wings glued on to it
- A normal housefly that has had its wings cut off and had *Zonosemata* fly wings glued on to it
- A normal housefly (unaltered)

1. In the above-described experiment, which of the following describes a way to limit the factors?
   a. Using a random mix of different species of jumping spiders in the experiment
   b. Spacing out the data collection throughout the day from morning to evening
   c. Allowing each fly and spider to be together in the container for a different length of time
   d. Presenting all of the different flies to the same spider during the experiment
   e. None of the above

2. How would you best summarize the data collected from this experiment?
    a. You would create a bar graph
    b. You would determine the median values and compare them to the mean values
    c. You would create a line graph
    d. You would conduct a regression analysis
    e. You would conduct a Chi Square analysis

3. What is the purpose of presenting a normal housefly to a jumping spider in this study?
    a. It allows us to determine if jumping spiders are faster than normal houseflies or not
    b. It allows us to see if a normal housefly has the ability to frighten away a jumping spider
    c. It shows us the expected result when a fly is incapable of frightening away a jumping spider
    d. It allows us to measure how frightened a housefly is of a jumping spider
    e. None of the above

4. In the experiment described on the previous page, which of the following is a possible **hypothesis** as to what characteristic(s) of the *Zonosemata* species of fly causes a jumping spider to retreat away from it?
    a. The spider may or may not attack the fly depending on how awake or sleepy the spider is
    b. The coloration of the fly's body and wings might make it look more like another jumping spider
    c. The fly might be able to escape from the spider if the spider is too slow
    d. The spider may not be hungry so the fly can get away
    e. None of the above

5. Suppose that you want to test the hypothesis that the spider will retreat from a *Zonosemata* species of fly because the sight of the pattern of stripes on the wings alone causes a fear reflex in the spider. Write a formal **prediction** in the space below that would support your hypothesis.

Using this data obtained from the experiment, answer the questions on the next page:

Table 1. Frequency of jumping spider retreat from Zonosemata flies and houseflies.

	Treatment				
	Untreated *Zonosemata* Fly	***Zonosemata* fly with its own wings glued back on**	***Zonosemata* fly with housefly wings glued on**	**Housefly with *Zonosemata* wings glued on**	**Untreated Housefly**
Trial 1	15	14	3	1	0
Trial 2	13	14	1	3	0
Mean	14	14	2	2	0

(Note: A jumping spider was presented with 20 flies from each of the 5 treatment categories each trial.)

6. Which of the following statements is supported based on the results presented above?
    a. The striped pattern of the Zonosemata's wings alone is a major factor in scaring off the spider
    b. The spider is not able to eat more than 15 flies per experiment
    c. The coloration of the Zonosemata's body alone is a major factor in scaring off the spider
    d. Only untreated Zonosemata flies are able to cause a spider to retreat
    e. The body coloration and striped wing pattern together is required to scare off the spider

7. What specifically is the purpose of the treatment described as "A *Zonosemata* fly that has had its Own wings cut off and then glued back on to the wing stubs"?
    a. To isolate the "striped wing pattern" variable so its effectiveness can be measured
    b. To measure the effects of the "striped wing pattern" and "body coloration" variables together
    c. To isolate the "body coloration" variable so its effectiveness can be measured
    d. To measure effect of the wing re-attachment procedure on a fly's "wing waving behavior"
    e. To isolate the "wing waving behavior" variable so its effectiveness can be measured

8. The experiment as it is described does not allow for the determination of the effectiveness of the "wing waving behavior" variable alone in scaring off the spider. Which of the following treatments might you include in the study to obtain measurements of this variable?
    a. Apply epoxy resin to the wing bases of an untreated *Zonosemata* fly so it cannot move its wings
    b. Take a *Zonosemata* fly that had its wings cut off and had normal housefly wings glued on it and then paint its body black like a normal housefly
    c. Apply epoxy resin to the wing bases of an untreated housefly so it cannot move its wings
    d. Take a housefly that had its wings cut off and had *Zonosemata* fly wings glued on to it and then paint its body with yellow and orange markings so it resembles a *Zonosemata* fly
    e. Use a dummy fly made of plastic and paint its body and wings to exactly resemble a *Zonosemata* fly