CORE COURSE REVIEW DOCUMENT

Foundational Component Area: LIFE & PHYSICAL SCIENCES

Component Area Option? No

Proposed Course: NEW Life I: Molecular & Cellular Concepts (Proposed as BIOL 1114).
Credit Hours: 4 (3-2)
Proposed by: Department of Biology
Date: October 19, 2016

Please document how the proposed course meets each of the following requirements. (You may provide a written explanation or copy and paste the appropriate information from the syllabus).

Content: *Courses in this category focus on describing, explaining, and predicting natural phenomena using the scientific method.*

This course is designed specifically for Biology and other natural science majors; however, it is suitable for all incoming freshmen students with sufficient high school preparation for success in college level science courses.

The lecture component of this course will explore basic molecular and cellular principles and concepts including the Scientific Method, Viral Structure and Function, Cell Theory, Cell Division, Cell Structure & Function, Biological Chemistry, Genes, and Gene Expression.

The laboratory component of this course will illustrate, demonstrate and provide opportunities for direct experience of the principles and concepts explored in lecture. In so doing, it will provide students an opportunity to use the tools and engage the approaches of biological research.

SKILLS: *Courses involve the understanding of interactions among natural phenomena and the implications of scientific principles on the physical world and on human experiences.*

At the culmination of this course, the students will be able to:

- Understand the ways in which science (biology in particular) impacts their lives
- Demonstrate effective use of a compound microscope
- Demonstrate the utilization of the Scientific Method in their laboratory exercises and projects
- Demonstrate the ability to work with numerical data and present data effectively
- Exhibit the skills needed to work as a productive member of a research team
- Describe and explain the rolls of the different parts of the cell
- Distinguish between the primary cell types and between cells and viral particles
- Appreciate the informational nature of genes and their expression
- Recognize the basic types of biomolecules their rolls in organisms

ASSESSMENT OF CORE OBJECTIVES: *Assessments should be authentic, intentional and direct. The following four Core Objectives must be addressed in each course approved to fulfill this category requirement:*

Critical Thinking Skills - *to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information*

- Students will be assigned weekly discussion topics. Each student will be required to post at least one comment to a discussion during the week it is assigned. One discussion topic will be selected early in the semester and another topic after the middle of the semester for assessment of students' critical thinking. Each student's contribution(s) to the discussion will be assessed using the Critical Thinking VALUE Rubric. While the subjects of the discussions selected for assessment may change from semester to semester, the following provide an example: early in the semester, "Are viruses alive?", and later in the semester "Are mutations good or bad?". The first is a question that stimulates animated debate even among seasoned professionals in biological fields. The second may elicit an immediate response of "Bad" from many students. However, critical consideration based on information acquired in this course and elsewhere should lead students to a more nuanced position. For all discussion posts, students will be urged to provide support for their statements and to respond, first, to the question, and second, to earlier posts by their classmates.

- The exercise will be used to determine if a student has exceeded the "benchmark" status of critical thinking as set by the AACU Critical Thinking VALUE rubric (attached). This is the expected level of achievement in the sciences for a freshman core class concerning this learning objective. Five rows of the Critical Thinking Rubric will be used: Explanation of Issues; Evidence; Influence of Context/Assumptions; Student's Position; and Conclusions (implications and/or consequences).

Communication Skills - to include effective development, interpretation and expression of ideas through written, oral, and visual communication

- *Each students will locate and read science news articles (print articles) posted on a major newspaper or other journalism outlet available to the general public (e.g., The Washington Post, The Wall Street Journal, Time, Newsweek, etc.) and choose one article that touches upon any of the weekly discussion topics presented in class. Once a student has chosen and posted an article, the student will research the topic of the article and critique its treatment in terms of the truthfulness and accuracy of its science. Students will evaluate their articles for content, accuracy, and implications. To do this, they will locate and assess relevant primary and secondary scientific literature, interpret the article in light of the scientific literature, analyze whether the article is truthful, misleading, or inaccurate, communicate their analysis to others, and communicate useful implications of the article to the public. Students will write short reports containing their analysis and present a 5 minute talk on their article/paper to their lab section that will include a short PowerPoint presentation, thus allowing this assignment to assess each student's written, oral, and visual communication skills.*

- *With this assessment, students will begin learning how to critically evaluate "real-world" information, how to ascertain the truthfulness of science reporting that targeted to the public at large, how to research within the primary and secondary biological literature, and how to effectively present science to a "peer" audience that will not necessarily be as knowledgeable about their chosen topic. Additionally, this assessment will demonstrate to students how their studies are directly relevant to the world outside of the classroom. Communication skills will be assessed using*

rubrics consistent with the AACU Written and Oral Communication VALUE Rubrics. Specifically, students will be assessed on Organization, Language, Sources and Evidence, Context, and the Ability to Deliver Content in a scientifically accurate, yet understandable, format.

Empirical and Quantitative Skills - to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions

- Students will perform an exercise from the lab manual that involves serial dilution, spectrophotometric measurements, and calculations of quantitative data while incorporating the scientific method (attachment: Measuring Life). This exercise will traverse multiple lab periods throughout the semester. Grading of the bacterial growth portion of the exercise will be used for this assessment.

- This activity includes the ability to obtain quantitative data, interpret numerical data, properly calculate, convert, represent, and communicate numerical data through tables and graphs, as well as use numerical data to make and support a point. This exercise will be used to determine if a student has demonstrated at least the "benchmark" status of empirical and quantitative skills as set by the AACU in their Quantitative Literacy VALUE rubric (attached). This is the level of expectation of achievement for a freshman core class concerning this learning objective. Five rows of the Quantitative Literacy Rubric will used: Interpretation, Representation, Calculation, Application/Analysis, and Communication.

Teamwork - to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal

- Individual student evaluation of the teamwork objective will become a component of the student's grade for laboratory (10% of their lab grade for the course). Students will each evaluate their perceived percentage contribution to the teamwork assignment by each student in their group as well as their own contribution. This will incorporate a "self-assessment" component of teamwork (attachment: Student Evaluation of Contribution to Measuring Life Assignment). This individual assessment for teamwork will be incorporated into the grading rubric for the overall assignment. (attachment: Measuring Life). This grading rubric will be used for grading purposes, but the core assessment will be performed as described below.

- The specific assessment for teamwork will be the student's work in groups to measure growth curves of microbes, RCBR plants, and C. elegans nematodes over multiple lab periods (see also Empirical and Quantitative Skills assessment above). Students working in teams will individually be assigned (or choose) specific responsibilities for the ongoing data collection throughout the semester. Individually collected data will be shared among their team members as well as among other teams to corroborate each other's observations. This exercise allows sharing of measurements, exhibiting collegiality, and demonstration of responsibility in completing a task by deadline within a group. Students will be grouped by random selection to develop fair, unbiased groupings of students. This activity will be used to determine if a student has demonstrated at least the "benchmark" status of teamwork as set by the AACU in their Teamwork VALUE rubric (attached). This is the level of expectation of achievement for a freshman core class concerning this learning objective. Three rows of the Teamwork Rubric will used:, Facilitates the Contributions of Team Members, Individual Contributions Outside of Team Meetings, and Fosters Constructive Team Climate.

- **ADDITIONAL INFORMATION:** Provide any additional information supporting course inclusion in the core (optional).

- **Learning outcomes for BIOL 1114 Lecture and Laboratory**

Lecture:

1. Describe the characteristics of life
2. Explain the methods of inquiry used by scientists
3. Identify the basic requirements of life and the properties of the major molecules needed for life
4. Compare and contrast the structures, reproduction, and characteristics of viruses, prokaryotic cells, and eukaryotic cells
5. Describe the structure of cell membranes and the movement of molecules across a membrane
6. Identify the substrates, products, and important chemical pathways in metabolism
7. Identify the principles of inheritance and solve classical genetic problems
8. Identify the chemical structures, synthesis, and regulation of nucleic acids and proteins
9. Describe the unity and diversity of life and the evidence for evolution through natural selection

Laboratory:

In addition to the 9 learning outcomes above:

1. Apply scientific reasoning to investigate questions and utilize scientific tools such as microscopes and laboratory equipment to collect and analyze data
2. Use critical thinking and scientific problem-solving to make informed decisions in the laboratory
3. Communicate effectively the results of scientific investigations

PLEASE ATTACH THE FOLLOWING

1. Syllabus
2. Assessment for Critical Thinking Skills
3. Assessment for Communication Skills
4. Assessment for Empirical & Quantitative Skills 5. Assessment for Teamwork

BIOL 1144 **Life I: Molecular & Cellular Concepts** **Fall/Spring 201X**
Lecture Syllabus

Instructor: John/Jane Doe, PhD	Office: BO XXX
Email: dr.doe@mwsu.edu	Office hours: See Dr. Doe's Schedule
Lecture: XXXXX Room: BO XXX	Labs: XXX Rm: BO 205

Course Philosophy:
Life I explores the molecular and cellular principles and concepts of biological organization and function that support all other aspects of biological study. Student participation is important to this exploration. Prepare for class, stay attentive, ask questions – of yourself, your classmates and your instructors. What you gain from this class (or any other) will be a function of what you invest in it.

Course Materials
Textbook (required): Life: The Science of Biology 10th ed. by Sadava, et al. , Sinaur & Macmillan Publishing

While laptops or tablets may be used to take notes, manual recording (yes! writing) will lead to greater understanding and recall. Lectures may be recorded, but inform the instructor that you will do so.

Refer to the current MSU *Handbook and Activities Calendar* for university policy on academic dishonesty, class attendance, student rights and activities. These conduct standards apply all of campus life, including both lecture and lab.

Assignments:
Reading:
Read the listed chapters in the textbook. Scan the chapters before coming to class and then read the material more thoroughly afterward class.

*Discussions:**
Weekly discussion topics will be posted on the course's *Desire* 2 *Learn* (D2L) site. Subsets of these assignments will be used for assessment of critical thinking and communication skills.

Quizzes:
Between major exams, quizzes may be used to assess ongoing learning outcomes.

Examinations:
There will be (2-4) lecture exams during the semester. Each will assume familiarity with material explored in the course up to the date of the exam.

Core Curriculum Assessment

This course satisfies the requirements for a core curriculum natural laboratory sciences course. Therefore, four skill components will be assessed during the course: Critical Thinking Skills, Communication Skills, Empirical and Quantitative Skills, and Teamwork Skills. The particular aspects of this course that will be used for assessment purposes are indicated in the syllabus by asterisks. Specifically, discussion topics will be used to assess critical thinking skills and as the basis for a student presentation that will assess oral, written, and visual communication skills. The lab exercise, *Measuring Life*, will be used to assess empirical and quantitative skills as well as teamwork.

Learning outcomes for BIOL 1114 Lecture

1. Describe the characteristics of life.
2. Explain the methods of inquiry used by scientists.
3. Identify the basic requirements of life and the properties of the major molecules needed for life.
4. Compare and contrast the structures, reproduction, and characteristics of viruses, prokaryotic cells, and eukaryotic cells.
5. Describe the structure of cell membranes and the movement of molecules across a membrane.
6. Identify the substrates, products, and important chemical pathways in metabolism.
7. Identify the principles of inheritance and solve classical genetic problems.
8. Identify the chemical structures, synthesis, and regulation of nucleic acids and proteins.
9. Describe the unity and diversity of life and the evidence for evolution through natural selection.

Course Grading:

Grade Scale	Components of Grade	
A ≥ 90	Lecture Exams --------	
B ≥ 80	Lecture Quizzes --------	75%
C ≥ 70	Weekly Discussions --------	
D ≥ 60	Laboratory --------	25%
F < 60		

Course Schedule:

Sequence of topics to be covered; timing subject to modification.

# of Lectures	Topic	Chapters
1	What is Life	1
1	Small molecules and the chemistry of life	2
2	Biomolecules & Macromolecules	3,4
1	Bioenergetics	8
1	Virus particles	26
1	Cell types – Prokaryotic v Eukaryotic	26, 5
2	Cell structures	5,6
2	Cellular Respiration	9
2	Photosynthesis	10
2	Cell signaling	7
2	Cell division	11
1	DNA replication	13
1	Genomes, Chromosomes & Genes	12, 17
1	Transcription	14
1	Translation	14
1	Mutations	15
1	Regulation of gene expression	16
1	Recombinant DNA technology	18
2	Differential gene expression in development	19
1	Genes, Development & Evolution	20

BIOL 1144 Life I: Molecular & Cellular Concepts Fall/Spring 201X
Laboratory Syllabus

Instructor: John/Jane Doe
Email: instructor@mwsu.edu
Office: BO XXX
Office hours: See Instructor's Schedule
Rm: BO 205

Laboratory Objectives
Laboratory Activities will reinforce and supplement the biological concepts explored in lecture. You will work in pairs or groups requiring the development of professional collaborative skills.

Course Materials
Lab Manual (required): Life 1: Cellular & Molecular Biology, Scales & Cook

Attendance
Due to the hands-on nature of the lab, it is crucial to attend the scheduled meetings. Failure to attend lab, to participate actively in the scheduled activities or to complete assignments will have a serious impact on the course grade.

Assignments:
Reading:
Read the lab exercise before lab. Minimal time will be spent in orientation in order to provide the maximum amount of time to complete the exercises, so arrive familiar with what will be done in lab.

Quizzes & Exams
Each week there will be a quiz, which will cover information from the previous lab exercise as well as information about the current lab. A comprehensive final exam will evaluate your understanding of the principles, concepts, and procedures involved in lab activities.

Core Curriculum Assessment

This course satisfies the requirements for a core curriculum natural laboratory sciences course. Therefore, four skill components will be assessed during the course: Critical Thinking Skills, Communication Skills, Empirical and Quantitative Skills, and Teamwork Skills. The particular aspects of this course that will be used for assessment purposes are indicated in the syllabus by asterisks. Specifically, the lab exercise, *Measuring Life*, will be used to assess empirical and quantitative skills as well as teamwork.

Learning outcomes for BIOL 1114 Laboratory

In addition to the 9 learning outcomes above listed on the lecture syllabus:

1. Apply scientific reasoning to investigate questions and utilize scientific tools such as microscopes and other laboratory equipment to collect and analyze data.
2. Use critical thinking and scientific problem-solving to make informed decisions in the laboratory.
3. Communicate effectively the results of scientific investigations.

Lab Grades

The lab portion of the course constitutes 25% of your total course grade. Components of the laboratory grade are shown below. Lab report due dates will be announced in lab.

Components of the Lab Grade
Lab Write-ups
Lab Quizzes
Participation/Teamwork
Final Exam

Lab Schedule

Tentative Lab Schedule

Week/Lab #	Subject/Exercise
1	How to be a Biology Major
2	Measuring Life*
3	Observing Life
4	Preparing Data for Publication
5	Cell Compartments & Membranes
6	Monitoring Enzyme Activity
7	Cell Division & DNA Isolation
8	Gel Electrophoresis 1
9	Mining the Genetic Data Set
10	Bacterial Transformation
11	Selection and Isolation of Transformed Bacteria
12	Gel Electrophoresis 2
13	Student Topic Presentation*
14	**COMPREHENSIVE FINAL EXAM**

Introduction

Obtaining and manipulating quantitative data are crucial tasks all scientists must be adept at performing. This laboratory exercise will introduce you to quantitative data collection with respect to measuring growth rates and other parameters for several living systems. In addition to accurate collection of data, scientists must present the results of their studies in clearly understandable formats. This exercise will also provide you with an opportunity to learn how to produce appropriate figures to present the results of the growth measurements you will make. In carrying out this exercise throughout multiple weeks of the course, you will work in teams. Each member of the team will be assigned specific measurements to make and will be responsible for sharing their collected data with other team members. Each team will also share their data with other lab teams. This aspect of the exercise illustrates another crucial part of modern science namely, collaboration.

Objectives

1. Measure the growth rates and other parameters of living organisms
2. Collect data
3. Generate figures to present the collected data
4. Work as part of a collaborative team

Bacterial Growth

Bacterial cells can divide quite rapidly, sometimes as often as every 30 minutes. Growth rates will depend on many environment factors to include, constitution of the growth medium, temperature, presence of other microorganisms, and/or presence of growth inhibitory chemicals (e.g. antibiotics).

Procedure

This lab will be conducted over multiple days for the various living organisms whose growth rates will be monitored, measured, recorded, analyzed, and presented in your write-ups. The data you individually collect will be shared among your immediate team members (lab group) as well as between your lab group and other lab groups.

Analysis of Bacterial Cell Growth Rates

Over the course of this lab period, your group will be responsible for making appropriate dilutions of bacterial cultures and monitoring their growth using spectrophotometry. Each lab group will have a unique set of growth conditions to examine. Differences may include species of bacterium, growth medium constituents, incubation temperature, or presence of antibiotic.

Each member of each lab group will be individually responsible for measuring the growth rate of either the stock culture or one of the three dilutions.

Growth Curve

1. Obtain a stock culture of bacterial cells provided by the instructor
2. Using aseptic technique, as demonstrated by the instructor, create a set of three, two-fold (2X) serial dilutions using sterile culture tubes and media. This will generate four tubes: original stock, 2X, 4X, and 8X dilutions. Follow the flow chart in figure 1.

3. Label the 4 provided flasks containing <u>50 ml</u> of sterile media to correspond to each of the 3 dilutions and the original, undiluted stock.
4. Inoculate each flask with 1ml of each corresponding serial dilution or the stock. Swirl the flasks gently, but sufficiently to thoroughly mix.
5. Remove 1 ml from each flask into a 1ml plastic cuvette and cover each cuvette with a small piece of parafilm. These will constitute the zero time point measurements.
6. Place the culture flasks in the shaker incubator set at 37˚C.
7. Zero a spectrophotometer to a blank of sterile media at a wavelength of 600nm
8. Read the optical dispersion (OD) of each cuvette from step 5. Record your data appropriately in the table corresponding to your group (Tables 1-4).
9. After the OD has been recorded, thoroughly wash out each cuvette for reuse for measuring the next time point.
10. After 20 minutes, retrieve the culture flasks and again remove 1 ml aliquots to the respective cuvettes.
11. Return the flasks quickly to the 37˚C incubator.
12. Measure the OD at 600 nm as previously for each bacterial culture and record your measurements.
13. Repeat Steps 9-12 at 20-minute intervals for the remainder of the lab period. You should be able to record 8 or 9 time points in total.

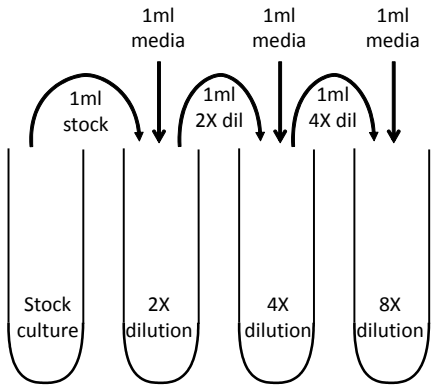

Figure 1. Flow chart to generate a set of 2-fold, serial dilutions. Transfer the indicated amounts of culture and media to each tube. Mix thoroughly between additions.

Titering of Cultures

1. Label a set of 4 1.5ml microcentrifuge tubes to correspond to the 4 dilutions.
2. Add 250 µl of sterile media to each microcentrifuge tube
3. Add 50 µl of each dilution to the corresponding tube, cap and mix well.
4. Obtain 4 Petri dishes of the appropriate growth media for your lab group and label them to correspond to each dilution.
5. Using aseptic technique, pipet all 300 µl of the bacterial solution onto the Petri dish and spread the media evenly over the surface of the growth medium.
6. Allow the solution to dry and soak into the solid media for 10-15 minutes, then invert the Petri dishes and transfer to a 37º C incubator.
7. After 12-24 hrs, remove the plates and count the number of colonies that have formed on each plate. Record these colony counts in the appropriate table and share the results as appropriate with you group members and with other groups.

Record of Results

Spectrophotometric measurements of cell densities

Record the OD_{600} of each culture at the indicated time points for your group as well as all other groups.

Table 1. Team 1 Results for optical dispersion of each dilution culture over 3 hours at 20 min intervals

Culture	20	40	60	80	100	120	140	160	180
Stock									
2X Dil									
4X Dil									
8X Dil									

Table 2. Team 2 Results for optical dispersion of each dilution culture over 3 hours at 20 min intervals

Culture	20	40	60	80	100	120	140	160	180
Stock									
2X Dil									
4X Dil									
8X Dil									

Table 3. Team 3 Results for optical dispersion of each dilution culture over 3 hours at 20 min intervals

Culture	20	40	60	80	100	120	140	160	180
Stock									
2X Dil									
4X Dil									
8X Dil									

Table 4. Team 4 Results for optical dispersion of each dilution culture over 3 hours at 20 min intervals

Culture	20	40	60	80	100	120	140	160	180
Stock									
2X Dil									
4X Dil									
8X Dil									

Displaying the data

Plot your team's data on the graph below. Use a unique symbol for each dilution. Create a figure legend for the graph that explains which dilution each symbol corresponds to and that describes any significant trends apparent in the data.

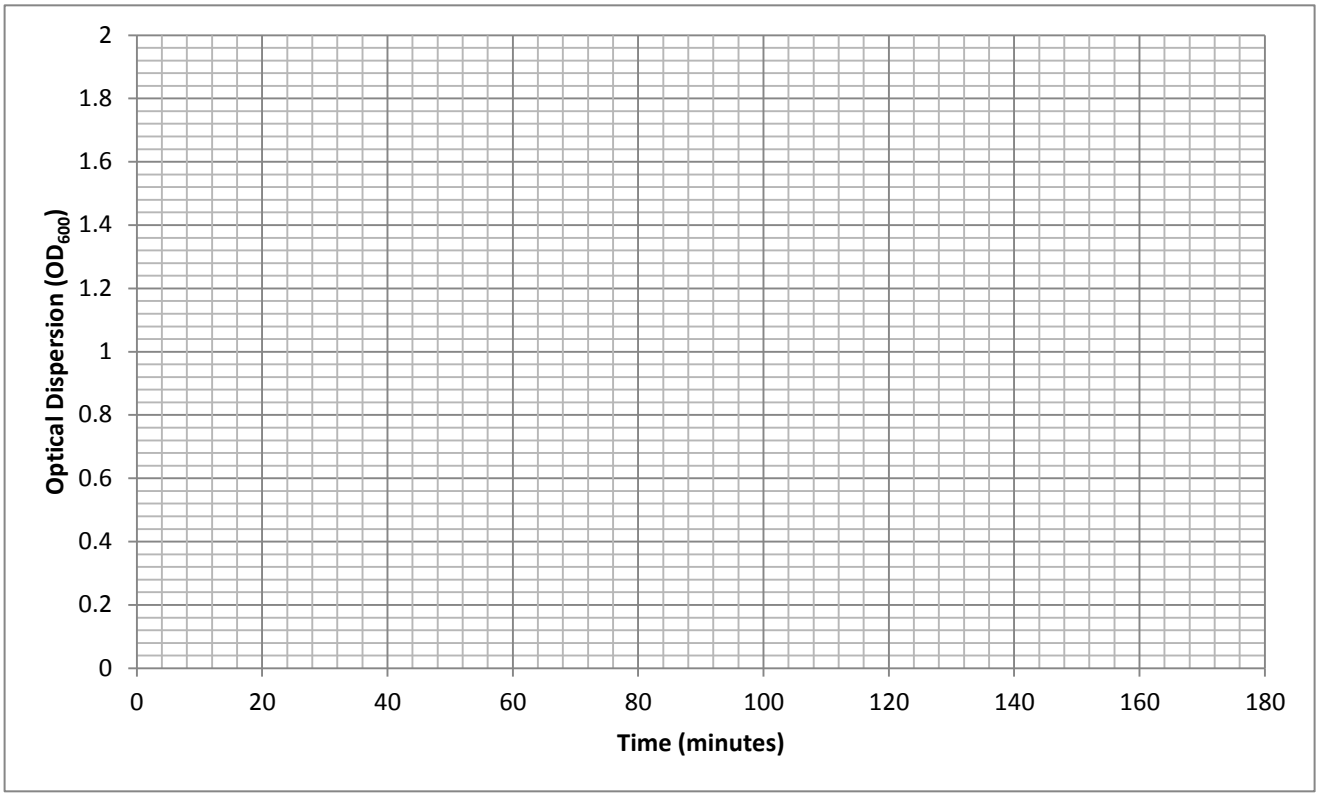

Figure 2.

Using Microsoft Excel, create a graph plotting all the data you obtained from the other three lab groups. This graph will constitute a 3rd figure complete with a figure legend that you will turn in to the lab instructor.

Table 5. Titering of serial dilutions

Culture	A Dilution Factor (DF)	B Colony Count (CFU)	C Amount of dilution plated (µl)	Calculation $\frac{A}{} \times \frac{B}{Cx10^3}$ Titer (CFU/ml)
Group 1				
Stock	1		50	
2X	2		50	
4X	4		50	
8X	8		50	
Group 2				
Stock	1		50	
2X	2		50	
4X	4		50	
8X	8		50	
Group 3				
Stock	1		50	
2X	2		50	
4X	4		50	
8X	8		50	
Group 4				
Stock	1		50	
2X	2		50	
4X	4		50	
8X	8		50	

Assessment of Critical Thinking

Description:
Students will be assigned weekly discussion topics. Each student will be required to post at least one comment to a discussion during the week it is assigned. One discussion topic will be selected early in the semester and another topic after the middle of the semester for assessment of students' critical thinking. Each student's contribution(s) to the discussion will be assessed using the Critical Thinking VALUE Rubric. While the subjects of the discussions selected for assessment may change from semester to semester, the following provide an example: early in the semester, "*Are viruses alive*?", and later in the semester "*Are mutations good or bad*?". The first is a question that stimulates animated debate among seasoned professionals in the field of biology. The second may elicit an immediate response of "Bad" from many students. However, critical consideration based on information acquired in this course should lead students to a more nuanced position.
For all discussion posts, students will be directed to provide support for their statements and to respond, first, to the question, and second, to earlier posts by their classmates.

Discussion Forum Assignment [*posted at the beginning of each weekly Discussion as a reminder of the purpose and tone of the assignment*]
Each week an open-ended question will be posed to initiate a Discussion on the course D2L site. At least one post to the forum is required for course credit; multiple posts are welcome and encouraged. The purpose of these Discussions is to stimulate creative thought on the subject of the week. Posts intended to clarify the issues raised by the question, statements of opinion, disagreements, clarifications, and conclusions are appropriate for this forum. The forum is a site for civil and constructive discourse where disagreements are resolved (or not) on the basis of clear communication presenting science-based evidence.
Assignment:
Visit the discussion forum *at least* once each week and post a response to the question of the week (required) and also to earlier posts by peers (optional). Two discussions, several weeks apart, will be selected for assessment of critical thinking skills, including explanation of the issues, use of evidence, recognition of the influence of context and assumptions, position statement(s), and conclusion(s) or implications/consequences.

Assessment of Communication Skills

Purpose:
To be successful, a professional in the sciences must be effective at developing, interpreting, and expressing ideas through written, oral, and visual communication means. To this end, BIOL 1114 students will demonstrate communication competency. This assignment is designed to assess communication skills.

General Assignment:
Using the Weekly Discussion Topics presented in class as guides, locate and read a science news article (print article) posted on any of the major news outlets available to the general public (e.g., *The Washington Post*, *The Wall Street Journal*, *BBC*, *Time* magazine, *Newsweek* magazine, *etc.*) that relates to one of the discussion topics. A discussion forum is available on the course D2L site that will serve as a sign-up sheet; once you have chosen your article, post the author and name of the article to the discussion forum. Check previous posts to verify that another student has not already posted your choice; only one student may review a particular news article. Choose and post a news article no later than mid-semester (date). Download and save a copy of the news article and, over the course of the semester, formulate a review of the news article that includes an explanation of the science being presented and a critique of how well that science was presented in the article. Prepare a short written assessment and a 5-minute PowerPoint presentation that will be delivered during the last lab meeting before the lab final (week 13). You will turn in your news article, your written evaluation, and your PowerPoint presentation. The written evaluation and PowerPoint presentation will include the following:

1. A synopsis of the chosen news article.
2. A succinct explanation of the science being presented in the newspaper article. This should be an accurate explanation of the science drawn from the primary and secondary biological literature. As part of your evaluation of the article, you will design a figure (a visual communication device – look at your textbook for examples of how different science concepts are visually presented) that explains the science.

3. A critique of the newspaper article relative to the actual science. What did the author get right; what did they get wrong; is there anything misleading; what could have been done better? If the news article includes its own figures, critique those as well.
4. An evaluation of whether a general, non-science audience is likely to have understood the article, or whether the article would have been accessible only to a science-literate audience. Depending on the topic, this could have real consequences – what might those consequences be? For example, is a story on Zika told such that people understand why they need to use insect repellent, or did the story simply elicit fear without being likely to engender changes in behavior?
5. Proper citation of the biological literature. At least three (3) primary or secondary journal articles from the biological literature will be used and properly cited (without plagiarism).

Assessment of Empirical and Quantitative Skills:

Measurements obtained individually by students in the first portion of the lab exercise, *Measuring Bacterial Growth*, will be used for the Empirical & Quantitative Skills assessment. Each student will be responsible for recording spectrophotometric data and plotting a growth curve. Additionally, each student will be responsible for calculations to determine the original titer of the bacterial culture and of multiple dilutions of that culture. Students will also learn to plot their measurements in graphical form and record data in tabular form.

The data record, calculations, and resulting graphical analysis will be graded to assess students' abilities to record, manipulate, and disseminate quantitative information. Students will submit a written lab report containing their calculations and figures, which will be assessed according to the AACU Quantitative Literacy VALUE Rubric (attached) specifically in areas of Interpretation, Representation, Calculation, Application/Analysis, and Communication.

Assessment of Teamwork:

Each student will be part of a 3- to 4-person lab group. Each will individually be responsible for one aspect of the measurement process and they will collaborate with their teammates to consolidate each team member's individual results into a single scientific figure for dissemination to other teams. Each team member's individual contribution to this effort will be assessed by the instructor during the lab period and as part of the graded assignment since each team member is uniquely responsible for one set of measurements. Each team will in turn disseminate their collective data to all other teams in the lab section. This dissemination will occur electronically (email) and will be coordinated by the laboratory instructor. Additionally, individual team members will evaluate their individual contributions and the contributions of their team peers through a confidential evaluation tool (see attached Student Evaluation of Teamwork) that will be administered by the instructor. The instructor will evaluate teamwork using the AACU Teamwork VALUE Rubric (see attached) specifically in areas of Facilitates the Contributions of Team Members, Individual Contributions Outside of Team Meetings, and Fosters Constructive Team Climate.