Biology 2010L (1 unit): Cell Biology and Biochemistry Lab; PLNU

Lab section:	Time and Place	Instructor
Section 2A	Tuesday 8:00 – 11:00 AM (Sator 120)	Prof. Scott Pittman
Section 2B	Tuesday 1:30 – 4:30 PM (Sator 120)	Prof. Scott Pittman
Section 1A	Wednesday 2:45 – 5:45 PM (Sator 120)	Prof. Scott Pittman
Section 2A	Thursday 8:00 – 11:00 AM (Sator 120)	Prof. Scott Pittman

You must attend the section in which you are registered. Extenuating circumstances requiring individuals to come to a different lab section on any given week will be considered if brought forward to the instructor well in advance.

Lab manual: The labs are available for purchase through University Readers as a printed reader https://store.cognella.com/17663. Everyone must have a reader purchased for their individual use. You will be turning in pages from the reader for grading.

Approach to lab work in Bio210: The Bio210 lab is designed to introduce students to some of the fundamental principles and methods used in modern biology research. Some lab activities will be completed in one week, while others will span multiple weeks. There will also be some labs where you are required to come in and perform some parts of the lab on your own time outside of the normal laboratory class. This is a necessary evil when doing some labs as it is impossible to schedule all components of a lab in a 3-hour time period.

Learning outcomes:
The labs are intended to help bring everyone up to the same level so that each person can:

1) Perform various lab techniques that are standard in biology and that will be required to perform many of the labs later in the biology degree.
2) Design experiments based on the scientific method using appropriate controls.
3) Produce written lab reports that effectively convey experimental purposes, methods, results (including data graphs and tables), and conclusions.

Because this class has such a heterogeneous population, many people may be at different levels at the start of the labs. I realize that some of the labs may seem like review for some. If this is the case, please be patient if the labs are 'easy' for you and use your knowledge to help others. You will definitely work your way up to more difficult labs in this course, and in future courses.

Assessment: The student's grade in lab, which is combined with their lecture grade to create a single overall grade for the course, will be based on the following four criteria: (1) lab quizzes, (2) lab reports, (3) lab questions, and (4) a lab practical exam. Each is described briefly below.

(1) *Lab quizzes*: For most weeks, students should expect a 5-point quiz at the beginning of lab covering the assigned reading (wet labs) or the previous week's work (dry labs).
(2) *Lab reports*: For some of the labs, you will be required to turn in a formal written lab report. These reports will include an introduction, detailed materials and methods, results, and a discussion. More information on how to write a lab report can be found in the lab manual, and in detailed instructions below.
(3) *Lab questions*: Each lab comes with a set of questions. These, along with any supplemental questions or data assigned by the instructor **will be turned in by the end of the lab.** Please see me if you are confused as to which questions you are to answer.
(4) *Lab practical exam*: Near the end of the lab course, students will be given a lab practical exam. Some questions will require hands-on work, while others will be thought questions regarding topics discussed and read during the course of the semester in lab. You are allowed to maintain a lab notebook with protocols, notes, hints, etc. that you will be able to use on the lab practical. However, you may only use your own notes incorporated into a lab manual, not your friends notes or notes taken during studying just prior to the practical.

Participation: ~15% of your lab grade will be based on participation in the lab. I will be watching to ensure that everyone is participating and pulling their share of the load during lab activities. If there are any issues, I will also discuss this with your lab partners and assign or reduce points as appropriate. You cannot learn in a lab setting without participating to the fullest. ***You will also do very poorly on the lab practical if you are not immersed into the lab activities each week.***

Laboratory attire and safety: Although we will not be working with anything particularly dangerous or sensitive in this course, it is always a very good idea to learn and practice strong lab safety procedures. Even the least dangerous chemicals, cells, or other biological/chemical components can cause problems when not used safely or properly. Also, we will be sharing a lab with other classes which do use bacteria and other aspects of biology which cause a more direct safety concern. **Thus, safety procedures and attire for Bio210 labs will be as follows:**

1) No open toe shoes (such as sandals) in the lab.
2) No food or drink in the lab. I will attempt to set up a table just outside the lab where you can set your water bottles if you wish to have access to them and drink (outside of the lab) during the lab class.

I reserve the right to take off up to 20% from each lab in which you do not follow the above rules regarding attire and food/drink.

Other rules and safety requirements such as lab coats, googles, and gloves will be discussed and followed as appropriate for each individual lab.

Lab notebooks:
Any good scientist keeps a detailed lab book of notes describing procedures, methods, etc. I will not be requiring you to keep a lab notebook of your own, but you will be able to use your own lab notebook (with handwritten notes on the labs) during the lab practical. There may not be copies of the lab manual or handouts in the lab notebook used for the lab practical.

Lab write-ups:
Lab reports must be submitted in a digital file through canvas as a doc, docx, or pdf file. Graphs and tables should be done using Excel; these can then be copied and pasted into your word document. We will be going over how to effectively create a graph and table using Excel. However, if you are still uncomfortable with using Excel, please ask your instructor.

At times, groups may turn in a single lab report, but everyone **MUST** work on the whole thing together. It is to your benefit to participate in writing each section and the analysis of the data yourself (both for learning and tests, etc.) ***Everyone must turn in their own set of questions for the labs.*** If I hear of individuals being forced to do an unfair amount of the work, or groups splitting up the report by sections (i.e. you write this part and I'll write this part), I will change this to requiring everyone to turn in their own lab report. Trust me, it is quite obvious by a lack of flow if sections are being written separately by different people and then it's all just being copied and pasted together!!!

The following sections should be included and each should be separated by a heading:

I. Introduction:
   a. Introduce the context of the lab, including all pertinent background information on the model system, the science behind the experiment, etc.
   b. State the purpose of doing the experiment. Briefly discuss the process or structure that the experiment involves and how it relates to the course content.
   c. Clearly state a hypothesis of the lab.
   d. State why you think that your hypothesis is correct. In other words, give some background information from class or the lab-book, or describe observations that have helped you generate this hypothesis. This should include citations.

II. Materials and methods:
   a. Describe how you set up the experiment and collected your data in sufficient detail so that someone else could replicate your study. Include all of the materials /supplies that you used. **This should be written in the <u>past tense</u>, in paragraph form.** *This should not be written like a bulleted protocol or list of reagents.*
   b. Identify the independent, dependent and controlled variables as appropriate.
   c. Describe any key calculations that were done to obtain the results shown in your graphs, etc.

III. Results:
   a. Summarize your results **in a paragraph**, but do not draw any conclusions. ***Do not forget that you do need to describe your results briefly in a paragraph that refers to the appropriate figures.***
   b. Provide a table of your results whenever appropriate.
   c. Provide a graph of your results on graph paper when appropriate. Make sure that your graph has a **descriptive title, that the axes are labeled, error bars are included when appropriate, and that the scales are done correctly**.
   d. Include a figure legend to accompany your figure / table.

IV. Discussion:
   a. Draw conclusions based on your data.
   b. State whether your hypothesis was supported or rejected by the data and describe why you have come up with that conclusion.
   c. State any problems that you had in your study, as well as what you could have done differently to avoid the problem.
   d. Describe your next set of experiments. What could you do next to expand on the information gained from this experiment
   e. Put the experiment into context with other similar or related experiments. Was this surprising? Did it fit with what others have observed? (requires citations).

Important hint for writing your lab report

You should think of the lab report as a sort of **hourglass of information**. You should start out broad in the introduction by introducing the broad topic and how this particular topic fits into biology as a whole (what is its importance). You should then narrow down and become more specific within the introduction as you start to introduce exactly what you did in this particular experiment and how that fits into the broader topic. Use this space to give some background information that helps the reader know why you did these experiments, and why you thought your particular hypothesis would be correct. Finally, you should finish the introduction with your particular hypothesis (where appropriate) and a brief sentence summary of what you did and what the results showed. Thus, you go from broad to specific.

The materials and methods and the results are then very specific referring to exactly what you did and what you saw. Finally, the discussion starts out narrow, re-defining what you saw and putting the results into perspective. The discussion should then get broader by relating these results and their interpretation to a broader perspective by discussing how it relates to the more general topic and biology in general. In the discussion, you go back out from specific to broad. What do the results tell you? Was your hypothesis supported or not? Was the data significant? What does this mean in context of the bigger picture? Based on the results, should you modify your hypothesis, do you need more trials, etc.? What are the next steps / future directions?

More information on how to write a lab report can be found in your lab manual, along with an example lab report.

Rubric for grading lab reports (write-up portion)

Neatness	Many typos and Sections are unlabeled 0 pt.	Several writing errors throughout 1 pt.	Typed and clean with few or no errors 2 pts.	_____pts.
Introduction	Poor intro No hypothesis stated. Lab is not put into context of the course content. No background is given. 0 pts.	Minimal intro, Hypothesis is stated, but unclear. Some background, but minimal context for the lab. 2 pts.	Good intro that puts the lab into context of the class or particular biological topic being studied, states a hypothesis that is being tested, and gives background information regarding that hypothesis. 5 pts.	_____pts.
Materials and methods	Unclear procedure, steps unclear or missing No variables identified 0 pt.	Clear procedure, but missing key steps, Variables incorrectly identified 2 pts.	Clear procedure with all necessary steps for a scientist to repeat the experiment, written in the past tense ("20 mL was added") Variables correctly identified 4 pts.	_____pts.
Results	Figures and tables legends and labels are incomplete No table of results Graph poorly done or missing Discussion of results hard to read, missing or unclear, inaccurate No statistical analysis of the data. 0 pts.	Table and graph are both present, but are not labeled clearly or the graph is confusing Explanation of graph, table and results is OK, but limited. Very little or no explanation of the results referring to appropriate figures / tables Graph does not include correct error bars 3 pts.	Figures and tables well labeled Good table of results Includes a graph of the average values of the trials with error bars representing standard deviation (as appropriate) Includes a t-test measurement to determine if there is a difference between control and test group(s) Explanation of results is clear, accurate, and complete 7 pts.	_____pts.
Conclusion	Poor conclusion, no discussion of problems or future study 0 pt.	Statement of conclusion is minimal, no discussion of problems or future study 2 pts.	Clear statement of conclusions, putting the data and results into context of the broader biological topic. Problems and/or future study ideas are discussed 5 pts.	_____pts.
Bibliography	No bibliography or citations 0 pt	Bibliography at the end, but no citations throughout the report, or bibliography is not in correct APA or MLA formatting 1 pt	Complete and correctly formatted bibliography with works cited throughout the report, including research for introduction (background) and conclusion (context) 2 pts	_____pts

Total = 25 points for write-up

Laboratory schedule:

Date	Lab activity	Lab section in reader	Purpose of the lab	Due / Notes
Unit 1: Lab Skills. Lab 1 – 3.				
Week 2 (9-5 → 9-7)	Lab introduction; Lab 1: Common Experimental Techniques Quiz #1	Lab syllabus Lab reader: "Lab #1 : Common Experimental Techniques"	Learn how to measure volumes and masses accurately. Learn how to make and use a standard curve	Bring laptops (if possible) Lab 1 questions due at the end of lab (15 points)
Week 3 (9-12 → 9-14)	Lab 2: Process of Scientific Inquiry Quiz #2	Lab reader: "Lab #2: Process of Scientific Inquiry"	Learn about experimental replicates and basic statistical analyses	Bring laptops (if possible) Lab 2 questions due at the end of the lab (15 points)
Week 4 (9-19 → 9-21)	Lab 3: Mini-lab on Microscopy Quiz #3	Lab reader: "Lab #3_Minilab on Microscopy"	Learn the basics of how to use a microscope	Lab 3 questions due at the end of lab (5 points)
Unit 2: Research Design and Ethics.				
Week 5 (9-26 → 9-28)	Lab 4: Enzymes and Denaturation (part 1) Quiz #4	Lab reader: "Lab #4: Enzymes and Denaturation"	Learn about enzymes and denaturation, and practice testing for enzyme activity using jello and pineapple	Plan for self-designed experiment due by the end of lab.
Week 6 10-3 → 10-5)	Lab 4 (cont.): Enzymes and Denaturation (self-designed exp) Quiz #5	Lab reader: "Lab #3: Enzymes and Denaturation"	Implement your self-designed experiment on denaturation. Learn how to plan and implement an exp.	Bring materials required for your self-designed enzyme denaturation exp.
Week 7 (10-10 → 10-12)	Bioethics 1 (access pre-reading and homework questions on canvas)	"Bioethics Reading and Questions" (must be completed before lab discussion)	Learn about and discuss bioethics in research (based on vaccination scenarios).	Unit 2 packet questions & lab 4 report due (35 pts) *-bioethics discussion preview Q's due before lab*
Unit 3: Research Design and Ethics (cont.).				
Week 8 (10-17 → 10-19)	**No lab this week (enjoy your brief break); good luck on exam 2**			
Week 9 (10-24 →10-26)	Lab 5: Metabolism in Plants & Animals (Part 1) Quiz #6	Lab reader: "Lab #4: Metabolism in Plants & Animals"	Learn about cellular respiration and photosynthesis, and how to measure extent of activity by measuring CO_2 levels	Plan for self-designed experiment due by the end of lab.

Week 10 (10-31 →11-2)	**<u>Lab 5 (cont.)</u>: Metabolism in Plants & Animals (self-designed exp) Quiz #7**	**Lab reader: "Lab #4: Metabolism in Plants & Animals"**	**Implement your self-designed experiment to study what affects fish respiration and/or plant photosynthesis.**	**Bring materials required for your self-designed cell resp. and photosynthesis lab.**
Week 11 (11-7 → 11-9)	**Bioethics 2 (access pre-reading and homework questions on canvas)**	**"Bioethics 2" (must be completed before lab discussion)**	**Final bioethical discussion focused on falsifying data and conflict of interest.**	**Unit 3 packet questions & individual lab 5 report due (35 pts)** ***bioethics discussion preview Q's due before lab***
Unit 4: Molecular Biology / Genetics Introduction.				
Week 12 (11-14 → 11-16)	**Lab Practical (50 points)**	**Review lab procedures**	**To assess whether you have learned and practiced the key lab concepts and techniques throughout the semester**	
Week 13 11-21 → 11-23	**No Lab**	**Thanksgiving break**		
Week 14 (11-28 → 11-30)	**<u>Lab 6</u>: Bacterial Conjugations (performing the lab) Quiz #8**	**Lab reader: "Lab #6: Bacterial Conjugations"**	**Perform bi-parental mating (bacterial conjugation). Analyze later that week.**	
Week 15 (12-5 → 12-7)	**<u>Lab 6 (cont.):</u> Bacteria Conjugation (dry-lab concepts) Quiz #9 (take home quiz) turned in**	**Lab reader: "Lab #6: Bacterial Conjugations"**	**Focus on bi-parental and tri-parental mating scenarios and how these can be used to study bacterial transfer of plasmids.**	**Unit 4 Q's and analysis of bacterial conjugation results (lab 6) due by the end of lab (20 pts)**

Point breakdown

Lab quizzes (9 x 5-pt)	(drop lowest score = 8 x 5)	40 points
Unit Q's and lab reports		125 points
Lab practical (1 x 55 pt)	(5 bonus points)	50 points
Lab participation and attitude		35 points
TOTAL		**250 points possible**