JOHNS HOPKINS
UNIVERSITY

Syllabus
Cell Biology Lab AS.020.316
1 Credit
Fall 2019

Instructors

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Teaching Assistants:
Tuesdays
Wednesdays
Thursdays

Course Description:
This course will reinforce the topics presented in AS.020.306 Cell Biology. The laboratory experiments use visible and fluorescence microscopy to study cell structure, cell organelles, and cytoskeleton in different model systems.

Course Objectives

1. Use current techniques and model systems to explore mechanisms of cellular biology.
2. Gain experience in data collection and analysis, interpretation of results, and experimental design.
3. Develop scientific writing and oral communication skills.
4. Understand the larger context of how disease states affect cellular function.

Lab Manual and Course Website:
There is no required textbook. The Lab Manual and all other assigned articles will be posted on Blackboard prior to the class session in which they will be discussed. To access Blackboard, visit http://blackboard.jhu.edu .

Attendance:
Attendance is mandatory. Being tardy for class will mean that you are unable to the take the quiz.

Pre-Lab Questions (5 pts each)
These questions must be answered before your class time on Blackboard. You will have as many attempts as you need to get full points on these questions. There will be no pre-lab questions to answer while you work on your final project.

Quiz (5 pts each)
At the beginning of each lab period except the first, a quiz will be given. If you are tardy, you will not be allowed to take the quiz. The quiz will cover the learning goals, background information and the day's experiment. There will be no quizzes the weeks that you work on your final project. There will be 8 quizzes.

Practicals (10 pts each)
Two essential lab skills will be tested during the lab. One will be setting up an Axiostar microscope in Koehler illumination and bright field or phase contrast. The other will be sterile technique in a cell culture hood.

Lab Notebook (3 pts each week)(an example is on Blackboard in the Lab Notebook section)
For each week, every lab member will enter the work that was done that day and the results of the experiment. If the manual was followed, simply name the procedure and the chapter and pages of the manual. Results should include numerical data, descriptions of results, figures (example: images of cells) and written legends for the figures. Your lab notebook will be updated every week including during your final project. Your lab notebook will be checked every week for the previous week's experimental write-ups.

Lab Reports (50 pts each)(more specific guidelines are found in this syllabus)
For each of the two model systems, there will be a short, 5-page lab report turned in by each lab participant. These will be due 1 week after we complete each model organism. In your lab report, you must briefly introduce the project, list the methods used, describe your results observed along with numerical data, images, blots or gels, and discuss your findings in a larger context. Cite any sources used in a citations section. Lab reports are expected to be handed in on time. Late lab reports will not receive full credit. The later the assignment, the less credit. Lab reports turned in later than one week after the due date will no longer be accepted for credit, unless explicit permission has been given by the instructor.

Final Project Proposal (50 pts)(more specific guidelines are found in this syllabus)
Using a posted list of apoptosis inducers and inhibitors or a list of bacterial clones producing RNAi for a set of C. elegans genes and the techniques mastered in this lab, each lab pair will write up a proposed experimental procedure for the final 2-3 weeks of class. You must write a hypothesis that you are going to test, and why you think that will be the outcome. There should be background to support your hypothesis. You will need to list required materials including samples and reagents needed for the experiments. Please be very specific! You must include a proposed timeline for the experiments. You may use flow cytometry, but we will not be able to do Western Blotting for any protein except GFP-tagged proteins. This proposal must be discussed with your instructor or TA before submission.

Final Presentation (50 pts)(more specific guidelines are found in this syllabus)
Each lab pair will present an oral presentation on their final project in 10 - 12 minutes. The presentation must include background, methods, results and discussion. Microsoft Powerpoint or similar programs can be used to prepare visual aids. All members of each group are expected to participate in preparation and presentation. It is always difficult to grade group assignments when the contributions of students are not always equal. The presentation will be formulated as a group, and the instructors will assign each group a raw grade, but points will be deducted from students who are unable to answer questions or who do not appear prepared for the presentation. Students who are exceptionally more prepared and able to answer questions, compared to their group members, may receive bonus points.

Grading:

Graded Instruments	%	Total Pts.	
Quizzes	11.7%	40 pts	5 pts x 8 weeks
Pre-Lab Questions	13.2%	45	5 pts x 9 weeks
Practicals	5.9%	20 pts	10 pts x 2 practicals
Lab Notebook Checks	10.6%	36 pts	3 x 12 weeks
Lab Reports	29.3%	100 pts	50 x 2 reports
Final Project Proposal	14.6%	50 pts	
Final Project Presentation	14.6%	50 pts	
Total	100%	341 pts	

Letter Grade	Percentage
A	93 100
A	90 92.99
B+	87 89.99
B	83 86.99
B	80 82.99
C+	77 79.99
C	73 76.99
C	70 72.99
D+	67 69.99
D	63 66.99
D	60 62.99
F	0 59.99

Syllabus is subject to change at the discretion of the instructor.

Ethics

During the progression of this course, students are encouraged to openly discuss their viewpoints regarding some controversial topics. As the quality of these discussions relies on student participation, it is necessary to be respectful of the thoughts and beliefs of others. Any student unwilling to abide by these guidelines may be asked to leave. You must be honest and truthful. Ethical violations include plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Report any violations you witness to the instructor. More information about university misconduct policies is at http://e-catalog.jhu.edu/undergrad-students/student-life-policies/

Students with Disabilities

Any student with a disability who may need accommodations in this class must obtain an accommodation letter from Student Disability Services, 385 Garland, (410) 516-4720, studentdisabilityservices@jhu.edu.

Semester overview:

Week of Sept. 2	Intro to Microscopy and Cells
Week of Sept. 9 – Week of Oct 7	C. elegans Characterize Myo 3
Week of Oct 7 – Week of Oct. 28	Mammalian Cell Culture
Week of Oct 28	Prep for Projects & Finish Cell Culture
Week of Nov 4 Week of Nov 18	Final Projects
Week of Nov. 25	Thanksgiving vacation
Week of Dec 2	Presentations

This overview is subject to change by the availability of reagents and the whims of science.

Weekly Outline

Week	Experiments
9/2	Introduction to Microscopy & Cells
9/9	Introduction to *C. elegans* & Myo-3
9/16	Preparing *C. elegans* for RNAi Treatment
9/23	Scoring RNAi Phenotype & Determining Efficiency of Knockdown
9/30	Measure Knockdown Efficiency by Western Blotting
10/7	Introduction to Cell Culture
10/14	Determining DNA Content in NIH 3T3 Cells by Flow Cytometry
10/21	Determining Cell Viability of NIH 3T3 Cells
10/28	Determining Myosin II's Function in Apoptosis
11/4	Final Projects
11/11	Final Projects
11/18	Final Projects
11/25	Thanksgiving vacation
12/2	Presentations

Lab Notebook

Your lab notebook for this course will be on Blackboard. Good record- keeping is essential in science, as it allows you to recall experiments and results.

Every week, your notebook entry should have a title, a date and a one sentence purpose or objective. Give the name of the procedures if they are in the manual, and make a note of any modifications. (1 pt)

In the results section, record tables, images, drawings with short explanations. Microscope images must have sample names, magnifications, fluorophores/fluorescent proteins and types of microscopy. Gels or blots must include sample names, gel lanes, staining, and antibody development. (1 pt)

The final section is a conclusion section. What did you accomplish by your work that day? Did you come to a conclusion about an experimental question? (1 pt)

A lab notebook is a critical part of good record-keeping. Among other things, it is a suitable way to store experimental information and results in one place. It is also meant to be a permanent, unalterable record of the work that was performed. You can go back and edit drafts, but do not delete previous information. Amend the information.

GUIDE TO WRITING LAB REPORTS

Lab Report 1 is due on your lab day in the week of Oct 7.
Lab Report 2 is due on your lab day in the week of Nov. 11.

Lab reports are the lab course version of a scientific paper. You want to present your data in a logical format and explain any interpretations of that data. A lab report (in contrast to published scientific work) will also include reasons the experiment may have turned out sub-optimally. Your lab report will follow the standard format of a scientific paper: title, introduction, materials and methods, results, and discussion.

You need to write in your own words.

Your lab reports will be graded on three major themes: being concise, clear and creative. Being clear in your writing is a skill you need whether writing a lab report or writing an email. Assume your reader does not have access to the lab manual, so make sure to give proper context. Your lab report should be based on your results, presented clearly and in logical order. Finally, it is difficult to be clear and creative as well as concise. If you understand the experiments, you should be able to stay within the limits without losing clarity. It is a fine balance. Lab reports to use the following format:

12 pt font, 1 inch margins, double spaced

Title (name and section belong here): [2 pts]

C. elegans labs or Cell Culture labs are not appropriate titles. Titles are meant to be descriptive of the overall point of the experiments or project.

Introduction: [10 pts] Length ~0.5 pg

The introduction provides the framework for the study. Set the context for the experiment, by explaining what information was known before your experiment. When evaluating whether to include information in the introduction, ask yourself, "does knowing this information help the reader understand why I did what I did?" In this section you may find yourself integrating information from sources aside from the lab notebook. When you do this, please cite the source. Start with a broad context and then narrow your focus. Ultimately, you need to describe what question(s) your experiments were trying to address, or describe the hypothesis of the experiment. Think about a hypothesis that encompasses the entire project.

Material and Methods: [8 pts] [length: 0.5 pg]

You should keep this section short by citing the laboratory manual. You need only briefly describe the approach you are taking. e.g "We used GFP tagged protein to observe the localization of myo-3" This is the only section in which it is OK to assume the reader has access to the lab manual.

Results: [20 pts] [length: at most 3 pages]

YOUR RESULTS SECTION IS NOT JUST RAW DATA. You need to digest the results and explain the important data. The first step in writing results is to organize your data in a logical fashion. Make graphs or tables to summarize your data and do any calculations necessary. In general, if your data are showing a trend, a graph makes sense. A table makes more sense when you are comparing various conditions or genetic strains. If you can't graph your data, and you cannot summarize it with a sentence or two, use a table. You should also verbally describe your findings as if you are presenting them to an audience. Describe important trends. Include a figure with microscope images where appropriate. Include a heading and a legend with your figures, graphs and tables. Figures, graphs and tables with the legend should almost stand on their own to explain the results. Number tables, graphs and figures so that you can refer to them in text. If you decide not to include data in your calculations, explain why the data was rejected.

Discussion: [10 pts] [1 page]
Any conclusions you draw belong in the discussion. In general, this section is about what the results mean. How do you interpret your results and their significance? Return to the question(s)/hypothesis raised in the Introduction. What light do your results shed on the question? You can discuss results in a 1,2,3 order, matching the experiments presented in the results to the conclusion; however, it is preferred that when several results in combination lead you to a certain conclusion, you discuss results in aggregate.

Final Project Proposal and Rubric

This is due on your lab day in the week of Oct. 21.

Each lab pair will write up a proposed experimental procedure for the final 2-3 weeks of class. You must write a hypothesis that you are going to test, predict the outcome and explain your prediction. There should be background to support your hypothesis. You will need a list of specific materials required, including samples and reagents needed for experiments. You must have a proposed timeline to perform the experiments. You may do any experiment in the lab manual, and the experiments must take at least two lab class times. You may propose an experiment not performed in lab, but the instructor must approve it.

Title (name and section belong here): (2 pts)
Titles are meant to be descriptive of the overall point of the experiments or project.

Overall organization (5 pts)
12 pt font, 1 inch margins, double spaced
1. Is your proposal organized, clear, and concise?
2. Have you proofread your proposal, eliminating grammatical and spelling errors?

Introduction (~1 page) (18 pts): You will introduce the reader to the question(s) you are going to address and provide background information that puts the proposed experiments in the context of past research on the topic in a logical manner. Looking up some relevant research papers or reviews will help to put your question into context. You don't need to do an experiment that has never been done before. You can replicate a study as long as it is something you have never done before. For example, the characterization of myo-3 experiments that we did as a class was assessed previously, but not on the specific strain of worms that we used or in the exact same manner. Therefore, you can do a similar characterization of a gene or change some aspect of how we tested the myo-3 gene's function.

1. What is your biological question? Put your hypothesis or question that this experiment will address in the context of relevant background.
2. If the question you are proposing addresses opposing hypotheses, have you included background relevant to both views?
3. What types of results do you expect? Have you briefly stated why/how your results will advance our current understanding of the field?
4. Why do you think this is an interesting question? This section should be written in paragraph format.

Experimental design (2-3 pages) (20 pts): In this section, include detailed information regarding the reagents you are going to use and detailed procedures as to how you are going to perform the experiment.

1. What specific data analysis will you ask to address the broad biological question?
2. What data / samples will you use? Why? This should include solutions and reagents
3. What tools/methods will you use? Why? This should have procedures.
4. What days will you do each step? Do you have a reasonable timeline to complete your experiments?
5. Are your experimental and control conditions clearly stated?
6. It is possible that you will get a result that will alter your experimental plan. Are there any results you can anticipate, that would cause you to revise your proposal?

You should have a short overview description of your experimental plan (a few paragraphs). The rest of this section should have lists of reagents and step- by- step protocols similar to the lab manual.

Literature Cited: (5 pts)
Only cite references you read and used in the text of your project proposal. Use in text citations (MLA format). The author's last name and page number from which the material is taken must appear in the text, and the complete reference must appear in your Literature Cited section. Do not do in text citations for material in the lab manual.

Final Presentation Guidelines and Rubric

Each pair will present an oral presentation on their final project in 8 - 12 minutes. Time permitting; there will be a possibility to ask questions to each group. Microsoft Powerpoint or similar programs can be used to prepare visual aids. All members of each group are expected to participate in preparation and presentation. Be creative, and make your presentation into a story (not a list of facts) in a logical ordered. The idea of these presentations is to get an understanding of your research question. Depending on how well your experiment worked, each section of your presentation may differ in length. Also, you may not need to explain all of your methods at one time. It may make more logical sense to explain one method then the results of that method, and then the next method etc.

Slide Design and Organization (4pt)

Slides should have appropriate titles, ascetically pleasing slides, appropriate size and labeling of figures, logical flow of ideas, clear presentation of thoughts, professional presentation, no typos, define terms or acronyms, and clear transitions between slides. Use figures and images as much as possible and limit the number of words on your slides.

Background Information (4 pt)

This is your big picture overview where you will address relevance, and state of the field. You can also bring up any interesting facts. The idea of the background is to give enough information to allow your audience to understand your reasoning for your hypothesis and methods. Use parts of your proposal background to guide you. Titles of slides should not be background, but rather "Endocytosis requires the coordination of many proteins to maintain cell viability"

Hypothesis (3 pt)

You must define your hypothesis of your experiment, which should be clear and concise.

Overview of the Methods (4 pt)

This is not meant to be a list of your protocol. Think of this more like the paragraph portion of your experimental approach in your proposal. This should NOT be a paragraph on a slide that you read to your audience. Use figures and images when appropriate and limit your words on all your slides. Titles of slides should not be methods, but rather "Endocytic function assayed using an endogenous cargo protein, Mup1" where I used figures demonstrating my method.

Results (5 pt)

Generally your titles for these slides should not be Results, but rather what results are in the slides. For example from a presentation on my research, "Truncated proteins, *SLA1, SLA2,* and *EDE1* cause endocytic defects" or "Flow cytometry-based screen for Mup1 internalization- defective cells yielded three classes of endocytic mutants." This is where you show your data.

This should be images, graphs, data tables etc.

Conclusion (5 pt)

This is where you interpret your data. Put it into the broader context. This is when your background and results should meet. What do your results imply? An example title for a conclusion slide "The entire endocytic pathway is represented by the three endocytic mutant classes " where I showed example mutants in the broader context of what is known already.

Future Directions (5 pt)

You should explain why your future directions are interesting and/or necessary. We have very limited resources. This is the opportunity to explain and discuss possible directions/methods if you had unlimited resources. Why would you use these methods?

Time (5 pt)

When presenting scientific work at conferences, time limits are a needed to stay on schedule, and to keep people interested you must get your message across within that time limit. If your presentation is less than 8 minutes or more than 12 minutes, these points will be deducted. The instructor will stop your presentation at 14 minutes and any topics not covered during the allotted time from the rubric will also be deducted.

Individual Effort (5 pt)

Both partners must participate during the presentation and when asked questions after the presentation. Both must try to clearly present ideas, have good eye contact with the audience, no flipping back and forth between slides, and speak at an appropriate volume.

It is always difficult to grade group assignments when the contributions of students are not always equal. The presentation will be formulated as a pair, and the instructor and TA will assign each group a raw grade, but points will be deducted from students who are unable to answer questions or who do not appear prepared for the presentation. Students who are exceptionally more prepared and able to answer questions, compared to their group members, may receive bonus points. Don't make up answers to questions though either.

Participation with other presentations (10 pt)

A key part of any presentation is an engaged audience. You will be given a participation sheet where it will list each presentation. You will write down questions and comments about each presentation including parts you found confusing. Time permitting for each presentation, there will be a possibility to ask your questions. If presentations are too long, we will have to skip the question part, but still write down all of your questions. You are expected to ask questions to presenters if there is time after the presentation. We will not be able to get to everyone's question after every presentation, so we will assess your participation via written comments.