

Welcome to Biocore 384 Cellular Biology Lab!

Learning Goals, Outcomes & Approach

Biocore Lab Courses Are All About The Process Of Science

You may be familiar with the model for scientific investigations known as the "Scientific Method." The model presents a logical sequence of steps leading from an initial observation to an experiment and interpretation of data. However, few scientists actually carry out investigations according to the rigidly defined linear sequence of steps. What they do is to engage in the following activities:

- 1. Making Observations and Generating Testable Questions:** *Making Observations* takes a careful, keen eye and experience in differentiating subtleties and slight differences in whatever you are sensing (visually— or smell, touch, taste too!). Through careful observation, we notice variations and patterns that provide the basis for developing questions and predictions that can be tested or measured in an empirical way.
- 2. Formulating Hypotheses Supported By A Rationale:** Forming hypotheses requires stating tentative explanations or answers to your testable question based on background knowledge about the system you are investigating. A hypothesis is not simply an 'educated guess'. It must be supported by a substantive rationale (what we will refer to as a *biological rationale*), have explanatory power, and make a prediction that can be tested.
- 3. Designing And Conducting An Investigation:** This process includes planning the methods and procedures for gathering data to answer a question, evaluate a hypothesis, or challenge a theory. You test hypotheses by designing *manipulative experiments* or making careful *systematic observations* that evaluate the actual outcome against the predicted outcome. The type and design of your investigations is based on the questions you ask as an investigator, your knowledge of the study system, AND the general "knowledge" available in the scientific literature. In short, you need to understand the complexity of the system before measuring it.
- 4. Analyzing and Interpreting Data:** Investigators attempt to find patterns and provide meaning in a group of data in a particular context. When working with data in this class, we will emphasize the need to explore *sources of variation* within and between comparison groups, and will help you make connections between your data, the concepts and context underlying the project, and the assumptions you are making in your experiment. Interpretation of data should bring you back to your hypothesis, which you can either support or reject. The analysis and interpretation of data will form the basis for inferring explanations about the natural world.
- 5. Constructing New Knowledge:** If you reject your hypothesis based on the interpretation of your data, you may conclude that the assumptions you made about the system are not valid or that the way you are thinking about your system is incorrect. *Important Note:* You have not failed or made a mistake if your experiment leads you to reject your hypothesis. Nor have you "proven" your hypothesis true if your data supports your prediction. You have simply supported or accepted your hypothesis—under this specific situation. With more precise measurement, different statistical tests, or repeated experimentation in different environmental conditions with different organisms etc... your data may force you to reject your hypothesis. This should lead you to a new, more sophisticated hypothesis as you increase your knowledge about the system. You might even find that the patterns that you see run counter to what you read in the scientific literature, in your textbooks, or even are in opposition to what your instructors think (gasp!). If that's the case, you have just learned or discovered something new! Now that is exciting and...that is the process of science.
- 6. Communicating your Science:** As you question your analysis/ interpretation, or when you talk about or write about your understanding, you expose your ideas to discussion and debate. This is sometimes uncomfortable but is an essential form of feedback, and it helps to clarify fuzziness in our thinking. Communicating and receiving feedback on your science, and reviewing scientific work of your peers provides essential quality control and expands the knowledge we have collectively as a scientific community. In practice, above and beyond meeting expectations for a grade-- communicating your science clearly and effectively provides a vehicle for sharing and constructing new knowledge with others, and allows the next generation of scientists (AKA next year's Biocore students) to "stand on the shoulders of giants" (Sir Issac Newton).

Course Learning Outcomes: How this Applies to Biocore 384

As instructors, we are here to help you and to facilitate your learning of biology and your development as a scientist in an active way, but ultimately you bear the responsibility for learning the material, developing skills and taking ownership of your education. We will challenge you to go beyond simple memorization of details, to interconnect concepts, applications and problems; to ask meaningful questions; to test well-developed hypotheses; and to communicate your findings to your instructors and peers within the realm of science. These are lofty goals! We set high standards for you because we expect that you can reach them!

Our goals for Biocore 384 are to:

- Give you experience working with the concepts discussed in Biocore 383 in an applied setting
- Engage you in the process of science as described above
- Give you experience working with the tools and procedures of cellular and molecular biology
- Improve your writing skills and quantitative reasoning skills [this is a CommB course, with emphasis on data analysis and statistics]
- Build on, apply and integrate concepts and skills you have learned in your previous Biocore courses.
- Continue to improve your capacity to work as a member of a productive, collaborative research team.
- Contribute to a safe, sustainable, socially and ethically responsible learning environment.

The Big Picture: Learning Outcomes for all three Biocore Lab Courses

*Note that the goals above are the same goals as Biocore 382 now applied to cell biology. They are also the same goals for third semester Biocore 486- Organismal Biology Lab. These are higher-level cognitive skills that take time to develop (multiple semesters!). *Students are only required to take two of the three Biocore labs. Many choose to take all three!*

At the end of two (or three) semesters of Biocore labs, students should be able to:

1. *Make careful, systematic observations*
2. *Ask testable, relevant, creative scientific questions*
3. *Search, sort and gather relevant background information from texts, primary literature, and the web.*
4. *Make predictions and formulate clear, testable hypotheses*
5. *Develop protocols that test hypotheses*
6. *Evaluate assumptions associated with experimental design and the biological system*
7. *Analyze data and make logical conclusions utilizing statistical reasoning*
8. *Communicate effectively about science through writing and oral presentations*
9. *Do productive group work*

Four Strategies for doing well in Biocore Labs

1. **Be prepared.** Do Pre-lab assignments and read the relevant section of the lab manual carefully ahead of your laboratory meeting time and be sure you understand the question(s) the project is attempting to answer and the approach you will be taking to answer these questions. Careful preparation will save you a great deal of time both during lab and in writing assignments. Pre-lab assignments are designed to help in this process.
2. **Make the most of the time you have in lab.** Collect the necessary data and make detailed notes in your lab notebook. In many cases we have allowed time in class for you to begin analyzing and discussing your data, preparing presentations and getting feedback from peers and instructors. Take advantage of this opportunity and resist the temptation to leave early. This is where the most learning takes place.
3. **Start writing your lab papers well before the deadline and pay attention to the many hints in the lab manual, TA weekly emails, handouts, and *Biocore Writing Manual*.** We emphasize writing in this course not only because communicating your ideas is part of the scientific process, but also because writing about a subject helps you understand more clearly and at greater depth. This takes time. Many times during the semester you will have the opportunity to have your paper reviewed by a peer before turning it in for a grade. This is an excellent opportunity to remedy problems before turning in a final copy. If your peers cannot understand what you have written it is unlikely that the instructor will understand.
4. Cultivate a relationship with your Biocore peers. **Your peers are an incredible resource and have much to offer you in the way of support and advice in this course. These are the people you can depend on for the next three semesters!**

Biocore 384- Cellular Biology Lab (2 cr.) Honors

Course Description

The laboratory course gives students practical experience working with the concepts introduced in Biocore 383 lecture. This lab will help you dive deeper into research and the process of science with three opportunities to generate and test your own research questions; and introduces tools and procedures of cell and molecular genetics together with statistics and an introduction to bioinformatics all integrated into three different research units (biochemistry of enzymes, molecular genetics of heat shock proteins, and signal transduction of the yeast mating pathway). This is a writing intensive course and meets CommB requirements.



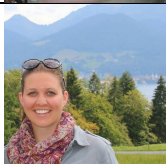

Required Resources

1. Biocore 384 Custom Lab Manual 2019 (available on Canvas and for print at Student Print)
2. Biocore Writing Manual 2018-19 (available on Canvas, at Student Print, and soon through Pressbooks)

Canvas URL <https://canvas.wisc.edu/courses/104763>

Class Meeting Location: All Lab and Discussion Sections meet in 341 Noland unless otherwise noted

Mode of Instruction: This is a face-to-face laboratory course with one weekly 3-hour lab led by the course chairs Dr. Janet Batzli or Michelle Harris and one weekly 50 min discussion section (required) led by your teaching assistants.

Instructors- Open Door policy--- Come see us!			
	Janet Batzli (Course Chair and Associate Director, Biocore) 363 Noland Hall, jcbatzli@wisc.edu , 608-263-1594 website: https://biocore.wisc.edu/people/batzli <i>Make an appointment or stop by- Open Door!</i>		
	Michelle Harris (Course Chair and Biocore Outreach Ambassador Advisor) 307 Noland Hall, maharris@wisc.edu , 608-262-7363 Website: https://biocore.wisc.edu/people/harris <i>Make an appointment or stop by- Open Door!</i>		
	Heidi Horn (Postdoctoral Teaching Fellow) 361 Noland Hall hhorn@wisc.edu Website: https://curriellab.wisc.edu/bio.php?id=Heidi+Horn		
	Seth McGee (Lab Manager) 339 Noland Hall, seth.mcgee@wisc.edu , 608-262-6189 website: https://biocore.wisc.edu/people/mcgee <i>Make an appointment or stop by- Open Door!</i>		
Lab	Disc Time	Lab Time	Graduate Teaching Assistants/ uTAs
1	Monday 12:05	TUES AM (8:50-1:20)	Karigynn Hansen/ Lauren Ross
2	Monday 1:20	TUES PM (1:20-4:20)	Kristina Garcia/ Sabrina Kabakov
3	Monday 3:30	WED PM (1:20-4:20)	Ron Dymerski/ Nate Richman
4	Tuesday 5:30	THURS PM (1:20-4:20)	Heidi Horn/ Baila Khan

Credit and Instruction

Biocore 384 is a 2-credit Honors laboratory course that includes a 3-hour in-class lab time led by Drs. Michelle Harris, Janet Batzli, or Heidi Horn and a 50-minute discussion section led by your graduate TA. You should plan to spend a minimum of 6 h outside of regular class hours each week to do lab readings (READ Lab Manual!), work on literature searches, project development, some data collection, data analysis, PowerPoint and poster preparation, paper writing, and peer review.

Drs. Harris and Batzli have an open door policy to talk about the course (the Biocore program more generally or other academic work) and will hold additional office hours during particularly busy weeks for consultation on lab projects, writing, data analysis and interpretation. Seth McGee, Biocore Lab Manager, will be available to support your development of projects and provide essential feedback as you gather materials, schedule experiments, learn techniques, and collect data. Graduate TAs will assist you during lab, facilitate discussion sections, send out timely information in weekly emails, and will grade and provide feedback on your written work. Our course instructional team also includes four undergraduate TAs

(one for each lab section) who will provide extra support during lab and discussion time, and help you in drafting papers and practicing oral presentations.

We are eager to support your learning in Biocore 384!

Biocore 384: Cellular Biology Laboratory - Spring 2019 Schedule

Your grade will be based on the assignments listed below. Check (√) assignments are scored simply adequate or inadequate; papers, posters and presentations are graded using rubric criteria described in the *Biocore Writing Manual*.

<i>Week/ (date)</i>	<i>Topic</i>	<i>Activities</i>	<i>Weight (due at start of class unless specified)</i>
1 (Jan. 22-25)	Tools and Techniques	<p>Disc None this week</p> <hr/> <p>Lab Equipment stations</p> <p>√ By end of Lab: Pipetting, water bath and spectrophotometry & data from timed reaction—demonstrate to instructor in lab</p>	
2 (Jan. 28-Feb 1)	Enzyme I: Alkaline Phosphatase & Kinetics	<p>Disc Read Enzyme lab manual Part A, Intro to Enzyme catalysis & calculations; decide final [S]</p> <p>Enzyme Pre-lab & Bioinformatics Primer</p> <hr/> <p>Lab Enzyme kinetics experiment ; Introduce expectations for Feedback Presentations (p. 43-44 WM); Examining Alkaline Phosphatase (AP) enzyme structure: Intro to Bioinformatics, AP physical models & Jmol tutorials</p> <p>√ By Friday Feb 1 (in lecture): calculation for enzyme activity; hand-drawn AP standard curve; graphs & calculations for estimations of K_m, V_{max}</p>	4%
3 (Feb 4-8)	Enzyme II: Proposal Feedback Presentation / Pilot Studies	<p>Disc Primary literature, Experimental Design & Feedback presentation prep</p> <p>√ Bring at least one relevant literature source & share w/ team – Workshop on reading, annotation & citation of primary literature using Mendeley Reference Manager</p> <hr/> <p>√ Experimental Design Worksheet (1/team)</p> <p>Lab Enzyme feedback presentation (1/team); Tutorial on making stock solutions</p> <ul style="list-style-type: none"> • Workshop on data analysis (generating histograms to evaluate assumptions and using t-tests to compare means) <p>√ Materials and schedule sheet- (1/team due 48h after lab)</p>	
4 (Feb. 11-15)	Enzyme III: Final Experiment	<p>Disc Expectations for Peer Review and Results/Discussion; Schedule TA writing conference</p> <p>Enzyme Research Proposal & Mendeley Access</p> <hr/> <p>Lab Teams collect data and begin data analysis;</p> <p>√ Statistics consultation with instructors (evaluation of assumptions- normality, independence) [R Studio workshop- Using RStudio to analyze enzyme data- histograms, box plots, t-tests, p-values]</p>	8%
5 (Feb. 18-22)	Molecular Genetics I: C. elegans, heat shock proteins, RNAi / GFP	<p>Disc: Formal Peer Review</p> <p>Constructive & Destructive group behavior exercise?</p> <p>TAs return graded research proposals with feedback</p> <hr/> <p>Lab Intro to worm unit: Concept mapping cellular signaling response</p> <p>Investigating <i>C. elegans</i> gene expression: identifying unknown heat-treated groups</p> <p>Tools & techniques: microscopy</p> <p>Worm photo contest!</p> <p>Final Enzyme paper & GEA due Sat or Sun Feb 23 or 24?</p> <p>Peer Review & Author's response</p>	15%
6 (Feb. 25-Mar 1)	Molecular Genetics II:	<p>Disc: Finding relevant info on WormBase and WormBook websites</p> <p>Planning for worm experiments</p> <p>√ Bring at least one relevant literature source & share w/ team [?Reed – Mendeley annotation refresher]</p>	2%

Biocore 383 Exam Feb. 26	Developing <i>C. elegans</i> experiment	Lab Workshop: Chi Square Test of Independence & 2-Factor ANOVA; Practice quantifying worm fluorescence, centrifugation & isolating eggs through bleaching √ Lab: Begin worm Experimental Design Worksheet (1/team) [HEIDI- activity CHECK if HSF1 and HSP16.2 have been crystalized! Can we reinforce molecular structure/ function here? How can we better connect the heat shock protein expression with bioinformatics, tissue level aspects of expression (neuromuscular/ intercellular v intracellular)?]	
7 (Mar 4-8)	Molecular Genetics III: Worm experiment	Disc Feedback presentation slide prep Worm Chi-Square Data Analysis pre-lab due beginning of disc Lab √ Experimental Design Worksheet (1/team) due beginning of lab Worm proposal feedback presentations (1/team) √ Materials and schedule sheet (1/team) due 48h after lab [Include a 'kill study' to evaluate treatment doses?] Start worm experiments -sign up for data collection (outside class)	4%
8 (Mar 11-15)	Molecular Genetics IV: Data Collection	Disc Worm research proposal mini-poster & Mendeley Access Biocore 486 preview; Check worms/apply treatment • Mid-semester eval Lab Final worm data collection (time varies) √ ImageJ raw data due by Fri Mar 15 5pm	12%
March 16-24 Spring Break			
9 (Mar 25-29)	Molecular Genetics V: Data Analysis, Conclusion and Posters	Disc √ Visual summary of raw data & analysis (individual) • Mid-semester eval feedback summary • Statistics consultations with instructor • TAs should try to turn back graded worm proposal posters here Lab Data interpretation, integration, and stats feedback presentation: [Teams show draft of poster] <i>Making appropriate conclusions based on evidence</i> √ Results/discussion feedback presentations	
10 (Apr 1-5)	Signal Transduction I: Intro to Yeast System	Disc Worm mini-posters (1/team) & GEA √ Mini concept map due beginning of discussion? receive GEA feedback Signal transduction intro; Construct pathway activity/ Concept mapping exercise Read Signal Transduction Lab Manual Lab Introduction to cell shape, B-gal, and Western blot assays Signal Transduction Prelab [Add questions that asks about pathway. Make sure students add pathway diagrams in their feedback presentations that emphasize the area in the pathway that is affected by the treatment.] √ Generate tentative question for Sign. Trans project (1/team)	15% 4%
11 (Apr. 8-12) Biocore 383 Exam April 8	Signal Transduction II: Present Proposals	Disc Feedback presentation slide prep √ Bring at least one relevant literature source to share w/ team [?Reed – Mendeley annotation refresher] Lab Signal transduction proposal feedback presentations (1/team) √ Materials and schedule sheet (1/team due 48 hr after lab)	
12 (Apr. 15-19)	Signal Trans III: Pilot Studies & Your Experiment	Disc Formal Peer Review Lab Data collection I (time varies)[Do expt during week days- No weekends] Signal Transduction proposal paper & Mendeley Access due 48h after discussion Peer Review & Author's Response	13% 2%
13		Disc Team – instructor data consultation meetings; conclusions & titles	

(Apr. 22-26)	Signal Trans IV: Data Analysis	Lab Data collection II (time varies) In class: Discussion section formatting: card sorting exercise	
14 (Apr. 29-May 3)	Signal Trans V: Final Present	Disc Group Peer Review final presentation Lab Formal presentations; Final course evaluation	
		Signal transduction formal PPT presentation (1/team)	12%
		Response to Reviewers & GEA (individual & 1/team)	4%
		Team work, class participation and check assignments	5%

Lab Etiquette

For use of 341 and 334 lab rooms: Access and independent use of lab rooms is a key component of our Biocore learning environment and community, but it comes with responsibility. You may use 341 for group or quiet study when no classes or meetings are in session. Use 334 for doing experiments and meeting with lab research teams. Non-Biocore students will be asked to leave unless they are accompanied by a Biocore student. Both 341 and 334 lab rooms have key lock boxes that you will be given access to after the start of the semester. If there is any misuse or suspected misuse of the rooms, if the rooms are not cared for or left untidy or down right dirty (remember the CLAW!), or if equipment/ books/ furniture are out of place or missing we will no longer be able to allow student access to these rooms outside of class time hours. In short, be good Biocore citizens and take care of your lab rooms!

Use of computers: You will have access to PC laptops. The laptops are in a locked cabinet in Rm 341 and can be checked out with your student ID upon request. Do not download applications to these computers and do not store your valuable files on the hard drive (the drives are wiped clean regularly).

During presentations by your peers or instructors: Your presence and participation in class is extremely important for your learning and the establishment of a positive, effective learning environment for everyone (students and instructors). With this in mind, we ask that you DO NOT have your computers open, use electronic devices or study for other courses during our class meeting time.

Group work & Participation All of your in-class work this semester will be done in research teams assigned by your instructors. We expect you to discuss ideas and work through problems and analyses with your classmates, especially your teammates. However, you must write two research proposals and the final Enzyme paper on your own. Note that the final Worm mini-poster and Signal Transduction presentation are group grades (**27%** of your final semester grade). **5%** of your final semester grade is based on team work, the quality of your check assignments, attendance, and participation in class discussions, peer review conferences, and research team efforts. This grade is determined by input from both your instructors and from your teammates' GEA (Group Effort Analysis). The 5% class participation and team work grade is guided by the GEA rubric and often plays heavily into borderline grades at the end of the semester. Work hard on creating a positive learning environment for your research team and for the course in general—it will help everyone AND your grade!

Papers, Posters & Presentations (Formal & Informal)

As a Writing Intensive/ CommB course, Biocore 384 provides a number of opportunities for you to improve your written and oral communication skills about science. Papers are to be written in the form of a scientific research paper and posters and are graded using the rubric criteria described in the Biocore Writing Manual. You and your research teams will prepare and present ungraded *informal feedback presentations* in the format of a research proposal when you are planning your research projects (similar to what graduate students do in their research labs). Feedback presentations will allow you to receive essential and valuable feedback from your instructors and peers prior to you doing your experiment AND prior to writing a research proposal.

Although not graded, feedback presentations are where a great deal of learning happens- for both the presenters and the audience. You and your team will also give one graded *formal presentation* at the end of the semester to summarize your ‘capstone’ signal transduction project. This requires presenters to focus on both the scientific rigor of the project as well as how it is presented to the audience. (See the Biocore Writing Manual for our expectations and oral presentation rubric.)

Peer review

You will have 2 opportunities to be a peer reviewer (as well as to have your work reviewed) this semester. You will turn in a copy of the review you received with each assignment, along with an author’s response form that briefly explains major revisions as well as what advice you took and did not take from your reviewer, and why. Your peer review grades will be based on your efforts in reading/ reviewing your peer’s writing and filling out *both the peer review and author response sheets*. Collectively the peer reviews are worth **4%** of your total semester grade. Even when not required, we strongly encourage you to use the peer review process before turning in papers or posters.

Late Assignment Policy

Papers & assignments must be handed in on time unless you have contacted your TA *ahead of time* to request an extension due to emergency or extenuating circumstances. Otherwise, we will deduct one grade per weekday it is late from the grade you would have received (*e.g.*, A->AB for one day late). Note that even an F paper (one week late) counts more than 0 (not handed in at all) when we total the final grades at the end of the semester. If you know of a religious observance or other commitment this semester that will keep you from attending class, let your TA, Janet Batzli and Michelle Harris know as soon as possible.

Creating an inclusive classroom.

In Biocore, we strive for the utmost equity for all students, TAs, and faculty/ staff, regardless of race, ethnicity, gender, sexual orientation, (dis)ability, socioeconomic status, country of origin, or religious affiliation. Our community and our science depend on engaging and embracing different perspectives and this starts with each of us understanding and recognizing our own biases. It takes a great deal of awareness and self-work to recognize bias. Most of us stumble at times, so we all need to practice.

If you experience or notice bias

Share when you first experience or notice bias. If you are further offended and continue to experience bias, do not hesitate to bring this to your instructor’s attention and/or report the case through UW Madison’s [Bias Incident Reporting system](#)

If you mistakenly say or do something you wish you hadn’t—apologize, say ‘I’m sorry’ and take ownership when you have offended someone, even if it was unintentional.

Discrimination and bias are not OK. Saying nothing perpetuates inequality. Speaking up reminds us of our inclusive classroom goal. It takes everyone to create a safe, supportive and productive learning environment. If even one of us feels stifled or unaccepted, we all lose out.

Honor and Honesty, Ethics and Social Responsibility is essential

It is absolutely essential that you report your data honestly and accurately: The validity and accuracy of scientific findings are open to review. Your data are NOT PERSONAL, nor are they correct/incorrect or good/bad. Therefore, data are not to be associated with a personal value judgment. We have had some problems in labs with students fabricating or changing data. We consider this a serious violation not only of ethics but also of scientific principle. You are not graded on your results but rather on how you analyze your data.

Plagiarism: We have had several instances where students have copied segments or whole sections of classmate’s papers, changed the wording/order a little, and claimed the work as their own, either in drafts for peer review and final papers or in pre-lab assignments. Not only is this **plagiarism**, claiming credit for the intellectual work of others is highly disrespectful and erodes trust within our Biocore learning community. If you find yourself tempted (especially late at night just hours before a paper is due—we’ve all been there) **JUST DON’T DO IT**. It is much better to ask for an extension, receive a slightly lowered grade for a late paper, or even receive a zero for a missing assignment than to plagiarize your classmates or someone else’s work. You

agreed to this when you signed the Biocore Honor Code during the first week of Biocore 381 and will be held accountable for violations according to UW Academic Code of Conduct 14.03
<http://students.wisc.edu/doso/acadintegrity.html>.

How you earn your final grade

We use an absolute grading scale in 384 (no curves!). Assignments, due dates, and assignment weight in percent are detailed in the schedule above. Pre-lab assignments are graded on a point percentage basis. Papers and posters are graded using rubric criteria described in the *Biocore Writing Manual* and reported to you as a letter grade (A+, A, AB, B+, B, B-, BC, C...). Letter grades are converted to numeric values when final grades are tallied at the end of semester (e.g. AB=89, B+=87). Check (✓) assignments are scored simply adequate or inadequate.

Your final grade will be determined from the sum of your letter grade assignments and pre-lab assignments, after each assignment is weighted as stated in the syllabus above and converted to a percentage score. Your final percentage score is converted to a final letter grade as follows:

Percentage

Letter

<u>Final Assignment %</u>	<u>Letter Grade</u>
90-100	A
80-89.9	B
70-79.9	C
60-69.9	D

*For those few individuals that are on the borderline at the end of the semester, we will assign intermediate grades (AB and BC) based on our evaluation of your participation (in both lab AND discussion), teamwork and your effort.