

# Honors Research and Seminar in Biochemistry & Molecular Biology (BMB)

## Guidelines and Expectations for both Students and Research Mentors within or outside of the BMB Program (BB 401/402 & BB 497/498)

The [general guidelines](#) for all courses for credit in undergraduate research and/or honors are applicable to this course and should be incorporated with the following guidelines that pertain the earning general education credit for taking this course.

### Responsibilities of the Student:

*HUB requirements:* Earning general education units is fairly intensive depending on how much research experience you have before being accepted into the BMB-Honors program. This includes required attendance and participation in laboratory meetings on a regular basis, the experience and use of the online research information and literature, exercises in critical thinking in design and execution of experiments mostly done in an independent project, and in scientific writing. You have as a co-requisite BB 497 (fall) and BB498 (spring) where an additional HUB unit is earned in Digital Media and Expression (DME).

### Responsibilities of All Research Mentors:

In agreeing to mentor a student in the BMB Honors program, you agree to make certain that opportunities are made available regardless of the amount of prior experience the student might have. These include training in online information sources, attendance and participation in lab meetings with ample feedback, encouraging critical thinking and independent work, and regular writing assessment of their notebook and in the end, their thesis. Mentors are required to respond to students' projects in a way that forces the students to think outside of the box, pursue new ideas, or take risks. Encourage students to be creative and use input

Students are enrolled for an entire year (and thus do not earn a grade until the completion of BB 402; if satisfactory after BB 401, a "J" grade is issued). The Honors Seminar is a co-requisite where they will meet with the other Honors and advanced undergraduate research students. Here they will learn and practice oral presentations, both formal and informal, use of digital media in their presentations, and details about scientific writing, including ethics and peer review issues. In your mentorship, you should encourage your student to practice presenting their work using digital media in additional settings. At some point during the semester, your student should be asked to give at least 1-1 oral presentations of their work and attain feedback on their performance from the group members.

In addition, both in the writing of the Honors Application and in their Honors Thesis, mentors should work closely with your student and help them in the art of scientific writing in working through several drafts.

## General Education (BU Hub)

### 1. Research and Information Literacy (RIL):

Learning Outcome 1: Students will be able to search for, select, and use a range of publicly available and discipline-specific information sources ethically and strategically to address research questions.

*Accessing Information:* This skill is needed for selecting a group and a project, and student should become familiar with methods for exploring and understanding the research literature, if not already achieved from earlier courses. Among the many tools available in the biological sciences, PubMed stands out as the most critical for *accessing information*. Other platforms, such as SciFinder, can also play a vital role in achieving Information Literacy depending on the research group. Nonetheless, *comfortable* familiarity with PubMed is an expected starting point for students engaged in the first semester of research.

*Assessing Information:* Progress in research and assessing research information is achieved in individual meetings with the group PI, and through group meetings, which all groups hold. At these meetings, literature is routinely discussed and judged as to the suitability for application to the research project at hand, and to the validity of the research. As with all courses, successful training in assessing information begins with the mentor. One advantage of Research and Information Literacy training in the research lab is the “flipped classroom” environment. In the sciences, the laboratory is the ultimate flipped classroom, and the novice researcher has the expertise and experiences of other undergraduate, graduate, and post-doctoral fellows also in the group as catalysts for the training. These other researchers serve as invaluable mentors, and the group meetings become a critical vehicle for information assessment.

*Using Information Ethically:* Ethics training is an important part of all research groups and should be incorporated in discussions at group and individual meetings.

Learning Outcome 2: Students will demonstrate understanding of the overall research process and its component parts, and be able to formulate good research questions or hypotheses, gather and analyze information, and critique, interpret, and communicate findings.

*Producing Information through Inquiry:* As per current practice, in order to register for Honors, a description of the project, and the student’s role in the project must be submitted. This process includes approval of the PI and/or BMB faculty-member sponsor in multiple rounds of drafts and final approval before submission. The Chairman of Research and Honors reads and approves all applications, and proper use of the literature is expected. Appropriate literature citations are required for the abstract of the project description and if found deficient, the Honors Committee contacts the student for corrections in the research literacy and scholarship.

### 2. Oral/Signed Communication (OSC):

Learning Outcome 1: Students will be able to craft and deliver responsible, considered, and well-structured oral and/or signed arguments using media and modes of expression appropriate to the situation.

*Learning Outcome 2:* Students will demonstrate an understanding that oral/signed communication is generally interactive, and they should be able to attend and respond thoughtfully to others.

*Learning Outcome 3:* Students will be able to speak/sign effectively in situations ranging from the formal to the extemporaneous and interact comfortably with diverse audiences.

For students registering Honors research, HUB credit for Oral Communication will be earned. The ability to orally present and discuss one's research results is an essential part of successful scientific inquiry. We include within this domain poster presentations, which by nature require both the oral presentation and an often-intense subsequent discussion. The main procedure for this training is the weekly research group meetings, and (often) additional subgroup meetings. As noted, all research groups have group meetings, and it is expected that an undergraduate registered for four credits of research will present at these meetings. This was made clear for all Honors mentors before they are allowed to approve a student's on-line application. Research provides the ideal format for achieving the three learning outcomes accomplished for OSC proficiency:

- 1) Craft and deliver responsible and well-structured arguments using media – typically in group meetings using PowerPoint presentations or other media appropriate for each research group.
- 2) Understand the interactive nature of OSC is clearly in action during research group meetings, and in particular, the skill of responding during discussions that follow their presentation at group meeting presentations. There is often considerable give and take amongst the group members, often with follow-up “chalk talk” analyses.
- 3) Speak effectively to diverse audiences in both formal and extemporaneous modes – groups meetings fulfill this as well with formal presentations required for the full project, and “Progress Reports” being of less formal nature.

Training in the preparation and presentation of oral presentations is typical of research groups as well. Groups often have their own signature style, which has evolved over the years, with training of undergraduates prior to their presentation undertaken by an assigned graduate student or post-doctoral fellow as the mentor. Further opportunities for presentations exist as well, typically for juniors and seniors.

### **3. Creativity/Innovation (CRI):**

Those students in Honors research will earn a CRI unit. Honors students are expected to be able to develop fairly complex and innovative research projects. Application of the CRI learning outcomes will be especially important as in this more extensive research students typically encounter new challenges that must be overcome, often with minimal guidance from the literature. Students are required to devise answers to problems that have never been posed before, problems whose answers cannot be found through Google. Honors research students are expected to display a greater degree of independence, and begin to take ownership of the direction of their research project. Students with more experience will have developed the patience and persistence over time in doing their project(s). Those with less experience will need help in developing this skill quickly. This kind of research will enable creativity to come to fruition. Research is a natural incubator for developing creative thought and students should be allowed this time with mentors challenging students to go beyond what they are learning as more

experience in research is gained. Given the intense timeframe of Honors research, students should be allowed to grow into leadership roles within a research group, and their creative ideas contributing to the project.

#### **4. Writing-Intensive (WIN):**

The training in discipline specific writing started during the application process with an in-depth scholarly application. For the student's training in the Writing-Intensive Hub unit in Honors research, students will work with their mentors developing and revising their research proposal, including several drafts, prior to enrollment. For registration for Honors, students will be required to write a complete proposal with informative title and abstract concerning the general objective of the laboratory, a well-defined research project, as well as a detailed a well-cited introduction describing the research problem, ending with a clearly written hypothesis. The proposal should be crafted in a well-structured form of a grant proposal. This proposal will allow for the incorporation of feedback, both scientific and stylistic, of previous versions from mentors and co-workers. This proposal will include, a set of aims that will describe how their hypothesis will be tested and the data analyzed. All parts should be well cited and include an extensive annotated bibliography. It is expected that progressive feedback is given by mentors and the program as these proposals develop from semester to semester.

Additionally, students should receive instruction on proper ways for keeping a scientific notebook consistent with the expectations in the laboratory. This ongoing writing experience should continue during their entire time in the laboratory. At all times during their time in the laboratory, feedback should be provided on the writing of a proper notebook. Students should demonstrate this art through the iterative feedback from mentors and co-workers.

Honors students are required to complete a thesis. This thesis will include drafts with feedback from mentors and will be in a different genre from the previous two writing exercises; that of a scientific progress report. This thesis will comprise part of their semester grade from their research mentor. A thesis will likely incorporate multiple elements common to research papers such as tables of data, figures of analyzed results, and diagrams of methods used in the research process. Additionally, throughout the entire research process up to this point, students will already have learned appropriate research information literacy, and reading related and representative scientific literature that will help compose their report. Lastly, these papers writing will be submitted to the Research & Honors Committee for use in program assessment.

#### **5. Digital/Multimedia Expression (DME):**

Students in Honors research will enroll in the 1-credit Honors Research Seminar as a co-requisite (BB 497 & BB 498). This course meets every week or two with the Honors class and offers these advanced students important underpinnings to their research; including organization and presentation techniques for scientific communication using various digital media. Specifically, help students prepare and present scientific problems and data using digital media and strengthen students' effectiveness in communication through written and oral venues. The specific Learning Outcomes for DME are outlined below:

*Learning Outcome 1:* Students will be able to craft and deliver responsible, considered, and well-structured arguments using media and modes of expression appropriate to the situation.

An oral presentation at the beginning of the semester in the form of a 10-minute symposium talk, a one-slide challenge in the middle of the semester, and another longer presentation at the end of the semester in the form of a defense of their research. The oral presentations are typically digital as a PowerPoint presentation, often with embedded videos, although other multimedia modes available in the Adobe Suite will be introduced.

*Learning Outcome 2:* Students will be able to demonstrate an understanding of the capabilities of various communication technologies and be able to use these technologies ethically and effectively.

While the primary medium for the presentations are slides for the oral presentation, designing slides that coherently guide the audience through the talk without an over-abundance of information is a targeted outcome. The slides themselves take advantage of various graphics packages (ChemDraw, Prism-GraphPad, Gaussian and Firefly, Quick Time videos, to name a few) incorporated into a concise PowerPoint presentation. These presentations are readily constructed from numerous presentations the student has given in the past in group and sub-group meetings (OSC HUB unit), and even presentations given at UROP poster sessions, as well as in regional and national meetings. Furthermore, at multiple points in BB 497 and/or BB 498 explicit introduction into scientific publication, both oral and written, is provided with guidelines in ethics of each mode.

*Learning Outcome 3:* Students will be able to demonstrate an understanding of the fundamentals of visual communication, such as principles governing design, time-based and interactive media, and the audio-visual representation of qualitative and quantitative data.

This outcome perfectly describes a scientific research presentation. Students must be concise and capable of a logical flow of thoughts as they present their results and draw their conclusions, often culminating in projections of future research directions. The proper presentation and visual design of both qualitative and quantitative data is demonstrated in the final oral presentations at the end of the semester. Training for the event really begins with the group meetings, but will be rounded out in the BB 497 and/or BB498 sessions.