

Information for MB&B Research Courses

MB&B 470a, 471b, 478a, 479b

Alan Garen, Instructor in Charge

Single-term research projects under faculty supervision.

Registration

1. A student must be sponsored by a Yale faculty member who will guide the project. See below for advice in finding a research supervisor.
2. To register, the student should complete the attached form.
3. Permission to enroll in these courses should be secured in advance from the student's Research Supervisor and the MB&B Faculty Advisor, who should sign the attached form.
4. The signed Registration Form should be submitted to the assistant to the instructor in charge by the date the student's course schedule is due.
Dr. Garen's assistant is Elizabeth Vellali, SHM CE26A, 72060, Elizabeth.vellali@yale.edu.
5. **There will be no organizational meeting for this course** - all of the information on how the course is run is included in this document. Students who have further questions after reading this document should contact the instructor in charge.

Enrollment Limitations

1. Enrollment in research for credit courses is usually limited to MB&B Juniors and Seniors who have successfully completed MB&B 300a and either MB&B 251La or 360Lb. Sophomores may take the course with permission of their advisor and the instructor in charge.
2. Enrollment in 478a and 479b is limited to Seniors. The DUS should sign the registration form for these two courses.
3. The student may not exceed the independent study credit limitations specified within the Academic Regulations of the University (which are: no more than one credit per term and no more than three credits total through end of junior year, and no more than two credits per term in the senior year) unless permission is granted by the Yale College Committee on Honor and Academic Standing.
4. Majors in the BS program may count no more than 2 independent research course credits toward the elective course requirements of the MB&B major (counting 1 credit as an MB&B elective, and 1 credit for the Sci elective).

Selection of Research Supervisor and Research Project

1. Students may perform research under the supervision of an MB&B faculty member. They may also perform biochemical, biophysical or molecular biological research with a full-time member of a department other than MB&B with the consultation and permission of the MB&B Faculty Advisor.
2. A good place to find information on all the labs at Yale is the web site of the Yale Combined Program in the Biological & Biomedical Sciences (<http://info.med.yale.edu/bbs/>), which provides 1-page descriptions of research in over 200 labs at Yale. The web site is so overwhelming that you will need help narrowing your choices. An excellent strategy is to talk to your MB&B academic advisor. He/she is very familiar with the other faculty at Yale.
3. To select a Research Supervisor, the student should make appointments to discuss research opportunities with one or more faculty members, preferably in the semester preceding the planned research start date. Before contacting a faculty member, make sure to read their research summary on the web site described

above, and try to learn more about them by looking at some of their recent publications, asking your MB&B academic advisor about them, etc. Then contact the faculty member by email, explain that you are interested in carrying out an independent research project for credit, and make sure to explain why you have a specific interest in the research being done by that faculty member. Then ask if you can have an appointment to meet and discuss research opportunities.

4. Acceptance of a student into a laboratory is by decision of the Faculty Research Supervisor. It will depend upon several factors including: the qualifications of the individual for the proposed research, the completion of laboratory courses, and the availability of space.

Hour Requirement

The student is expected to work the equivalent of 10 hours per week for a single-credit course (470a, 471b) or 20 hours per week for double-credit courses (478a, 479b).

Work for Pay

Simultaneous research for credit and work for pay in the same laboratory is discouraged. Any exceptions to this policy should receive permission of the Research Supervisor and the DUS. In these cases the work for pay should be in addition to the 10 hours per week for credit and the nature of the paid work should be distinct from the work done for credit.

Course Requirements

1. *Research Proposal (5% of overall grade)*

The student must submit by the last Friday in September (470a, 478a) or the last Friday in January (471b, 479b) an original typed research proposal describing the project. The proposal should be approved by the Research Supervisor and sent by email to Dr. Garen (alan.garen@yale.edu). The text of the proposal should be single-spaced in 12-point font and should not exceed two pages of text, one page of bibliography, and one page of figures. The proposal should include the following items:

- Hypothesis.* One or two sentences about the project's focus in the form of a question.
- Background Information.* Two or three paragraphs describing the current state of the field and the scientific context for the project.
- Specific aim(s).* A list of the research project goals with an explanation of how these will be achieved. Items *a-c* should fit within the two-page limit.
- Bibliography.* A list of 5-10 articles, including title, authors, journal name, volume, year, and page numbers, that provide the background and the context for the project. The references should be numbered and cited within the proposal description. The student is expected to have read these papers. The bibliography should be included on page 3.
- Figure.* Include one figure and legend on page 4 that clarifies the proposal.

The proposal will be graded by the Instructor in Charge based upon:

- Compliance with proposal guidelines*
- Clarity of the scientific writing*
- Demonstrated understanding of the project's rationale*

The grade on the proposal will constitute 5% of the overall grade in the course.

Students can discuss the graded research proposal with the instructor in charge for guidance in writing the final report.

2. **Group Seminar (20% of overall grade)**

The student will provide a 15 min. oral presentation of the completed work to the Research Supervisor and research group.

- The presentation should be done within two weeks prior to the first day of reading week.
- The Research Supervisor will grade the oral presentation based on the following criteria:

- 1) *Did the student demonstrate an understanding of the scientific background of the project?*
- 2) *Did the student provide a clear description of the original data generated during the semester?*
- 3) *Did the student correctly interpret these data?*
- 4) *Did the student identify an appropriate set of follow-up experiments?*
- 5) *Was the overall presentation well organized and clear?*

3. **Research and Research Report (75% of overall grade)**

- The student should prepare a 12-15 page double-spaced research report, with a text of approximately 3500 words, not including the bibliography and figure legends. This report should describe the basis for the experiments, summarize the data collected, and describe the conclusions supported by the data.
- The report will be graded by the research supervisor and the instructor in charge. The report should be submitted to the Research Supervisor and to the Instructor in Charge by email (alan.garen@yale.edu) by the last day of the Yale College Reading Period (and copy elizabeth.vellali@yale.edu).
- The research report should include the following components:
 - a. Title Page.* Include title, name and department of the faculty member in whose laboratory the project was performed, the name of the student, and the date.
 - b. Abstract.* Include a one-paragraph summary of the research project, scientific context and primary conclusions. This abstract should be 250 words or less.
 - c. Introduction.* Scientific background for the research project including a summary of the literature in the field and a justification that leads into the experiments that were performed. If desired, one or two figures (original or taken from the literature and referenced) can be included in this section.
 - d. Methods.* A brief description or literature references to outline the experimental methods employed. Clarity and brevity in this section is important. The methods section must be less than two pages (<750 words) in length, unless the research project is focused primarily upon methods development, in which case there is no specific limit.
 - e. Results.* Description of experimental results and variables investigated. Include tables, charts or figures to summarize the data.
 - f. Discussion.* Interpretation of the experimental data in relation to the scientific knowledge in the field and the question posed in the original hypothesis in the research proposal. If the project did not yield significant results, this should be indicated and a possible explanation provided.
 - g. Bibliography.* The bibliography in the research proposal can be used as a starting point. Each reference should be cited in the text and include authors, title, journal name, volume, year and page numbers.
 - h. Figure legends.* The legend should describe the contents of each figure.
- The research report should represent the work of the student. It is appropriate for the student to receive feedback on early drafts of the report from peers or other members of the laboratory. The oral presentation

is an ideal opportunity for the student to receive critical feedback on the project. However, the report also should describe the work done by the student.

- In those cases where a student has performed research on the same project over the course of multiple semesters, it is appropriate to modify a previous report. The report should also clearly differentiate results obtained in the current semester from those obtained in earlier semesters.
- The following criteria will be used to assign the grade:
 - a. Did the student follow the guidelines of the research report?*
 - b. Did the student demonstrate an understanding of the scientific background of the project?*
 - c. Did the student provide a clear description of the original data generated during the semester?*
 - d. Did the student correctly interpret these data?*
 - e. Was the overall presentation well organized and clear?*
- The research report will be graded by the Research Supervisor and the Instructor in Charge of the course. The grade of the Research Supervisor will be based on the quality of the student's performance in the laboratory as well as the report.
- Students are encouraged to discuss the research report with the Research Supervisor and Instructor in Charge.

Failed Course

In the absence of a Residential College Dean's authorization, failure to meet the deadline for submission of the report can result in the recording of a failing grade by the Yale College Registrar.

Yale College Undergraduate Regulations

Cheating on examinations, plagiarism, improper acknowledgment of sources in essays, and the use of a single essay in more than one course except in academically appropriate circumstances with the prior permission of the instructors.*

*See the memorandum of the Yale College Executive Committee, Cheating, Plagiarism, and Documentation, which appears as [appendix F](#) for the Yale College Undergraduate Regulations.

In MB&B there are specific professors who serve as academic advisors for each graduating class. See the web page: <http://medicine.yale.edu/mbb/academicprograms/undergraduate/faculty/> for a list of the current advisors. Please pick one of the advisors for your class and contact them for an appointment. In most cases you can keep the same advisor until you graduate, allowing you to get to know your advisor well and to get very personalized attention. You can contact me as DUS for issues that your advisor cannot deal with. I suggest you take the time to get to know your advisor, visit them regularly, and really tell them about yourself, your academic situation, and your future career plans. If you develop a good relationship with your advisor, they will be an excellent person to write a reference letter for you when you are ready to graduate and move on to a graduate/professional school or job.