The graduate research track in Bioinformatics and Computational Biology (BCB) accepts students from molecular biology, biochemistry, computer science, and mathematical backgrounds, and trains them in innovative, multidisciplinary bioinformatics research. The track builds upon UCSC's renowned bioinformatics program, with particular strengths in comparative and functional genomics, non-coding RNA discovery, protein bioinformatics, and structure prediction. Nineteen faculty members from four departments participate in the BCB research track. Their research groups are internationally recognized for pioneering work on applications of Bayesian statistical methods and hidden Markov models to biological sequence data, the development of widely used computational tools for the analysis and comparison of whole genomes, protein structure and function prediction, and the discovery of non-coding RNA genes. UCSC is the primary release site for the public version of the human genome, the ENCODE project, and a focal point for archaeal and extremophile genomics. UCSC is also a major player in protein-structure and function prediction, DNA microarray analysis, high-throughput and single-molecule sequencing, and integrative investigations of infectious disease and stem cell processes. New BCB students undertake rigorous core coursework, conduct laboratory rotations, and are exposed to a rich environment of regular seminars and group meetings. Students interact closely with BCB faculty members while undertaking their dissertation research, and have first-hand access to state-of-the-art computation tools and lab facilities throughout their training, including cluster computing, DNA microarray fabrication equipment, and high-throughput sequencing facilities. Students receive financial support throughout their graduate career, contingent upon remaining in good academic standing.

**Core BCB Faculty**

Angela Brooks  
Trascriptomoe Analysis of RNA Splicing and Cancer

Rebecca Dubois  
Structure, Function, and Engineering of Virus Proteins

Ed Green  
Genome Sequence Assembly and Comparative Genome Analysis

David Haussler  
Computational Biology

Richard Hughey  
Bioinformatic Tools for Sequence Analysis and Prediction

Kevin Karplus  
Protein Structure Prediction and Design

Jim Kent  
Computational Genomics

Todd Lowe  
Computational and experimental discovery of non-coding RNAs, microbial genomics, extremophile biology

Josh Stuart  
Computational Functional Genomics

Christopher Vollmers  
DNA Sequencing Tools for the Analysis of B cells

**Collaborating Faculty**

Mark Akeson  
Computational Tools for Angstrom-scale Control and Analysis of DNA and RNA Using Nanoscale Pores

Manny Ares  
Splicing and RNA Processing

Phil Berman  
Biotechnology and Infectious Diseases

Ólöf Einarsdóttir  
Bioenergetics, Redox Metalloproteins, Electron Transfer, Proton Translocation, Flash-Photolysis, Time-Resolved Spectroscopy

Lars Fehren-Schmitz  
Human Palaeogenomics & Molecular Anthropology

Camilla Forsberg  
Hematopoietic stem cells, transcriptional regulation, chromatin, blood cell development, cell surface receptors, genomics

Doug Kellogg  
Molecular Mechanisms that Coordinate Cell Growth and Cell Division

Harry Noller  
Structure and Function of the Ribosome

Karen Ottemann  
The Molecular Virulence Factors of Helicobacter pylori

Nader Pourmand  
Biosensors, microarray, nanotechnology, pathogens, sequencing, genotyping, DNA fingerprinting

Jeremy Sanford  
Post Transcriptional Control of Gene Expression
Inferring the Evolutionary Dynamics of Species and Populations Using Genome-scale Data Sampled Over Time

Mechanisms Underlying Responses and Adaptations of Organisms to Toxic Metal Exposures

Molecular Mechanisms of Biofilm Formation in Vibrio cholerae

Exon Recognition and Alternative Splicing

Administrative Structure

Two committees guide the BCB Track:

Graduate Advising Committee (GAC for Advising)
The Advising Committee is comprised of three program faculty. Responsibilities include student orientation and advising, setting rotation assignments, rotation talk advising and feedback, evaluating and approving oral examination topics, assigning oral examination committees, ensuring thesis committee meetings are held, and allocating University support for continuing students.

Graduate Admissions Committee (GAC for Admissions)
The Admissions Committee is comprised of three program faculty plus 1-2 student representatives. Responsibilities include reviewing applications, planning recruiting activities, accepting students and developing offers of support. Student representatives must be in the Ph.D. program and have already advanced to candidacy. Student representatives will be selected by the Admissions Committee based on student nominations or volunteers.

Application and Admission to the BCB PhD Program

Deadlines
The application deadline is sometime in early December for admission to the program in the fall of the following academic year. Application procedures and information are available on the PBSE web page (http://pbse.ucsc.edu/PBSE-Application.html). The on-line application is available at https://gradapp.ucsc.edu/start.html. After the deadline, files are reviewed by the Admissions Committee. Late applications are accepted only in exceptional circumstances and subject to available resources. The Admissions Committee will review no applications after April 30 of each academic year.

Admission criteria
The Admissions Committee evaluates candidates based on numerous indicators of potential, which include but are not limited to the following:
• Evidence of research potential and commitment to research in the statement of purpose
• Previous research experience
• Evidence of research potential in letters of recommendation (3 required)
• GRE scores: both general and subject (Biology, Biochemistry, or Chemistry) exams
• GPA
• Grades in relevant undergraduate courses
• Evidence of quantitative and analytical skills
• Evidence of ability to communicate in writing
• Indications of special expertise, experience, or cultural perspectives that the student may contribute to our program
• Performance in interviews

Admission process
After evaluation of each file, the Admissions Committee ranks the applicants. The number of offers made can fluctuate from year to year, depending on the relative strength and size of the applicant pool, and resources available. The BCB program is committed to supporting all of its graduate students for the five years of a normal degree. Therefore, our
total number of offers is guided by the resources (e.g. Teaching Assistant (TA), Graduate Student Researcher (GSR), Fellowships, etc.) that we expect to have available.

The top ranked applicants are contacted by telephone and invited for a formal interview visit organized by the Admissions Committee prior to any offer. Many interviews are held over a 2-day period in January or February. Prospective students meet with BCB faculty and students. Feedback from the interview is used to determine offers. The Graduate Division formally notifies prospective students of the offer by March 15. Students are required to accept or decline the offer by April 15.

**International students**
Because of limited resources to cover out-of-state tuition, which remains in effect for the duration of the degree, relatively few international students are admitted to the program. The University will cover a significant proportion of the out-of-state tuition after a student advances to candidacy. Consequently, students are encouraged to advance after successful completion of the Oral Qualifying Examination, to minimize tuition expenses to themselves and the department.

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**Getting Started**

**General advising**
In the 1st year, the BCB Advising Committee and the faculty who supervise rotations are responsible for providing academic and research advice. After students join their thesis lab, then the thesis advisor assumes guidance responsibilities. Students are always welcome to seek additional advice from the Advising Committee, especially concerning procedural issues.

**Administrative Support**
Administrative support for the PBSE program is provided by Teel Lopez and Tracie Tucker. Teel Lopez will provide most administrative support to all first year PBSE students, including organization of advising meetings and research rotations. First year BCB student teaching assignments will be made by Tracie Tucker. After the first year, Teel Lopez will provide administrative support for MCDB track students, while Tracie Tucker will be the primary administrator for BCB track students.

**Email**
All BCB graduate students will have two email accounts. The @ucsc.edu account will be set up automatically for them by the time they arrive for fall quarter. The @soe.ucsc.edu account is required for all engineering graduate students. To apply for your required SOE e-mail account go to new-accounts and follow the instructions there. Indicate Tracie Tucker as your sponsor. Your SOE account should be activated within three days. The email address for each graduate student is included in a departmental alias, bmegrads@soe.ucsc.edu. The majority of communications with students from the department office will be done through email; students should develop the habit of checking both emails at least once a day.

**Mailboxes**
Graduate Student mailboxes are currently located in Baskin Engineering, Room 312B. This mailbox is for official university business or research related mail (only). Students should use their home address for personal mail, bills, etc.

**Office supplies**
Graduate students should purchase their own office supplies for use in classes. The School of Engineering does not provide those supplies. Students serving as a teaching assistant (TA) for a course may obtain supplies needed to perform their TA duties from SOE Instructional Support (Engineering 2, Room 298). Such supplies might include overhead transparencies and markers for discussion sections, pens to use in correcting papers, and paper for documentation. After students join their thesis lab, they should consult with the lab P.I. about funding for supplies.
Photocopying
There are photocopiers available on the 2nd and 3rd floors of Engineering 2 for instructional and personal copying. A photo copy card can be checked out from SOE Instructional Support (E2-298), for use by the instructor and the TA(s). After students join their thesis lab, they should consult with the lab P.I. about funding for photocopying. For personal copying, students may purchase copy cards at the Science or McHenry Library.

TA assignments
The School of Engineering appoints teaching assistants on a quarterly basis. The application procedure as well as other TA resources can be found here: https://ga.soe.ucsc.edu/ta. Teaching assignments are made by balancing financial needs of students, past performance and assignments, requests of the instructors, and the needs of the department. Every effort is made to accommodate everyone's preference. Students should feel free to communicate with the Graduate Program Advisor (Tracie Tucker) about their teaching preferences. In addition to attending and assisting in lectures, TAs are generally expected to lead discussion sections and to hold weekly office hours. To schedule office hours in one of three locations please see https://ga.soe.ucsc.edu/ta/office-hours.

Financial support
The BCB program strives to support graduate students for up to 5 years. Support is provided in the form of Graduate Student Researchships (GSRs), Teaching Assistantships (TAs) and a limited number of fellowships. Faculty advisors generally support their students during the summer as GSRs. Continued support is contingent on making both academic and research progress.

Ph.D. Program in the BCB Track
Predoctoral fellows in the track in Bioinformatics and Computational Biology must complete rigorous coursework in bioinformatics, chemistry, biology, and statistics. We also require new students to conduct research rotations in both computational and experimental laboratories. BCB students also have the flexibility to craft their graduate curriculum to suit individual interests, creating a strong foundation for their independent dissertation research. Advanced graduate students work under the direct supervision of one of nineteen affiliated faculty members, while also interacting closely with other faculty members. Training in this interdisciplinary research environment has enabled our students to lead bioinformatics efforts to understand biology and disease, advancing the frontiers of biomedical research, with graduates now in top university faculty positions and leading industrial research laboratories.

First Year
• Core bioinformatics series
  • BME 205: Bioinformatics: Models and Algorithms
  • BME 220: Protein Bioinformatics
  • BME 230: Computational Genomics
• Teaching and Research in Bioinformatics (BME 200)
• Advanced graduate courses or makeup courses to fill deficits
• Participation in research meetings and seminars (BME 280B)
• Research rotations
• Annual Review at end of year

Second Year
• Selection of a thesis advisor
• Begin thesis research
• Formation of faculty thesis committee for student guidance in following years
• Participation in research meetings and seminars
• Advanced graduate courses
• Bioethics course
• Annual Review at end of year
• Advancement to Candidacy in the Summer following your 2nd year
Third Year
• Thesis research
• Thesis proposal and candidacy exam
• Participation in research meetings and seminars
• Advanced graduate courses (as desired)
• Annual Review at end of year

Following Year(s)
• Completion of thesis research
• Annual committee meetings
• Participation in research meetings and seminars
• Advanced graduate courses (as desired)
• Annual Review at end of year
• Public presentation of thesis defense

1st-year student orientation
Newly admitted students are expected to arrive early in the week before classes begin to participate in orientation. The campus provides a general orientation for new graduate students. It is not required but is strongly recommended, as it provides useful general information that would be difficult to acquire elsewhere. The PBSE program provides an in-house orientation that includes biosafety training, computer resource orientation, and an introduction to our science library. A PBSE research conference and welcome dinner at the beginning of the quarter provides a great opportunity to meet faculty and continuing graduate students.

Advising interviews
Students accepted into the Ph.D. program meet individually with members of the Advising Committee during the first week of Fall quarter (typically on orientation day) to review their academic background and plan a curriculum for first year. In addition, students may meet individually with the Advising Committee during Winter and Spring quarters of their 1st year for informal feedback on their progress and to provide feedback to the Advising Committee on the program.

Language requirement
Proficiency in a foreign language is not a requirement for the BMEB/BCB Ph.D. program.

Teaching requirement
Students are required to serve as teaching assistants (TAs) for 2 quarters during the degree. Students are encouraged to TA for 2 different courses to obtain more experience and knowledge. Duties should require no more than 20 hours a week and will likely include weekly office hours and sections, as well as grading, proctoring exams and preparation of course material for distribution (e.g. handouts, taping lectures). Graduate students are not expected or permitted to write narrative evaluations, although their comments may be solicited and incorporated by the instructor.

Course work
Predoctoral fellows in the track in Bioinformatics and Computational Biology must complete rigorous coursework in bioinformatics, chemistry, biology, and statistics. We also require new students to conduct research rotations in both computational and experimental laboratories. BCB students also have the flexibility to craft their graduate curriculum to suit individual interests, creating a strong foundation for their independent dissertation research. Advanced graduate students work under the direct supervision of one of nineteen affiliated faculty members, while also interacting closely with other faculty members. Training in this interdisciplinary research environment has enabled our students to lead bioinformatics efforts to understand biology and disease, advancing the frontiers of biomedical research, with graduates now in top university faculty positions and leading industrial research laboratories.
Graduate core courses
Students are expected to attend all class meetings and complete all assignments to pass. Grades are A for excellent, B for satisfactory, and C or F for unsatisfactory. The letter grade option is encouraged for students planning to apply for NSF or other fellowships during their graduate career.

BME 205 Bioinformatics Models and Algorithms
Offered in Fall quarter. Covers bioinformatics models and algorithms: the use of computational techniques to convert the masses of information from biochemical experiments (DNA sequencing, DNA chips, and other high-throughput experimental methods) into useful information. Emphasis is on DNA and protein sequence alignment and analysis.

BME 230 Computational Genomics
Offered in Winter quarter. Genomics databases: analysis of high-throughput genomics datasets; BLAST and related sequence comparison methods; pairwise alignment of biosequences by dynamic programming; statistical methods to discover common motifs in biosequences; multiple alignment and database search using motif models; constructing phylogenetic trees; hidden Markov models for finding genes, etc.; discriminative methods for analysis of bioinformatics data, neural networks, and support vector machines; locating genes and predicting gene function, including introduction to linkage analysis and disease association studies using SNPs; and modeling DNA and RNA structures.

Rotation selection
The purpose of rotations is to provide students with diverse research training in 3 different laboratories, and to allow students and faculty to determine whether they can establish a productive collaboration. Before the beginning of fall quarter, 1st year students submit to MCDB Graduate Coordinator, Teel Lopez, a ranked list of 3-5 faculty names and a brief explanation of why they are interested in those faculty. Before submitting their choices, students should talk to faculty regarding potential projects and whether the faculty will be taking rotation students. Rotation assignments are made by the Advising Committee. Students are generally assigned their 1st choice unless there are multiple students who list the same 1st choice. In that case, students are given their 2nd choice. Faculty are not permitted to make any promises to students regarding permanent positions in their lab, officially or unofficially, during the entire year until the last week of the Spring quarter. Discussions regarding permanent positions in labs may begin after the Spring rotation talks. Students may not rotate in laboratories in which they have previously carried out work prior to entering the Ph.D. program, whether as an undergraduate, volunteer or technician, unless special permission is granted.

Occasionally, a student may not find a suitable laboratory at the end of 3 rotations. They may select a 4th laboratory for a summer rotation with the permission of the Advising Committee and the rotation advisor. Laboratories outside the program may be selected but, in this case, the student may be considered to have left the program unless determined otherwise prior to the 4th rotation.

Summer rotations prior to Fall quarter enrollment
Graduate students may do a Summer rotation if they can find a faculty member who can provide financial support during the summer. A Summer rotation may not be extended into a Fall rotation.

Rotation talks
In the final week of instruction each quarter, the seminar time slot is devoted to short rotation talks by the 1st year students. Typically, each talk is 6-8 minutes with an additional 2 minutes for discussion, but times may vary depending on class sizes.

Evaluation of rotation performance
Performance in each rotation is graded as satisfactory/unsatisfactory and summarized in a narrative evaluation by the rotation advisor. Performance is evaluated on the basis of research effort and progress, intellectual mastery of the project, and performance in the talk. Faculty should submit evaluations in a timely manner.

Faculty responsibility to rotation students
While rotation students may work closely with one or more members of the laboratory, the primary responsibility for
supervision lies with the faculty member. Faculty are encouraged to meet regularly with the rotation student to discuss their progress. Faculty should also attend the rotation talk. If unable to do so, another BMEB faculty member should be asked to attend the talk and provide an evaluation.

**Selection of a thesis laboratory**

No specific discussion of thesis laboratory choice is permitted between faculty and students until notification by the Advising Committee at the end of Spring quarter. When notified, students may approach faculty members to discuss the possibility of joining their group. Students may elect to join a laboratory in which they have not rotated. Students who are unable to secure a thesis laboratory should contact the Advising Committee to seek assistance in scheduling a possible 4th rotation. Students who are unable to secure an advisor to sponsor their thesis research are considered to be in unsatisfactory academic standing, and will not be allowed to continue in the program.

**Co-sponsorship of BCB Ph.D. students**

Co-sponsorship of BCB graduate students is not a formal option, regardless of whether one or both sponsors are members of the BCB graduate program.

**Seminars**

The Biomolecular Engineering & Bioinformatics Department sponsors several regular weekly seminar courses. All graduate students are required to register and attend at least one course.

- **BME 280B**: Seminar on Bioinformatics
- **BME 281A**: Seminar on Processive Enzymes and Nanopores
- **BME 281B**: HIV Vaccine Research
- **BME 281C**: Seminar in Cancer Genomics
- **BME 281E**: Seminar in Genomics
- **BME 281F**: Seminar on Blood Cell Development
- **BME 281H**: Seminar in Comparative Genomics
- **BME 281K**: Seminar on Protein Structure Prediction
- **BME 281L**: Seminar in Computational Genetics
- **BME 281P**: Seminar in Nanotechnology and Biosensors

**Failing a course and academic probation**

Students who fail any course, including an undergraduate course or rotation assignment, must meet with the Advising Committee to review their progress. At that time they may be placed on academic probation. If their progress does not improve after an additional quarter, they may be asked to leave the program. All failed courses must be made up at the next available opportunity.

**2nd year advising meeting**

Early in Fall quarter, the Advising Committee meets with 2nd year students to discuss their progress, 2nd year coursework, training in the responsible conduct of research, and preparation for oral exams.

**Training in the responsible conduct of research**

NIH recommends two Responsible Conduct of Research (RCR) training experiences in Ph.D. programs. The first RCR training experience in our program is our Research and Teaching course (BME 200), taken by graduate students during their 1st year. The course includes readings about and discussion of keeping accurate and durable records; forms and consequences of fraud, plagiarism, and other forms of academic misconduct; honest reporting of data; writing and reviewing grants; authorship; conflict of interest; working with collaborators; and humane and appropriate use of animals in research.

The second RCR training experience is participation of senior graduate students (in their 4th or 5th year) in seminars and
guided discussions with invited scholars from academic, industrial, and public-policy sectors on RCR-related topics. BCB collaborates with the UCSC Science and Justice Research Center to organize sessions appropriate for BCB graduate students.

Selection of original research proposal topics for the oral examination
In preparation for the oral exam, students are asked to submit a short summary of 2 research proposals (as described below) for approval by the Advising Committee no later than the end of fall quarter. Approval of the outside research summary is contingent on the proposed research being sufficiently different in system and experimental approach from prior research (rotations, prior work experience, and thesis topic).

Selection of oral examination committee
The oral examination committee comprises 3 members of the BCB program plus 1 tenured faculty from outside the program. The student's research advisor will not be a member of the exam committee. The inside members of the orals committee are assigned by the Advising Committee based on oral exam topic areas and distributing assignments fairly among faculty. The outside member is chosen in consultation with the student and advisor, and must be a tenured faculty member (either an Associate or Full Professor) either from a different discipline from UCSC or a tenured member of the same or a different discipline from another campus. Tenured UCSC faculty from other departments who are affiliated with our MCD Graduate Program may serve as outside orals committee members. Scientists from a non-academic environment require a petition for exception.

Avoidance of apparent conflict of interest
Formal evaluation of a student may lead to an apparent conflict of interest for a faculty member. Such situations can include, but are not limited to, serving on an oral or thesis committee for the student of a spouse or significant other. In such situations where an apparent conflict of interest could occur, the faculty should recuse him/herself. They may, however, serve as an ad hoc advisory member of such thesis committees, but will not participate in the formal evaluation process. Informal situations are not subject to apparent conflict of interest considerations.

Plagiarism - definition, guidelines, and consequences
The UCSC Code of Student Conduct states: "Plagiarism is defined as the use of intellectual material produced by another person without acknowledging its source. This includes, but is not limited to: 1) copying from the writings or works of another into one's academic assignment without attribution, or submitting such works as if it were one's own; 2) using the views, opinions, or insights of another without acknowledgement; or 3) paraphrasing the characteristic or original phraseology, metaphor, or other literary device of another without proper attribution." In assignments for class and when writing research articles and grants, students must express ideas in their own words and must give credit to the sources of the ideas. When cases of plagiarism are discovered, the disciplinary actions are severe. After a first incident of plagiarism, the instructor will generally assign a 0 on the assignment that contained a plagiarized portion or portions, and the Department Chair and the Graduate Dean will be notified of the incident. After a second incident of plagiarism, the program will recommend to the Department Chair and the Graduate Dean that the student be expelled from our graduate program.

Written proposals
A written proposal is required on each of 2 different topics, 1 on the student's research, and the 2nd on a research topic not directly related to the student's past or present research but clearly under the general scope of Biomolecular Engineering & Bioinformatics. The proposals are meant to provide practice in writing research proposals for postdoctoral fellowships or other funding opportunities, and to provide a starting point for the oral exam. Each proposal should state the question being addressed or the hypothesis being tested, summarize the factual and conceptual basis for the proposal, and briefly describe the experimental approach. Each project should address a significant research question, and the proposed work should be achievable during the course of the student’s Ph.D. training. Each proposal should be 2-3 pages long. References may be included on a separate page. Plagiarism will not be tolerated (see Plagiarism section above). Students are provided with 2 examples of written proposals by the Advising Committee as a guide in the Fall quarter preceding their oral exam.
Dissertation research summary
This will summarize the student's thesis research. The format should be as described above. Students may consult with faculty members or others in preparing this summary if they wish, but the writing must be entirely the student's.

Outside research proposal
This proposal will be on an area of research clearly outside the area of the student's dissertation, but within the general area of Biomolecular Engineering & Bioinformatics. It should be an original proposal, written and conceived of independently, but students may consult with faculty, other students, and experts in the field. Faculty discussing proposals with students should promote scientific discussion, rather than coach the student. The Advising Committee must approve the subject of this proposal in advance. This proposal challenges the student's scientific creativity, and is designed to expand the student's area of expertise beyond the area of the dissertation research.

Oral exam timeline
Early October Call for oral proposals. December 1 Students submit to the Advising Committee 1-2 paragraphs describing their thesis research, and 1-2 paragraphs describing their proposed outside research proposal. December 8 Students submit to BMEB Graduate Program Advisor and the Advising Committee a proposed oral committee. March 1 Students schedule their oral exam for the Spring quarter. Spring quarter Students submit their proposals to their examining committee no later than 2 weeks prior to the exam date. May 21 Oral exam must be completed.

Oral examination format
The committee meets for 10-15 minutes prior to the start of the examination to review the student's file and discuss any specific issues relevant to the examination. Students are called in and asked to give a short (~10 minute) presentation for one proposal - they are encouraged to use the whiteboard, but are not allowed to bring prepared overheads or PowerPoint presentations. They may be interrupted at any time during this presentation and asked to elaborate on or clarify points. This process is then repeated for the second proposal. The oral exam may also cover scientific areas other than those directly concerned with the research proposals. The examination typically takes 2-3 hours, after which the student is asked to leave the room. The committee discusses the performance and comes to a consensus. The student is invited back in and informed of the outcome of the examination. Students pass or fail - there are no conditional passes. The quality of the written proposal alone is not sufficient to merit passing. A passing performance requires demonstration of the ability to design and execute an independent research project and to defend ideas. Students are generally expected to formulate and evaluate hypotheses, as well as design experiments that will test those hypotheses. If the student passes, s/he may nevertheless be advised to take further coursework. If the student fails, s/he may be given the option of re-taking the examination with the same committee after appropriate preparation and guidance. If a student fails twice, s/he must leave the program. A terminal Master's degree may subsequently be awarded, provided that the student has satisfied the requirements for the Master's degree, including submission of a written thesis and a defense. A written summary of the oral exam outcome is prepared by the chair of the oral exam committee, and reviewed and signed by all committee members. A copy is provided to the student and a copy placed in their file.

Progress Toward a Thesis
Selection of the thesis committee
After successful completion of the oral exam, the student should immediately assemble their thesis committee in consultation with their thesis advisor. The committee comprises the advisor plus two BME faculty members. A majority of the members must be members of the UCSC Academic Senate. While outside members specializing in the thesis research are permitted, they are not mandatory. Outside members must be tenured members of an academic institution. The student must meet with their thesis committee at least once per year until completion of the Ph.D. degree. The committee will provide continuing guidance throughout the development of the thesis, will provide ongoing assessment of the student's progress, and will evaluate the completed dissertation.

Graduate student academic progress reports
The Graduate Division requires an annual report of progress for every PhD student. At the end of each academic year, the BCB advising committee will meet to evaluate the academic progress of each student and set out requirements due
in the coming year. A summary of this evaluation will be sent to each student and will include a statement of any deficiencies in meeting requirements.

**Advancement to candidacy**
Advancement to candidacy occurs by the end of the 3rd year (9 quarters). Students give a research seminar. This should be attended by the thesis committee. A passing evaluation of the seminar leads to advancement to candidacy. Students have an additional 3 years (9 quarters) to complete their degree within normative time. (Note: International students, who remain “out-of-state” until advancement to candidacy, are encouraged to give their seminar before the beginning of the 3rd year, to minimize the fee costs to themselves and the department. In this case, students will have an additional 4 years (12 quarters) to complete their degree within normative time.)

**Target time and normative time**
The target time for the Ph.D. is 5 years. The normative time for the Ph.D. degree within the University of California is 6 years. Students who fail to complete their thesis within this time must request an extension from the Graduate Division. The form for requesting an extension is available in the BSOE Graduate Advising Office. This petition must include a detailed timetable for completion and must be signed by the student, faculty advisor and graduate director prior to submission to the Graduate Dean. If the Ph.D. degree is not awarded within 7 years from the date of advancement to candidacy, the student's candidacy shall lapse and the student will be required to pass a new oral qualifying exam prior to submitting the dissertation or undergo such other formal review as the student's department shall direct, and the result of this examination or review shall be transmitted in writing to the Graduate Council (Academic Senate Regulation 18.6).

**Preparation of the thesis**
When the student’s advisor and thesis committee have agreed that the research is ready to be submitted, the student may proceed with "writing up" according to the guidelines prescribed by the University Library and the Graduate Division. The dissertation is of critical importance, because it reflects the candidate's ability to do independent research at a high level of scholarship and creativity. The dissertation should make clear that the candidate is familiar with and able to critique and evaluate previous work done in his or her specialty field, and that the candidate has made a significant contribution to knowledge, at least part of which is of a quality and quantity worthy of at least 2 publications. The outline of the thesis should be approved by the thesis committee prior to preparation of the thesis. The thesis should be provided to the committee no less than one month prior to the thesis defense date. The thesis defense should comprise an open seminar. After the seminar, the thesis committee will meet with the student to discuss any changes to the thesis required for completion. Upon submission of the final thesis, the committee will sign the cover page and grant the Ph.D. Formal award of the Ph.D. is made by the Graduate Division. Summer thesis defenses are discouraged, since many faculty are absent and no formal seminar series is in place during the summer.

**Other BCB/BMEB/BSOE Program Policies**
BSOE and Graduate Division forms are available from https://ga.soe.ucsc.edu/current/forms. All forms, applications, etc. in connection with the Graduate Division must be routed through the BCB/BMEB Graduate Program Advisor (Tracie Tucker).

**Completion of previous degrees**
1. No student may enroll as a graduate student at UCSC until a bachelor’s degree has been completed.
2. Newly accepted students who are currently completing another graduate degree normally will not be permitted to enroll in the BCB/BMEB Graduate Program until the previous degree has been completed (or abandoned).

**Leaves of absence**
1. Students are expected to engage in their graduate student activities continuously (including the summer) from the time of admission until completion of the Ph.D. thesis. Any leave of absence must be authorized in advance.
2. Approval for a leave of absence will be recommended to the Graduate Dean only under unusual or exceptional circumstances. Requests for leave must be submitted in writing to the Advising Committee and must include justifications and the consent of the student's advisor or the Advising Committee, whichever applies to the individual
student.
3. Time spent on leave continues to count toward all departmental and university time requirements, including, but not limited to, passing the qualifying exam, the three-year limit after advancement to candidacy, and the six-year limit on normative time for completion of graduate work at UCSC.
4. Making use of an approved leave of absence will not jeopardize maintaining the satisfactory academic progress that must be reported annually to the Graduate Dean.
5. If a leave of absence is granted, it is the responsibility of the student to be familiar with all relevant departmental and university regulations, and to file any necessary paperwork both with the BSOE Graduate Advising Office and the Graduate Division. Please consult with the BCB/BMEB Graduate Program Advisor (Tracie Tucker).
6. International students have additional responsibilities to meet restrictions imposed by their visas, and must also have approval from International Services (visa@ucsc.edu).
7. Re-admission to the program after a leave is contingent upon satisfying any conditions set by the department or the Graduate Dean.

Normal course loads
1. BCB/BMEB graduate students are expected to work full-time towards their degrees and, therefore, students should enroll for 15 units of credit each quarter.
2. Once formal upper-division and graduate courses recommended by the student's advisory committee have been completed, it is expected that the student will normally enroll in 15 units of BME 297, Independent Study, each quarter (unless taking a 5 unit graduate elective) plus 2 units of BME 280 if this is offered by the thesis advisor. Advanced students will enroll in BME 299, Thesis Research.
3. Lighter or heavier loads must be approved in advance by the Advising Committee.

Ph.D. thesis defense
The BCB/BMEB Graduate Program requires a formal thesis defense before awarding the Ph.D. degree. This requirement must be satisfied before the thesis committee signs the cover page and other forms indicating that the thesis has been accepted. The defense takes place after all members of the committee have approved the written thesis. The defense must be a public seminar, attended by a majority of the candidate's thesis committee, in which the candidate formally presents the substance of the thesis. After the seminar, the public must have sufficient opportunity to question the candidate. The thesis committee may then meet in private with the candidate for further questions, before determining whether the candidate's thesis is accepted or rejected, or whether any problems need to be resolved. If both the thesis and the defense are acceptable, the cover page and necessary forms will be signed by the committee members, and all departmental requirements pertaining to the Ph.D. thesis defense will have been satisfied.

Expected timetable for the Ph.D. degree
The BCB/BMEB Ph.D. was conceived as a five-year program. Under normal circumstances, students should plan to follow this timetable:
1. Enter at the beginning of the Fall quarter.
2. Complete core and background courses in the first two years.
3. Take qualifying examination and advance to candidacy by Fall quarter of the third year (international students advance before the beginning of the third year).
4. Complete research and finish writing thesis by end of the fifth year. Deviations from this pattern require good justification. Deviations must be approved by the student's advisory committee and by the Advising Committee. Approval is not automatic and should be sought as soon as the need is anticipated.

Leaves and qualifying examinations
1. Students must obtain written permission first from their advisor, then from the department graduate director for all leaves.
2. Students not registered or not on leave for any given quarter must turn in the required paperwork the following quarter (summer excepted) or they will be dismissed from the program.
3. Students who formally withdraw from the program without the successful completion of either a thesis or the qualifying examination must submit formal notification to the Advising Committee and BCB/BMEB Program Advisor.
4. Students must take the qualifying examination before the beginning of Fall quarter of their third year or they will not be allowed to register for courses or serve as a TA or RA. The Graduate Division will be notified, and course enrollment will be denied. Any exceptions to this policy must be made in writing by the student's faculty sponsor (or BCB committee member) prior to the beginning of the Fall quarter.

5. If explicitly invited to do so by the examination committee, students who fail the qualifying examination have one quarter to produce a Master's Capstone Project (on current research) or retake the examination. Such cannot extend past the Fall quarter of the third year in residence without written permission from the Advising Committee.

Direct Admission into the BCB Graduate Program
The direct admit program is designed to allow direct admission of qualified students into faculty labs. Students who qualify for direct admission are those who have already completed a Master’s degree or who have extensive research experience. In addition, highly qualified international students who cannot be supported by the rotation program can be admitted by investigators with sufficient financial resources. All decisions regarding direct admits are made by the Graduate Admissions Committee; individual faculty may not make offers of admission to applicants without first consulting with the Admissions Committee. Direct admits have all of the same requirements as other students, with the exception of rotations. In lieu of the rotation requirement, direct admit students are required to complete two extra graduate courses to ensure that they are exposed to diverse areas of research. At the discretion of the Advising Committee, the graduate core courses may be waived if it is determined that the student has already passed equivalent graduate level courses. Faculty sponsors will be allowed to accept Ph.D. students directly into their labs if BCB Admissions and Advising Committees are satisfied that the candidate’s file has sufficient academic merit for admission. All direct admits must apply via the usual application procedures. The faculty sponsor (not the department) will be responsible for full support of the directly admitted student in all cases. Direct admit students must fulfill all other Ph.D. requirements (core courses, elective courses, two quarters of teaching assistantships). In the event a directly admitted student needs to find a different lab, the student will be responsible for finding a new faculty sponsor in order to remain in the program. The new faculty sponsor will assume responsibility for funding the student.

Checklist for Graduation
1. Complete and file application for degree form for the quarter of graduation:
   http://graddiv.ucsc.edu/student_affairs/forms.php
2. Schedule dissertation seminar with the BCB/BMEB Graduate Program Advisor (Tracie Tucker).
3. At least three (3) months before graduation, meet with thesis committee to determine thesis content and format.
4. At least one (1) month before thesis defense, give all committee members a copy of thesis for review.
5. Two (2) weeks before thesis defense, meet with thesis committee again for final feedback.

Appendix: UCSC APPEALING ACADEMIC JUDGMENTS
Revisions approved by Graduate Council on April 24, 2008 and effective July 1, 2008
Students have the right to appeal various institutional judgments concerning their academic standing at UC Santa Cruz including dismissal from graduate standing, placement on probationary status, narrative evaluation or grade notation, and their academic progress. This appeal procedure applies only to current graduate students at UC Santa Cruz and is not available to appeal denial of admission or readmission to any program. The scope of this procedure is limited to the matters listed above, and excludes complaints regarding student employment as a Teaching Assistant, student discipline, auxiliary student services (such as housing, child care, etc.), and sexual harassment, which are covered by other policies and procedures. This document outlines the four levels of complaint resolution available to graduate students at UC Santa Cruz:
1. Instructor appeal
2. Departmental appeal
3. Graduate Dean appeal
4. Graduate Council appeal
Throughout all stages of the appeal process, both parties are strongly encouraged to seek informal resolution. The Dean of the Division of Graduate Studies may be consulted for informal resolution at any stage of the process. In addition graduate students may contact the Office of the Ombudsman for assistance with informal complaint resolution. Working toward informal resolution does not preclude continuation of a formal appeal. However, unless a request for extension
of a deadline is granted as provided below, informal resolution efforts shall not serve in any way to stay or extend an applicable filing deadline.

Requests for Extension of Filing Deadlines
Except as otherwise provided in this policy, any party may for good cause seek an extension of a deadline by filing a request with the Dean of the Division of Graduate Studies. Such request must be submitted in writing prior to the deadline for which an extension is sought, and must explain the reason(s) why an extension is necessary. The decision to grant or deny a request is within the discretion of the Dean and shall be final and binding.

Basis for Appeals
An appeal may be filed based upon one or more of the following grounds, provided that the action complained of has had a material impact on the student’s academic standing:
1. Procedural error or violation of official policy by academic or administrative personnel;
2. Judgments improperly based upon non-academic criteria including, but not limited to, discrimination or harassment on the basis of race, color, national origin, religion, sex, disability, age, medical condition, ancestry, marital status, citizenship, sexual orientation, or status as a veteran or special disabled veteran, or any personal or arbitrary reasons;
3. Special mitigating circumstances beyond the student’s control not properly taken into account in a decision affecting the student’s academic progress;
4. Capricious or arbitrary application of appropriate criteria in a manner not reflective of the student’s performance in relation to a course or program requirement.

Procedure for Appeals
Throughout the appeals process all time periods refer to working days within the academic term or during the normal working days of summer. Students should be aware that appeals begun late in spring or in summer may be delayed by the unavailability of specific faculty and/or the Graduate Council. A written appeal must be initiated within thirty (30) working days of the action being appealed. The student must seek resolution of the action sequentially as described below, unless the action complained of is not an evaluation or grade notation. In that instance, the student would begin the appeal with Step II below.

Step I. If the student is appealing an evaluation or grade notation, the appeal must be submitted to the instructor who provided the evaluation or grade notation. The term “working days” means Monday through Friday, excluding University holidays.

Step II. For all other appeals, or if the student is continuing the appeal of an evaluation or grade notation, the appeal must be submitted to the student’s major department;

Step III. The Dean of Graduate Studies;

Step IV. The Graduate Council.

In all cases (Step I through IV), the appeal should indicate the action(s) being appealed, the date(s) the action(s) occurred, the grounds upon which the appeal is based, and the outcome desired.

Step I. Instructor Appeal
If a student is appealing a narrative evaluation or grade notation, the student must submit a written appeal to the instructor of the course within thirty (30) working days of the deadline contained in the campus Academic and Administrative Calendar for submittal of narrative evaluations or grade notation or, if that deadline has passed, of the actual date when the faculty member filed the narrative evaluation or grade notation. The faculty member’s Department Chair should be copied on the appeal, in order to inform the student if the faculty member is unavailable. The faculty member may elect to meet with the student to discuss the appeal and determine if a reasonable compromise can be reached that is acceptable to both parties. The faculty member must submit a written response to the student with a copy to the student’s Department Chair within thirty (30) working days of receipt of the Step I appeal. This deadline may be extended by the Department Chair or his/her designee should the faculty member be away from campus for research, administrative duties, sabbatical time, or personal leave. If the course in question was sponsored by a unit other than the student’s home department, the appeal should be addressed to the instructor of the course and copied to the two Chairs jointly.
Step II. Department Appeal
The student may continue the appeal of an evaluation or grade notation with the Department. In addition, a student may begin the appeal of any other action at this level. Students continuing the appeal of an evaluation or grade notation must submit a written appeal to the Department Chair of the faculty instructor of the course. If the course in question was sponsored by a unit other than the student's home department, the student's home Department Chair should be copied. Review of the appeal at the departmental level should be conducted by the departmental graduate affairs committee or analogous group. This group should minimally include two or more faculty members. If a faculty member’s action(s) is the subject of the appeal, s/he must recuse him or herself from the committee. Departments may also elect to establish an ad hoc committee to handle appeals filed in a given academic year. The committee will initiate a review process within ten (10) working days of receipt of the appeal. The committee will receive the written appeal from the student, all pertinent material from the faculty member and student, and any additional material considered germane to the appeal either by the student or the faculty member. The committee may request additional information, as it deems necessary. The committee or its designated members may elect to interview the faculty member and/or student involved in the appeal. The committee will render its decision in written form within seven (7) working days of the conclusion of the review process. If the action being appealed, such as probation or dismissal, was initiated by the department, the review process remains the same.

Step III. Dean of Graduate Studies
The student may elect to submit a written appeal of the department’s decision to the Graduate Dean. The decision must be appealed within thirty (30) working days from the date the departmental decision was transmitted to the student. At the discretion of the Graduate Dean, the appeal may be assigned to the Associate Graduate Dean. Additionally if the Dean determines that the appeal should be submitted directly to the Graduate Council (for example, if the Dean determines that a fair and impartial hearing may be jeopardized by conflicts within the Graduate Division or other extenuating circumstances), the Dean may refer the appeal directly to the Graduate Council. The Graduate Dean will review all documents and records submitted in the departmental review. In addition the Graduate Dean may meet with the student, faculty member(s), and/ or graduate affairs committee, where appropriate, and may consider additional materials as s/he deems appropriate. In most cases the Graduate Dean will seek resolution within one academic term. The Graduate Dean may suggest a resolution of the appeal in written form within seven (7) working days of completion of his/her review. After fourteen (14) working days, the suggested resolution, if not accepted, becomes null and void.

Step IV. Graduate Council
The student may submit a final appeal to the Graduate Council. The Graduate Council is a committee of the Academic Senate. There are ten Santa Cruz faculty members, plus the Dean of Graduate Studies serving ex officio. In addition, there are one Library representative nominated by the UCSC Librarians Association, no more than three Graduate Student Association representatives, and one Postdoctoral Scholars Association Representative. The student will submit a written appeal to the Graduate Council through the Academic Senate Office. The Dean of Graduate Studies will forward all pertinent documents to the Graduate Council for evaluation. The Chair may request additional information, as s/he deems necessary. The Graduate Council Chair in consultation with the Graduate Council will review the file and determine whether sufficient cause exists to justify a formal hearing. If the Council declines to hear the case, the Council will issue a written statement to that effect. This would be the final conclusion of the appeals process. If the Council determines that a hearing is to be held, the student and instructor or department Chair will be notified in writing at least thirty (30) calendar days in advance of the hearing date. The Graduate Council Chair may at his/her discretion constitute a subcommittee of at least four members, including at least one student representative, to hear the appeal, or s/he may convene the Graduate Council as a whole, as appropriate to the case and circumstances. At least seven (7) calendar days prior to the hearing date, each party shall provide the other with all relevant materials, including: names of all witnesses and any and all written materials to be introduced at the hearing. Copies of this material must also be submitted to the Graduate Council at least fourteen (14) calendar days prior to the hearing. During the appeal, the Graduate Council shall review the charges. At the hearing, the Graduate Council may interview such witnesses as are brought to the hearing by either party or such other witnesses as the hearing committee considers relevant. During the procedure, the graduate student members of the Graduate Council participate fully and equally with faculty members of the Graduate Council to review the issues of the case and ensure due process for the student.
The graduate students are not to be viewed as a special resource or advocate for the student to any greater degree than any individual faculty member of the Graduate Council.

A formal hearing will follow these procedures and conditions:

1. The student:
   a. shall be present throughout the hearing. If the student fails to attend the hearing, s/he shall be considered to have abandoned her/his appeal unless deferral was granted by the Graduate Council;
   b. may be accompanied by a Senate member of her/his choice, if desired and available;
   c. may be accompanied by a graduate student of her/his choice to serve in an advisory role, if desired and available;
   Please note: although Graduate Council will attempt to accommodate requests, the non-availability of a requested accompanying Senate member or graduate student is not sufficient cause for delay of an appeals hearing, nor does it affect the legitimacy of the Council’s findings.
   d. shall have the right to present evidence, including witnesses, first; and
   e. may cross-examine all witnesses presented by the instructor, department or dean. If the student desires a Senate member as an advisor and is unable to secure a Senate member to serve in this role, the Graduate Council, at the student’s request, will appoint a faculty member to act in this role. This advisor may or may not be a member of the Graduate Council. A Graduate Council member serving in this capacity shall be recused from the Graduate Council deliberations of the appeal.

2. The hearings will be confidential and limited to the principals (student, Senate member selected by the student, graduate student selected by the student, and instructor or department representative or relevant administrator), and members of the Graduate Council (but see 3 and 5 below).

3. By prior arrangement, witnesses may be interviewed as part of the hearing process.

4. All witnesses other than the student and the instructor (or department representative or other relevant administrator) shall be excluded from the hearing except when testifying.

5. Evidence may be oral or written, but must be limited to issues raised in the original written complaint. Formal rules of evidence shall not apply, and evidence shall be admitted if of the type upon which reasonable people are accustomed to rely in the conduct of serious affairs. The Graduate Council may, in its discretion, exclude irrelevant or unduly repetitive evidence. At its discretion the Graduate Council may agree to hear closing arguments (either oral or written at the Council’s discretion) as to the correct resolution of the matter. If the Council determines to allow written closing arguments, the hearing process shall be deemed complete upon the parties’ submission of their written arguments to the Council.

6. The meeting shall be tape recorded, or, at the option of the student, a stenographer may be provided at the student’s expense. The student shall have access to a copy of the tape recording and may copy the tape at her/his expense. All records pertaining to the hearing shall be kept by the Graduate Council for a period of three years. Student records shall be retained beyond that time if there is an outstanding request by a principal party to the review to inspect them.

7. The Graduate Council will reach its decision subsequent to completion of the hearing. The deliberations of the Graduate Council shall be in private. The Graduate Council shall submit a written decision to the Graduate Dean, including an explanation of the basis of its decision and a written recommendation, within ten (10) working days of the date of completion of the hearing process.

8. Consistent with Senate authority, the Graduate Dean will make the final decision on all cases involving probation and dismissal. The Graduate Council will have final decision-making authority in all other cases.

9. The Graduate Dean will have the administrative responsibility to implement the elements of the final decision and to ensure that the instructor involved and/or Department abide by the terms of the final resolution of the appeal. In addition the Graduate Dean will take reasonable steps to ensure that the student is not subject to any form of retaliation and is further restored to good standing with the Department if so determined by the decision of the review. This may include the provision of lost wages or fellowship funds if so determined by the decision of the review.

V. Financial Support

Financial support will continue for the student for the term in which the appeal is submitted. Support beyond this term will be contingent upon approval of the Department and the Graduate Dean, and determined on a case-by-case basis.

VI. Ramifications of Appeal Process

A faculty member may request his or her name be removed from the course in the final academic transcript. No punitive actions may be taken against the instructor on the basis of these procedures. Neither the filing of an appeal by
a student nor the final disposition of the appeal shall, under any circumstances, become a part of the personnel file of the instructor. The use of non-academic criteria in assigning a grade is a violation of the Faculty Code of Conduct. Sanctions against an instructor for violation of the Faculty Code may be sought by filing a complaint in accordance with CAPPM 002.015 or the relevant collective bargaining agreement. A complaint may be filed by the student or by others consistent with CAPPM 002.015. No punitive action may be taken against the complainant on the basis of these procedures. Neither the filing of an appeal by a student nor the final disposition of the appeal shall, under any circumstances, become a part of the complainant’s file. The instructor may, if he or she feels that his or her record has been impugned by false and malicious allegations, file charges against the complainant through the office of the Vice Chancellor for Student Affairs.