Cell, Molecular, and Developmental Biology

Assessment Plan for the PhD Program

Program Learning Outcomes

The Ph. D. program in Cell, Molecular and Developmental Biology has seven learning outcomes that graduating students should acquire during the course of their studies and so be well equipped for gainful and satisfying employment in the sciences and related areas.

Learning Outcome 1: Knowledge of factual information, theoretical principles and methodological approaches.

Each student must complete three core courses: one in cell biology (three options available – Plant Cell Biology (4 units, Fall), CMDB Cell Biology (4, Winter), Fundamentals of Neuroscience (3, Fall)), one in molecular biology (four options available – BCH Molecular Biology (3, F), The Plant Genome (4, W), CMDB Molecular Biology (4, F), Fundamentals of Neuroscience (3, W)), and one in Developmental Biology (two options available – Plant Development (4, Spring), CMDB Developmental Biology (4, S)). The majority of students take the three CMDB courses during the first year and these supply them with the breadth of information required as a base for their ongoing studies in their specialist area. These courses are augmented by more specialist courses and seminars, the courses typically being taken in their first year of study while many of the seminar courses are ongoing through the tenure of the graduate student. Specifically the students are required to take an additional elective course and two specialist seminars.

Approach:

The course plan for each student is determined by the Graduate Advisor for Entering Students with regard to any course deficiencies, the program’s course requirements, and the students desired area of research specialization. The Graduate Advisor also helps the students choose rotations in faculty labs by identifying possible major professors whose research interests are close to the student’s own interests. The rotations along with the final assignment to the major professor’s laboratory contribute to the student’s acquisition of knowledge, theory and method in the biomedical sciences. The student’s Guidance Committee (selected at the end of second quarter) provides additional advice concerning additional course selections the student may require into the second year. The successful completion of the written qualifying examination, consisting of three, four-hour components in the separate fields of cell, molecular and developmental biology represent a significant learning outcome for the CMDB Ph.D. students, which, added to their course work results in them being exposed to a significant body of knowledge in Cell, Molecular and Developmental biology within their first 18 months of study.
Assessment Methods:

Assessment in the core and specialist courses are by letter grade while assessment for seminars is by S/NC (which for CMDB257 - the program seminar series, is based on attendance). Rotations are currently graded S/NC however we will initiate a process by which faculty can briefly comment on the student's aptitude for research and study, thereby helping to identify and solve any deficiencies as early as possible. These comments will become part of the student's file. In addition, assessment of the student's chosen project in the laboratory of their major professors is inevitably part of the oral qualifying examination for which a written presentation of their proposed research project is required. The questions in the written qualifying examination are developed by the relevant committee within the CMDB program (consisting of the three lead instructors of each of the core course and two other CMDB faculty, one being from the CMDB Executive Committee). Assessment of the written qualifying examination is by this committee with input from other faculty.

A student who passes five or more of the total of six questions is awarded a pass.

Learning Outcome 2: Critical thinking, synthesis of ideas and communication skills.

Students will be able to critically read and analyze the scientific literature in the context of existing theories with the knowledge that these can be challenged, modified or upended, as is the nature of science. They will be able to identify those questions that remain outstanding and identify experimental approaches that may offer their solution. Most importantly they will be able to properly apply this ability to their own research project and in doing so develop their own scientific career.

Approach:

The students will commence learning these skills through their rotations with the process becoming more focused once they have selected their major professor and research question. The preparation and presentation of the Research Proposal that is a mandatory requirement of the oral qualifying examination (which must be completed before the end of the 7th quarter of studies) in the format stipulated within the CMDB Student Handbook (which is in part based on the grant submission format to NSF and NIH). Each year the students are required to write an Annual Research Project Evaluation (ARPE) document, the format of which is also based on NIH and NSF guidelines. This report covers the work the students have completed in their previous year and its preparation is explicitly meant to provide training in critical thinking and scientific analysis to the students specific to their research project and field of expertise. In addition to the written document, the annual evaluation includes an annual oral presentation to their dissertation committee, which also acts as training in critical thinking and data analysis as well as in scientific communication. All students from second year onwards are also required to present their research (as either an oral presentation or a poster) at the Annual CMDB Research Symposium held in Spring of each year. Students will also be encouraged to apply for competitive national scholarships with some training provided in the expanded CMDB257 seminar series held each Winter quarter.
Students will be able to communicate their research outcomes to a lay audience, and will be able to successfully publish research articles in peer-reviewed scientific journals.

**Assessment Methods:**
The students are required to pass their oral qualifying examination in order to progress to candidacy with the assessment of their written research proposal and its oral presentation to the Oral Qualifying Examination being an essential component of this examination. The ARPEs are assessed by the student’s Dissertation Committee with a negative evaluation leading to the student’s progress being closely monitored by the Graduate Advisor for Continuing Students and the Program Director, with further written and oral presentations being requested within the normal one year time frame. Oral and poster presentations at the Annual Research Symposium are assessed by faculty judges using appropriate metrics made known to students ahead of time. Successful publication of research in peer-reviewed journals provides a simple and obvious means of assessment.

**Learning Outcome 3:** Knowledge and application of ethics in research, effective interpretation of evidence and broader implications arising from these.

Students will be able to undertake research consistent with US government, University of California and Howard Hughes Medical Institute guidelines developed for the ethical conduct of scientific research, will be able to analyze and interpret data (using appropriate statistical analyses where appropriate) and, will be able to present and defend their research in the context of scientific argument.

**Approach:**
The students will be made aware of the proper ethical conduct of science both through the mentorship of their major professor (with additional guidance from their oral qualifying examination committee and their dissertation committee) and from compulsory attendance at the CMDB257 seminar series (“Science Practice and Professionalism”) held each winter quarter. The preparation and critiques of the ARPEs will provide students with ongoing training in the analysis of their data, as will be preparation of research papers for publication, along with the review process associated with scientific publication. Oral and poster presentations at the Annual Research Symposium provide the students with the opportunity to present their research outcomes in a formal scientific session.

**Assessment Methods:**
Attendance at CMDB257 is compulsory and students awarded the S/NC grade based on attendance. The assessment of both ARPEs and presentations made at the Annual Research Symposium are described above (Learning Outcome 2).

**Learning Outcome 4:** Adherence to research milestones.
The students will learn the importance of producing scientific outcomes within a targeted and reasonable time frame, as measured by successful experimental
outcomes followed by their publication in peer-reviewed professional scientific journals and their presentation at professional meetings. The students will be guided to defend their thesis within the normative time established by the programs (five years).

**Approach:**

Within the laboratories of their major professor, progress towards completion and publication of research will be monitored through presentations at lab meetings and through one-on-one meetings with their major professor. At the next level, the student’s dissertation committee will monitor progress on an annual basis, with the ARPE being an important guiding document.

**Assessment Methods:**

The primary programmatic method of assessment will be the ARPEs through the Dissertation Committees. A list of the student’s oral and poster presentations and publications for the previous year will be submitted as part of the ARPE, in order for this to be documented and evaluated.

**Learning Outcome 5:** Effective teaching skills.

The students will acquire the organizational and communication skills required to be effective teachers.

**Approach:**

The program requires that each student undertake two quarters as Teaching Assistants in life science courses within the College of Natural and Agricultural Sciences with preference given to courses closely aligned to cell, molecular and developmental biology. All students must first complete training provided by the Teaching Assistant Development Program (TADP).

**Assessment Methods:**

Assessment will be made through the successful completion of TADP training and through the quality of student and instructor evaluations.

**Learning Outcome 6:** Professional skills.

The students will learn the professional and leadership skills required to be successful scientists.

**Approach:**

In addition to the process outlined in the five learning outcomes above (with particular reference to the “Science Practice and Professionalism” course offered each winter), the students will develop professional skills through the chairing of scientific sessions at the Annual Research Symposium, the mentorship of junior students in the program by two senior students (selected by their peers), student participation in CMDB committees (the CMDB257 Seminar Committee, the CMDB Annual Research Symposium Committee) and in the running of the Annual
Research Symposium (with faculty guidance) and in the writing and submission of grant and fellowship proposals. Students play an active role in the nomination of some CMDB257 speakers and subsequently host their visits to UC Riverside with one student performing a similar function on the Institute for Integrative Genome Biology seminar committee. One student nominated by their peers (and approved by the Director) serves on the Executive Committee.

**Assessment Methods:**

In addition to the assessments outlined above, assessment is also made through the active participation of the students in the committees on which they serve and their abilities to perform the tasks assigned to them (such as chairing sessions at the Annual Research Symposium, hosting invited speakers). Feedback to the students is made through conversation with the relevant committee chair, graduate advisor or Director based on their own observations or on the comments of invited guests, other faculty or students. Success in the writing and submission of grant and fellowship proposals will be evaluated by the number awarded. In this context, conference presentations and the number of papers published in peer-reviewed journals will also be noted here although these are also covered in Learning Outcome 2. The success rate will be annually reviewed by the program and remedial strategies discussed and instigated.

**Learning Outcome 7:** Satisfaction with the program and their chosen career path.

Students will have an academically and professionally enriching experience within the program and will leave with the tools necessary to embark on their career of choice in the sciences.

**Approach:**

The students will be canvassed annually both as a group and individually for their assessment of the program through discussions with the Director or the Graduate Advisors. These comments will then be brought to the attention of the Executive Committee and appropriate changes or clarifications enacted where appropriate. Exit interviews of all students will be conducted by both the Director and Graduate Advisor for Continuing Students. The CMDB Student Handbook will be annually updated.

**Assessment Methods:**

Assessment of student concerns and advice will be made by the Executive Committee with consultation of faculty where it is seen appropriate. Assessment of the Program’s ability to meet the needs of the students will be by periodic internal and external review as determined by Graduate Division.
Assessment Plan for the MS Program

Program Learning Outcomes

The M.S. program in Cell, Molecular and Developmental Biology has six learning outcomes that graduating students should acquire during the course of their studies and so be well equipped for gainful and satisfying employment in the sciences and related areas.

**Learning Outcome 1:** Knowledge of factual information, theoretical principles and methodological approaches.

Each student must complete three core courses: one in Cell Biology (three options available – Plant Cell Biology (4 units, Fall), CMDB Cell Biology (4, Winter), Fundamentals of Neuroscience (3, Fall)), one in Molecular Biology (four options available – BCH Molecular Biology (3, F), The Plant Genome (4, W), CMDB Molecular Biology (4, F), Fundamentals of Neuroscience (3, W)), and one in Developmental Biology (two options available – Plant Development (4, Spring), CMDB Developmental Biology (4, S)). The majority of students take the three CMDB courses during the first year and these supply them with the breadth of information required as a base for their ongoing studies in their specialist area. These courses are augmented by more specialist courses and seminars for a total of 36 units of credit.

**Approach:**

The course plan for each student is determined by the Graduate Advisor for Entering Students with regard to any course deficiencies, the program’s course requirements, and the students desired area of research specialization. The Graduate Advisor also organizes rotations in faculty labs and helps to identify a major professor whose research interests are close to the student’s own interests. The rotations along with the final assignment to the major professor’s lab contribute to the student’s acquisition of knowledge, theory and method in the biomedical sciences. The student’s Guidance Committee (selected at the end of second quarter) provides additional advice concerning additional course selections the student may require into the second and final year of their studies.

**Assessment Methods:**

Assessment in the core and specialist courses are by letter grade while assessment for seminars is by S/NC (which for CMDB257 - the program seminar series, is based on attendance). There is S/N rotation of the assessments.

**Learning Outcome 2:** Critical thinking, synthesis of ideas and communication skills.

Students will be able to critically read and analyze the scientific literature in the context of existing theories with the knowledge that these can be challenged, modified or upended, as is the nature of science. They will be able to identify those
questions that remain outstanding and identify experimental approaches that may offer their solution. Most importantly they will be able to properly apply this ability to their own research project and in doing so develop their own scientific career.

**Approach:**

The students will commence learning these skills through their rotations with the process becoming more focused once they have selected their major professor and research question. M.S. students are required to write an Annual Research Project Evaluation (ARPE) document, the format of which is also based on NIH and NSF guidelines. This report covers the work the students have completed in their previous year and its preparation is explicitly meant to provide training in critical thinking and scientific analysis to the students specific to their research project and field of expertise. In addition to the written document, the annual evaluation includes an annual oral presentation to their dissertation committee, which also acts as training in critical thinking and data analysis as well as in scientific communication. M.S. students are required to present their research progress (as either an oral presentation or a poster) at the Annual CMDB Research Symposium held in Spring of each year. Students will be able to communicate their research outcomes to a lay audience, and will be able to successfully publish research articles in peer-reviewed scientific journals.

**Assessment Methods:**

The Guidance Committee, together with the student’s major professor, will provide the student with the feedback required for a successful transition to the research component of M.S. degree. This will also be achieved through the work of the student’s Thesis Committee and through the preparation of the ARPE. The ARPEs are assessed by the student's Thesis Committee with a negative evaluation leading to the student’s progress being closely monitored by the Graduate Advisor for Continuing Students and the Program Director, with further written and oral presentations being requested before submission of the thesis. Oral and poster presentations at the Annual Research Symposium are assessed by faculty judges using appropriate metrics made known to students ahead of time. Successful publication of research in peer-reviewed journals provides a simple and obvious means of assessment.

**Learning Outcome 3:** Knowledge and application of ethics in research, effective interpretation of evidence and broader implications arising from these.

Students will be able to undertake research consistent with US government, University of California and Howard Hughes Medical Institute guidelines developed for the ethical conduct of scientific research, will be able to analyze and interpret data (using appropriate statistical analyses where appropriate), and will be able to present and defend their research in the context of scientific argument.

**Approach:**

The students will be made aware of the proper ethical conduct of science both through the mentorship of their major professor (with additional guidance from their
oral qualifying examination committee and their dissertation committee) and from compulsory attendance at the CMDB257 seminar series (“Science Practice and Professionalism”) held each winter quarter. The preparation and critiques of the ARPEs will provide students with ongoing training in the analysis of their data, as will be preparation of research papers for publication, along with the review process associated with scientific publication. Oral and poster presentations at the Annual Research Symposium provide the students with the opportunity to present their research outcomes in a formal scientific session.

Assessment Methods:

Attendance at CMDB257 is compulsory and students awarded the S/NC grade based on attendance. The assessment of both ARPEs and presentations made at the Annual Research Symposium are described above (Learning Outcome 2).[10]

Learning Outcome 4: Adherence to research milestones.

The students will learn the importance of producing scientific outcomes within a targeted and reasonable time frame, as measured by successful experimental outcomes followed by their publication in peer-reviewed professional scientific journals and their presentation at professional meetings. The students will be guided to defend their thesis within the normative time established by the programs (two years).

Approach:

Within the laboratories of their major professor, progress towards completion and publication of research will be monitored through presentations at lab meetings and through one-on-one meetings with their major professor. At the next level the student’s thesis committee will monitor progress on an annual basis, with the ARPE being an important guiding document.

Assessment Methods:

The primary programmatic method of assessment will be the ARPEs through the Thesis Committees. A list of the student’s oral and poster presentations and publications for the previous year will be submitted as part of the ARPE, in order for this to be documented and evaluated.

Learning Outcome 5: Professional skills

The students will learn the professional and leadership skills required to be successful scientists.

Approach:

In addition to the process outlined in the four learning outcomes above (with particular reference to the “Science Practice and Professionalism” course offered each winter), the students will develop professional skills through the chairing of scientific sessions at the Annual Research Symposium, student participation in CMDB committees (the CMDB257 Seminar Committee, the CMDB Annual Research Symposium Committee) and in the running of the Annual Research
Symposium (with faculty guidance). Students play an active role in the nomination of some CMDB257 speakers and subsequently host their visits to UC Riverside with one student performing a similar function on the Institute for Integrative Genome Biology seminar committee. Students will be strongly encouraged to publish their research outcome when appropriate and this will be used as a metric of success with the qualification that not all M.S. degrees lead to peer-reviewed publications.

**Assessment Methods:**

In addition to the assessments outlined above, assessment is also made through the active participation of the students in the committees on which they serve and their abilities to perform the tasks assigned to them (such as chairing sessions at the Annual Research Symposium, hosting invited speakers). Feedback to the students is made through conversation with the relevant committee chair, graduate advisor or Director based on their own observations or on the comments of invited guests, other faculty or students. Presentation at conferences and successful publication of research in peer-reviewed journals provides a simple and obvious means of assessment.

**Learning Outcome 6:** Satisfaction with the program and their chosen career path.

Students will have an academically and professionally enriching experience within the program and will leave with the tools necessary to embark on their career of choice in the sciences.

**Approach:**

The students will be canvassed annually both as a group and individually for their assessment of the program through discussions with the Director or the Graduate Advisors. These comments will then be brought to the attention of the Executive Committee and appropriate changes or clarifications enacted where appropriate. Exit interviews of all students will be conducted by both the Director and Graduate Advisor for Continuing Students. The CMDB Student Handbook will be annually updated.

**Assessment Methods:**

Assessment of student concerns and advice will be made by the Executive Committee with consultation of faculty where it is seen appropriate. Assessment of the Program’s ability to meet the needs of the students will be by periodic internal and external review as determined by Graduate Division.