Department of Biological Sciences

Graduate Student Handbook

California State University
SAN MARCOS

TABLE OF CONTENTS

WELCOME

Welcome graduate students! We are truly excited to have you in our program!

This handbook is designed to inform you of our policies, procedures, and requirements and to help answer many of the questions you may have as you move toward completing your degree. Although every effort has been made to keep this handbook current, policies and courses can change – please consult the University Catalog and Graduate Programs website for the most current and binding information. Your individual thesis advisor will be your primary contact and they will help you choose courses and design your research program. A lot of helpful information can also be found on the Office of Graduate Studies & Research website (http://www.csusm.edu/gsr/). In addition, key forms can be found at https://www.csusm.edu/biology/bioms/currentstudents.html.

For specific program related questions, feel free to contact me directly.

Welcome to the Department of Biology!

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Associate Professor of Biological Sciences
Coordinator of Graduate Program for Biological Sciences

INTRODUCTION:
MASTER OF SCIENCE IN BIOLOGICAL SCIENCES

The graduate program in biological sciences at California State University San Marcos (CSUSM) leads to a research-based Master of Science (MS) degree. Our program provides the opportunity for students to receive advanced training in biological sciences and to pursue independent research investigations in specialized areas of interest. Laboratory and/or field research is an integral component of the program, which emphasizes a "hands-on" approach with close faculty mentoring. Research experience also enables students to hone investigative skills related to experimental design & implementation, and data analysis & interpretation. Another important feature of our program is the Teaching Assistantship requirement, which is designed to give students the opportunity to discuss and implement pedagogical strategies employed in science education. Graduates with a MS in Biological Sciences will be prepared not only to continue study at the Ph.D. level, but also to successfully pursue careers in private industry or government affiliated labs and agencies, and to teach at the college level.

The graduate program in Biological Sciences fosters the integration of many disciplines. A wide range of faculty expertise and research interests enables the department to offer a curriculum that spans the fields of molecular genetics and development, aquatic biology, evolution, ecology, physiology, microbiology, immunology and molecular & cellular biology. Students may develop a program of courses and research tailored to their individual interests within the areas of faculty expertise. In addition, students may choose a research supervisor outside of the Biological Sciences Department to be on their committee, allowing them to pursue interdisciplinary studies, special field research, or industry projects. Seminar courses focus on the primary literature and are presented as a forum for open interchange and dissemination of scientific knowledge.

Our department has sophisticated research laboratories equipped with state-of-the-art instrumentation. Facilities include a vivarium, greenhouse, tissue culture laboratory, environmental growth chambers, and equipment for radioisotope and modern molecular biology work. The close proximity of the campus to marine, chaparral, and desert environments provides many opportunities for field studies. Excellent computer facilities also are available for computational intensive research.

MENTORING

It is our belief that the quality of a student's graduate experience is, in large measure, a reflection of mentoring. Too often, especially in graduate programs that have large student-faculty ratios, students do not receive adequate faculty supervision. In our program, each student is carefully mentored throughout her/his training at CSUSM. No student will be without a thesis advisor (aka “thesis chair”, “major advisor”) at any time during their course of study, including during periods of part-time study or leaves of absence from the program. Our aim is to include our graduate students in the every-day life of the department via teaching opportunities, participation in faculty research programs, and involvement in general departmental activities such as colloquium series, and social events.

Prior to acceptance into our program, students must be accepted by a thesis advisor whose research interests best match those of the student. This is facilitated when students make contact with faculty prior to applying to the program. However, should a student’s research interests change (see list of faculty research interests herein) before they advance to candidacy, the student is free to switch to another thesis advisor.

Students should keep in contact with their thesis advisors as necessary, and at a minimum meet with them at the beginning of every semester. One of the first activities a new student should request is to meet with their assigned thesis advisor and fill out a Program of Study Form (**Appendix A**). This form will help the student plan which courses to take, how to make up for any course deficiencies, and how to transfer any outside graduate course credit.

OVERALL DEGREE PROGRAM

General Requirements

There are several specific requirements that must be met in order to earn the Master of Science in Biology degree. Students must complete these requirements in less than five years. While described in more detail below, in brief these requirements include:

I. **Coursework**: Our program requires a minimum of 30 semester units of study at the advanced level (courses numbered 500-698). Twenty-four of these units are from required courses, and the remaining six are elective. Coursework must be approved by the student's thesis committee and be recorded on a signed Program of Study Form (**Appendix A**).

II. **Research design and thesis proposal:** In order to be considered for advancement to candidacy, graduate students must have 1) obtained approval of their program of study, 2) developed a thesis proposal, and 3) successfully defended the proposal before their thesis committee. They must also meet any deficiencies if they were accepted conditionally. On approval of their thesis proposal, classified graduate students will be advanced to candidacy, and may then enroll in Bio 698.

III. **Completion and defense of a written thesis:** The thesis must be based on original field or laboratory research, approved by the student's thesis committee, and defended in a public oral presentation to faculty and students.

IV. **Completion of at least one semester as a teaching assistant:** Because effective communication is important to success at the Master's level, the program in Biological Sciences requires that a graduate student normally serve as a Teaching Assistant for one semester.

PROGRAM OF STUDY

Each graduate student must complete specific coursework that will lead to fulfillment of requirements for the Master of Science degree. This coursework is to be detailed on the Program of Study (POS) form (**Appendix A,** online form) and approved by the student's thesis committee before the student advances to candidacy. The POS should be developed in consultation with the thesis advisor and the student's thesis committee, with a focus on gaining depth of knowledge in a particular sub-discipline of biological science.

Thesis Committee Establishment

Each student must obtain the permission of a tenure-track Biological Sciences faculty member to serve as their thesis advisor (typically the student's assigned thesis advisor when admitted to the program). Together the thesis advisor and student will select additional thesis committee members so that the thesis committee has at least 3 members. In addition to the thesis advisor, the thesis committee must consist of a second tenure track CSUSM faculty member from the Biological Sciences Department, and the third member can be any person (CSUSM or outside of campus) who has a terminal degree (doctorate) and has expertise relevant to the research. Any additional members can be included as desired by the major advisor and student if that person has an advanced degree (Master's Degree or higher) and has pertinent background to the research topic. While more than three people can be on a thesis committee, know that extra members may mean extra scheduling difficulties for proposal and thesis defenses.

A student must obtain the written consent of each member who will serve on the thesis committee (see Thesis Committee Form, **Appendix B,** online form). In some cases, a student will rely primarily on the thesis advisor for thesis development; in other cases, the committee members (e.g., a research supervisor) will be consulted more substantively. It is the student's responsibility to keep all committee members informed of thesis progress and to ask the thesis advisor for guidance on the appropriate level of involvement for their thesis committee members.

Coursework

Your coursework will include at least 30 units of courses at the graduate level and all courses must be included on the Program of Study. Additional courses for the area of study may be required as determined by the thesis committee. Required courses are: Scientific Communication (BIOL 600, 3 units), Computational/Quantitative Elective (3 units), Internship in Biology Instruction (BIOL 685, 2 units), two seminars chosen from BIOL 560-566 (2 units each), Directed Studies (BIOL 697, 6 units), and Thesis (BIOL 698, 6 units). Bio 697 is taken prior to defending the thesis proposal and Bio 698 is taken after the proposal is successfully defended and the student has advanced to candidacy. The remaining units (6) of graduate level coursework will be comprised of elective lecture/lab courses selected by the student and her/his committee (see list of potential department courses listed herein). The POS also may include additional courses needed to satisfy prerequisites for students admitted with conditional classified status (units not applicable to the required 30). The formal POS must be submitted for approval to the student's thesis committee before the end of the second semester after admission to the program.

The Computational/Quantitative Elective of 3 units can be met with one of the following courses: Biol 480 (Bioinformatics), Biol 502 (Population Genetics), Biol 503L (Molecular Biology/Genomics), Biol 531 (Biology Data Analysis I: Linear), Biol 532 (Biology Data Analysis: Multivariate), or Biol 535 (ecological modeling). It is important for the student and their thesis advisor to determine which of these options will best prepare the student for the data analysis involved in their thesis project.

Typical Two-Year Full-time Course of Study

Year 1, Fall Semester	**Units**
Biology 600	3
Biology 697	3
Elective Seminar or Graduate Course	2-3
Develop Program of Study (POS)	
Establish Thesis Committee	
Year 1, Spring Semester	
Quantitative/Computational Elective	3
Biology 685*	2
Biology 697	3
Submit approved POS	
Defend thesis proposal and advance to candidacy	
Year 2, Fall Semester	
Elective Seminar or Graduate Course	2-3
Biology 697 or 698**	3
Elective Seminar or Graduate Course	2-3
Year 2, Spring Semester	
Biology 698**	3
Elective Seminar or Graduate Course	2-3
Defend and file thesis	
Additional Year(s)	
Biology 699	2-6

*The teaching internship (BIOL 685) can be taken at any time

**Students typically defend their thesis proposal by the end of the second semester or beginning of the third semester. If all other deficiencies are cleared, after a successful proposal defense the student advances to candidacy and are then allowed to enroll in BIOL 698.

(Note: Students may need to register for additional units to meet financial aid requirements).

Typical Three-Year Part-time Course of Study- (6 units or less*)

Year 1, Fall Semester	**Units**
Biology 600	3
Biology 697	3
Establish Thesis Committee, Develop Program of Study (POS)	
Year 1, Spring Semester	
Biology 697	3
Biology 685	3
Submit approved POS	
Year 2, Fall Semester	
Elective Seminar or Graduate Course	2-3
Quantitative/Computational Elective	3
Defend thesis proposal and advance to candidacy	
Year 2, Spring Semester	
Biology 698**	3
Elective Seminar or Graduate Course	2-3
Year 3, Fall Semester	
Biology 698**	2
Elective Seminar or Graduate Course	2-3
Year 3, Spring Semester	
Biology 698**	1
Elective Seminar or Graduate Course	2-3
Defend and file thesis	
Extra Semester if Necessary	
Biology 699	2-6

* Students with 6 units pay part-time fees/tuition. For some financial aid purposes 6 units allows students to be considered for full reimbursement. Note that some funding agencies consider 9 units to be full time instead of 6 units.

** If all other deficiencies are cleared, after a successful proposal defense the student advances to candidacy and are then allowed to enroll in BIOL 698.

Coursework Restrictions

Any course taken at CSUSM or other institutions at the 300-level or below may not be used in the Program of Study for the MS degree. With prior approval from the Graduate Coordinator, Master's students may count up to three (3) units of 400-level science majors (non-General Education) courses towards their 30 unit requirement. Up to six (6) units of graduate coursework from other Universities or from CSUSM taken prior to admittance in the MS program can be applied toward the degree. Students should not expect that such courses will transfer unless the student can show, to the satisfaction of the faculty in the Biological Sciences Department, that this coursework is equivalent to CSUSM graduate course work. In no case will courses that were taken more than seven years prior to the filing of the thesis be counted toward graduation. Students may not elect credit/no credit for any course counted toward the degree that is also offered on a letter grade basis. Course prerequisites will be enforced, unless consent of instructor is granted.

Units from graduate-level courses that were successfully completed while a student was an undergraduate at CSUSM will not count toward the Master's degree unless a specific concurrent enrollment form was approved by Registration and Records during the student's final undergraduate semester.

ADVANCEMENT TO CANDIDACY

Advancement to candidacy is the process by which students become approved to carry out their research project with a successful thesis proposal defense. To be eligible for advancement, a graduate student must have attained classified status (i.e. completed any deficiencies noted in their letter of acceptance to the program) and have constituted a thesis committee.

The Advancement Process

A student becomes advanced after (1) they have successfully defended a research proposal orally before their thesis committee, (2) they have completed all deficiencies identified upon admission to the program, and (3) they have passed the graduate writing assessment requirement (GWAR) as detailed below.

The research proposal is a document which outlines the original research ideas and plans of the graduate student. While the actual format may vary depending on the thesis advisor's preferences, all proposals should include the information provided in the section "Required Proposal Components and Accompanying Guidelines" below. The proposal will first be prepared while taking Biol 600. The student and thesis advisor will likely go through several drafts before the thesis advisor decides the proposal is ready to be sent to other committee members. **Early drafts (those that require extensive rewrites, grammatical errors etc.) of the proposal should be exchanged only with the thesis advisor and should <u>not</u> be sent to committee members**. A wise graduate student will contact committee members early in the advancement process to determine the availability of the committee to meet. Find out when any of your members might be on sabbatical or out of state before trying to schedule a proposal date. **The finished proposal should be sent to the entire committee at least two weeks prior to the date for the proposal defense**. Do not give the proposal to your committee only days before your defense – while it might be the only subject on your mind, your committee likely has many other obligations and needs time to review the proposal. A committee member may refuse to attend your proposal defense (resulting in rescheduling) if they have not had enough time to review the proposal. Most proposal defenses include a brief presentation by the student to the committee, followed by a question and answer period. Afterwards, the student will be asked to leave the room while the committee decides if the student is ready to carry out the proposed research. A repeated defense may be necessary if the committee decides that the student is not ready to proceed. Upon approval of the proposal, the committee and thesis advisor will sign the advancement to candidacy form (**Appendix C,** <u>online form</u>). The original of this form and the Program of Study form need to be given <u>by the student</u> to the Graduate Coordinator of the Biological Sciences Department.

Required Proposal Components and Accompanying Guidelines

General Considerations:

1. All text must be 1.5-spaced in 12-point Times New Roman or 11-point Arial font.
2. Margins should be one inch on all sides.

Title Page

1. Title should convey the specific nature of the proposed study.
2. Your name
3. Thesis committee members

Abstract ***approx. length: 300 words***

1. Briefly convey the research to be conducted, including the rationale so that a general scientific audience can understand what you will be doing.
2. Include the hypothesis or objective of the study, an overview of methods, and a brief statement of expected results and their significance.
3. Avoid acronyms, abbreviations, citations, and technical jargon specific to the field.
4. Write as one paragraph with no citations.

Specific Aims/Objectives ***approx. length: 1 page***

1. Start with a brief narrative describing the long-term goals or objectives of the research project and the hypothesis to be tested (if there is one).
2. This is followed by a list of 2-3 Specific Aims describing how these hypotheses will be tested or objectives met. Make sure they are attainable during the program time.
3. Summarize the expected outcomes (if the research proposed is hypothesis driven).

Background and Significance ***approx. length: 6 pages***

Review the primary literature, summarizing the key information that is relevant to your proposed research.

1. Cover the state of existing knowledge, including literature citations and highlights of relevant data (some may be published or unpublished from your lab). Avoid outdated research.
2. Provide the rationale for the proposed research.
3. Explain gaps that the project is intended to fill.
4. Include the potential contribution of this research to the scientific field (significance)

Study Design/Research Plan ***approx. length: 6 pages***

The purpose is to describe how the research will be carried out. For each Aim of the project describe the following:

1. Any preliminary data that relates to accomplishing that Aim.
2. The experimental procedures to be used, measurements to be made, analyses to be performed and statistical tests to be applied.
3. Treatment groups versus controls where appropriate and details such as sample size, IACUC and IRB approvals as appropriate for the research proposed.
4. Often a figure is useful for describing what experimental and control groups will be tested and which analyses will be made.
5. Citations for published procedures, software, and statistical references.
6. Any potential difficulties or limitations and how they will be overcome.
7. Expected results or outcomes and alternative approaches that will be used if unexpected results are found.

Budget *(optional)* ***approx. length: 1 page***

1. Itemize major expenses.
2. Specify the sources of funds to be used to cover these expenses and any fellowships/scholarships you will be applying for.

Timeline

1. Include timeline for data collection, analysis, presentations, and meetings.
2. Be clear about timing for proposal and thesis defense.

References ***minimum 20 references***

Follow one consistent format for all references! Use the format followed by a leading journal in your particular discipline of biology. Be consistent! Use of a reference manager such as Zotero is recommended for easy formatting https://biblio.csusm.edu/guides/zotero .

Figures and Tables (optional)

1. Use figures, tables, or flowcharts where needed to illustrate complex ideas, designs and methods. This can help explain complicated experimental designs, intracellular pathways, geographical sampling locations, etc.
2. All figures and tables must include concise, explanatory legends or captions**. Table captions are presented above the table, while figure legends are presented below the figure**.
3. If you reproduce someone else's figure, you must include a citation in the legend indicating where this figure or schematic diagram came from. This citation needs to be included in your References section.

   Note: The MS thesis of former members of your lab should be cited like any other work, following the standard format for a dissertation.

Proposal Timing

The formal written thesis proposal is to be presented no later than the beginning of the second year of full time study, or after 12 units of graduate coursework have been completed. Students are strongly advised to undertake the proposal defense as early as possible for the following reasons:

a. students cannot enroll in BIOL 698 until they have advanced to candidacy; six units of 698 are required for the degree
b. students must be advanced to candidacy before they can apply to graduate
c. the proposal should be defended before any major research toward the thesis begins. Part of the proposal defense process is to allow the committee help the student design their project. If most or all of the research is done prior to the proposal defense, and major research design flaws are discovered, the committee can ask the student to redesign or repeat part or all of the research
d. students who do not attempt the proposal defense in a timely fashion may be dropped from the program

Faculty are not expected to convene for a proposal defense during summer, university vacations, or the semester break in December/January. However, faculty may choose to attend defenses during breaks; the likelihood of this increases with the amount of notice given to the committee by the student.

THE THESIS

The thesis is the culminating experience for each student and is a substantial product of original empirical research carried out under the close supervision of a faculty thesis advisor and the thesis committee members. The format of the final thesis is to be determined by the faculty thesis advisor and the submitted thesis must comply with CSUSM Library standards (see the Graduate Studies website). The final thesis must be publicly presented and defended to the Thesis Committee, and the final submitted thesis must incorporate any recommended changes from the committee.

Thesis Completion Process

Our program allows you to finish all of your course work in four semesters. However, progress toward the thesis varies a great deal among students. Although faculty do their best to provide the moral support and expertise you need to design, carry out, and write your thesis, the self-discipline and motivation you will need to complete your work must come from you. In the end, it is UP TO YOU to start your thesis, to keep it on track, and to bring it to final completion. Your progress is ultimately your responsibility.

You should start thinking about your thesis project very early on, even in your first semester. You are encouraged to schedule regular meetings with your thesis advisor to talk over ideas. Ask your advisor if they would be willing to set deadlines for you if you think it will help you to move ahead (but do not blame your advisor if you fail to meet the deadlines!). As a graduate student, you can no longer afford to think of summers and University holidays/breaks as "time off." Rather, those should be times in which you work especially hard on your research. We realize many of you work off campus, so setting practical goals for yourself can ensure constant progress on your thesis.

Theses always require more work than students expect. Typically, an idea must be refined and refined again--and again--over the course of several months. Multiple drafts of your written work with your thesis advisor will be necessary. Some frustration is inevitable, but it can be minimized by proper planning, realistic expectations, and a healthy attitude toward constructive criticism. One of the strengths of our graduate program is that we set high standards for our students. This means more effort and patience is required of you, but the result of your work will be a high-quality thesis of which you can be proud.

Only after you and your thesis advisor approve your thesis, is it time to send it to the rest of your committee. As with the proposal, it is not the job of the committee to help with early basic editing. Rather, they should receive what you and your advisor consider to be a finished product. You must give this final draft of your thesis to your committee at least two weeks prior to the defense date to allow them time to review it. If you wait until the last week of the semester to give your thesis to your committee and to schedule a defense date, do not be surprised if your committee is unavailable. The final step in your program is to orally and publicly defend your thesis and then incorporate any last changes requested by your committee before you submit your thesis to the library. *Faculty are not expected to convene for a thesis defense during summer, university vacations, or the semester break in December/January*. However, faculty may choose to attend defenses during breaks; the

likelihood of this increases with the amount of notice given to the committee by the student. Guidelines for the required electronic thesis submission are on the library website.

TEACHING APPRENTICESHIP

Direct teaching experience is a required educational exercise for our Master's students. The experience of designing syllabi and pre-lab lectures, of leading labs, and writing/grading assignments is invaluable for students whether or not they proceed into teaching careers. There are several options for fulfilling the teaching obligation. Most students teach a section of one of our lower-division major or non-major laboratories (BIOL 210, 211 or GES 102), which are taught every semester. These well-structured courses have developed curricula to aid the student teacher. During the semester the student teaches they will sign up for BIOL 685 and they will receive a small salary. If a student has had extensive, relevant teaching experience, they may petition the graduate studies committee for waiver of the teaching requirement by first contacting the graduate coordinator. Discuss with your thesis advisor which semester would be best for you to teach and then contact the graduate coordinator to ask about teaching opportunities for that semester. You are expected to be available to teach every lab of your assigned class during your teaching semester.

ENROLLMENT AND REGISTRATION

Continuous Enrollment
Once accepted into the program, students must be continuously enrolled during each semester unless they apply for a leave of absence (see Leave of Absence below). Students need not enroll in courses during the summer, unless they expect to file their thesis during summer. You must be enrolled when you defend/file your thesis.

Leave of Absence
In accordance with CSUSM policy, a student may request a leave of absence for valid medical, planned educational, or professional reasons on a semester-by-semester basis. The form should be obtained from the graduate studies website. The Graduate Coordinator must fill in information and sign the form, then the student will bring the form to the Office of Registration and Records before the end of the add/drop period of enrollment. No more than two semesters (not including summer) will be excused through authorized leaves of absence. **Authorized leaves of absence do not extend the time limit for degree completion.** For example, if you enroll for three years, take two leaves of absence (miss year four) you will only have one year remaining to complete your degree. During a leave of absence, the student will not have access to most University resources or to faculty time.

Time Limit for Degree
A graduate student has five years to complete the course work and thesis. If the student does not complete the requirements within the five years, they will be dropped from the program. A student may petition the Dean of Graduate Studies and Research for special consideration to extend the time limit at one semester intervals. The student must meet with the Graduate Coordinator of Biological Sciences who will complete the form to state the reasons for the extension and include a specific plan to complete the degree requirements. The Dean of Graduate Studies will decide if the extension will be granted.

Graduate Standing Continuation (Extended Learning E699)
The purpose of the Extended Learning E699 course is to allow students to be enrolled with the university (continuing the mandatory graduate standing status), without requiring specific products or faculty involvement (i.e. course carries no units, is not graded, no instructor of record). This course is used during the final semester when a student has already finished writing their thesis and the committee has already reviewed the thesis but the student needs to complete final paperwork to submit the thesis to the library. Students who are still working closely with an advisor on their thesis research and/or writing should enroll in the graduate-level independent study course (BIOL 699), rather than the Extended Learning E699. The E699 course can only be taken once and can be used during a semester or during the summer. When authorized by the Graduate Coordinator of Biological Sciences, E699 provides access to certain university resources (e.g., the library, e-mail/computing accounts) while the student works independently to finish their thesis filing. Registration for this enrollment status is offered through Extended Learning (follow the instructions on the GRAD E699 Enrollment Form, **Appendix D,** online form).

GRADUATE WRITING ASSESSMENT REQUIREMENT

CSUSM requires that each student complete the Graduation Writing Assessment Requirement (GWAR) to assess writing proficiency by all graduate students. Students will not be advanced to candidacy unless they have met this requirement and students must pass the GWAR to remain enrolled in the MS program.

In the Department of Biological Sciences, a student will have met the GWAR requirement if they scored ≥4.0 on the GRE writing exam. If the student scored less than 4.0, then the major paper assignment from Bio 600 (to be determined by the instructor) will be evaluated. All biology graduate students are required to take Bio 600 which involves the development of a research paper/proposal. This document will be reviewed and scored by two people, the instructor of record of Bio 600 and the student's thesis advisor; if the instructor and advisor is the same person, another biology department tenure-track faculty member will be selected (likely a member of the thesis committee). The proposal will be scored according to the rubric detailed below including scores (1 to 4 points) in each of four areas: Style and Format, Mechanics, Content and Organization, and Integration and Critical Analysis. The minimum acceptable combined score from all four sections is 10 points, with no scores of "1" on any section, resulting in a minimum average of 2.5 for all sections. If the student does not pass the GWAR with their Bio 600 paper evaluation, then they will meet with both reviewers to examine the weaknesses of the document and obtain suggestions for improvement. The student will revise and resubmit the document for re-evaluation. If the student does not pass the GWAR with their revised Bio 600 paper, then the student will be referred to the writing center where they will receive help with the document that has instructor/advisor comments. The student will then re-submit the paper to the original reviewers for a third evaluation. If the student is unable to pass the GWAR during the third evaluation of the document, then they will be considered to have failed the GWAR requirement and will be discontinued from the program. At any time during this process, the student may be referred to ALCI (American Language and Culture Institute) for further evaluation and instruction.

GWAR RUBRIC

I. Style and Format

4: In addition to meeting the requirement for a "3," the paper consistently models the language and conventions used in the scholarly/ professional literature appropriate to the student's discipline. The manuscript would meet the guidelines for submission for publication in a peer reviewed journal in the student's field of study.

3: While there may be minor errors, conventions for style and format are used consistently throughout the paper. Demonstrates thoroughness and competence in documenting sources; the reader would have little difficulty referring back to cited sources. Style and format contribute to the comprehensibility of the paper. Suitably models the discipline's overall scholarly style.

2: The style and format are broadly followed, but inconsistencies are apparent. There is selection of less suitable sources (non-peer reviewed literature, web information). Weak transitions and apparent logic gaps occur between topics being addressed. The style may be difficult to follow so as to detract from the comprehensibility of the manuscript.

1: While some discipline-specific conventions are followed, others are not. Paper lacks consistency of style and/or format. It may be unclear which references are direct quotes and which are paraphrased. Based on the information provided, the reader would have some difficulty referring back to cited sources. Significant revisions would contribute to the comprehensibility of the paper.

II. Mechanics

4: In addition to meeting the requirements for a "3," the paper is essentially error-free in terms of mechanics. Writing flows smoothly from one idea to another. Transitions effectively establish a sound scholarly argument and aid the reader in following the writer's logic.

3: While there may be minor errors, the paper follows normal conventions of spelling and grammar throughout. Errors do not significantly interfere with topic comprehensibility. Transitions and organizational structures, such as subheadings, are effectively used which help the reader move from one point to another.

2: Grammatical conventions are generally used, but inconsistency and/or errors in their use result in weak, but still apparent, connections between topics in the formulation of the argument. There is poor or improper use of headings and related features to keep the reader on track within the topic. Effective discipline-specific vocabulary is used.

1: Frequent errors in spelling, grammar (such as subject/verb agreements and tense), sentence structure, and/or other writing conventions make reading difficult and interfere with comprehensibility. There is some confusion in the proper use of discipline-specific terms. Writing does not flow smoothly from point to point; appropriate transitions are lacking.

III. Content and Organization

4: In addition to meeting the requirements for a "3," excels in the organization and

representation of ideas related to the topic. Raises important issues or ideas which may not have been represented in the literature cited. Would serve as a good basis for further research on the topic.

3: Follows all requirements for the paper. Topic is carefully focused. Clearly outlines the major points related to the topic; ideas are logically arranged to present a sound scholarly argument. Paper is interesting and holds the reader's attention. Does a credible job summarizing related literature. General ideas are expanded upon in a logical manner thereby extending the significance of the work presented beyond a re-statement of known ideas.

2: Ideas presented closely follow conventional concepts with little expansion and development of new directions. Certain logical connections or inclusion of specific topics related to the student's area of study may be omitted. Ideas and concepts are generally satisfactorily presented although lapses in logic and organization are apparent. The reader is suitably introduced to the topic being presented such that the relationship to the student's area of study is obvious.

1: The paper is logically and thematically coherent, but is lacking in substantial ways. The content may be poorly focused or the scholarly argument weak or poorly conceived. Major ideas related to the content may be ignored or inadequately explored. Overall, the content and organization needs significant revision to represent a critical analysis of the topic.

IV. Integration and Critical Analysis

4: In addition to meeting the requirement of a "3," the document presents the current state of knowledge for the topic being addressed utilizing a diversity of opinions. These various, and possibly conflicting, opinions are presented in a balanced manner and seamlessly woven together to illustrate a complete grasp of the literature across multiple research approaches utilizing appropriate national and international peer-reviewed journals. Essential findings of multiple sources are accurately and concisely paraphrased, analyzed, and integrated. Original sources are clearly identified and correctly cited in both the body of the text and the reference section. Organizationally, smooth and effective transitions between topics lead the reader through an orderly discussion of the topic being addressed. The gaps in current knowledge are clearly identified and significant directions and approaches that fill these gaps are identified.

3: There are inconsistencies in the organization and logic of the presentation, but still clear analysis of the presented materials. While synthesis of all aspects of the topic may show varying degrees of development, the overall consistency, thoroughness, and analysis result in a well-crafted document.

2: Identification of key topics or uncertainties in the field may be incomplete. New concepts resulting from a synthetic presentation of ideas is poorly developed or lacking. Complex topics and related concepts are awkwardly presented and linkages among topics may be unclear.

1: Weakness is evident in the coverage of the field and analysis resulting in incorrect or poorly developed synthesis of results. Analysis is limited to categorizing and summarizing topics. The resulting manuscript degrades the comprehensibility of the document and the identification of knowledge gaps.

GRADES AND POLICIES

Academic Continuation

Graduate students must maintain an overall GPA of 3.0 and earn at least a C (2.0) in all courses, except those graded credit/no credit. Students who are admitted as conditionally classified because of GPA deficiencies may not earn less than a B (3.0) in the first three graduate courses taken at the 500 or 600 level at CSUSM (excluding Bio 697). Any student whose overall GPA falls below 3.0 for two semesters, or who receives more than three grades of C (2.0) or lower, will be discontinued from the program.

Incomplete Grade

It is incumbent upon the student to initiate the request for an incomplete grade and to reach an agreement with the instructor regarding completion of the course work. A request for a grade of incomplete will be denied if the instructor believes it is inappropriate (see University Catalog). All incomplete grades must be completed within one year in accordance with CSUSM policy.

Repeating a Course

According to the CSUSM policy, "Graduate and post baccalaureate students may repeat up to two (2) courses in order to meet graduation requirements. Repeating a course does not expunge the earlier attempt from the student's record, but it may improve the student's grade point average (GPA). This policy is applicable only to non-thesis courses taken at CSU San Marcos." Additional details of this policy are available in the policy document "APC 307-96" dated 2008.

Appeals

A graduate student who is aggrieved about a course evaluation, candidacy decision, or degree requirement should first discuss the matter with the relevant faculty member, then the thesis advisor, then the graduate coordinator, and then the department chair. If the matter cannot be informally resolved, then the student may file a formal grievance in accordance with CSUSM policy.

Ethics

Students are expected to understand and comply with all ethical standards that apply to scientists. Students must also abide by professional standards of conduct in the field of biological sciences. Violations of ethical standards will be dealt with seriously and in accordance with CSUSM policy. The Biological Sciences Department does not tolerate plagiarism or cheating in any form, and violations of our academic honesty policies may result in dismissal from the program.

GRADUATION AND COMMENCEMENT

To graduate in any given semester (fall, spring or summer), the thesis must be defended and filed with the library by deadlines posted for that semester. The dates change, but generally the last day to file will be early May, early August and early December for spring, summer and fall graduation, respectively. You will need to make an appointment contact the appropriate librarian and review materials posted on the library website to learn about requirements prior to the filing date.

You must apply to graduate with the University (**Appendix E**). If you do not graduate during the semester you applied, you will need to cancel the application and reapply for the appropriate semester. Make sure to meet with your thesis advisor early enough to ensure you have completed all of the coursework, teaching requirements, and thesis requirements before you apply to graduate.

Commencement, the major walking and hooding ceremony, currently only occurs in May. While there may be a small ceremony for fall graduates, the May ceremony is the large, University-wide program. Some thesis advisors may require students to have filed their thesis before walking.

UNIVERSITY RESOURCES

Library
The library is a major resource for graduate level study. The library now has 250,000 books and bound periodicals, 800 print journals, access to 11,000 electronic journals and 100 research databases. Electronic search, CD-ROM, interlibrary loan, and media services are available. Log in or chat with a librarian at: https://biblio.csusm.edu/ .

Financial Aid
Several sources of financial aid are available to graduate students in addition to teaching assistantships. Students are responsible for identifying other sources of aid, and may wish to consult with the University's Office of Financial Aid. For more information, please go to: https://www.csusm.edu/finaid/index.html .

Graduate Research Dissemination Fund
The Graduate Research Dissemination Fund provides financial assistance to help graduate students present their research completed at CSUSM. Appropriate activities include support for travel to a conference at which a student's paper or poster has been accepted, page charges for publication of a research paper, and other activities designed to help disseminate the results of student.

- Funds are distributed on a first-come, first-served basis, until funds for the current year run out
- Students may only receive one award
- Potential sources of other support will influence the size of the award
- Group projects as well as individual projects may be funded

Interested students may get the application form from the Office of Graduate Studies, CRA 5102. For further information:
https://www.csusm.edu/gsr/documents/new_graduate_travel_application.pdf .

Office for Training, Research & Education in the Sciences (OTRES) Program
This office functions as the administrative home for several projects that focus on student and faculty career development and institutional curriculum enhancement in the natural sciences, behavioral sciences, math and other related disciplines. We are committed to increasing diversity in science and academia, and to making CSUSM the institution of choice for students and faculty interested in the sciences. The OTRES sponsors programs that focus on science education, student support services, research training, research participation and workshops and seminars for all STEM scholars. You can find more information at:
https://www.csusm.edu/otres/index.html

FINAL TIPS FOR A SUCCESSFUL DEGREE

- Meet regularly with your thesis advisor. Keep them informed of your progress, lack of progress, etc. Do not disappear for weeks on end!

- Design your Program of Study early and keep checking it. Make sure you will have the 30 required units by the time you want to file your thesis. It can be extremely frustrating to be done with the research and have to enroll in more coursework.

- Make sure you plan the best semester to do your teaching experience.

- If you came in "conditionally classified", rectify your requirements early. You cannot advance to candidacy until you are "classified".

- Be on campus as much as possible. Do not just come for classes, but instead spend time on campus; otherwise you are missing out on a lot of the graduate experience. Make friends with other grad students, discuss problems, hang out in lab to see how things run, etc.

- Keep your committee informed of your progress or any major changes. Do not let two years go by between your proposal and thesis defense without chatting with your committee. This is especially important if you are making changes to your research.

- If you feel like you are not making much progress, ask your advisor for deadlines to help give you more structure.

- When in doubt, ask.

- Work hard.

- Do not procrastinate.

- Have FUN and take ownership of your research!

THE BIOLOGICAL SCIENCES FACULTY

Faculty Research Interests

Elinne Becket, Assistant Professor (Ph.D. Molecular Biology 2012: University of California, Los Angeles). Dr. Becket received a BS in Biochemistry from UCLA in 2008 and completed her doctorate in 2012 as a UCLA Whitcome Fellow in Molecular Biology with a focus on antibiotic resistance and DNA Repair in *Escherichia coli*. She went on to do postdoctoral research as an AP Giannini Fellow in the Department of Urology at the University of Southern California (USC), studying epigenomics in renal carcinoma, before being recruited as a Scientist in diagnostic assay and platform development at Zymo Research Corporation in 2015. She joined CSUSM in 2018, where her research focuses on examining the effects of anthropogenic input and stormwater on the evolution of antibiotic resistance along the southern California coast. Please visit https://elinneb.wixsite.com/becketlab for more information.

Becket E, et al (2020) "Draft Genome Sequences of *Bacillus glennii* V448, *Bacillus saganii* V47-23a, *Bacillus* sp. V59.32b, *Bacillus* sp. MER_TA_151, and *Paenibacillus* sp. MER_111, Isolated from Cleanrooms where the Viking and Mars Exploration Rover Spacecraft were Assembled." *Microbiol. Resour. Announc*. 9(26):e00354-20.

Becket E, Chopra S, Duymich CE, Lin JJ, You JS, Pandiyan K, Nichols PW, Siegmund KD, Charlet J, Weisenberger DJ, Jones PA, and Liang G. 2016. Identification of DNA methylation-independent epigenetic events underlying clear cell renal cell carcinoma. *Cancer Res.* 76(7):1954-1964.

Becket E, Tse L, Yung M, Cosico A, Miller JH. 2012. Polynucleotide phosphorylase plays an important role in the generation of spontaneous mutations in *Escherichia coli. J Bacteriol.* 194(20):5613-5620.

Liu A, Fong A, **Becket E**, Yuan J, Tamae C, Medrano L, Maiz M, Wahba C, Lee C, Lee K, Tran KP, Yang H, Hoffman RM, Salih A, and Miller JH. 2011. Selective advantage of resistant strains at trace levels of antibiotics: a simple and ultrasensitive color test for the detection of antibiotics and genotoxic agents. *Antimicrob Agents Chemother.* 55(3):1204-1210.

Tracey K. Brown, Professor (Ph.D. Biology 1999; University of California, Los Angeles). Dr. Brown joined the Biology faculty at CSUSM in Fall 2002 after conducting postdoctoral work at the San Diego Zoo Institute for Conservation Research. Her research interests stem from a curiosity of the intricate relationship between an animal and its environment. Dr. Brown's current research involves various aspects of conservation, restoration and physiological ecology, with a focus on native reptiles.

Greco, B.,Andrews, J.**Brown, T.K**., Swaisgood, R.R. and N.G. Caine. 2012. Social learning in captive African Elephants (*Loxodonta africana africana*). *Animal Cognition*, Published Online 12/14/2012. DOI 10.1007/s10071-012-0586-7

Brown, T.K., J.M. Lemm, J. Montagne, J.A. Tracey and A.C. Alberts. 2008. Spatial ecology, habitat use, and survivorship of resident and translocated Red Diamond Rattlesnakes (*Crotalus ruber*). In *The Biology of Rattlesnakes*, ed. Hayes, W. K., K. R. Beaman, M. D. Cardwell, and S. P. Bush. Loma Linda, California: Loma Linda University Press.

Brown, T.K. and K.A. Nagy. 2007 Lizard energetics and the sit-and-wait vs. wide-foraging paradigm. In *Lizard Ecology: The Evolutionary Consequences of Foraging Mode*, pp. 120-140, ed. Reilly, S.M., L.B. McBrayer and D.B. Miles. Cambridge, U.K.: Cambridge University Press.

John Eme, Assistant Professor (Ph.D. Biology, 2010: University of California Irvine). Prior to Dr. Eme's appointment to the CSUSM faculty in Fall 2017, he was a postdoctoral researcher at McMaster University in Ontario, Canada and the University of North Texas. Our lab explores comparative vertebrate physiology, including developmental biology, fish thermal biology and the cardiovascular system. We are interested in the biology of fish and reptiles, including Crocodilians, equatorial tropical fishes, fishes in southern California, embryonic reptilian cardiovascular systems, and freshwater fishes.
Lab Website: https://comparativephysiology.weebly.com

Cooper CJ, Mueller CA, **Eme J** (2019) Temperature tolerance and oxygen consumption of two South American tetras, *Paracheirodon inessi* and *Hyphessobrycon herbertaxelrodi*. *Journal of Thermal Biology*, **86**, https://doi.org/10.1016/j.jtherbio.2019.102434

Eme J, Cooper CJ, Alvo A, Vasquez J, Muhtaseb S, Rayman S, Schmoyer T, Elsey RM (2019) Scaling of major organs in hatchling female American alligators (*Alligator mississippiensis*). *Journal of Experimental Zoology A*, **331**, 38-51

Eme J, Mueller CA, Lee AH, Melendez C, Manzon RG, Somers CM, Boreham DR, Wilson JY (2018) Daily, repeating fluctuations in embryonic incubation temperature alter metabolism and growth of Lake whitefish (*Coregonus clupeaformis*). *Comparative Biochemistry and Physiology A*, **226**, 49-56

Matthew A. Escobar, Professor (Ph.D. Plant Biology 2002; University of California, Davis). Dr. Escobar joined the Biology faculty at CSUSM in Fall 2005 after completing postdoctoral work at Lund University in Sweden. He is primarily interested in plant molecular biology and biotechnology, with a particular emphasis on the development of the root system. Previous research projects have focused on resistance to crown gall disease and the regulation of alternative respiratory pathways in plants.

Ehrary, A.*, Rosas, M.*, Carpinelli, S.*, Davalos, O.*, Cowling, C.*, Fernandez, F.*, and **Escobar, M.A,** (2020). Glutaredoxin *AtGRXS8* Represses Transcriptional and Developmental Responses to Nitrate in Arabidopsis thaliana roots. Plant Direct. 00: 1-12. **https://doi.org/10.1002/pld3.227**. * CSUSM student

Rasmusson, A.G., **Escobar, M.A.**, Hao, M., Podgorska, A., and Szal, B. (2020). Mitochondrial NAD(P)H oxidation pathways and nitrate/ammonium redox balancing in plants. Mitochondrion. 53: 158-165.

Patterson, K.*, Walters, L.A.*, Cooper, A.M.*, Olvera, J.G.*, Rosas, M.A.*, Rasmusson, A.G., and **Escobar, M.A.** (2016). Nitrate-regulated glutaredoxins control *Arabidopsis* primary root growth. Plant Physiology. 170: 989-999.

Walters, L.A.* and **Escobar, M.A.** (2016). The *AtGRXS3/4/5/7/8* glutaredoxin gene cluster on *Arabidopsis thaliana* chromosome 4 is coordinately regulated by nitrate and appears to control primary root growth. Plant Signaling and Behavior. 11: e1171450.

Araji, S.*, Grammer, T.A.*, Gertzen, R.*, Anderson, S.D.*, Mikulic-Petkovsek, M., Veberic, R., Phu, M.L., Solar, A., Leslie, C.A., Dandekar, A.M., and **Escobar, M.A**. (2014). Novel roles for the polyphenol oxidase enzyme in secondary metabolism and the regulation of cell death in walnut. Plant Physiology. 164: 1191-1203.

*CSUSM student

Rosalina Stancheva Hristova, Research Faculty (Ph.D., 2005: Sofia University, Bulgaria). Dr. Stancheva's research interests focus on aquatic biology with emphasis on the ecology, biogeography and systematics of the algae and their use as water quality indicators. The most current research includes studies on toxin-producing cyanobacteria from streams and lakes. This research involves a combination of field and laboratory work, including advanced light and electron microscopy, and molecular analyses in collaborations with other faculties.

Stancheva, R., Kristan, N., Kristan, W., Sheath, R. G. 2020. Diatom genus *Planothidium* from streams and rivers in California (USA): diversity, distribution and autecology. - Phytotaxa 470: 1-30.

Paul, M.J., Jessup, B., Brown, L.R., Carter, J.L., Cantonati, M., Charles, D.F., Gerritsen, J., Herbst, D.B., **Stancheva, R.,** Howard, J., Isham, B., Lowe, R., Mazor, R., Mendez, P.K., Ode, P., O'Dowd, A., Olson, J., Pan, Y., Rehn, A. C., Spaulding, S., Sutula, M., Theroux, S. 2020. Characterizing benthic macroinvertebrate and algal Biological Condition Gradient models for California wadeable streams, USA. - Ecological Indicators 117, 106618.

Conklin, K. Y., **Stancheva, R**., Otten, T., Fadness, R., Boyer, G., Read, B., Zhang, X., Sheath, R. G. 2020. Molecular and morphological characterization of a

novel dihydroanatoxin-a producing *Microcoleus* species (cyanobacteria) from the Russian River, California, USA. - Harmful algae 93: 101767.

Julie M. Jameson, Associate Professor (Ph.D. Immunology and Virology 1999: University of Massachusetts Medical Center). Prior to Dr. Jameson's appointment to the CSUSM faculty in Fall 2012, she was an Assistant Professor at The Scripps Research Institute in La Jolla, CA. Her laboratory is interested in studying how obesity and type 2 diabetes impact epithelial tissues such as the skin, intestine, and lung causing complications such as chronic nonhealing wounds and increased susceptibility to infection. She is currently the Director of the biology graduate program and has enjoyed mentoring graduate students in her lab since 2012. You can find more information at her lab website: https://juliejamesonlab.weebly.com/

Park, C., Cheung, K.P., Limon, N., Costanzo, A., Barba, C., Miranda, N., Gargas, S., Johnson, A.M.F., Olefsky, J.M., and **Jameson, J.M**. (2019) Obesity modulates intestinal intraepithelial T cell persistence, CD103 and CCR9 expression, and outcome in dextran sulfate sodium-induced colitis. *J. Immunol.* 203:3427

Dutt, S.B., Gonzales, J., Boyett, M., Costanzo, A., Han P.P., Steinberg S., McKay D.B., and **Jameson J.M.** (2017). mTOR inhibition by everolimus does not impair closure of punch biopsy wounds in renal transplant patients. Transplant Direct. 3:e147.

Costanzo, A., Taylor, K., Dutt, S., Han, P., Fujioka, K., and **Jameson, J.M.** (2015). Obesity impairs γδ T cell homeostasis and antiviral function in humans. PLoS One. 10:e0120918.

James K. Jancovich, Assistant Professor (Ph.D. Molecular and Cellular Biology 2007: Arizona State University). Dr. Jancovich joined the Biology faculty in the Fall 2011 after completing his postdoctoral work at Arizona State University. He is primarily interested in understanding the genomics, evolution and the host-pathogen interactions that influence the host-range and pathogenesis of ranaviruses that infect cold-blooded vertebrates.

Trung, H., **Jancovich, J.K.,** Tripuraneni, L., Heck, M.C., Langland, J.O., and Jacobs, B.L. 2017. Characterization of a PKR inhibitor from the pathogenic ranavirus, *Ambystoma tigrinum virus*, using the heterologous vaccinia virus system. *Virology*, 511: 290-299.

Allen, A.G., Morgans, S., Smith, E., Aron, M.M. and **Jancovich, J.K.** 2017. The *Ambystoma tigrinum virus* (ATV) RNase III can modulate host PKR activation and interferon production influencing viral pathogenesis. *Virology*, 511: 300-308.

Aron, M.M., Allen, A.G., Kromer, M., Galvez, H., Vigil, B. and **Jancovich, J.K.** 2016. Identification of essential and non-essential genes in *Ambystoma tigrinum virus*. *Virus Research*, 217: 107-114.

Jane C. Kim, Assistant Professor (Ph.D. Biology 2011; Massachusetts Institute of Technology). Dr. Kim's research is aimed at understanding how cells accurately copy their genetic material, primarily using budding yeast genetics and molecular biology approaches. She is particularly interested in so-called "weak links" of DNA such as simple DNA repeats that form secondary structures. Precise regulation and accuracy of replicating these repetitive sequences are critical in preventing genome instability associated with neurodegenerative and neuromuscular genetic diseases such as Huntington's and Myotonic Dystrophy. She grew up in the San Fernando Valley, CA but spent 15+ years on the East Coast getting her B.S. at Yale, Ph.D. at MIT, and postdoctoral training at Tufts University. She is delighted to be teaching and conducting research with undergraduates and master's students at California State University San Marcos, a role she has had since Fall 2016.

Neil AJ, **Kim JC**, and Mirkin SM. Precarious maintenance of simple DNA repeats in eukaryotes. *BioEssays*. 2017 Jul 13. PMID: 28703879.

Kim JC, Harris ST, Dinter T, Shah KA, and Mirkin SM. The role of break-induced replication in large-scale expansions of $(CAG)_n \cdot (CTG)_n$ repeats. *Nat Struct Mol Biol*. 2017 Jan;24(1):55-60. PMCID: PMC5215974.

Aksenova AY, Greenwell PW, Dominska M, Shishkin AA, **Kim JC**, Petes TD, and Mirkin SM. Genome rearrangements caused by interstitial telomeric sequences in yeast. *Proc Natl Acad Sci U.S.A.* 2013 Dec 3;110(49):19866-71. PMCID: PMC3856781.

Kim JC and Mirkin SM. The balancing act of DNA repeat expansions. *Curr Opin Genet Dev*. 2013 Jun;23(3):280-8. PMCID: PMC3703482.

Dennis Kolosov, Assistant Professor (Ph.D. Animal Physiology 2016: York University, Toronto, Canada). Dr. Kolosov received a HBSc in Biology in 2010 and completed his doctorate in 2016 in Animal Physiology at York University with a focus on the role of tight junction proteins in regulating epithelial permeability in aquatic vertebrates. Following his doctoral work, Dennis held Natural Sciences and Engineering Research Council (NSERC) and McCall MacBain Teaching and Leadership postdoctoral fellowships in the Department of Biology at McMaster University (Hamilton, Canada) studying molecular mechanisms of epithelial ion transports in insects, before being recruited as an Assistant Professor at CSUSM. At CSUSM, Dennis's research focuses on uncovering novel mechanisms of epithelial ion transport regulation using vertebrate and invertebrate model organisms and cell and tissue culture approaches. Techniques employed in Dennis's lab range from bioinformatics and molecular biology to electrophysiology, pharmacology and bioassays.

Kolosov, D., & O'Donnell, M. J. (2020). Mechanisms and regulation of chloride transport in the Malpighian tubules of the larval cabbage looper Trichoplusia

ni. Insect Biochemistry and Molecular Biology, 116, 103263. http://doi.org/10.1016/j.ibmb.2019.103263

Kolosov, D., & O'Donnell, M. J. (2019). Malpighian tubules of caterpillars: blending RNAseq and physiology to reveal regional functional diversity and novel epithelial ion transport control mechanisms. The Journal of Experimental Biology, 222(22), jeb211623–20. http://doi.org/10.1242/jeb.211623

Kolosov, D., Jonusaite, S., Donini, A., Kelly, S. P., & O'Donnell, M. J. (2019). Septate junction in the distal ileac plexus of larval lepidopteran Trichoplusia ni: alterations in paracellular permeability during ion transport reversal. Journal of Experimental Biology, 222(Pt 11), jeb204750. http://doi.org/10.1242/jeb.204750

Kolosov, D., Tauqir, M., Rajaruban, S., Piermarini, P. M., Donini, A., & O'Donnell, M. J. (2018). Molecular mechanisms of bi-directional ion transport in the Malpighian tubules of a lepidopteran crop pest, Trichoplusia ni. Journal of Insect Physiology, 109, 55–68. http://doi.org/10.1016/j.jinsphys.2018.06.005

Kolosov, D., Piermarini, P. M., & O'Donnell, M. J. (2018). Malpighian tubules of Trichoplusia ni: recycling ions via gap junctions and switching between secretion and reabsorption of Na+ and K+ in the distal ileac plexus. Journal of Experimental Biology, 221(Pt 5), jeb172296. http://doi.org/10.1242/jeb.172296

Deborah M. Kristan, Associate Professor (Ph.D. Biology 2001: University of California, Riverside). Prior to Dr. Kristan's appointment at CSUSM in Fall 2003, she was a postdoctoral fellow in the Department of Biological Sciences at the University of Idaho. Research interests include physiology, immune responses to parasitic worm infections, and biological aging with a focus on the effects of chronic parasite infection on ability of small rodents to respond to other environmental demands such as calorie restriction and diet supplements.

Gomez, S.R., Morgans, S. and **Kristan, D.M**. 2019. Rapamycin exposure to host and to adult worms affects life history traits of *Heligmosomoides bakeri*. *Exp. Parasitol*. 204, 107720. https://doi.org/10.1016/j.exppara.2019.107720.

Rodriguez, K.A., Valentine, J.M., Kramer, D.A., Gelfond, J.A., **Kristan, D.M**., Nevo, E., and Buffenstein, R. 2016. Determinants of rodent longevity in the chaperone-protein degradation network. *Cell Stress Chaperones* 21:453-466.

Clark, P.R., Ward, T.W., Lang, S.A., Saghbini, A., **Kristan, D.M**. 2013. Order of inoculation during *Heligmosomoides bakeri* and *Hymenolepis microstoma* coinfection alters parasite life history and host responses. *Pathogens* 2:130-152.

William B. Kristan III. Associate Professor (Ph.D. Biology 2000: University of California, Riverside). Dr. Kristan joined CSUSM in 2006 and studies population biology, landscape ecology, and conservation biology, principally on birds. He is interested in mathematical and computational approaches to ecological problems and uses a variety of tools such as mathematical population models and GIS to address problems in these subject areas. Recently his work has focused on ways in which anthropogenic resources affect predator-prey relationships, and on ecological effects of water runoff from urban areas on ecological communities.

Vourlitis, G.L, C. Defotis, and **W. Kristan**. 2015. Effects of soil water content, temperature and experimental nitrogen deposition on nitric oxide (NO) efflux from semiarid shrubland soil. Journal of Arid Environments 117:67-74.

Kristan, W.B. III, M.D. Johnson, and J.T. Rotenberry. 2007. Choices and consequences of habitat selection for birds. The Condor 109:485-488.

Kristan, W.B. III and W.I. Boarman. 2007. Effects of anthropogenic developments on Common Raven nesting biology in the west Mojave Desert. Ecological Applications 17:1703-1713.

Kristan, W.B. III. 2003. The role of habitat selection behavior in population dynamics: sources, sinks, and ecological traps. Oikos 103:257-468.

Carlos Luna Lopez, Assistant Professor (PhD. In Bioengineering 2014, University of Maryland College Park). Dr. Carlos Luna is a Bioengineering scientist that seeks to understand stem cell mechanobiology. Prior to his arrival at CSUSM, he was a Postdoc at UCSD (2017) and at the University of Maryland (UMD, 2014-2016). He did his graduate school in Bioengineering at UMD (2014) and studied Physics at the Universidad de Sonora, Mexico (2008). He is interested in cell biophysics, cell and tissue mechanics, stem cells and neuroscience. His lab uses an interdisciplinary approach based on biology, engineering and physics —with a focus on live-cell imaging— to understand how physical interactions affect cellular behavior.

Carlos Luna, Laura Detrick Sameer B. Shah, Avis H. Cohen, Helim Aranda-Espinoza. 2013. Mechanical properties of the lamprey spinal cord: uniaxial loading and physiological strain. *Journal of Biomechanics*

Carlos Luna, Kimberly M. Stroka, Harry Bermudez, Helim Aranda-Espinoza. 2011. Thermodynamics of monolayers formed by mixtures of phosphatidylcholine/ phosphatidylserine. *Colloids and Surfaces B: Biointerfaces*.

Carlos Luna, Alvin G. Yew, Adam H. Hsieh. 2015. Effects of angular frequency during clinorotation on mesenchymal stem cell morphology and migration. *NPJ Microgravity*.

Bianca R. Mothé, Professor (Ph.D. Molecular and Cellular Pathology 2002: University of Wisconsin-Madison). Dr. Mothé started her appointment at CSUSM in Fall 2003. Dr. Mothé conducted her postdoctoral work at a vaccine company named Epimmune, Inc in San Diego, CA. Her areas of specialization are immunology and virology, with research interests in designing novel vaccines for rapidly mutating viruses and th impact of immune responses on stem cells.

Mothe BR, Stewart BS, Oseroff C, Bui HH, Stogiera S, Garcia Z, Dow C, Rodriguez-Carreno MP, Kotturi M, Pasquetto V, Botten J, Crotty S, Janssen E, Buchmeier MJ, Sette A. 2007. Chronic Lymphocytic Choriomeningitis Virus Infection Actively Down-Regulates CD4+T Cell Responses Directed against a Broad Range of Epitopes. J Immunol 179(2):1058-67.

Bui HH, Botten J, Fusseder N, Pasquetto V, **Mothe B**, Buchmeier MJ, Sette A. Protein sequence database for pathogenic arenaviruses. 2007. Immunome Res. 8;3:1.

Sette A, Sidney J, Bui HH, del Guercio MF, Alexander J, Loffredo J, Watkins DI, **Mothe BR**. 2005. Characterization of the peptide-binding specificity of Mamu-A*11 results in the identification of SIV-derived epitopes and interspecies cross-reactivity. Immunogenetics 57:53-68.

Casey A. Mueller, Associate Professor (Ph.D. Environmental Biology 2011: University of Adelaide, Australia). Dr. Mueller joined the faculty at CSUSM in Fall 2015 after completing postdoctoral work at the University of North Texas and McMaster University, Canada. Dr. Mueller is a comparative developmental physiologist who examines the interaction between the environment and the developing phenotype of animals, and how developmental physiology influences animals later in life. She works with a range of organisms, with a focus on invertebrates, fishes, and amphibians, to investigate energy use and respiratory and cardiovascular function under different environmental conditions across development.

Melendez CL* and **Mueller CA** (2021) Effect of increased embryonic temperature during developmental windows on survival, morphology and oxygen consumption of rainbow trout (*Oncorhynchus mykiss*). Comp Biochem Physiol A, 252, 110834 (doi 10.1016/j.cbpa.2020.110834) *CSUSM graduate student

Mueller CA, Bucsky J, Korito L and Manzanares S (2019) Immediate and persistent effects of temperature on oxygen consumption and thermal tolerance in embryos and larvae of the Baja California chorus frog, *Pseudacris hypochondriaca*. Front Physiol 10:754 (doi 10.3389/fphys.2019.00754) CSUSM undergraduates

Scheffler ML, Barreto FS, **Mueller CA** (2019) Rapid metabolic compensation in response to temperature change in the intertidal copepod, *Tigriopus*

californicus. Comp Biochem Physiol A 230, 131-137 (doi 10.1016/j.cbpa.2019.01.017) CSUSM undergraduate

Brian J. Norris, Professor. (Ph.D. Cellular and Developmental Biology 1989: Harvard University). Dr. Norris started in Fall, 1995. Dr. Norris did his postdoctoral work at U.C. Berkeley and University of Pennsylvania School of Medicine. His area of specialization is neurophysiology with research interests in neural networks that produce simple behaviors in invertebrates.

Norris BJ, Wenning A, Wright TM, Calabrese RL. 2011. Constancy and variability in the output of a central pattern generator. *J Neurosci*. 31(12):4663-74.

Calabrese RL, **Norris BJ**, Wenning A, Wright TM. 2011. Coping with variability in small neurona networks. *Integr Comp Biol*. 51(6):845-55.

Norris BJ, Weaver AL, Wenning A, García PS, Calabrese RL. 2007. A central pattern generator producing alternative outputs: pattern, strength, and dynamics of premotor synaptic input to leech heart motor neurons. *J Neurophysiol.* 98(5):2992-3005.

Betsy A. Read, Professor (Ed.D. Biology 1989: Ball State University). Prior to appointment at CSUSM in Fall 1993, Dr. Read worked as a Postdoctoral Fellow in the Microbiology Department at The Ohio State University. Dr. Read's area of expertise is Molecular Cell Biology with special emphasis in genomics and functional genomics of marine phytoplankton. While her broad and long term research objectives are to understand the molecular mechanisms governing the nanoscale shape and patterning of the calcium carbonate exoskeleton of marine coccolithophorids, her immediate research goals are to understand the molecular underpinnings of calcification and coccolithogenesis in *Emiliania huxleyi*, and to specifically identify the genes and corresponding proteins involved in these processes.

Cuvelier ML, Allen AE, Monier A, McCrow JP, Messié M, Tringe SG, Woyke T, Welsh RM, Ishoey T, Lee JH, Binder BJ, DuPont CL, Latasa M, Guigand C, Buck KR, Hilton J, Thiagarajan M, Caler E, **Read B**, Lasken RS, Chavez FP, Worden AZ. 2010. Targeted metagenomics and ecology of globally important uncultured eukaryotic phytoplankton. *Proc Natl Acad Sci* U S A. 107(33):14679-84.

J. Mark Cock, Lieven Sterck, Pierre Rouzé, Delphine Scornet, Andrew E. Allen, Grigoris Amoutzias, Veronique Anthouard, François Artiguenave, Jean-Marc Aury, Jonathan H. Badger Bank Beszteri, Kenny Billiau, Eric Bonnet, John H. F. Bothwell, Chris Bowler, Catherine Boyen, Colin Brownlee, Carl J. Carrano, Bénédicte Charrier, Ga Youn Cho, Susana M. Coelho, Jonas Collén, Erwan Corre, Corinne Da Silva, Ludovic Delage, Nicolas Delaroque, Simon M. Dittami, Sylvie Doulbeau, Marek Elias, Garry Farnham, Claire M.M.

Gachon, Bernhard Gschloessl, SvenjaHeesch, Kamel Jabbari, Claire Jubin, Hiroshi Kawai, Kei Kimura, Bernard Kloareg, Frithjof C. Küpper, Daniel Lang, Aude Le Bail1, Catherine Leblanc,Patrice Lerouge, Martin Lohr, Pascal J. Lopez, Cindy Martens, Florian Maumus, Gurvan Michel Diego Miranda-Saavedra, Julia Morales, Hervé Moreau, Taizo Motomura, Chikako Nagasato, Carolyn A. Napoli, David R. Nelson, Pi Nyvall-Collén, Akira F. Peters, Cyril Pommier, Philippe Potin, Julie Poulain, Hadi Quesneville, **Betsy Read**, Stefan A. Rensing, Andrés Ritter, Sylvie Rousvoal, Manoj Samanta, Gaelle Samson, Declan C. Schroeder, Béatrice Ségurens, Martina Strittmatter, Thierry Tonon, James Tregear, Klaus Valentin, Peter von Dassow, Takahiro Yamagishi, Yves Van de Peer & Patrick Wincker. 2010, The *Ectocarpus* genome and the independent evolution of multicellularity in the brown algae. *Nature* 465: 617–621.

Stephane C. Lefebvre, G. Harris, **Betsy Read**, Richard Webster, Nikos Leonardos, Richard J. Geider, Jose L Garrido, Christine.A. Raines Characterisation and expression analysis of the *Lhcf* gene family in *Emiliania huxleyi* reveals differential responses to light and CO_2. *Journal of Phycology*, 2009: 24(1) 123-134.

Arun Sethuraman, Assistant Professor (Ph.D. Bioinformatics and Computational Biology, Genetics 2013: Iowa State University). Prior to joining the faculty at CSUSM in Fall 2016, Dr. Sethuraman was a Research Assistant Professor/Postdoctoral Associate at the Center for Computational Genetics and Genomics, Temple University, Philadelphia. Dr. Sethuraman is an evolutionary computational biologist, working on developing statistical models and methods to study the adaptive genomics of structured populations and incipient species. He is specifically interested in the effects of population demography and natural selection in driving evolutionary trajectories in species of conservation (e.g. turtles) and invasion (e.g. predatory lady beetles) concern. On the computational side, his interests include methods for numerical optimization, clustering, and parallelization.

Sethuraman A, Janzen FJ, Weisrock DW, Obrycki JJ Insights from population genomics to enhance and sustain biological control of insect pests, *Insects* DOI: 10.3390/insects11080462

Vansant H*, Vasquez Y*, Obrycki JJ, **Sethuraman A** Coccinellid host morphology dictates morphological diversity of the parasitoid wasp, *Dinocampus coccinellae*. *Biological Control.* DOI: 10.1101/460998

Sethuraman A, Gonzalez NM*, Grenier CE*, Kansagra KS*, Mey KK*, Nunez-Zavala SB*, Summerhays BEW*, Wulf GK* (2018) Continued misuse of multiple-testing correction methods in population genetics - a wake-up call?, *Molecular Ecology Resources*. DOI: 10.1111/1755-0998.12969

Hey J, Chung Y, **Sethuraman A**, Lachance J, Tishkoff S, Wang Y (2018), Phylogeny estimation by Integration over Isolation with Migration Models, *Molecular Biology and Evolution.* DOI: 10.1093/molbev/msy162

Sethuraman A (2018), Estimating relatedness using admixture proportions in structured populations, *G3*. DOI: 10.1534/g3.118.200485

Thomas J. Spady, Assistant Professor (Ph.D. Biochemistry and Molecular Biology 1999: University of Nebraska Medical Center). Prior to joining the Biological Sciences department Fall 2008, Dr. Spady was a postdoctoral researcher at UCSD and with the center for Conservation and Research for Endangered Species at the San Diego Zoo. His current research integrates lab and field based methods to investigate reproductive ecophysiology and its application for conservation of bears and other Temperate Carnivora. Dr. Spady's lab conducts field research in the Black Hills of South Dakota during the summer and laboratory based projects at CSUSM during the school year.

Himelright BM*, JM Moore*, RL Gonzales*, AV Mendoza*, PS Dye, RJ Schuett, BS Durrant, BA Read and TJ **Spady** (2014). Sequential ovulation and fertility of polyestrus in American black bears (Ursus americanus). Conservation Physiology 2: doi:10.1093/conphys/cou051

Gonzales RL*, AV Mendoza*, BM Himelright*, JM Moore* and TJ **Spady** (2013). American black bear mating behavior and chemosensation of estrus. Ursus 24(2):139-147.

Spady TJ, DG Lindburg and BS Durrant (2007). Evolution of reproductive seasonality in bears. Mammal Review 37:21-53.

*CSUSM Student

Diego Sustaita, Assistant Professor (Ph.D. Ecology & Evolutionary Biology 2013: University of Connecticut). Dr. Sustaita is a proud product of the CSU system, having completed his undergraduate and master's degrees in biology at CSU Northridge before undertaking a Ph.D. program at UCONN. He joined the Biology faculty at CSUSM in Fall 2016 after completing his postdoctoral work at Brown University. He is fundamentally interested in the morphological and biomechanical bases to organismal adaptation, particularly with regard to feeding and locomotor systems of birds and mammals.

McElroy EJ, **Sustaita** D, McBrayer LD. 2020. Applied functional biology: linking ecological morphology to conservation and management. Integrative & Comparative Biology 60: 402-412.

Sustaita D, Rubega MA, Farabaugh SM. 2018. Come on baby, let's do the twist: the kinematics of killing in loggerhead shrikes. Biology Letters 14 20180321 DOI: 10.1098/rsbl.2018.0321.

Sustaita D, Rubega MA. 2014. The anatomy of a shrike bite: bill shape and bite performance in Loggerhead Shrikes. Biological Journal of the Linnean Society 112: 485-498.

Darcy Taniguchi, Assistant Professor (Ph.D. Biological Oceanography 2013; Scripps Institution of Oceanography, University of California, San Diego). Dr. Taniguchi is highly interdisciplinary in her intellectual interests. She earned her bachelors degrees in mathematics and biology and graduate degree in biological oceanography, all at the University of California, San Diego. She is joining the Biology Department at CSUSM in the fall of 2018. Her research has largely explored the characterization and response of marine communities and organisms to varying environmental conditions and biological interactions. Most of her work has focused on understanding planktonic communities that make up the base of the food web in the ocean.

Taniguchi, D.A.A., M.R. Landry, P.J.S. Franks, K.E. Selph. 2014a. Size-specific growth and grazing rates for picophytoplankton in coastal and oceanic regions of the eastern Pacific. *Marine Ecology Progress Series*. 509:87-101.

Taniguchi, D.A.A., P.J.S. Franks, F.J. Poulin. 2014b. Planktonic biomass size spectra: an emergent property of size-dependent physiological rates, food web dynamics, and nutrient regimes. Marine Ecology Progress Series. 514:13-33.

Taniguchi, D.A.A., P.J.S. Franks, M.R. Landry. 2012. Estimating size-dependent growth and grazing rates and their associated errors using the dilution method. Limnology and Oceanography: Methods. 10:868-881.

George Vourlitis, Professor (Ph.D. Ecology 1997 from University of California, Davis). Dr. Vourlitis is a terrestrial biogeochemist who's research interests lie in quantifying how human activities associated with climate and land use change alter carbon (C) and nitrogen (N) cycling and storage of terrestrial ecosystems. Dr. Vourlitis conducts his research in semi-arid shublands of southern California, which experience large inputs of atmospheric N from fossil fuel burning, and in the tropical savanna of the southern Amazon Basin, which are experiencing rapid deforestation and climate change. Dr. Vourlitis' research is primarily field-based and focuses on all levels of biological organization, including metagenomics of soil microorganisms that are critical in C and N cycling, plant growth and species composition, which affect terrestrial C and N storage and biodiversity, and whole-ecosystem studies of C and N cycling.

Vourlitis, GL, K Kirby, I Vallejo, J Asaeli, JM Holloway (2020) Potential soil extracellular enzyme activity is altered by long-term experimental nitrogen deposition in semiarid shrublands. *Applied Soil Ecology, in press*.

Vourlitis, GL, J Jaureguy; L Marin; C Rodriguez (2020) Shoot and root biomass production in semi-arid shrublands exposed to long-term experimental N input. *Science of the Total Environment*, 754 (2021) 142204; https://doi.org/10.1016/j.scitotenv.2020.142204.

Vourlitis, GL A Zappia, OB Pinto Jr, PHZ Arruda, FB Santanna, HJ Dalmagro, FA Lobo, JS Nogueira (2019) Spatial and temporal variations in aboveground woody carbon storage for cerrado forests and woodlands of Mato Grosso, Brazil. *Journal of Geophysical Research: Biogeosciences*, **124**. https://doi.org/10.1029/2019JG005201.

BIOLOGICAL SCIENCES COURSES

Note: courses may change and additional courses may be offered each semester. Please consult the online catalogue and schedule of classes.

Courses Open to Advanced Undergraduate or Graduate Students

BIOL 502 (4) Population Genetics Study of how populations evolve in response to demography and natural selection, to understand genetic diversity and variation. Includes a study of mutation, drift, neutral theory, migration, selection, structure and inbreeding. Lab includes a small-scale population genetics project, involving local flora and fauna. Lab covers DNA extraction, quality control, PCR, genotyping, sequencing, bioinformatics using R to address questions about evolutionary history and genomic diversity. *Three hours of lecture. Three hours of laboratory. Prerequisite for undergraduates: BIOL 352.*

BIOL 503 (4) Modern Molecular Biology and Genomics An introduction to modern application of molecular biology, including genomics. Specific topics covered will include genome sequencing, transcript profiling, genome-wide association studies, and large scale mutagenesis. Using the primary literature as a guide, the class explores both the technologies that underlie modern molecular biology and the impacts that current studies are having on our understanding of all biology, from agriculture to human disease. Accompanying laboratory provides students with hands-on experience in the analysis of genomic data sets. *May not be taken for credit by students who have received credit for BIOL 596G, 403. Prerequisite for undergraduates: BIOL 351 or BIOT 355.*

BIOL 504 (3) Virology A comparative survey of bacterial, animal and plant virus variations, including retroviruses and prions. Emphasis is placed upon the variations in structure, nucleic acid composition, and replication patterns. The relationship of viruses to disease is given serious consideration. *Prerequisite for undergraduates: BIOL 351 or 355.*

BIOL 505 (3) Physiological Ecology Advanced exploration of the interactions between animals and their environment. Focuses on major life processes such as respiration, endothermy versus ectothermy, torpor, hibernation, and the physiological trade-offs between growth, storage, reproduction and survival. Physiological features of animals that permit them to live in extreme environments including the deep sea, deserts, boreal/polar regions, and caves will be discussed. *Field trip(s) outside of class may be required. Prerequisite for undergraduates: BIOL 353.*

BIOL 512 (3) Physiology of Aging Examines changes in animal physiology that occurs during aging. Subjects include evolutionary and proximate causes of aging, physiological mechanisms proposed to explain aging, and methods to study and to manipulate rate of aging (e.g. caloric restriction). Both theoretical concepts and empirical examples will be addressed. *Prerequisite for undergraduates: BIOL 353.*

BIOL 512L (1) Physiology of Aging Laboratory Provides hands-on experience in techniques currently used to study physiological changes during aging. Students will design and perform experiments that demonstrate central topics of the biology of aging. Exact labs will change as the field of biogerontology develops, but may include experiments to test effects of caloric restriction, trade-offs between reproduction and longevity, declines in physiological systems with age, and cellular resistance to oxidative stress. Model organisms will typically include small

rodents, insects, and nematode worms. *Three hours laboratory. Prerequisite or Corequisite: BIOL 512.*

BIOL 513 (3) Ecology of Parasitism Parasites have regulatory effects on host populations, impart significant economic impact, and are sensitive indicators of pollution as well as other natural and anthropogenic effects. Examines the interaction of parasites with their hosts. The host-parasite interaction creates a unique physiological and genetic system as both host and parasite adjust and adapt to the pressures imposed by the other. Modes of parasitism, life cycles, mechanisms of infection, alteration of host behavior, and novel physiological pathways will be examined as a biological arms race is waged between genetically distinct organisms. *Prerequisite for undergraduates: BIOL 354.*

BIOL 514 (3) Physiology of Parasitism Examines the physiology of hosts and parasites including how host physiology affects its susceptibility to parasites and subsequent host response to infection. Explores how parasite physiology influences their ability to infect hosts. Subjects will range from whole animal metabolism and immune response to specific biochemical pathways that change during parasitism. Both theoretical concepts and empirical examples will be addressed. *Prerequisite for undergraduates: BIOL 353.*

BIOL 514L (1) Physiology of Parasitism Laboratory Provides hands-on experience in techniques currently used to study host-parasite physiology. Students will design and perform experiments that illustrate central topics of host-parasite associations. Subjects will change as the field develops, but may include studies of susceptibility, infection intensity, time to clear parasites and physiological effects of parasites on host life history. Focuses mainly on macroparasites and their vertebrate and invertebrate hosts. *Three hours laboratory. Prerequisite or Corequisite: BIOL 514.*

BIOL 515 (3) Medical Physiology An advanced study of human physiology, particularly as it relates to disease. Examine physiological systems at the molecular, cellular and organ levels. Course consists of lectures, student reviews of current articles from the New England Journal of Medicine, group presentations, and class discussions designed as an in-depth examination of a particular disease, its causes and current treatments. Subjects will be organized around physiological systems and their defects. The section on the immune system might conclude with a discussion of AIDS, while the section on the respiratory system might conclude with a discussion of asthma. *May not be taken for credit by students who have received credit for BIOL 596A. Prerequisite for undergraduates: BIOL 353.*

BIOL 520 (3) Advanced Molecular Cell Biology Treatment of contemporary areas of interest in cell biology, molecular genetics, and development. Subjects covered may include, but are not limited to: the cell cycle, signal transduction and cell-cell communication, the regulation of gene expression, determination and differentiation, and oncogenes. *May not be taken for credit by students who have received credit for BIOL 428. Recommended Preparation: BIOL 368 and CHEM 304. Prerequisite for undergraduates: BIOL 351 and 352.*

BIOL 531 (3) Biological Data Analysis I – Linear Models A large fraction of common statistical analysis types in the biological sciences can be expressed as a linear model. Teaches students to use linear models to statistically analyze data, and emphasizes the conceptual unity of seemingly disparate analytical techniques. Specific analysis types will include: analysis of variance, analysis of covariance, linear regression, logistic regression, and log linear models. New advances in likelihood-based model selection will also be addressed. Additional subjects will be selected by students. Prerequisites for undergraduates: *BIOL 215.*

BIOL 532 (3) Biological Data Analysis II - Multivariate Analysis From molecular biology to ecosystem studies, technology is facilitating collection of large, multivariate biological data sets. Multivariate analyses1seek to simplify, summarize, and test hypotheses about these complE~x.datasets. Addresses major issues in multivariate analysis, and will introduce students to common analysis types and visualization approaches. Subjects covered will include: principal components analysis, discriminant analysis, canonical correlation, and redundancy analysis. Additional subjects will be selected by students based on their needs and interests. *Prerequisite for undergraduates: BIOL 215.*

BIOL 533 (4) Geographic Information Systems Applications in Landscape Ecology Explores how landscape structure and pattern affect ecological processes, at the individual, population, community, and ecosystem levels. Applications to land use planning and conseNation biology will be covered. The primary enabling technologies for this new, rapidly growing discipline include remote sensing (such as satellite imagery) and geographic information systems (GIS), which will be covered during a weekly lab session. *Prerequisite for undergraduates: BIOL 354.*

BIOL 535 (3) Ecological Modeling An introduction to the use and development of mathematical models for simulating dynamics of ecological systems. Modeling theory and techniques will be demonstrated to provide a background on how models are developed and used in ecology. Models developed for simulating the effects of abiotic and biotic controls on ecological processes include continuous and- discrete-time population models, "gap" models, cellular automata, fisheries, and biogeochemical and biogeographical models. *Prerequisite for undergraduates: BIOL 354.*

BIOL 536 (3) Biogeochemical Cycles and Global Change Biological, chemical, and physical processes controlling the transport and transformation of carbon, nitrogen, phosphorus, sulfur, and trace metals in natural ecosystems and at the global level. Global models of the major elemental and hydrologic cycles are discussed, with emphasis on the linkages between cycles and the effects of human perturbations. *Prerequisite for undergraduates: BIOL 354.*

BIOL 537 (3) Microbial Physiology Current concepts and research involving the interactions of microorganisms with their environment, particularly those environments affecting human health. Demonstrates the interrelatedness of microbial ecology and medical microbiology. The course will (1) present modern experimental techniques used in conducting these interdisciplinary studies; (2) emphasize unusual bacteria pathways and cell signaling mechanisms found across the Bacteria, Archea and Eukarya, and (3) discuss the roles of microbial physiology in parthogenesis and the biotechnology industry. *Prerequisite for undergraduates: BIOL 351 or 367.*

BIOL 540 (3) Molecular Methods in Ecology and Evolution Theory and practical application of modern molecular tools to identify and study ecological and evolutionary relationships. *Two hours lecture and three hours laboratory. Prerequisite for undergraduates: BIOL 352.*

BIOL 560 (2) Seminar in Molecular Cell Biology Readings from the original literature, discussions, and writing on selected current subjects in cell and molecular biology. *May be repeated with new content for a maximum of four (4) units toward the Master's degree. Prerequisites: BIOL 351 for undergraduates, or enrollment in Master of Science in Biology Program.*

BIOL 561 (2) Seminar in Genetics Readings from the original literature, discussions, and writing on selected current subjects in genetics. *May be repeated with new content for a maximum of four (4) units toward the Master's degree. Prerequisites: BIOL 352 for undergraduates, or enrollment in Master of Science in Biology Program.*

BIOL 563 (2) Seminar in Physiology Readings from the original literature, discussions, and writing on selected current subjects in physiology. *May be repeated with new content for a maximum of four (4) units toward the Master's degree. Prerequisites: BIOL 353 for undergraduates, or enrollment in Master of Science in Biology Program.*

BIOL 564 (2) Seminar in Evolution Readings from the original literature, discussions, and writing on selected current subjects in evolution. *May be repeated with new content for a maximum of four (4) units toward the Master's degree. Prerequisites: BIOL 212 for undergraduates, or enrollment in Master of Science in Biology Program.*

BIOL 565 (2) Seminar in Ecology Readings from the original literature, discussions, and writing on selected current subjects in ecology. *May be repeated with new content for a maximum of four (4) units toward the Master's degree. Prerequisites: BIOL 354 for undergraduates, or enrollment in Master of Science in Biology Program.*

BIOL 566 (2) Seminar in Aquatic Biology Readings from the original literature, discussions, and writing on selected current subjects in aquatic biology. *May be repeated with new content for a maximum of four (4) units toward the Master's degree. Prerequisites: BIOL 354 for undergraduates, or enrollment in Master of Science in Biology Program.*

BIOL 576 (1) Laboratory Experience in Neurobiology Provides hands-on experience using the latest techniques in neurophysiology. Students will record intracellular signals in neurons using an invertebrate model nervous system. Students will gain experience in physiological and anatomical techniques. *Three hours of laboratory. May not be taken for credit by students who have received credit for BIOL 597A. Co/Prerequisite: BIOL 476.*

BIOL 596 (1-3) Advanced Topics in Biology Advanced study of selected biological topics based on current problems or advances, and as demand warrants. *Students should check the Class Schedule for listing of actual topics.*

BIOL 597 (1) Advanced Topics in Biology Lab Laboratory in selected advanced topics in biology. Topics based on current problems or advances, and as demand warrants. *Students should check the Class Schedule for listing of actual topics. Three hours laboratory.*

Courses Open Only to Graduate Students

BIOL 600 (3) Scientific Communication Practical experience in the preparation of written, oral and poster presentations in the biological sciences. Students will also actively take part in the peer

review process commonly used to evaluate the scientific and technical merits of research proposals. Final products may include formal grant (NSF or NIH) and thesis proposals. *Enrollment restricted to students with Graduate standing. May not be taken for credit by students who have received credit for BIOL 610 or 611.*

BIOL 604 (3) Advanced Developmental Physiology An in-depth analysis of developmental physiology concepts, including how animal function develops, the influence of the environment on development, and developmental origins of disease. Covers the basics of developmental biology, the link between development, physiology and evolution, the interaction between the environment and physiology during development, phenotypic plasticity, and the development of physiological systems. Readings from the primary literature will deepen appreciation for how developmental physiology can inform many biological fields. *BIOL 604 is dual-listed with BIOL 404. These courses will be taught together by the same instructor. May not be taken for credit by students who received credit for BIOL 404. Enrollment Restrictions: Enrollment restricted to students in the Biological Sciences graduate program.*

BIOL 604L (1) Advanced Developmental Physiology Lab Provides hands-on experience with experimental techniques for examining developmental physiology across a range of animal groups. Will cover techniques in how to examine, stage and rear developing animals, assess phenotypic responses to altered environmental conditions, perform ecotoxicological assays, and measure morphology and physiology. Will include multi-week experiments to assess changes in physiology during development. Statistical analyses will be performed and experimental results will be presented in written and oral forms. Field trip(s) during or outside of class may be required. *BIOL 604L is dual-listed with BIOL 404L.These courses will be taught together by the same instructor. May not be taken for credit by students who received credit for: BIOL 404L. Enrollment Restrictions: Enrollment restricted to students in the Biological Sciences graduate program. Three hours of laboratory.*

BIOL 620 (4) Advanced Ecological Monitoring An overview of the various approaches used to assess ecological condition (status) and change over time (trend) for ecosystems, vegetation types, populations, and biological communities. Lectures that provide conceptual understanding will be combined with hands-on practical exercises in the lab, so that students will be prepared to apply their knowledge to real-world conservation problems. Readings from the primary literature will explore the challenges and controversies involved in ecological monitoring. *Enrollment restricted to students with Graduate standing. May not be taken for credit by students who have received credit for BIOL 420.*

BIOL 634 (3) Advanced Human Cardio Physiology In-depth analysis of human cardiovascular physiology. Strong focus on human physiology, supported by comparative animal models. Taught through combination of lectures and case studies, providing overview of cardiovascular biology, and links between environment, disease and cardiovascular physiology. Specific topics include embryonic cardiovascular development, blood flow, blood pressure, cardiovascular neural regulation, cardiac morphology, hemodynamics, and cardiac disease. Students will be required to read peer-reviewed literature and write an expanded academic paper on a heart physiology topic.

BIOL 634 is dual-listed with BIOL 434. Students may not receive credit for both. Enrollment Restrictions: Enrollment restricted to students in the Biological Sciences graduate program.

BIOL 656 (3) Advanced Molecular Medicine Advanced understanding of molecular medicine and recent advances in the field taught through a combination of didactic methods and the use of case studies. Includes advanced principles of molecular medicine, modern discoveries in cellular and molecular mechanisms of disease, applications of clinical research, relevant topics in biomedical ethics, and current developments in personalized medicine. We will approach these subjects from the perspective of evaluating the process of therapeutic or vaccine approval from bench to bedside. *May not be taken for credit by students who received credit for: BIOL 686-4. Enrollment Restrictions: Enrollment restricted to students with graduate standing.*

BIOL 663 (3) Advanced Principles of Conservation Biology An in-depth focus on the princples and practices of conservation and restoration ecology. Factors that affect the creation, destruction, and distribution of biological diverseity are examined. Class discussions and assignments will focus on human destruction and degradation of habitats, invasive species introductions, accelerated species extinctions, pollution, global climate change, and species over-exploitation. The selection of maintenance of conservation areas will be explored, as well as the theory and methodology for restoring degraded habitats. *May not be taken for credit by students who have received credit for BIOL 363 or BIOL 463. Enrollment restricted to students with Graduate standing.*

BIOL 683 (3) Tropical Ecology A survey of the unmanaged and managed tropical terrestrial ecosystem and the biotic (living) and abiotic (non-living) factors that affect tropical ecosystem structure and function. Emphasis will be on the community dynamics and biogeochemical cycling of tropical ecosystems, and how these processes are affected
by land-use and land-cover change. *This course will be taught together with BIOL 383 by the same instructor. Enrollment Requirement: BIOL 210, 211, and 212. Prerequisite BIOL 354; enrollment is restricted to students who have not taken BIOL 383.*

BIOL 685 (2) Internship in Biology Instruction Supervised instruction in a laboratory course in the biological sciences. *May be repeated, but no more than two (2) units may be applied toward the 30 units in the Master's degree. Enrollment restricted to students with Graduate standing.*

BIOL 686 (1-3) Graduate Topics in Biology Lecture and discussion of selected topics with emphasis on current problems and advances in subdisciplines of biological science. *Students should check the Class Schedule for listing of actual topics. Enrollment restricted to students with Graduate standing.*

BIOL 687 (1-2) Advanced Methods in Biology Graduate-level field or laboratory techniques in a specialized area of contemporary biology. *Students should check the Class Schedule for listing of actual topics. Enrollment restricted to students with Graduate standing.*

BIOL 690 (3) Terrestrial Plant Ecology Survey of the factors that influence the physiology, distribution, and abundance of land (terrestrial) plants. Focuses on plant ecophysiology, plant population dynamics (e.g., dispersal, germination, and recruitment), plant-plant and plant-animal interactions, and the effects of the abiotic factors (e.g., climate, water, and nutrients) on the

structure and function of terrestrial plant communities. *This course will be taught together with BIOL 390 by the same instructor. Prerequisite: BIOL 354; enrollment is restricted to students who have not taken BIOL 390.*

BIOL 697B (2) 697C (3) 697D (4) 697E (5) 697F (6) Directed Studies Laboratory or field research directed or sponsored by Biological Sciences faculty. *May be repeated for a maximum of six (6) units toward the Master's degree. Enrollment restricted to students with Graduate standing. Enrollment restricted to students who have obtained consent of instructor.*

BIOL 698B (2) 698C (3) 698D (4) 698E (5) 698F (6) Thesis Design, implementation, and analysis of a formal research project in the biological sciences. *May be repeated for a maximum of six (6) units toward the Master's degree. Graded Credit/No Credit. Prerequisite: Advancement to candidacy. Enrollment restricted to students who have obtained consent of instructor.*

BIOL 699B (2) 699C (3) 699D (4) 699E (5) 699F (6) Thesis Extension Registration is limited to students who have received a grade of Satisfactory Progress (SP) in BIOL 698 and who expect to use the facilities and resources of the University to work on or complete the thesis. *May be repeated. Graded Credit/No Credit. Enrollment requirement: prior registration in BIOL 698 with an assigned grade of Satisfactory Progress (SP). Units may not be applied to the required units for the Master's degree. Enrollment restricted to students who have obtained consent of instructor.*

APPENDIX A

PROGRAM OF STUDY – MASTER OF SCIENCE IN BIOLOGICAL SCIENCES

Name: _____ Date: _____

Course Deficiencies: If none, check here: _____

Course Number/Name	Units	Semester Taken	Grade

Required Courses

Course Number/Name	Units	Semester Taken	Grade
BIOL 600 Scientific Communication	3		
Computational/quantitative: _____	3		
BIOL 697 Directed Studies	6		
Seminar in _____	2		
Seminar in _____	2		
BIOL 685 Internship in Biology Instruction	2		
BIOL 698 Thesis	6		

Elective Courses

Course Number/Name	Units	Semester Taken	Grade

Total Units (30 required): _____ **Total Units at 500 level:** _____

Required coursework: _____ **Total Units at 600 level (15 required):**_____

Elective coursework: _____

_____	_____	_____
Thesis Chair (print name)	Thesis Chair (signature)	Date
_____	_____	_____
Thesis Committee Member (print name)	Thesis Committee Member (signature)	Date
_____	_____	_____
Thesis Committee Member (print name)	Thesis Committee Member (signature)	Date
_____	_____	_____
Thesis Committee Member (print name)	Thesis Committee Member (signature)	Date

APPENDIX B

Department of Biological Sciences
Thesis Committee Membership Record

_____ _____
(Graduate Student Name) (Date)

_____
(Proposed Thesis Topic or Title)

I agree to serve as a member of the thesis committee for the above mentioned graduate student.

(Committee Member Name)	(Committee Member Signature)	(Date)	☐ Check if Research Supervisor
(Committee Member Name)	(Committee Member Signature)	(Date)	
(Committee Member Name)	(Committee Member Signature)	(Date)	

I agree to serve as chair of the thesis committee for the above mentioned graduate student, and approve the two faculty members who have signed above as committee members.

(Thesis Advisor Name)	(Thesis Advisor Signature)	(Date)
(Former Thesis Advisor Name)	(Former Thesis Advisor Signature)	(Date)

The Graduate Studies Committee approves the thesis committee for the above mentioned graduate student.

(Graduate Coordinator Name)	(Graduate Coordinator Signature)	(Date)

When completed, this form will be placed in the student's folder in the Department of Biological Sciences. Copies may be sent to the student, other committee members and the former advisor if applicable. If there are changes in committee composition, the student should complete a new form.

APPENDIX C

California State University
SAN MARCOS

Masters Degree
Advancement to Candidacy Form
BIOLOGICAL SCIENCES

Student Name _____ ID Number _____

Email _____ Phone Number _____

CANDIDACY REQUIREMENTS

A graduate student who has been met any conditions set upon their admission to the program is normally advanced to candidacy by his/her faculty advisor after the student has:

1. Developed a program of study approved by the student's thesis committee,
2. Orally presented an approved proposal for thesis research
3. A thesis committee that has been approved by the graduate studies committee. A formal thesis proposal must be orally presented to the committee no later than the beginning of the second year of full time study or after twelve (12) units of graduate coursework have been completed

REQUIRED SIGNATURES

Graduate Coordinator: _____ _____ _____
Print *Sign* *Dat*

Thesis Chair, Project Chair or Comprehensive Exam Advisor: _____ _____ _____
Print *Sign* *Date*

Committee Members: _____ _____ _____
Print *Sign* *Date*

_____ _____ _____
Print *Sign* *Date*

_____ _____ _____
Print *Sign* *Date*

APPENDIX D

California State University
SAN MARCOS

Office of Graduate Studies and Research

GRAD E699 Enrollment Form

GRAD E699 -- Graduate Standing Continuation. Provides continuation of graduate standing for students finalizing culminating activities (thesis, project, or comprehensive exam).

GRAD E699 carries zero credit units, has no instructor of record, and is "graded" CR automatically upon completion of the term. It is designed to confer enrollment status for the purpose of the continuous enrollment policy. The course may not be repeated.

GRAD E699 Criteria for Enrollment: GRAD E699 is designed for Master's students who have completed all of their graduate coursework, including the for-credit supervised thesis/project coursework called for in their respective graduate programs. Students who are still working closely with an advisor should enroll in their respective department's graduate-level independent study course, rather than GRAD E699.

Directions for Enrolling in GRAD E699

1. Obtain approval from the graduate program coordinator.
2. After obtaining graduate program approval and coordinator signature, submit this completed form to Registration and Records.
3. Course payment and add/drop deadline policies apply.

Student name:		
Program:		Year:
Campus ID:		☐ Summer
Email:		☐ Fall
Telephone:		☐ Spring
Student Signature:		Date:
Graduate Program Coordinator Name:		
Signature:		Date:

This form can be found at http://www2.csusm.edu/rgsip/graduate_studies/index.htm on the Office of Graduate Studies and Research webpage.

APPENDIX E

Graduation and Commencement

Information:

The online link to apply to graduate is: http://www.csusm.edu/enroll/graduation/index.html

How to apply for graduation

- Applications for graduation are now completed online through your student center. Graduation Application Information.
- Your graduation application must be submitted to Cougar Central by the deadline listed below. The hours of operation of Cougar Central are listed on their website.
- Contact your department or program advisor for any special requirements for the graduation application process
- If you apply for graduation but then do not finish that term, you will need to submit two forms: (1) a Graduation Cancellation Form, and (2) a new graduation application. The Graduation Cancellation Form can be obtained from Cougar Central.

When to apply for graduation

Master's degree candidates should file for graduation in accordance with the following schedule:

- For graduation at the end of the **Fall Semester**: November 15
- For graduation at the end of the **Spring Semester**: March 15
- For graduation at the end of the **Summer Term**: March 15

Note: If the above dates should fall on a weekend or holiday, the deadline will be at the close of business on the previous working day.

Commencement information

Information about Commencement can be found on the Commencement website.