

California State University, Fresno – Department of Biology
Graduate Degree Programs

01/16/06

Graduate Programs in Biology

Dr. Shirley Kovacs, Department Chair
Dr. Paul Crosbie, Graduate Coordinator

At California State University, Fresno, faculty researchers are using the most innovative and advanced equipment available today, and applying to their study that same practice of meticulous observation that has allowed current scientists to revolutionize the fields of ecology, molecular and cellular biology, vertebrate and invertebrate physiology, entomology, microbiology, parasitology, botany, systematics, and animal behavior. The Master of Science program in Biology offers opportunity for advanced learning in all of these areas, while also preparing students to teach these disciplines, conduct technical work, acquire professional industry positions as lab directors or researchers, or pursue advanced education at the doctoral level. The on-campus facilities and the surrounding region offer many opportunities for students desiring an active research experience.

The university's location in the San Joaquin Valley puts students within three hours drive to High Sierra, foothill, coastal, and forest environments, if their research interest is ecologically based. The Biology Department is also a member of a consortium that manages and operates the Moss Landing Marine Laboratory (MLML). Moss Landing is located on the California coastline between Santa Cruz and Monterey and offers students a practical and theoretical education in the marine sciences. It provides extensive field and laboratory work that cannot be duplicated on individual CSU campuses.

Further Information

You may also contact Dr. Paul Crosbie, Graduate Coordinator, CSUF Department of Biology, 2555 East San Ramon Avenue, Fresno, CA 93740-0073, (559) 278-2074. E-mail: pcrosbie@csufresno.edu (fax: 559-278-3963). World Wide Web at <http://www.csufresno.edu/graduatestudies>. For more information on the interdepartmental Master of Science degree in Marine Science write to: Moss Landing Marine Laboratories, P.O. Box 223, Moss Landing, CA 95039.

California State University, Fresno is one of the California State Universities and is an equal opportunity/affirmative action institution, which does not discriminate because of sex, race, age, color, religion, national origin, sexual orientation, marital status or disability.

The California State University is committed to providing equal opportunities to men and women CSU Students in all campus programs, including intercollegiate athletics.

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Mission Statement and Program Summary

Mission: To provide state-of-the-art educational experiences that will prepare students to make valuable contributions to society where a knowledge and understanding of biological organisms and processes are required.

Goal: To provide a solid foundation in modern biology, specialized education to improve career opportunities and provide a basic knowledge foundation for advanced study.

The Faculty: Our faculty have been trained at a wide range of outstanding research universities. Their expertise ranges from the organismal to the molecular.

The Program: M.S. emphasizing two research foci:

1. Ecology and evolution focus.
2. Molecular cellular and developmental biology focus.

The Facilities:

- Greenhouse facilities-growth chambers.
- The university: an arboretum.
- Newly renovated facilities.
- New research equipment.
- Research laboratories.
- Microscopy and Imaging Center.

The opportunities for our students:

- Many faculty have active research programs for graduate students to choose from.
- Teaching assistantships are available.

Where are our graduates?

- Ph. D. programs.
- Medical schools and health professions.
- Health and biotechnology industries.
- Government and academia.

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Master Degree Deadlines Spring 2004 through Fall 2004

Requirement	Requirement Description	Spring 2004 Graduation	Summer 2004 Graduation	Fall 2004 Graduation
Advancement to Candidacy Filing Deadline	Last day to apply for advancement to candidacy to be eligible for graduation the following term. Advancement must be achieved no later than one semester prior to the term in which you wish to register for the culminating experience and/or apply for the degree to be granted.	October 3, 2003	March 5, 2004	March 5, 2004
Graduation Application Period	The filling period for the master's degree to be granted is during the first two weeks of each semester or summer. Applications are available in the Division of Graduate Studies, Thomas Administration Building, Room 132. A \$35.00 non-refundable graduation application fee is required.	Jan. 22, 2004 - February 6, 2004	May 25, 2004 - June 11, 2004	Aug. 23, 2004- Sept. 3, 2004
Thesis Proposal	Thesis proposals and Advancement to Candidacy, due to the biology department faculty	Sept. 26, 2003	Feb. 27, 2004	Feb. 27, 2004
Final Thesis (299) Draft Deadline	Final Thesis draft, fully edited and signed, is due in the Division of Graduate Studies, Thomas Administration Building, Room 132.	March 22, 2004	June 28, 2004	Oct. 25, 2004
Completion of Academic Work	All courses and requirements must be completed. All paperwork must be submitted to your graduate adviser or department office for processing. Contact your adviser or department concerning the submission of the required Master's Degree Clearance form.	May 12, 2004 (final day of instruction)	Aug. 13, 2004 (final day of instruction)	Dec. 8, 2004 (final day of instruction)
Departmental Clearance Deadline	Master's Degree Clearance forms are due in the Division of Graduate Studies, on behalf of all graduating students. Semester grades and grade reports for all "I", "RD", and "SP" graded courses (other than thesis and project) must be on file with the University Records Office. Last day to submit paperwork to the Division of Graduate Studies for graduating students.	May 21, 2004	Aug. 13, 2004	Dec. 17, 2004

*Your department should set deadlines earlier than those listed above. Check with your graduate adviser.

Note: All dates above are tentative until the finalization of the university's Academic Affairs Calendar.

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Master of Science in Marine Science – Degree Requirements

This degree program - to be offered as an interdepartmental degree in cooperation with Moss Landing Marine Laboratories (MLML) - provides the opportunity for students to acquire a practical and theoretical education in the marine sciences to prepare them for careers as marine specialists, scientists, and teachers. The program at Moss Landing provides extensive field and laboratory work for advanced study in the marine sciences, which is not duplicated on individual CSU campuses.

The Master of Science in Marine Science degree program is administered through MLML and a consortium campus with emphasis on biology, geology, or other department; depending on the choice of the student. The prospective student must meet the entrance requirements for the home campus department and will be accepted into classified or conditionally classified status by normal procedures at that campus (see previous information for biology procedures summary). Conditionally classified students must become, classified by home campus procedures. MLML may impose additional requirements for classification.

The Thesis Committee will be composed of at least three members, including one faculty member from MLML (who is ordinarily the thesis adviser) and, at the discretion of the home campus, a representative of that campus. The other member or members of the Thesis Committee may be from MLML, the home campus, or elsewhere with the approval of the thesis adviser. The final colloquium must be given at the home campus.

Additional MLML Degree Requirements Including Coursework. A student becomes eligible for the master's degree in marine science after the following requirements have been satisfied:

	Units
Courses in 100 series (requires any three of the following five courses: M SCI 103, M SCI 141, M SCI 142, M SCI 143, M SCI 144)	12
Courses in 200 series (including 2 units of M SCI 285T, 286T or 287T, and 4 units of M SCI 299)	15
Electives (course[s] in the 100 and/or 200 series) approved by Thesis Committee	<u> 3</u>
Total	30

Note: Quantitative Marine Science, M SCI 104, does not count toward the degree.

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Certificate of Advanced Study Program in Biotechnology

California State University, Fresno offers a Certificate of Advanced Study Program in Biotechnology. This intensive one-year post-baccalaureate program emphasizes molecular biology and a wide range of laboratory skills at the forefront of modern biotechnology. The biotechnology field is growing rapidly, and as new products and applications are commercialized, there is increased need for highly skilled personnel capable of working in both research and production areas. Enrollment is limited to 12 to 15 students per year, who work closely with faculty in a variety of lecture and laboratory courses. Among the techniques studied are purification of biological macromolecules, gene splicing, DNA sequencing, culturing of mammalian cells, hybridoma production, and plant cell culturing and cloning.

The Certificate Program can lead to potential careers in expanding fields, such as drug and hormone production in the pharmaceutical industry, monoclonal antibody production for medical diagnostics, crop improvement, industrial bioprocessing and medical research. The program also provides a background for further postgraduate studies in fields such as biochemistry, molecular biology and agricultural biotechnology. Some of the courses may also be used at California State University, Fresno as components of master's degree programs in biology, chemistry, plant science, and related departments.

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Master of Science - Degree Requirements

The Biology Department awards a Master of Science degree. It involves five steps.

1. **Admission** *by the University to the Graduate School.*
2. **Classification** *as a Biology graduate student. This is granted by the Biology Department to students who have earned a bachelors degree in biology with a sufficiently high level of scholarship to undertake graduate training. Classification is acceptance of a student, by the Biology Department, to begin work of courses that may be counted toward the Masters degree.*
3. **Advancement to Candidacy.** *A student is advanced to candidacy by the Biology Department on satisfactory completion of the graduate writing requirement, the formation of a graduate committee and their agreement on a graduate course program, a thesis project, and other requirements.*
4. *As a candidate, the student will complete degree requirements and present their research results as a thesis and in a colloquium.*
5. **Granting of the degree** *occurs on the satisfactory completion of all coursework, submission and satisfactory defense of a thesis, and other requirements.*

Admission

There are four steps required to gain admission to the Master of Science program.

1. **University Application:** Students are admitted to the University as a post baccalaureate student. Please contact Graduate Admissions about entrance requirements and the application process. Domestic students can apply on-line at www.csumentor.edu.
2. **GRE:** The GRE is required for all applicants by the university. The subject GRE (Biology) is optional, but the GRE may be used to support classification as a Biology Graduate student as described in Appendix A.
3. **Letters of Recommendation:** Two letters of recommendation are required. They should be sent to:
Paul Crosbe
2555 E San Ramon MS SB73
Fresno, CA 93740
4. **TOEFL:** TOEFL is a University requirement for international students, who should apply through International admissions.

After review by the Biology Department graduate coordinator, students are assigned to one of two categories:

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1. Classified - full graduate standing in the department. This indicates admission into the department and constitutes the beginning of the student's graduate program in the Biology Department.
2. Conditional - students with deficiencies that can be corrected in one semester. The requirements to qualify for classified standing are lists in Appendix A.

Biotechnology Certificate Program

It is possible to complete the Biotechnology Certificate Program while completing the Master's of Science in Biology. The program consists of 20 course units, 11 units may also count toward the Master's Program course work. Please see the Biology Department for more information.

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Requirements For Conditional Students to Attain Classified Standing

1. A maximum of 10 units taken prior to attaining classified standing in the Biology Department, including transfer and post baccalaureate units, may be applied toward the master's degree program of courses.
2. Course work done to complete the competency requirements, as described in the Catalog and summarized in Appendix A, may not be applied to the graduate program requirements.
3. Students must work with the graduate program coordinator for the swift completion of any competency requirements, as described in the Catalog and summarized in Appendix A. This meeting should occur before their first semester. A temporary advisor will be assigned to students upon request to aid students in developing relevant courses for their intended graduate study.
4. Conditional graduate students must notify the graduate coordinator that they have completed the requirements to become classified. The graduate coordinator will file a Notice of Classified Standing with the Graduate Division.

Requirements For Advancement to Candidacy

1. Classified students may file for Advancement to Candidacy, no sooner than their second semester as a classified student and no later than the semester prior to the expected final semester of their graduate career. Carefully check the requirements for advancement and check deadlines on the university calendar. Note: the deadlines are usually early in the semester.
2. *Before a student may Advance to Candidacy they must satisfactorily complete the Graduate Student Writing Requirement. Instructions for the completion of this requirement are listed in Appendix C. The scoring rubric used to evaluate student submissions is also provided in Appendix C.*
3. To advance to candidacy a student must:
 - a. Engage a member of the graduate program faculty to serve as research advisor and thesis committee chair.
 - b. Establish a Thesis Committee with a minimum of three members of the graduate program faculty, and at least two members of the Biology Department graduate program faculty. Non-faculty professionals having special expertise relevant to the student's research program may be included as additional (e.g., fourth) members of the thesis committee if they have attained adjunct faculty status within the Biology Department or other University department.

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- c. Develop of coherent program of study including identification of 30 units of course work and a thesis research plan. The requirements for this are described in the catalog and summarized in Appendix B.
- d. Have completed at least nine units of coursework toward your proposed program - not including the semester you are enrolled in when you apply for candidacy.
- e. Have achieved a minimum grade point average of 3.0 in all course work taken from the earliest term listed on the petition for advancement to candidacy. The GPA includes all coursework taken in this timeframe, including courses in other departments unrelated to the biology degree program.
- f. Students are required to submit their thesis proposal to the Biology Department at least one week before any deadline dates. The proposal must be approved by all members of the thesis committee prior to distribution to the department. The Biology Department faculty is permitted at least two weeks to review the proposed thesis. The proposal will be considered by the department at departmental meetings or by special ballot, not less than two-week review period. These proposals can be submitted at any time to the department faculty for formal review. However, the Graduate Division has deadlines that pertain to graduation during the following semester, and each student is responsible for meeting deadline dates.
- g. During the department review the proposal will be evaluated for meeting the Graduate Division writing requirement. Students who do not meet the writing requirement guidelines will be asked to rewrite their proposal and submit it a second time. Students are urged to submit the proposal before the deadline to allow time for revisions.
- h. Students are required to submit the Advancement to Candidacy Form, signed by the student and their thesis program advisor, to the Graduate Coordinator for approval. The form is attached to the thesis proposal and distributed to the Biology Department.
- i. The cover sheet of the thesis proposal should contain the names of the student's thesis committee, thesis program advisors name, student's name, date, and the title of the project.

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Information for the Candidate -

1. Immediately after Advancement to Candidacy, submit a Thesis Committee Assignment Form signed by the student, their thesis program advisor, and their thesis committee members, to the graduate coordinator for approval. The student is responsible for taking the form to the Graduate Division offices.
2. The chair of the student's thesis program and the Biology Department Graduate Coordinator must approve fundamental changes made to the graduate research plan.
3. Written requests for changes in courses listed in the student's Advancement to Candidacy Form must be submitted to the Graduate Division, with the approval of the thesis advisor, graduate coordinator, and the Dean of Graduate Studies.
4. There is a five-year limit on courses used to complete requirements for the master's degree. Up to two courses taken prior to the five year date may be "validated for currency" by special exam or other approved method designated by the faculty instructor.
5. *CR*-graded course work cannot be used to satisfy degree requirements unless special permission is granted by the Graduate Division and the course is only offered as *CR*. No course with a grade below *C* may apply on the master's degree.
6. Students must maintain a GPA of 3.0 on all coursework taken during the period of matriculation for the master's degree.

Requirements for Thesis and Colloquium

1. Biology graduate students must write a thesis to complete their degree.
2. The thesis must show originality, appropriate organization, clarity of purpose, critical analysis, and accuracy and completeness of documentation where needed. Critical and independent thinking is required. It must meet standards for publication in the scholarly journals of that discipline. Students must enroll in four units of thesis (299). The thesis should be written in discussion with the student's thesis committee, particularly the thesis committee chair.
3. If thesis work is not completed the semester for which the student has enrolled in 299, a grade of *SP* is entered. If the grade is not replaced within two years, the department may require the student to reenroll in 299.
4. Students must maintain continual enrollment at the University while: 1) completing a grade of *SP* in thesis (299), or a grade of *I* in any other course, OR 2) during the semester in which an application for the degree is to be granted. Students may apply for an official leave of absence with the Graduate Division to be exempted from this rule.

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5. Due dates for the thesis are determined by the Graduate Division and are listed in the University Calendar. The date is early in the semester. It is possible to make a few changes in the thesis after submission to the Graduate Division. No changes may be made after the last day of instruction for that semester or after the date assigned by the Graduate Division thesis consultant. The thesis committee, before submission to the graduate program, must approve the thesis.
6. Students must submit their thesis at least two weeks before the university due date to their thesis committee members. Some committee members may require more than two weeks to read the thesis and if they request more time the student must distribute the thesis to that committee member earlier. Students should expect substantial rewriting of their thesis in response to committee member comments and suggestions. Students expecting to graduate in the summer semester should check with their committee about their schedule.
7. The thesis must conform to the Graduate Division criteria on matters of format, documentation, and quality of writing. This information must be obtained from the Graduate Division.
8. Final publication of the thesis requires the student turn in on original and two photocopies signed by the thesis committee, ready for binding and microfilming, to the Graduate Division. A receipt for binding and a microfilming fee should accompany the thesis copies. This must be completed by the last day assigned by the thesis consultant.
9. Students must also present their research in a colloquium. This is a formal presentation of research results. This must be completed seven days prior to the last day of instruction for the semester the student wishes to graduate.
10. The date, time and place of the colloquium must be arranged in consultation with the thesis committee members and in coordination with the Biology Department staff. Only certain days and times may be available. Students must also arrange for the appropriate equipment for their presentation (projector, overhead....).
11. Students must produce and post notices for the colloquium. Colloquium notices must be posted at least seven days before the colloquium around the Science building and other appropriate sites.

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Requirements To Graduate

1. To graduate students must have completed the steps outlined in the above sections of this document within the appropriate time frames.
2. Students must file an application for the granting of the Master of Science degree (Master's Degree Application) and pay the diploma fee. This must be completed early in the semester in which the student expects to complete all requirements for the degree. The deadline for filing this application is determined by the University. This deadline is very early in the semester and is listed in the University Calendar. The University Calendar is available in the schedule of courses for that semester.
3. Upon final submission of the graduate thesis, the student's are required to file a "Graduate Clearance Form". The student and their advisor must complete this form, before submitting it to the graduate coordinator and the department chair.

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Appendix A

Criteria for Classified status in the M.S. program of the Department of Biology, CSU Fresno. Passed by unanimous vote of the attending department faculty at their meeting, Friday 26 September, 2003.

1) Verbal and written communication

- a. 60th percentile on the verbal portion of the General GRE **OR**
- b. A grade of B or better in an upper division writing course **OR**
- c. A score of 80% or better on the writing exam used to fulfill the undergraduate writing requirement (the UDWE) **OR**
- d. A mean score of 4.5 or higher on the writing portion of the General GRE

2) Quantitative analytical skills

- a. 60th percentile on the quantitative portion of the General GRE **OR**
- b. A grade of B or better in introductory calculus

3) Disciplinary knowledge

- a. 60th percentile on the GRE Biology subject test **OR**
- b. Completion of the following upper division courses or their equivalents with a grade of B or better: Genetics, Evolution, either Cell Biology or Ecology, and one other upper-division or graduate course appropriate to the student's specialty. Equivalency is determined by the graduate coordinator in consultation with faculty teaching core courses at CSU Fresno **OR**
- c. No less than a grade of C in each of the courses listed as part of b. above **AND** an overall GPA of 3.0 or better for at least the last 25 semester units of upper-division courses in natural sciences.

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Appendix B

Develop a coherent program of study.

1. Identify a thesis topic.
2. Submit a plan for completing all coursework within this framework
 - a. 200-series courses - 21 units
 - b. Electives - may be 100 or 200 - series 9 units
 - c. At least 18 units must be in the biological sciences
 - d. No more than 6 units of independent study or research (BIOL 290 or BIOL 295) may be used on the program of study.
 - e. Four units of thesis (BIOL 299) are required; not more than four units of thesis (BIOL 299) may be used on the program of study.
3. At least 10 units of course work from the approved graduate program must be completed after advancement to candidacy. Units taken during the semester that the student applies for candidacy will be considered as having been completed after advancement.
4. Maintain a minimum grade point average of 3.0 in all course work taken from the earliest term listed on the petition for advancement to candidacy, including courses not listed on the program of study but undertaken during the same time period.
5. Write a plan for graduate work including a research plan, I.E. the thesis proposal.

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Appendix C

To satisfy the Graduate Writing Requirement

1. The writing requirement must be completed before the student submits a petition for Advancement to Candidacy. The written document for evaluation may be submitted at any time after Classified Admission to the Biology Department.
2. Submission deadlines:
 - a. If the student intends to meet the semester Graduate Division deadline for Advancement to Candidacy (only necessary if the student wishes to graduate the following semester): the first Friday of the semester.
 - b. If the student does NOT intend to graduate the following semester: no later than four calendar weeks before the last day of instruction.
3. To meet the writing requirement the student must submit a formal paper demonstrating writing skill at the graduate level. This graduate level paper may be a research proposal, a literature review in their field, a paper from a directed research project, or another paper that meets the objectives for the writing requirement (listed below in #4).
4. The student's writing should demonstrate:
 - a. Comprehensibility
 - b. Clear organization and presentation of ideas
 - c. The ability to organize ideas logically so as to establish a sound scholarly argument
 - d. Thoroughness and competence in documentation
 - e. The ability to express in writing a critical analysis of existing scholarly/professional literature in the student's area of interest
 - f. The ability to model the discipline's overall style as reflected in representative journals
5. The paper is distributed to a three-member review committee (not to include the student's graduate advisor) chosen by the graduate coordinator. The review committee has two weeks to complete review.
6. The paper will be scored using a rubric (1 - 5) in each of four areas: "I. Style and Format", "II. Mechanics", "III. Content and Organization", and "IV. Integration and Critical Analysis".
7. The scoring rubric is appended below. The minimal acceptable combined score from all of the four (I-IV) sections is 12 points (a mean of 3, "satisfactory", rating on each section), with no less than a score of 2 ("developing") on any one section.
8. Students who fail have two options:
 - a. Resubmit an edited paper to the original review committee.
 - b. Appeal – A new committee will be selected to review student submissions.
9. Students that fail to complete the writing requirement following Step 8 (above), must petition the Biology Department for a solution. The Biology Department may require the student to take

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a course, to write a new document for evaluation, or require any other action determined to be appropriate for the individual student.

10. Students that fail to complete the writing requirement following step 9 (above) will be dismissed from the program.

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Scoring rubric used to evaluate student submissions to satisfy the Graduate Writing Requirement.

I. Style and Format:

5-Exemplary: In addition to meeting the requirement for a "4," 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 biological journal in the student's field of study.

4-Accomplished: 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 journalistic style.

3-Satisfactory: The style and format are broadly followed, but inconsistencies are apparent. There is selection of less suitable scientific 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.

2-Developing: While some biological 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.

1-Beginning: The stylistic conventions of scientific writing are not followed. Fails to demonstrate thoroughness and competence in documentation. Inappropriate style and format make reading and comprehensibility problematic.

II. Mechanics:

5-Exemplary: In addition to meeting the requirements for a "4," 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.

4-Accomplished: 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.

3-Satisfactory: 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 scientific vocabulary is used.

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2-Developing: 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 scientific terms. Writing does not flow smoothly from point to point; appropriate transitions are lacking.

1-Beginning: Paper contains numerous errors in spelling, grammar, and/or sentence structure, which make following the logic of the paper extremely difficult. Scientific terms are misused.

III. Content and Organization:

5-Exemplary: In addition to meeting the requirements for a "4," 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.

4-Accomplished: 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.

3-Satisfactory: 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.

2-Developing: 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.

1-Beginning: Analysis of existing scholarly / professional literature on the topic is inadequate. Content is poorly focused and lacks organization. The reader is left with little information about or little understanding of the paper's topic.

IV. Integration and Critical Analysis:

5-Exemplary: The document presents the current state of knowledge for the topic being addressed utilizing a diversity of scientific opinions. These various, and possibly conflicting, opinions are presented in a balanced manner and seamlessly woven together to illustrate a complete grasp of the scientific 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.

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4-Accomplished: 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.

3-Satisfactory: 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.

2-Developing: 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 scientific topics. The resulting manuscript significantly degrades the comprehensibility of the document and the identification of knowledge gaps.

1-Beginning: The manuscript contains numerous flaws in the essential components of a literature review. The manuscript lacks a successful synthesis of disparate works, and there is no logical flow to the presentation. These issues result in a manuscript with limited comprehensibility and utility in illustrating the author's effective grasp of the material.

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Research Activities

Faculty expertise spans the range of biology from molecular to ecological. Our faculty is actively engaged in research in the following two foci:

Ecology and Evolution focus:

The Ecology and Evolutionary Biology research group within the CSU, Fresno Department of Biology is involved in a diverse array of research disciplines that focus upon the plant and animal communities of the California Coast. These beautiful and often pristine aquatic and terrestrial environments provide nearby natural laboratories with which to study an array of biological systems and processes. In particular, ecological research includes studies of plant population and community ecology, systems analysis of freshwater ecosystems, wildlife ecology and physiological ecology. Evolutionary research includes the study of insect-microbe interactions, population dynamics of plant-associated bacteria, evolution of bacterial catabolic pathways, and molecular systematics and biogeography of marine algae.

Molecular Cellular and Developmental Biology and Physiology focus:

Research opportunities in the Molecular, Cellular and Developmental (MCD) Biology and Physiology realm at CSU, Fresno exploit the newest technologies to address scientific questions, within three major groups - Microbiology & Immunology, Animal Physiology, and Plant Genetics & Development. Both medical and environmental issues occupy the Microbiology group. Specific topics of study include:

- bacterial pathogenesis and cholera vaccine production
- the role bacteria may play in the pathogenesis of the autoimmune disease, Lupus
- the microbial catabolic pathways useful for bioremediation of man-made chemicals, e.g., herbicides

Research interests in the Animal group focus on cellular physiology, particularly membrane transport studies and the endocrinology of reproduction.

Within the Plant group, the predominate issues are plant genomic evolution of vascular and non-vascular plants, using both classical genetic and molecular systematic approaches, and higher plant development mechanisms, using cellular fine structure and studies of programmed cell death. More applied endeavors of plant molecular biology include the genetic basis of both starch biosynthesis and disease resistance. Studies on DNA fingerprinting in grapes, in cooperation the Agricultural College, open a new area of agricultural forensics.

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Faculty and Research Interests

Raymond H. Abhold, Ph.D., Rutgers University. Neurochemistry, the action and interaction of neuropeptides in control of blood pressure.

David M. Andrews, Ed.D., University of Maine. Science education; applying and evaluating the constructivistic model of teaching learning and assessment in national K-16 science education reform projects and systemic initiatives.

Steve Blumenshine, Ph.D., University of Notre Dame. Aquatic ecology; food webs; role of predation and nutrient enrichment on the structure and dynamics of aquatic communities and ecosystems; fish growth and bioenergetics.

Alejandro Calderon-Urrea, Ph.D., Yale University. Developmental biology. Study of developmentally regulated programmed cell death in plants using genetic, molecular and cellular approaches.

David L. Chesemore, Ph.D., Oklahoma State University. Wildlife management and animal ecology, natural resource management, applications of biometry, scientific and nature photography.

John Constable, Ph.D. Plant Physiology; Physiological ecology; Plant responses to global climate change; Water carbon and nitrogen relations.

Paul R. Crosbie, Ph.D., University of California, Davis, Parasitology: host-parasite interactions, parasite life history strategies and ecology, parasite systematics and phylogenetics using both molecular and morphological approaches.

Madhusudan V. Katti, Ph.D., University of California, San Diego. Ecological, behavioral, and physiological responses of animals to environmental variation at natural and human-induced extremes.

Ruth Ann Kern, Ph.D., Duke University. Terrestrial Plant Ecology; Plant population and community ecology of montane ecosystems.

Shirley A. H. Kovacs, Ph.D., Oregon State University. Immunology and cell and molecular biology; molecular structure and function of antigens associated with autoimmune connective tissue (arthritis) disease; evolution of RNA splicing.

James P. Prince, Ph.D., Cornell University. Plant molecular genetics and crop improvement; Genome evolution and disease resistance in plants.

Mamta Rawat, Ph.D., Microbial physiology and genetics.

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Larry G. Riley, Jr., Ph.D. University of Hawaii. Organismal physiology and endocrinology, Comparative endocrinology, Endocrine regulation of growth, glucose and fat metabolism, Neuroendocrine mediators of appetite.

Fred E. Schreiber, Ph.D., Ohio State University. Forensic entomology, plant insect interactions, insect pathology.

Brian Tsukimura, Ph.D., University of Hawaii. Comparative physiology, reproductive endocrinology, environmental factors affecting reproduction.

Alice D. Wright, Ph.D., University of Michigan. Bioremediation, microbial physiology, metabolism of argichemicals in microorganisms, microbial ecology and diversity.

Lenore W. Yousef, Ph.D., University of California, Berkeley. Membrane physiology; Membrane transport and the nervous system.

Frederick W. Zechman, Ph.D., Louisiana State University. Molecular and morphological approaches to systematics and biogeography; molecular evolution; marine and freshwater phycology.

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Biology Department Adjunct Faculty

In addition to the regular Biology faculty, the department maintains close associations with professionals in the community. More than two dozen local scientists, many of them internationally known, serve as Adjunct Faculty. Adjunct Faculty from the UC Medical Education Program, US Department of Agriculture, US Forest Service, Endangered Species Recovery Program, California Department of Fish and Game, several regional medical institutions, and other agencies and programs offer classes, advise CSUF students, and sponsor cooperative research. Following is a list of some of the Adjunct Faculty.

Brian L. Cypher, Ph.D. Zoology, 1991, Southern Illinois University, Carbondale. Research Ecologist for the Endangered Species Recovery Program. Current research efforts include ecology and conservation of endangered San Joaquin kit foxes.
Phone: 661-398-2201

Ellen A. Cypher, Ph.D. in Plant Biology, 1993, Southern Illinois University, Carbondale. Principle plant ecologist for the Endangered Species Recovery Program.
Phone: 661-398-2201

Patrick A. Kelly, Ph.D. Zoology, 1990, University of California, Berkeley. Director of the Endangered Species Recovery Program in Fresno, California.

Kathryn Purcell, Ph.D. in Ecology, Evolution, and Conservation Biology from the University of Nevada, Reno. Research Wildlife Biologist with the US Forest Service, Pacific Southwest Research Station, Forestry Sciences Lab in Fresno, CA. Research interests include wildlife-habitat relationships, dealing with issues of habitat quality and response to habitat alteration.

Kent T. Yamaguchi, Md. University of California, San Francisco. Clinical Professor of Plastic Surgery at the University of California, San Francisco. Chief of Plastic Surgery at the University Medical Center and the Veterans Medical Center in Fresno, California.