

**Course Title:** Graduate Thesis Research and Professional Development

**Course:** SIO 299

**Contact Information:**

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**Course Description:**

SIO 299 provides master's and doctoral students with the opportunity to conduct advanced research in the marine sciences. The Scripps Institution of Oceanography (SIO) offers a PhD or MS in Oceanography, Marine Biology, and Earth Sciences. In addition, SIO offers a joint doctoral degree in Geophysics with San Diego State University.

SIO 299 will facilitate the development of critical thinking and problem-solving skills, independent research aptitude, proficiency in using modern research tools and techniques, and the rigorous interpretation of data in the context of the current literature. It emphasizes active involvement in research projects, including field-based methods, if appropriate. Students are strongly encouraged to develop their own research questions. Research ethics, professional development, and the responsible conduct of research will be incorporated throughout the course. Training on ensuring rigor and reproducibility for research results will be emphasized. As part of the 299 instruction, evaluation, and revision of the student's Individual Development Plan (IDP) will be prioritized to define short- and long-term career goals.

While employment (e.g., a GSR or IA appointment) is performed as a service for a defined period or a specified set of activities, academic effort under SIO 299 is undertaken in pursuit of a defined academic goal (MS or PhD) that is not always associated with a precise expectation of time or with predetermined activities. This means that learning outcomes and assessment methods will be determined and administered over several years. However, a subset of objectives that should be achieved in a particular quarter must be discussed to ensure timely grading and completion each quarter.

**Prerequisites:** Admission to an SIO PhD or MS graduate program. Enrollment requires permission of the instructor, typically the thesis research advisor or co-advisor.

**Units:** Up to 12 units per quarter with one advisor (with the possibility of up to 16 units if the student has multiple advisors). Each unit represents 3 hours or more of academic activity per week, as outlined by UC San Diego Academic Senate and the Western

Association of Schools and Colleges (WASC) credit-hour policy. Therefore, 12 units of SIO 299 credits correspond to a minimum 36 hours of academic activity per week for each week of the quarter. To remain a full-time student, individuals must be registered for 12 units per quarter. Early career PhD students and most MS students will be enrolled in a combination of coursework and research (SIO 299) to satisfy their full-time status. However, more senior graduate students are expected to be primarily focusing on academic activities related to SIO 299.

**Grading:**

S/U grades only. All work is due no later than Friday of Finals Week. Final Grades are due no later than Tuesday following Finals Week. Any requests for additional time should be made in accordance with UCSD's policy on Incompletes: <https://senate.ucsd.edu/Operating-Procedures/Senate-Manual/Regulations/500#B>

**Course Topics:**

**Course topics will vary from quarter to quarter; there may be topics not listed here that will be relevant for some students.**

1. Research Methods
  - Overview of research paradigms and approaches
  - Formulating research questions and objectives
  - Understanding the research process
2. Literature Review and Conceptual Framework
  - Conducting a comprehensive literature review
  - Critical analysis of the relevant published data
  - Identifying research gaps and justifying the research study
  - Developing a conceptual framework
3. Research Design, Data Collection, and Data Analysis
  - Design of experimentation, observations, statistical methods, and/or models
  - How to perform experiments, data analysis, and/or modeling
  - Data collection methods
  - Data analysis and interpretation
  - Quantitative data analysis
  - Qualitative data analysis
  - Interpreting research findings and drawing conclusions

4. Writing and Presenting Research Findings
  - Scientific writing skills
  - Effective data visualization and graphical representation
  - Oral presentation skills
5. Research Ethics, Responsible Conduct of Research, and Professional Development
  - Ethical principles in research
  - Professional conduct in workplace
  - Professional and respectful communication skills
  - Plagiarism and intellectual property rights
  - Review and discussion of Individual Development Plan (IDP)

### **Learning Outcomes:**

Upon completion of the course, the student will have enhanced and further developed skills in the following areas.

1. Formulation of research hypotheses in the context of current knowledge
2. Determination of scientific approaches to testing a research hypothesis
3. Proper lab experimental design, field sampling strategies, data analysis methods, model design, and/or access to archived data to ensure rigor and reproducibility
4. Performing experiments, field work, model simulations, statistical analyses, and/or archived data syntheses to address a research hypothesis
5. Analysis and interpretation of data
6. Development of alternative hypotheses and explanations for the results
7. Synthesis of results with current literature to formulate new scientific knowledge and hypotheses
8. Written and oral presentation of research findings (communication skills)
9. Consideration and incorporation of ethical issues in research
10. Evaluation and guidance of short- and long-term professional goals (IDP review)

### **Assessment Methods:**

1. Research Practice: Evaluation of the student's laboratory, field, engineering or computational techniques, data collection and analysis, problem-solving skills, attention to laboratory/field safety, and practice of the responsible conduct of research. Regular attendance and participation are required as is attendance for any scheduled research group meetings. Performance metrics can include development and utilization of project-specific methodologies, successful organization of research activities, and

acquisition of background knowledge through literature review. Please refer to the PhD milestones document (Appendix 1), which provides a basic set of expectations to be met each year in order to receive a satisfactory grade.

2. Written Research Report (Optional): A written report that includes the background & significance, initial plans, new results, data analysis and interpretation, and future plans. Student and instructor will decide together if this is needed each quarter.

3. Oral Presentation: An oral presentation that contains background & significance, initial plans, new results, data analysis and interpretation, and future plans. A 15-20 minute presentation at one of the weekly lab meetings satisfies this requirement.

### **Resources and Materials:**

Resources and materials will be provided by the thesis advisor's research program or collaborators. Students are expected to familiarize themselves with the specific protocols and techniques relevant to their project. The course instructor and associated personnel are available for consultation and support.

### **Additional Information:**

Maintaining a safe and respectful environment in the lab/field is required at all times. All safety procedures should be strictly followed. Also, while this course is largely self-directed, regular meetings with the course instructor and thesis or guidance committee are required to ensure progress, support, and instruction. This includes development and discussion of the Individual Development Plan (IDP) with the thesis advisor and committee members for students in their second year and beyond.

### **Campus Policies**

- [UC San Diego Principles of Community](#)
- [UC San Diego Policy on Integrity of Scholarship](#)
- [Religious Accommodation](#)
- [Nondiscrimination and Harassment](#)
- [UC San Diego Student Standards of Conduct](#)

## Appendix 1 – PHD only.

Ph.D. TIMELINE/MILESTONES (9/23, please refer to the SIO PhD Student Handbook for updates)

- Year 1. Coursework and departmental exam. Student completes core coursework. To be in good standing, students must maintain a GPA above 3.0 and successfully pass the departmental exam for their curricular group, which will normally be scheduled during the summer following the first year. Curricular groups specify their own expectations for the first year, ~~which may include identifying an advisor (if the student starts out with a rotating advisor), identifying an initial research project, and possibly completing sufficient research to present results as part of the departmental exam.~~
- Year 2. Initial research. At the start of the academic year, the student should work with the advisor to determine objectives for the year. This process can take advantage of information in the SIO Advisor/Advisee Expectations document and can make use of a student-initiated Individual Development Plan. In some curricular groups, students may be expected to complete additional coursework in year 2 (maintaining a GPA above 3.0). As an outcome of the departmental exam, the exam committee might communicate to the student specific recommendations to address identified shortcomings e.g. through additional coursework or supervised projects. Recommendations from the exam committee should be addressed in year 2 in consultation with the advisor and the exam committee. By the end of year 2, a student's research progress should be sufficient to contribute to the first chapter of their PhD thesis. Student should fulfill the ethics course requirement (usually by taking SIOG 232 Ethical and Professional Science or SIOB 273 Professional Ethics in Science).
- Year 3. Advancement to candidacy (qualifying). At the start of the academic year, the student should work with the advisor to determine objectives for the year. Student should form their PhD thesis committee by the end of winter quarter. To be in good standing, the student must qualify by the end of Year 3\*. Before qualifying, student should have completed all required coursework, as specified by their curricular group, including fulfilling the ethics course requirement. The qualifying exam requires writing and orally defending (to the PhD committee) a thesis proposal that lays out a research plan for the PhD thesis.

- Year 4. Ongoing research. At the start of the academic year, the student should work with the advisor to determine objectives for the year. Student should meet with their PhD thesis committee at least once to check on progress since qualifying. By the end of year 4, student will have completed and written up research representing at least half of the material that will appear in the final dissertation. Ideally, this will have been submitted as at least one journal article, and a second article may be in preparation.

- Year 5. Defending. At the start of the academic year, the student should work with the advisor to determine objectives for the year. Student should be well on their way to finalizing their PhD theses (e.g., research for all chapters is complete) at the end of year 5 in preparation for the upcoming defense. We recognize that there may be extenuating circumstances\*, and the student's advisor and the PhD thesis committee can agree to extend the student's academic timeline beyond year 5 if adequate justification can be provided and if funding is available from the advisor.

\*For students who are in the Fall 2019 cohort or older, the Graduate Division issued an automatic extension of time limits due to COVID-19.. Students who had not advanced to candidacy by winter 2020 received a 2-quarter extension to their pre-candidacy time limit and a 2-quarter extension to their support time limit.

Students who had advanced to candidacy by winter 2020 received a 4-quarter extension of their support time limit.

These university-approved extensions do not come with a guarantee of additional department funding.