

OCSC/BIOL 4122 - ADVANCED STUDIES IN MARINE ANIMAL DIVERSITY

1. Description

This course provides an in-depth examination of cellular, physiological, behavioural and ecological adaptations in marine animals. Lectures will be combined with discussions of relevant papers from the primary literature on topics of current interest which may relate morphology, ecology, evolution, natural history, species interactions and practical applications. Students will also gain hands-on experience by designing and conducting research projects involving live or preserved animals.

Learning outcomes

Upon successful completion of this course, you will be able to:

- Discuss adaptations in a diversity of marine animals inhabiting various environments.
- Understand the foundations of scientific research on marine animals.
- Understand and apply basic research principles in marine biology and ecology.
- Assess and communicate the significance and limitations of research results.

2. Evaluation

Project reports (choice of 4X15% or 3x20%)

60%

Students will have to prepare reports that outline the methods and results of each project. Templates/guidelines will be provided ahead of time.

Oral presentation

Presentation skills will be evaluated as each student gives a 10 min presentation on a species/topic of his/her choice.

20%

Participation

Students will be expected to read an assigned paper¹ before each class, and participate in the discussion. Each day, a student will be chosen to open/lead the debate by giving a brief synopsis of the assigned paper and formulating the first comments to open the general discussion. Participation during activities and research projects will also be evaluated, and the lab book will be marked.

20%

¹Note that the list of papers will be made available on D2L 2-3 weeks before the start of the course.

News reports (extra credits)

Students will be given the opportunity to submit up to two summaries (2 pp; single-spaced; worth max. 2.5%) of scientific news or events related to marine science (e.g. from conference, blog, news site, newspaper, journal). Summaries should include a clear overview of major ideas/findings presented and a critical assessment of their strengths, limitations, etc. These are essentially free bonus points.

5%

3. Schedule

DAY	TIME		
	9:00-12:00	12:00-13:00	13:00-16:30
1 22 April	<ul style="list-style-type: none"> • Presentation of syllabus. • Review of guidelines. • Lecture I: Diversity overview. • Safety orientation. 	Lunch	<ul style="list-style-type: none"> • Tour of OSC, JBARB, CDRF. • Workshop on using lab resources. • Prepare for Project I.
2 23 April	<ul style="list-style-type: none"> • Discussion on assigned readings of Biodiversity module. • Lecture II: Morphology / colour / light. 	Lunch	<ul style="list-style-type: none"> • Project I: Identification and assessment of biodiversity • Select topic of oral presentations.
3 24 April	<ul style="list-style-type: none"> • Submit lab book. • Discussion on assigned readings of Morphology module. • Lecture III: Species interactions. 	Lunch	<ul style="list-style-type: none"> • Prepare lab materials, supplies and data sheets for Project II. • Work on Report I.
4 25 April	<ul style="list-style-type: none"> • Due: Report I. • Discussion on assigned readings of Species Interactions module. • Lecture IV: Regenerative abilities. • Work on oral presentations. 	Lunch	<ul style="list-style-type: none"> • Project II: Forms and functions.
5 26 April	<ul style="list-style-type: none"> • Submit lab book. • Discussion on assigned readings of Regeneration module. • Lecture V: Life cycles 1. 	Lunch	<ul style="list-style-type: none"> • Work on oral presentations. • Prepare lab materials, supplies and data sheets for Projects III and IV. • Work on Report II
6 27 April	Work on project reports / Prepare oral presentations / Prepare projects Workshop TBD (e.g. spawning, tagging, ways of measuring/weighing, biosafety)		
7 28 April	Work on project reports / Prepare oral presentations / Prepare projects Workshop TBD (e.g. spawning, tagging, ways of measuring/weighing, biosafety)		
8 29 April	<ul style="list-style-type: none"> • Due: Report II. • Discussion on assigned readings of Life Histories module (Part 1). • Lecture VI: Life cycles 2. 	Lunch	<ul style="list-style-type: none"> • Project III: Species interactions.
9 30 April	<ul style="list-style-type: none"> • Submit lab book. • Discussion on assigned readings of Life Histories module (Part 2). • Work on Report III. • Prepare Project IV. 	Lunch	<ul style="list-style-type: none"> • Start project IV: Life histories (Part 1).
10 1 May	<ul style="list-style-type: none"> • Due: Report III • Lecture VII: Deep Sea. • Work on Report IV. 	Lunch	<ul style="list-style-type: none"> • Finish Project IV: Life histories (Part 2).
11 2 May	<ul style="list-style-type: none"> • Submit lab book. • Discussion on assigned readings of Deep Sea module. • Tips on oral presentations. 	Lunch	<ul style="list-style-type: none"> • Examine larval cultures. • Lab cleanup. • Work on Report IV.
12 3 May	<ul style="list-style-type: none"> • Due: Oral presentations. • Final discussions. 	Lunch	<ul style="list-style-type: none"> • Due: Report IV. • Deadline to submit reports for extra credit (if any).

4. Textbooks

No textbook required. You need to purchase a hardcover lab book.

5. Suggested Resources

McIntyre A. (2010). Life in the World's Oceans: Diversity, Abundance and Distribution. Wiley-Blackwell.

Rex M.A. & Etter R.J. (2010). Deep-Sea Biodiversity: Pattern and Scale. Harvard University Press

Ruppert E.E., Fox R.S. & Barnes R.D. (2003). Invertebrate Zoology: A Functional Evolutionary Approach. Seventh Edition, Thomson Brooks/Cole.

Brusca R.C. & Brusca G.J. (2003). Invertebrates. Second Edition, Sinauer Associates.

Additional lists of suggested resources are available on the course shell

6. Instructor

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Teaching Assistants (TAs):

Jasmin Schuster
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7. Assessment Guidelines

7.1 Research projects (60%)

See *Appendix 1* for tips and grading rubric.

You will get the choice between having the 4 reports count for 15% each or keeping only the 3 best reports valued at 20% each. However, you must submit ALL reports.

Project I – Identification and assessment of biodiversity

1. Using guidebooks and keys, you will identify as many critters as possible in a tank.
2. You will examine the biodiversity associated with rocks and/or rhodoliths.

Project II – Forms and functions

1. A set of species will be selected/assigned.
2. For each species, you will thoroughly describe:
 - a. Colour/shape
 - b. Diet/feeding mode
 - c. Motility/locomotor mode
 - d. Response to external stimuli
 - e. Weapons (defensive/offensive, if any)
3. Based on the above, you will compare focal species and provide a diagnosis of habitat and life style for each.

Project III – Species interactions

1. Pairs or groups of species will be selected/assigned.
2. You will make observations and carry out experiments to characterize:
 - a. Symbiotic relationships
 - b. Predator-prey interactions
 - c. Competitiveness
 - d. Influence of external factors on the above

Project IV – Life histories

1. One or two species may be selected/assigned.
2. For each, you will determine:
 - a. Body size
 - b. Gonad morphology and maturity
 - c. Sexual dimorphism, if any
 - d. Fecundity
 - e. Oocyte shape/colour
 - f. Oocyte size frequency distributions
 - g. Sperm motility
 - h. Fertilization success (if culture successful)
 - i. Embryonic development (if culture successful)
3. From the literature you will discuss the reproductive strategy of each species.
4. Part 2 of this project will involve monitoring of the larval cultures (if successful).

7.2 Oral presentation (20%)

Oral skills will be evaluated as each student gives a presentation on a chosen marine animal (or group of marine animals). This can either be a species, a genus, or a broader taxonomic level, depending on the circumstances. The student may present and discuss aspects of the morphology, behaviour, ecology, physiology, and evolutionary biology of the chosen marine taxon. The presentation should include the student's original ideas and views (e.g. highlighting any special interest, current questions, gaps in the knowledge, future areas of research). This presentation should be well grounded in the primary literature (scientific papers) rather than solely on textbook material. It can, but does not have to be, linked to one of the course projects.

The presentation should be 8-10 minutes, followed by a 5-min question period.

See *Appendix 1* for tips and grading rubric.

7.3 Participation (20%)

Participation will be evaluated based on the following criteria:

10%

- Level or preparation/involvement – class discussions
- Efficacy as discussion leader (when it is your turn)
- Involvement in the question period during oral presentations
- Anonymous evaluation by fellow students

10%

- Level or preparation/involvement – research projects
- This will be measured by evaluating your lab books (4 times x 2.5%)
- See *Appendix 1* for lab book grading rubric

7.4 Extra credits (up to 5%)

Two “extra credit” seminar/activity/news reports, worth a maximum of 2.5% each, may be submitted. In other words, there are 105% available in the class but grades will be calculated as if there were only 100% available. The extra credits are basically free points.

You can prepare an extra credit report based on a conference or event you recently attended, or based on news/information seen on a reputable website (blog, newswire, journal). The event/news/seminar must relate to biological or ocean science in some way.

A report must be 1.5 to 2 pages (single-spaced). It will include (1) a full description and clear overview of the event attended or news report, (2) a clear outline of the major activities/findings, (3) a critical assessment of their strengths and limitations. For this last segment, I want to know what you thought of both the (3a) contents and (3b) the delivery. There will be deductions for grammar and spelling errors.

A maximum of two extra credit reports can be submitted at any time during the course. Submissions will be accepted until the end of the last day of class.

8. Appendix 1 – Grading Rubrics & Other Helpful Resources

8.1 Project Reports

8.1.1 Tips for preparing your project reports

Title Page

- Title of the project. *The title says what you did. It should be brief (aim for ten words or less) and clearly outline the main point of the investigation. For example: "Effects of temperature on feeding rates of green sea urchins".*
- Names author(s) with affiliation(s).
- Date submitted.

Introduction *The Introduction explains the purpose of the project. It usually contains background information relevant to the project, the key hypotheses or objectives, and a brief outline of the approach (how the objectives were met or the hypotheses tested).*

Materials & Methods *Describe the steps you completed during your investigation, and the materials you used. Be sufficiently detailed that anyone could read this section and duplicate your experiment. It may be helpful to provide a Figure (diagram) to illustrate your experimental setup or a Table to list your different experimental conditions.*

Results *Present data obtained from your experiments, using Tables and/or Figures appropriately to support the text. Keep to the facts, not any interpretation of what they might mean. Provide statistical analysis when possible.*

Discussion

This is where you interpret the data and determine whether or not a hypothesis was verified. You should discuss the significance of your results in a broader context and compare them to previous accounts of a similar nature. This is also where you would discuss any mistakes you might have made while conducting the investigation (acknowledge the limitations of your study). You may even wish to describe ways the study might have been improved.

Conclusions *Most of the time the conclusion is a single paragraph that sums up the key findings and what they mean.*

References *Support all statements with appropriate citations and make sure to list all references. Use a clear and consistent style. Refer to scientific publications for style examples.*

Tables & Figures *Tables and Figures must be numbered consecutively and labeled with a descriptive caption (the caption appears above a Table, and under a Figure). They can be included in the text where appropriate or at the end of the report after the References (Tables followed by Figures). Be sure to refer to all Tables and Figures in the text of your report.*

NOTE: *Be careful to avoid the many forms of plagiarism (you may not always realize you are doing it, and penalties are severe). A guide can be found [here](http://www.mun.ca/writingcentre/plagiarism/) (http://www.mun.ca/writingcentre/plagiarism/).*

8.1.2 RUBRIC for grading the project reports

Title Page (___/2)

0. Absent
1. Incomplete
2. Complete

Introduction (___/15)

Background information (___/5)

0. No background info
1. General background info only from class protocols
2. Background info from textbooks, superficial explanations
3. Background info from textbooks, with expanded explanations
4. Good background info from at least two sources, including primary papers
5. Background info includes detailed explanations and various cited sources (or exceptional explanation with extra info)

Purpose, objectives or hypotheses clearly stated (___/5)

0. No purpose/objectives/hypotheses stated
1. Poor statement of purpose, no clear objectives/hypotheses
2. Adequate statement of purpose, no clear objectives/hypotheses
3. Good statement of purpose, no clear objectives/hypotheses
4. Good statement of purpose and clear objectives/hypotheses
5. Excellent statement of purpose and clear objectives/hypotheses

Organism(s) studied is/are stated (___/2)

Relevance/significance of study is indicated (___/3)

0. No attempt to include relevance
1. Weak relevance, not well explained
2. Weak relevance, but well explained, or good relevance but not well explained
3. Good or great relevance, well explained

Materials & Methods (___/20)

Organization (___/4)

0. No text subdivisions or logical flow
1. Few/unclear subdivisions, weak flow
2. Poorly justified subdivisions, poor flow
3. Good, clear subdivisions, logical flow
4. Excellent, well justified subdivisions, great flow

Use of tables/figures/diagrams (___/2)

0. Tables/figures would have been useful but were not included
1. Tables/figures were used, but were incomplete or not clear
2. Table/figures were used and were clear, or were not warranted

Completeness of description (___/10)

2. Very minimal/incomplete description of methods
4. Some elements present but many missing
6. Relatively complete description but missing key elements
8. Complete description but not always clear
10. Complete and clear description, nothing missing

Accuracy of description (___/4)

1. Largely inaccurate description of methods
2. Mix of accurate and inaccurate segments
3. Largely accurate, only minor inaccuracies
4. Wholly accurate description of methods

Results (___/25)

Organization (___/4)

0. No text subdivisions or logical flow in results
1. Few/unclear subdivisions, weak flow
2. Poorly justified subdivisions, poor flow
3. Good, clear subdivisions, logical flow
4. Excellent, well justified subdivisions, great flow

Presentation (___/10)

2. No tables or figures included
4. Few tables or figures, or poorly designed ones
6. Adequate tables and figures, not always clear or well designed
8. Adequate tables and figures, suitably clear
10. Great use of tables and figures, perfectly clear and representative

Completeness (___/5)

1. Results incomplete, missing a lot of key information
2. Results incomplete, missing some key information
3. Relatively complete results, missing a few minor elements
4. Complete results, most information present
5. Exhaustive results, all information present (cannot see anything missing)

Factual content (___/4)

1. Several interpretations were included in the results
2. Mix of facts and interpretations
3. Mostly facts and only few exceptions
4. Only facts were stated in the results

Statistics (___/1)

0. Statistics would have been useful but were not used
1. Statistics were used appropriately, or were not warranted

Units and symbols appropriately used and presented (___/1)

Discussion & Conclusion (___/25)

Organization (___/4)

0. No text subdivisions or logical flow in discussion
1. Few/unclear subdivisions, weak flow
2. Poorly justified subdivisions, poor flow
3. Good, clear subdivisions, logical flow
4. Excellent, well justified subdivisions, great flow

Completeness (___/5)

1. Few aspects discussed, missing a lot of key information
2. Many aspects discussed, missing some key information

3. Most aspects discussed, missing a few minor elements
4. Complete discussion, most key results were discussed
5. Exhaustive discussion, all results very completely discussed

Support (____/10)

0. No sources cited to support statements
2. Citations missing for most statements
4. Citations missing for several statements
6. Citations missing for few statements
8. Most statements supported, but some unclear or inadequate
10. Most/all statements appropriately supported

Conclusion or critical aspect (____/3)

0. No attempt to critically discuss the results and/or methods
1. Some attempt to critically discuss the results and/or methods, weak arguments
2. Some attempt to critically discuss the results and/or methods, good arguments
3. Excellent critical discussion of results and/or methods

Significance and perspectives (____/3)

0. No attempt to highlight significance of findings, or suggest improvements/future studies
1. Weak attempt to highlight significance, or suggest improvements/future studies
2. Good attempt to highlight significance, or suggest improvements/future studies
3. Significance well highlighted, good suggestions for improvements/future studies

References (____/10)

Completeness (____/5)

1. Section on references missing or misplaced
2. Most citations/references incomplete or unclear
3. Some citations/references incomplete or unclear
4. Most citations/references complete and clear
5. All citations/references complete and clear

Style/format (____/4)

1. Several style inconsistencies
2. A few style inconsistencies
3. Style largely consistent
4. No inconsistencies detected

Number/nature of references appropriate (____/1)

Spelling and grammar (____/3)

0. Several typos and/or grammatical errors (>15)
1. 10-15 typos and/or grammatical errors
2. 5-10 typos and/or grammatical errors
3. < 5 typos and/or grammatical errors

Total ____ /100 (all reports worth a total of 60%)

8.1.3 Other resources on writing lab reports

<http://www.lib.uoguelph.ca/get-assistance/writing/specific-types-papers/writing-lab-reports-or-research-reports>

<http://guides.lib.purdue.edu/content.php?pid=232776&sid=1940943>

8.2 Oral Presentations

8.2.1 Tips for preparing your oral presentation

SECTION (weight)	TIPS
Content (35 pts)	<p>Ask yourself: Is the technical component clear, is the coverage of material sufficient or insufficient, is there a logical flow to the content presented?</p> <p>The lecturer should:</p> <ul style="list-style-type: none"> • Relate topic clearly to audience • Remain on topic • Include sufficient information, scientific evidence • Use authoritative, credible evidence (mainly primary publications) • Clearly cite sources for data shown and assertions made
Organization (35 pts)	<p>Ask yourself: Do you have a clear idea of the different elements of your presentation? Are you using presentation aid(s) in an appropriate and efficient manner (e.g. are the slides overcrowded, the font size too small, do you position yourself so that the projected image is visible to all)?</p> <p>During the different parts of the talk, the lecturer should:</p> <ul style="list-style-type: none"> • Introduction Secure audience attention Clearly establish purpose/topic for presentation • Body Use clear organizational pattern (logical flow) Use transitions between points • Conclusion Offer summary of topic/ideas Provide closure • Question period: answer questions thoroughly and accurately
Delivery (30 pts)	<p>As yourself: Is the audience listening or concentrating on other things? Are you speaking too quickly, are you projecting your voice, are you looking at the audience or the projector/screen, do you speak in full sentences and in a coherent fashion or do you wander from topic to topic, do you exhibit a good/confident posture? Do you finish your talk within the time allotted?</p> <p>The lecturer should:</p> <ul style="list-style-type: none"> • Effectively use vocal variety in rate and intensity to maintain audience interest • Use appropriate pronunciation, articulation, grammar • Use language that is appropriate to scientific topic and audience • Use physical behaviours that support the message (including appropriate eye contact, facial expressions, gestures, posture, personal appearance) • Adhere to time requirements (making good use of time without going over)

8.2.2 RUBRIC for grading the oral presentation

Content – Coverage

Topic was well mastered and covered adequately (good balance between breadth and in depth).

15 13 11 9 7 5 3 1

Content – Support

Arguments and photos/figures were clearly presented and properly supported (citing sources, credit).

10 8 6 4 2

Content – Logical flow

Presentation flowed smoothly, with logical links between major themes/segments.

10 8 6 4 2

Organization – Introduction / conclusion

Presentation included a clear introduction and a clear conclusion.

10 8 6 4 2

Organization – Structure

Major segments/themes of the presentation were appropriately separated to optimize clarity. Each was devoted an adequate amount of slides/time.

15 13 11 9 7 5 3 1

Organization – Layout / design of visual aids

Slides were not cluttered and font size was appropriate, easy to read. Text and images were balanced and adequately chosen to explain/present the material.

10 8 6 4 2

Delivery – Clarity

The presentation was enjoyable / entertaining (good pace, voice projection, pronunciation, eye contact).

10 8 6 4 2

Delivery – Time

Made effective use of time (not too short), without going over (not too long).

10 8 6 4 2

Delivery – Question period

Clear/concise responses were provided, demonstrating a good understanding of topic.

10 8 6 4 2

Total _____ /100 (worth 20%)

8.3 Lab Books

8.3.1 Tips for keeping a lab book

You need to purchase a hardcover lab book before the first class. Its purpose is for you to keep a permanent record of your work, which should be detailed, accurate and clear enough to be understood and reproduced by someone else. *It will be instrumental in the preparation of your project reports.*

Please follow these procedures:

- Identify your lab book clearly in the front section
- Only use a pen with black or blue ink to write (neatly and legibly) in the book
- Leave the first few pages blank for a Table of Contents (to be updated daily)
- Number each page consecutively
- Date your notes appropriately
- Never erase, white out or tear away any content, simply strike out any error
- If used, computer sheets must be securely taped/stapled inside your lab book
- Clearly organize your notes using sections, bullets, tables or figures, as appropriate
- Keep your book safe and submit it on time (you can leave it in the lab or carry it with you)

8.3.2 RUBRIC for grading the lab book

CATEGORY	5	4	3	2	0
Lab book submitted on time _____ /5	Yes				No
General appearance _____ /5	Follows all procedures: Table of contents complete; pages numbered; blue or black ink used; no white-out or missing pages; dates present. Neatly written.	Lab notebook does not follow one of the outlined procedures. Neatly written.	Lab notebook does not follow two of the outlined procedures. Neatly written.	Lab notebook does not follow 3 of the outlined procedures.	Lab notebook does not follow 4 or more of the outlined procedures. Sloppy or hard to read.
Background components /preparation _____ /5	Major background elements and additional elements that add to the preparation (thoughtful comments, graphics, etc.) are present.	Most elements are present and in clear order.	Few elements are present and/ or in poor order.	Several elements missing and/ or in poor order.	No background elements present.
Procedures/protocols _____ /5	Procedures are listed in clear steps (numbered, bulleted or in a flow chart). Many details are present.	Procedures are listed in clear steps but not perfectly ordered. Some details are present.	Procedures are listed but not in a logical order or are difficult to follow. Very few details.	Procedures are not listed or are inaccurate.	Not able to repeat lab with this information or NO procedures listed.
Data _____ /5	Clear and accurate representation of data using tables and/or diagrams and/or drawings. Figures and tables are labeled and titled. Calculations show all work and proper units.	Accurate representation of data using tables and/or diagrams and/or drawings. Figures and tables are missing labels and/ or titles. Calculations not all clear or missing units.	Few tables and/or diagrams and/or drawings and/or calculations are presented. Some data missing.	Data are not clearly shown OR are inaccurate. Most data missing.	No data collected.

Total _____ /25 (each evaluation worth 2.5% x 4 = 10%)

8.3.2 Other resources on using lab books and examples of lab book entries

<http://www.ruf.rice.edu/~bioslabs/tools/notebook/notebook.html>

<http://nsmn1.uh.edu/rforrest/Notebook.pdf>

<http://guides.lib.purdue.edu/content.php?pid=232776&sid=1925915>