BIOLOGY 410 PHYSIOLOGY OF MARINE ANIMALS

Instructor Dr. Julie Schram (she/her/hers)
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Office hours: Tuesday, Thursday 1- 4 pm, virtually in Office hr zoom room (Meeting ID: 498 711 7046; Passcode: 978173) or by appointment

Lecture: Monday, Wednesday, Friday 9:30-10:30 am, virtually in Biol 410 zoom room; (Meeting ID: 845 2300 0384, Passcode: 0g072a)

Required texts: Hill, RW; Wyse, GA; and Anderson, M. Animal Physiology. 3rd or 4th edition. Sinauer Press.

Pechenik, J.A. A Short Guide to Writing about Biology. (9th edition. Pearson)

Handouts and extra readings will be assigned for discussion

Prerequisites Biology 310 (C or higher) or by direct consent of the instructor

Course Overview:

An integration of concepts that were learned in previous more specialized courses (physiology, biochemistry, ecology) within the context of evolutionary physiology. Because of our close proximity to the marine environment, we are in a unique position examine physiological adaptations of marine organisms. We will focus on experimental approaches to investigating physiology through discussions using pertinent primary literature that emphasize contemporary methodology common to physiological research

Learning Objectives:

At the end of this course, students will be able to:

- Explain how marine animals physiologically adapt to changes in environmental salinity, oxygen, temperature, and nutrients.
- Compare how diving mammals including whales, seals, penguins and invertebrates adapt to their marine environment.
- Identify special adaptations of marine animals to extreme environments that include bioluminescence, cryopreservation, and color change.
- Interpret primary literature results through reading and discussions of peer reviewed literature
- Design and prepare and oral presentation on a topic of interest related to an aspect of marine animal physiology
- Write a literature review consistent with scientific writing standards

Class Blackboard website:
You can find a copy of the syllabus, assignments, lecture notes and outlines as well as your grades on the UAS Blackboard web site for this course. Lecture notes will usually be posted sometime after the lecture. Please check your e-mail account that is associated with your class registration on a regular basis or have your mail forwarded to ensure you don't miss announcements. I will post or email information regarding schedule changes, due dates and other information you would not want to miss throughout the course.

Disability Support:
Students needing accommodations or modifications should contact and arrange to meet with the course instructor. To request accommodations for this and any other UAS courses, please contact Disability Services as soon as possible. Accommodations will need to be requested each semester of attendance.

You will need to provide official documentation of your disability. I will work with you and DSS to arrange for appropriate adjustments or modifications. If you experience a disability and would like information on support services, contact Disability Support Services (796-6000) or visit the DSS website

Course Requirements

1. Read required materials and come to class ready to discuss the readings.
2. Participate in class discussions and activities.
3. Research, develop, and prepare presentations of recent research.
4. Complete all exams.

General Course policies:

1) Attendance is expected. Students are responsible for all materials presented and discussed during class periods, including instructor, guest lectures and peer presentations.

2) Class participation is a significant portion of this course. There will be individual and/or group activities for which students receive credit as part of their daily class participation. There are no make-ups for missed participation points unless accompanied by an appropriate excuse (see below).

3) If a student is ill or otherwise unable to attend class, contact your instructor before you miss class to obtain an alternate assignment to take the place of missed participation points and, if necessary, arrange a make-up exam. If you are ill you must present a dated medical documentation of your illness within one week of the absence.

4) There will be limited opportunities for extra credit. Extra credit will only be available for the entire class; there will be no individual extra credit. There will not be sufficient opportunities for extra credit to make up for any assignment.

Expectations and Evaluation:

- Lecture subjects are noted in the attached syllabus schedule, you are expected to attend/view all lectures.
- Please read the assigned material before coming to class.
- The syllabus may be revised. Some minor adjustment may be necessary to make additional time for certain subjects or less for others.

Notes on zoom lectures:

Please know that you can (and should if you need/want to) log into your UA Zoom account and change your Zoom settings to adjust virtual backgrounds, edit how your name appears in your profile, and or select an image you prefer to use as your profile picture. If you do change how your name appears in Zoom, please let me know by email (or however you feel comfortable contacting me) so I know which name to associate with graded assignments, notes on participation, etc. Please do login to your UA Zoom account when attending class meetings.

Some additional reminders include the following.

- We will use technology for virtual meetings and recordings in this course. Our use of such technology is governed by FERPA, the Acceptable Use Policy and UAS's Student Code of Conduct. I will not share recordings of our class activities outside of course participants, which include your fellow students, and any teaching assistants, and any guest faculty or community-based learning partners that we may engage with. You may not share recordings outside of this course. Doing so may result in disciplinary action.

- Our class sessions will all be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live.

Grading Policies:
Your grade will reflect an accumulation of your total points earned in the class. Exams (300); Discussion and Participation (50); Research paper including literature review (100); Research Presentation (50). Asking Questions after presentations (10).

Assignment	# of assignments	Points per assignment	Total points per assignment
Exams	2	150	300
Research discussion lead	1	40	40
Discussions & Participation	5	10	50
Research Topic Paper	1	150	150
Research Presentation	1	50	50
Presentation Questions	2	5	10
Total Points possible:	---	---	600

≥ 90% = A
80-89% = B
70-79% = C
60-69% = D
≤ 59% = F
Incompletes are only given in the cases of medical emergencies

Exams:
There will be two examinations worth 150 points apiece (see course outline). The first exam will cover lecture material up to and including material presented prior to the exam on February 26th.

The second exam will emphasize material covered after March 1st and include questions on information from student presentations. The second exam will be given on April 28th.

Both exams will be administered virtually, and I will allocate will extra time in addition to regularly scheduled class time to ensure sufficient time is available for exam completion. Bring a calculator to each exam. Makeup exams are given **ONLY** with prior consent of the instructor!

Discussions & Participation (90 points total – 40 for presenting + 50 for discussion participation):
We will have 5 papers to discuss during this class and student pairs will be responsible for leading the productive discussions for each paper. All students will need to participate in the discussion. Students who are leading the discussions will turn in an outline of the paper and provide discussion questions. The student pair presenting will work on the outline and questions together.

Research Topic Paper - Literature Review (150 points total)

- Each student will review the literature of a topic of their interest related to marine animal physiology.
- You will select a **minimum** of 10 pieces of primary literature that you will synthesize in a review paper. I expect this paper to be 8-10 double spaced pages.
- To successfully include necessary information and appropriate formatting, please refer to provided materials and Pechenik on crafting a review paper.
- Your paper will include an abstract (no more than 250 words), an introduction, and a synthesis of the findings of the literature that you read.
- You will prepare 2 drafts of this paper that you will turn in for constructive comments and review

Writing timeline:

Date	Assigned writing
March 5	1St draft due for peer review
March 19	Peer review comments due to me and author
April 2	2nd draft due to me
*April **30***	Final paper due

Research Presentation:

Students will give a 20-minute presentation (15-minute talk + 5 minutes for questions) on their research topic. Students are expected to utilize visual aids effectively and present the material without reading a script. Your presentation will be graded (50 points) with the following considerations:

- Scientific content
- Factual information supported by literature citations
- Visual display of your information (remember to cite your images and graphics). I will look for spelling and good use of visual aids.
- Ability to answer questions
- Timing of your presentation: (leave enough time for questions but no more than 5 minutes). You should aim for a 15-minute presentation and be ready to answer questions/ lead a short discussion for 5 minutes following your presentation.

Presentation questions

Each student is required to ask at least 2 questions during all of the student presentations. You do not need to ask a question after each presentation, but you need to ask 2 questions over the 2-week presentation period.

Course Outline

All readings are from Hill et al., Animal Physiology text unless otherwise noted.

Day	Date	Topics	Reading
		Week 1	
M	1/11	Introduction to the course. Discussion of your general interests and how to select a focused research topic. (See last page of syllabus)	NA
W	1/13	The basis of physiological adaptation. The marine environment: physical and chemical considerations	Ch. 1
F	1/15	Nutrition, feeding, and digestion with a focus on marine animals	Ch. 6
		Week 2	
M	1/18	No class *Martin Luther King Holiday*	NA
W	1/20	Energy metabolism, why does this matter? • Read Handout: Schmidt Nielsen Body Size and the Problem of Scaling	Ch. 7-8
F	1/22	Metabolic rates of marine animals: How is this measured in the lab and in the field?	Ch. 7-8
		Week 3	
M	1/25	Metabolic rates of marine animals continued • **Title of your research paper is due**	Ch. 7-8
W	1/27	Discuss appropriate Paper Discussion format - demo	TBA
F	1/29	The energetics of aerobic activity	Ch. 9
		Week 4	
M	2/01	Thermal relations; effects of temperature on metabolism Due:	Ch. 10
W	2/03	**Paper Discussion #1:** Dyck, M. G. and Kebreab, E. (2009). Estimating the energetic contribution of polar bear (*Ursus* maritimus) summer diets to the total energy budget. Journal of Mammalogy. 90:585–593.	
F	2/05	Temperature effects on functional states of molecules, **Literature review list**	Ch. 10
		Week 5	
M	2/08	Avoidance and tolerance of freezing	TBA
W	2/10	Heat shock proteins and thermal tolerance in marine animals.	TBA
F	2/12	Hormones in marine organisms; their importance in reproduction, metabolism, and ecology	Ch. 16+ handouts
		Week 6	
M	2/15	Reproductive Physiology of Marine Mammals	Ch. 17
W	2/17	**Paper Discussion #2:** Prohaska et al. (2013) Assessing reproductive status in elasmobranch fishes using steroid hormones extracted from skeletal muscle tissue. Conservation Physiology	

F	2/19	Reproductive Physiology of Marine Invertebrates	Ch. 17
		Week 7	
M	2/22	Oxygen in the environment; review solubility of gases	
W	2/24	Review for midterm – study guide review	
F	2/26	**Midterm**	NA
		Week 8	
M	3/01	Respiration and circulation: A review of oxygen binding and respiratory physiology with an emphasis on marine animals	Ch. 22, 24
W	3/03	**Paper Discussion #3:** Williams, C. L., Meir, J. U., and P. J. Ponganis (2004). What triggers the aerobic dive limit? Patterns of muscle oxygen depletion during dives of emperor penguins. J. Exp. Biology. 214, 1802-1812	
F	3/05	**Draft of your review paper submitted electronically.** Discuss peer review evaluation of papers	NA
		3/8-3/12 Spring break (Have a safe and restful break!)	
		Week 9	
M	3/15	Respiration and diving physiology	Ch. 26
W	3/17	Diving Physiology	TBA
F	3/19	Diving Physiology **Peer review comments are due to authors and to me.**	TBA
		Week 10	
M	3/22	*Guest lecture*: Craig Young, deep-water animals. Sex under pressure: Deep sea larval dispersion	TBA
W	3/24	**Paper Discussion #4:** Sigwart & Chen (2018) Comparative oxygen consumption of gastropod holobionts from deep-sea hydrothermal vents in the Indian Ocean. Biol Bull	
F	3/26	Physiological adaptations in special aquatic habitats; thermal vents/seeps.	TBA
		Week 11	
M	3/29	Color change in marine animals (cephalopods, crustaceans, and fish)	TBA
W	3/31	Bioluminescence. How do marine animals produce light? Visual adaptations in marine animals.	TBA
F	4/02	Chemical defenses of marine animals with emphasis on marine invertebrates. **Second draft of your research paper is due to me electronically**	TBA
		Week 12	
M	4/05	Effects of ocean acidification, endocrine disruption, and other stressors on marine animals. Part 1	TBA
W	4/07	**Paper Discussion #5:** Swezey et al. (2020) Evolved differences in energy metabolism and growth dictate the	

		impacts of ocean acidification on abalone aquaculture. PNAS. 117	
F	4/09	Effects of ocean acidification, endocrine disruption, and other stressors on marine animals Part 2.	TBA
		Week 13	
M	4/12	*Mike Flunker, Hannah Forshee*	NA
W	4/14	*Emily Vernon, Jessica Whitney*	NA
F	4/16	*Kenedy Williams, Dillon Quealey*	NA
		Week 14	
M	4/19	*Jonathan Calleja, Robert Cole*	NA
W	4/21	*Colten Mack, Jordan Lewis*	NA
F	4/23	Final exam review	

Final exam is scheduled during finals week on April 28th Wednesday, 10:15 – 12:15.

Final papers are due electronically by midnight on Friday, April 30th.