Spring 2022 - High-altitude Biology & Medicine/Physiology of O_2 Transport

v.1 - Jan.17.2022

BIL 261| & Cross-listed BIL 661 & **MBE 670 for graduates**
Tue & Thu 2:40-3:55 PM
Cox Building - 217

Instructor:
Kevin G. McCracken
Department of Biology
Marine Biology & Ecology, Rosenstiel School of Marine & Atmospheric Science
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University of Miami
Miami, FL 33146

Office & Lab:
188 Cox Building (Lab - Coral Gables Campus) & 211 South Grosvenor (Office - RSMAS)
The 188 Lab is on the 1st floor of Cox, north side of the building

Office Hours:
Tue & Thu before and after class, or by appointment

Course Website:
http://www.duckdna.org/O2/

Email:
kevin.g.mccracken@gmail.com

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Course Description:
This course provides an introduction to the study of effects of hypoxia (low O2) in relation to both high-altitude biology and medicine, and intermittent hypoxia associated with diving physiology. It focuses on mechanisms of hypoxia resistance influencing the requirement to match O_2 supply and demand throughout the O_2 cascade: a) gas exchange (hypoxic ventilatory responses (HVR) & morphology of lungs and air sacs), b) circulatory O_2 delivery (Hb-O_2 affinity, blood hemoglobin content [Hb]), hematocrit (Hct), & cardiac output), c) tissue O_2 diffusion (muscle capillarity & myoglobin (Mb) function), and d) energy metabolism (mitochondrial respiration & enzyme function). Lectures and discussions will draw from disciplines as diverse as genomics, integrated physiology, population genetics, biochemistry, gene expression, evolution, and alpine medicine. The taxonomic examples from the literature will include humans, other mammals, and birds primarily, including both terrestrial and diving species.

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Student Learning Objectives:
By the end of this course students will have a solid foundation in the physiological and molecular mechanisms influencing the O_2 transport cascade, as related to function at high altitude and physiological adaptations for underwater diving, both of which are related in so far that hypoxia is encountered. For undergraduate students, this course will prepare you for an entre into fields of medicine, integrated physiology, and population genetics and genomics, including applications to medical fields. For graduate students, this course is meant to be a beginning. It will offer an opportunity to integrate physiological, evolutionary, and biomedical thinking into your current research and will give you perspective for future forays in the field.

- Develop foundation in the physiological and molecular mechanisms influencing the O_2 transport cascade.

- Preparation for entry into fields of medicine, integrated physiology, and population genetics and genomics, including cross-discipline applications to biomedical fields.

- Integrate physiological, evolutionary, and biomedical thinking into your current research (primarily for graduate students).

- Develop presentation & speaking skills.

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Schedule of Lecture Topics

Lecture Topic	
Introduction	Intro
--- Introduction to the O2 Cascade & Conceptual Issues	
--- History of High-altitude Medicine	
--- Intermittent Hypoxia & Diving Physiology	
Gas Exchange	
--- Hypoxic Ventilatory Response (HVR)	
--- Lung Morphology	
Circulatory O_2 delivery	
--- Hemoglobin-O_2 Affinity	
--- Blood Hemoglobin Content [Hb] & Hematocrit (Hct)	
--- Cardiac Output	
Mid-term Exam (after spring break)	TBA
Tissue O_2 Diffusion	
--- Muscle Capillarity & Myoglobin (Mb) Function	
--- Diving Birds & Mammals	
Tissue Energy Metabolism	
--- Mitochondrial Respiration	
--- Enzyme Function	
--- Gene Expression	
Final Exam	TBA
Class Presentations (15 min talk + Q&A)	TBA

Course Format:
The course will be highly interactive, involving instructor and student-led discussion of many assigned readings. Students will be expected to prepare for each class section by completing the assigned readings (e.g., usually 1-2 important journal articles), thinking about previous lecture topics, and preparing insightful questions for the instructor and their classmates. Early during the semester, each student will choose a particular example of a specific environmental challenge related to high-altitude hypoxia and present to the class a 15-min PowerPoint presentation followed by time for questions and answers. There will be a mid-term exam following spring break and then a final exam. Both will be written/typed format.

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Optional Text:
High Altitude Medicine and Physiology, 6th Edition (2021) by Andrew Luks, Philip Ainslie, Justin Lawley, Robert Roach, and Tatum Simonson. CRC Press, Boca Raton, FL.

ISBN-13: 978-0367001353

Most readings will be from the primary literature supplied by your professor. These articles are made available on the course website each week via a link at http://www.duckdna.org/O2/.

Grading:

Participation	30%
Exam 1	30%
Exam 2	30%
Presentations	10%

*Attendance to all classes is mandatory.

Participation: You are signing up for a course called "High-altitude Biology & Medicine/Physiology of O_2 Transport" so I assume you are self motivated to learn the material. I expect everyone to show up for every class unless you are sick or have an acceptable reason for being excused from the class. "Participation" doesn't mean just showing up, though. This is a small class, so participation means engaging in the material, asking relevant questions, and providing insights that others do not see. Because most class sessions will follow a discussion, you should also take notes as you read so that you are prepared for a vigorous discussion and can both answer and submit questions to your peers. We will review the answers to all questions during our discussion, but you should also strive to come up with some of your own questions regarding the readings. So…. participation means being fully engaged and prepared for class.

Preparation of Notes & Questions Before Class: To help guide you with your preparation during reading and effort formulating questions for the class, I will usually ask you to provide me your notes on each reading at the end of each class, which I will return to you the following class. This will comprise part but not all of your participation grade, which also we be determined by your verbal contributions.

Make-up Requirement: 1 missed class is allowed during the semester, for whatever reason, not subject the make-up requirement. For each excused missed class following the 1st---to receive full credit toward your 30% participation grade--- in lieu of attendance and participation you must deliver to the instructor a 1-page typed, single-spaced, summary/analysis of EACH missed reading, abstracted in your own words and analyzed critically to highlight the points of reading you did/did not understand. This must be completed no later than 2 weeks after the missed class. This make-up policy applies to both excused and unexcused absences in excess of 1 missed class.

Exams: Two written exams will be assigned, a mid term and a final. The answers should be typed These will differ somewhat for graduate and undergraduate students.

Presentation: Animals offer many diverse and intriguing solutions to the problem of high-altitude hypoxia. **The August Krogh Principle states: "For many problems there is an animal on which it can be most conveniently studied".** Early during the semester, each student will follow August Krogh's advice and choose a particular example of how a specific animal solves problems and challenges related to high-altitude hypoxia and present to the class a 15-min PowerPoint presentation. These will be scheduled TBA at the end of the semester. Graduate students enrolled in the class are expected to incorporate components of their research if relevant and feasible.

Exam Make-up and Incomplete Policy:
Make-up exams are discouraged. If circumstances are such that you are unable to take the exam at the scheduled time, please contact me by e-mail (kevin.g.mccracken@gmail.com) in advance of the exam. Incomplete grades will only be authorized under special circumstances. Your participation in the course will factor into this decision.

Student Code of Conduct:
Students are subject to the UM Student Honor Code. The *existence or appearance* of plagiarism, cheating, or any other forms of academic dishonesty will not be tolerated, and will result in immediate failure of the course (not just the assignment). Students that *participate or appear to participate* in these types of activities will receive a F as the final recorded grade, be withdrawn from the course, and referred to the Dean of Students and Honor Council. Participation in this course implies that these terms are mutually agreed upon.

Civil rights and Disability protections:
The University of Miami strives not to discriminate on the basis of race, color, creed, national origin, religion, age, sex, sexual orientation, gender identity, veteran status, physical or mental disability, marital status, changes in marital status, pregnancy or parenthood, or genetic information. The University of Miami strictly prohibits retaliation for opposing discriminatory practices by all its personnel. This policy affects employment policies and actions, as well as the delivery of educational services at all levels and facilities of the university.

Needs of students with disabilities will be accommodated in a confidential and respectful manner following university and federal policies pertaining to ADA accessibility with efforts to make all possible reasonable accommodations. Please talk to the instructor if you require any special assistance. The Office of Disability Services in the Academic Resource Center, N201, Whitten University Center provides disability services; 305-284-2374 (Voice), 305-284-3401 (TDD).

Student Athletes and Military:
Student athletes and members of the U.S. military should coordinate their absences with the instructor in advance. The same applies to off-campus interviews such as for medical school admission.