UNIVERSITY OF GUELPH
COLLEGE OF BIOLOGICAL SCIENCE
DEPARTMENT OF INTEGRATIVE BIOLOGY
COURSE OUTLINE
BIOL*4010
ADAPTATIONAL PHYSIOLOGY (0.5)

Winter 2017

Course Goals

This course will provide an in depth coverage of strategies of adaptation of organisms to various environmental conditions. The course will be of value to students interested in the physiological and biochemical basis for the distribution of animals. Environmental constraints and the limits of adaptation will provide the underlying framework for the course. The evolution of adaptive processes as well as phenotypic adaptation will be examined. Examples of recently published research will be used to familiarize students with developing areas, analytical techniques and the investigative approaches used in studying environmental adaptation.

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Professor: T.E. Gillis
Room: 3471 Science Complex, ext 58786
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Availability: Please email to make an appointment.

PREREQUISITES: ZOO*3210 or equivalent.

USEFUL TEXTS

Environmental Physiology of Animals. 2nd edition. 2005. Willmer, P., Stone, G. and Johnston, I. Blackwell Science Limited.
Biochemical Adaptation: Mechanism and Process in Physiological Evolution. 2002. Hochachka, P.W. and Somero, G.N. Oxford University Press.

METHODS OF ASSESSMENT AND IMPORTANT DATES

First midterm examination 30% in class date Thursday 16 Feb. 2017.
Writing assignment 20% (Topic and details TBA). Due date: 10 March 3:00 PM handed in via the dropbox on course website (D2L).
Final Examination 50% date and location TBA

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LECTURE SCHEDULE

Tuesday and Thursday 11:30 – 12:50 AM MCKN 031

LECTURES AND AVAILABILITY OF LECTURE MATERIAL

Lecture material (PDFs of Powerpoint presentations) will be available online via Courselink at least the day before the lecture. These PDFs do not contain all the information conveyed in the lectures. Attendance at all lectures is highly recommended.

LEARNING OUTCOMES:

By the end of this course students should have the knowledge and skills to:
1. Understand the mechanisms involved in adaptation of a variety of aquatic and terrestrial invertebrates and vertebrates to changing temperature, salinity, high pressure, high altitude and low nutrient availability. They will be able to extrapolate this information to novel situations.
2. Understand how such adaptations may have evolved.
3. Provide examples of how recent research in comparative animal physiology has contributed to our understanding of basic science (e.g. structure-function relationships, acclimation/acclimatization changes) and applied science (e.g. aquaculture, global climate change).
4. Understand the use of some of the tools and instruments employed in studying environmental adaptation.
5. Write a coherent and concise essay relating to environmental adaptation using the primary literature.

TOPICS COVERED (subject to modification)

INTRODUCTION

a) Constraints on life in water and on land. The environmental factors that affect the survival of organisms.

b)Changing environmental conditions during the evolution of life.

c) What drives organisms to adapt?

d) How much environmental change is needed to drive adaptation?

e) What evolutionary constraints limit the ability to adapt?

f) Stress and adaptation.

g) Homeostasis and enantiostasis.

TEMPERATURE

a) Introduction and background

b) Freezing tolerance of terrestrial insects and vertebrates (nucleating proteins, cryoprotectants).

c) Freezing avoidance by Arctic and Antarctic teleost fish (antifreeze molecules).
d) Adaptation to changing environmental temperatures (heat shock proteins, enzymes, membranes, pH changes and alphastat regulation).

e) Biomedical implications of diets rich in marine mammals and cold water fishes.

LIFE IN THE ABYSS

a) Adaptation to high or changing pressure.

b) Buoyancy regulation in deep-sea cephalopods, crustaceans, fishes and marine mammals.

c) Metabolic adaptations of hydrothermal vent and cold seep organisms.

OSMOTIC ADAPTATION

a) Adaptation to high salt environments (halophilic bacteria, plants and animals).

b) Adaptation to changing salinity. Solute systems of marine invertebrates and lower vertebrates.

c) Desiccation tolerance (intertidal and desert organisms).

LIVING WITH TOO LITTLE OR TOO MUCH OXYGEN

a) Too little oxygen. Anaerobic metabolism of anoxia tolerant marine invertebrates, fish and marine mammals.

b) Life at high altitude: humans (Sherpas, Quechua), other mammals (llamas, alpacas) and birds.

c) Too much oxygen (e.g. tidepool anemones, corals, cold water organisms)

METABOLIC DEPRESSION AS ADAPTATION TO VARIOUS CONDITIONS

a) Estivation in lungfish and snails.

b) Hibernation in mammals.

c) Dormant embryonic stages (Brine shrimp, annual fish, delayed implantation of embryos).

d) Lifespan and aging as adaptations.

SENSORY ADAPTATIONS

a)Visual pigments and depth

b) Echolocation and acoustical lipids of marine mammals.

SYMBIOSIS

a) Adaptation to reduced energy and/or nutrient availability (tropical coral reefs, giant clams and hydrothermal vent and cold seep organisms).

b) Digestive deficiencies. (shipworms, termites).

EVOLUTIONARY CONSIDERATIONS

a) Evolution of adaptive mechanisms (e.g. evolution of antifreeze molecules).

b) Salinity-related allele selection.

c) Toxins and toxin resistance.

d) Adaptation to anthropogenic environmental challenges.

OTHER IMPORTANT POLICIES AND PROCEDURES

Late policy: Work that is handed in late will be penalized 10% for every day that it is late.

Absence and Illness: If you are absent from classes during the semester, you will be expected to make up missed lecture material on your own. If requesting academic consideration on medical or compassionate grounds, be prepared to provide supporting documentation. Be sure to obtain a written statement of your revised grade evaluation from the instructor. See the undergraduate calendar for information on regulations and procedures for Academic consideration.
http:www.uoguelph.caéregistrarécalendarséundergraduateécurrentéc08éc08-ac.shtml

E-mail communication: As per university regulations, all students are required to chec k their uoguelph.ca e-mail account regularly: e-mail is the official route of communication between the University and its students.

Drop Date: The last date to drop one-semester Winter 2017 courses, without academic penalty, is Friday March 10 2017. For regulations and procedures for dropping courses, see the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Copies of assignments: Keep paper and other reliable back-up copies of all assignments.

Academic misconduct: The University of Guelph is committed to upholding the highest standards of academic integrity and expects all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. The Academic Misconduct policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml
Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission a assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.
The university takes a serious view of academic misconduct and will severely penalize students who are found guilty of offenses associated with misappropriation of others` work or improper access to scholarly resources.

Accessibility: The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty, staff and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community`s shared commitment to an open and supportive learning environment. Students requiring service or accommodation,

where due to an identified, ongoing disability or a short-term disability should contact the Student Accessibility Services (SAS) as soon as possible.The SAS website is: https://www.uoguelph.ca/csd/ and the campus ext. is 56208.

Other student services: For assistance with learning, writing, research, technology skills, study habits and any other general academic support contact the Learning Commons (McLaughlin Library). The Learning Commons website is: www.learningcommons.uoguelph.ca and the campus ext. is 53632.

Electronic recording of classes: The electronic recording of classes is expressly forbidden without the prior consent of the instructor. This prohibition extends to all components of the course. When recordings are permitted they are solely for the use of the authorized student and may not be reproduced, or transmitted to others, without the express written consent of the instructor.