

SEP. 10 2012

GRANDE PRAIRIE REGIONAL COLLEGE

DEPT. OF SCIENCE & TECHNOLOGY

COURSE OUTLINE

ZO 2410

Animal Physiology I - Homeostasis

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Course Description:

This course examines how animals function at the organ system level. Particular attention is given to the adaptive significance of different modes of functioning. We explore how animals are able to survive in their individual environments. Comparing diverse mechanisms for solving problems, with examples taken from both vertebrates and invertebrates, provides the student with a broad understanding of animal physiology. All animals must solve similar problems related to regulating levels of gases, energy, temperature, water and ions. The process of natural selection has resulted in the formation of various solutions, enabling animals to occupy a wide variety of different habitats.

Prerequisites: Biology 1070

Textbook: Schmidt-Nielsen, Knut, 1997, *Animal Physiology: Adaptation & Environment*, 5th edition, Cambridge University Press, 612pp

Requirements:

Participation in lectures and tutorials is required in this course and regular attendance is expected. Those who choose not to attend must accept the consequences. In this regard, your attention is directed to the *Academic Guidelines of Grande Prairie Regional College*.

All assignments must be completed and handed in on time. Late assignments will not be corrected. Each week, questions from the appropriate chapters in the textbook will be assigned to each student. Answers will be prepared and presented in the next tutorial session. Evaluation of presentations will be performed by both the students and the instructor. The purpose of these assignments is to help the student keep up with and understand the lecture material. Problems concerning the lecture material will be dealt with during the tutorial sessions and, therefore, it is important to review lecture notes before attending tutorials.

Evaluation:

Seminar Presentations:	10%
Quizzes:	20%
Mid-term Examination:	30%
Final Examination:	40%

General Topics:

1. Introduction to Physiology [1 hour]
2. Enzyme Kinetics & Cellular Metabolism [5 hours]
3. Energy Metabolism & Thermal Regulation [9 hours]
4. Circulation [5 hours]
5. Respiration [5 hours]
6. Osmotic & Ionic Regulation [10 hours]

TOPIC OUTLINE:

1. Introduction to Physiology

- A. What is physiology?
- B. Subdisciplines of physiology
- C. Structure-function relationships
- D. Relationship between evolution and adaptations
- E. Homeostasis and regulatory mechanisms
- F. General models of equilibrium and regulation
- G. Positive and negative feedback control systems

2. Overview of Enzyme Kinetics and Cellular Metabolism

- A. Metabolism - general
- B. Laws of Thermodynamics
- C. Free energy and entropy
- D. Types of Reactions
- E. Coupled reactions and the transfer of energy
- F. Enzymes
 - properties [structure, mechanism of action]
 - specificity and active sites
 - factors affecting rate [temp, pH, cofactors]
 - enzyme kinetics [zero order, 1st order, 2nd order reactions]
 - substrate affinity
 - K_m , V_{max} , Michaelis-Menton & Lineweaver-Burk equations
 - mechanisms of enzyme control [competitive, non-competitive and allosteric inhibition]
- G. Energy carriers [energy-rich phosphates, nucleotides]
- H. Aerobic and anaerobic metabolic pathways
 - glycolysis
 - citric acid cycle
 - beta-oxidation

*** QUIZ 1 ***

3. Energy Metabolism and Thermal Regulation

- A. Basal and standard metabolic rates
- B. Calorimetry
- C. Principle of Q_{10}

- D. Respiratory quotient
- E. Factors affecting metabolic rate
 - body size
 - temperature
 - location
- F. Ectotherms, endotherms and heterotherms
 - energy costs and consequences
 - comparisons
- G. Temperature preference, tolerance, resistance
- H. Active and passive mechanisms for heat generation and loss
- I. Regulation of body temperature
 - shivering and non-shivering
 - counter-current heat exchangers
 - vascular shunting
 - insulation and evaporative cooling
 - behavioural adaptations [acclimation, acclimatization, torpor, hibernation, aestivation]
 - fever
 - control [sensory/integration systems]

*** MID-TERM EXAMINATION ***

4. Circulation

- A. Survey of different vascular systems
 - open systems
 - closed systems
- B. The mammalian heart
 - electrical activity
 - mechanical properties and the cardiac cycle
- C. Other vertebrate hearts
- D. Factors affecting heart rate and stroke volume
- E. Blood flow [hemodynamics]
- F. Regulation of capillary blood flow
- G. Cardiovascular control by the CNS

5. Respiration

- A. General considerations
- B. Respiratory pigments
- C. Gas Laws
- D. Oxygen transport in the blood
 - oxygen carriers
 - factors affecting the oxygen dissociation curve
- E. Carbon dioxide transport in the blood
- F. Gas exchange between respiratory surface and the blood
- G. The vertebrate lung
- H. The vertebrate gill
- I. Regulation of body pH
- J. Regulation of gas transfer and respiration

*** QUIZ 2 ***

6. Osmoregulation & Ionoregulation

- A. Relationship between ion transport and water balance
- B. Problems of osmoregulation
- C. Osmoregulation in aquatic versus terrestrial environments
- D. Mammalian kidney function
 - structure of the kidney
 - urine production
 - regulation of pH
 - water reabsorption & urine concentrating mechanisms
 - countercurrent systems
- E. Freshwater versus seawater fishes
- F. Osmoregulation in a desert environment
- G. Other regulatory organs
 - salt glands
 - chloride cells
 - frog skin
 - urinary bladder

*** FINAL EXAMINATION ***