

STUDY GUIDE

Environmental Physiology/Ecology

Exam I

BIO 3610

Text Resources: Marchand, *Life in the Cold* – Chapter 2, Chapter 4, pp. 93-107

Molles, *Ecology: Concepts and Applications* – Selected portions noted on Lect. Schedule

Laboratory: Energy Exchange (“Canimals”), Small Mammal Respiration

STUDY QUESTIONS/NOTES: Review your notes and records of our discussions. List all terms, review definitions, and then classify them (make list) under the following headings:

- Energy Exchange Processes – e.g. conduction, condensation, sublimation, snow metamorphosis, etc.
- Metabolic/Physiological Processes – thermogenesis, piloerection, thermoregulation, etc.
- Acclimatization strategies – fur thickening, subcutaneous fat development, lowering the LCT, etc.
- Quantities (and units) – Thermal conductivity (k), Respiratory Quotient, Emissivity, BMR, LCT, heat of vaporization, boundary layer thickness, etc.
- Laboratory – colorimetry– direct vs. indirect, acclimatization, characterizing animal metabolic rates
- Models – diagrammatic (e.g. paths of energy flow, the “box model of living system”, mathematical models

APPLICATION QUESTIONS: Note: This is not an exhaustive set of exercises; add more from notes.

- Describe the effects of Earth’s shape and movements upon net radiation reaching a given point on the planet. For example, our plans are to travel approximately 5° further north in latitude where we hope to find more snow, shorter days, cooler average temperatures. Yet growing season and snowfall is also influenced by proximity to Lake Michigan.
- What radiation and/or energy transfer process(s) are involved in each of the following situations as it relates to the temperature of a winter-active plant or animal?
 - Bright, sunny day in which a rabbit sits on top of a crusty layer of snow.
 - A muskrat or beaver swims to the submerged entrance of its lodge.
 - The same muskrat or beaver as it "dries off" within the lodge above water table.
 - A cardinal eats corn at a bird feeder, then perches on a branch, feathers fluffed.
 - One student hiking with cotton next to skin *versus* one with polypropylene; both with nylon shells.
- How do each of the following morphological or physiological or behavioral features influence heat and water balance between organism and environment? Use mathematical expressions (models) to explain the effect on Q and or E.
 - Leaf epidermal hairs that make leaves look whitish to the eye. [(e.g. "Dusty Miller" or Mullein (*Verbascum*)]
 - Stomata that close in response to reduced soil water potential.
 - Body heat is conserved as a result of piloerection in winter-active mammals.
 - Leaf rolling in grasses such as *Ammophila* or shrubs such as *Rhododendron*.
 - Mammals survive winter in enclosed nests or underground burrows.
- Explain each of the following using the appropriate concepts, processes, or models
 - Your skin feels colder when you jump from 70 F air into a 70 F swimming pool.
 - Ground temperature often decreases more on cold, clear nights than under clouds.
 - Steam rises from the warm fecal droppings of a white-tailed deer.
 - Other factors being equal, a white-tailed deer will have less net heat loss when it
 - Gathers with a small herd on a south-facing slope on a sunny winter afternoon
 - Spends an overnight in a dense thicket of aspen trees and shrubs.
 - A squirrel finds a warmer air by climbing up from the snow surface to a 10-ft tree limb.
- Describe an experiment in which your goal is to determine the LCT of a small mammal.
- What physical processes cause snow metamorphosis and how is microclimate under the snow affected?