

STUDY GUIDE

Environmental Physiology/Ecology

Exam I

BIO 3610

Text Resources: Marchand, *Life in the Cold* – Chapter 2, Chapter 4, pp. 93-107
Smith/Smith, *Ecology & Field Biology* – Chapter 3, pp 48-50; Chapter 8, pp. 132-135

Laboratory: Energy Exchange (“Animals”), 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:

- a. Energy Exchange Processes – e.g. conduction, condensation, sublimation, snow metamorphosis, etc.
- b. Metabolic/Physiological Processes – thermogenesis, piloerection, thermoregulation, etc.
- c. Acclimatization strategies – fur thickening, subcutaneous fat development, lowering the LCT, etc.
- d. Quantities (and units) – Thermal conductivity (k), Respiratory Quotient, Emissivity, BMR, LCT, heat of vaporization, boundary layer thickness, etc.
- e. 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.

1. 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?
 - a. Bright, sunny day in which a rabbit sits on top of a crusty layer of snow.
 - b. A muskrat or beaver swims to the submerged entrance of its lodge.
 - c. The same muskrat or beaver as it "dries off" within the lodge above water table.
 - d. A cardinal eats corn at a bird feeder, then perches on a branch, feathers fluffed.
2. Explain each of the following using the appropriate concepts, processes, or models
 - a. Your skin feels colder when you jump from 70 F air into a 70 F swimming pool.
 - b. Ground temperature often decreases more on cold, clear nights than under clouds.
 - c. Steam rises from the warm fecal droppings of a white-tailed deer.
 - d. Other factors being equal, a white-tailed deer will have less net heat loss when it
 - i. Gathers with a small herd on a south-facing slope on a sunny winter afternoon
 - ii. Spends an overnight in a dense thicket of aspen trees and shrubs.
 - e. A squirrel finds a warmer air by climbing up from the snow surface to a 10-ft tree limb.
3. 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..
 - a. Leaf epidermal hairs that make leaves look whitish to the eye. [(e.g. "Dusty Miller" or Mullein (*Verbascum*)]
 - b. Stomata that close in response to reduced soil water potential.
 - c. Body heat is conserved as a result of piloerection in winter-active mammals.
 - d. Leaf rolling in grasses such as *Ammophila* or shrubs such as *Rhododendron*.
 - e. Mammals survive winter in enclosed nests or underground burrows.
4. Describe an experiment in which your goal is to determine the LCT of a small mammal.
5. 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.