

LOOKING BACK: Remember Bernd Heinrich's bumblebee experiments in Chapter 1 (SA #5)? His attempt to elucidate the energy relationships of bumblebees in cold regions illustrated an approach that involved a combination of field studies and laboratory studies. His study focused in part on the subject of *thermoregulation*, the process whereby organisms regulate their temperatures amid variations in microclimate. Study Assignment #12 invites you to apply what you have learned about climatic and microclimatic conditions to consider how plants and animals confront the physical environment and maintain their temperatures within tolerable limits.

FORWARD: It should be obvious to us that for plants and animals to survive they must continually deal with environmental variation (spatially and temporally). To make matters more challenging, your text will state the following concept: *Most species perform best in a fairly narrow range of temperatures*. The focus of SA #12 will be to emphasize the challenges of *environmental fluctuations* and narrow *tolerance ranges*, and then survey ways that creatures regulate body temperatures.

READING: Molles Chapter 4, pages 93 - 100 (Note happily that you should have already completed some of this reading in SA #8 and #9.)

PROCEDURE: This is the last assignment of new material before Exam I. Because the assignment is not a long one, you should have time to review your notes and Study Guides in preparation for the upcoming exam.

Please begin this assignment by reading the two concept statements within the assigned pages of Chapter 4 and the corresponding "Summary Concepts" at the chapter's end. Then, skim the pages and note the boldface vocabulary and the illustrations. Finally, read carefully and write answers to the **STUDY QUESTIONS** below. The attached Study Outline provides a conceptual framework which we will use in lecture-discussion. Note that Chapter 4 continues from page 100 with a more detailed discussion of thermoregulation which time will not permit us to include in BIO 2130.

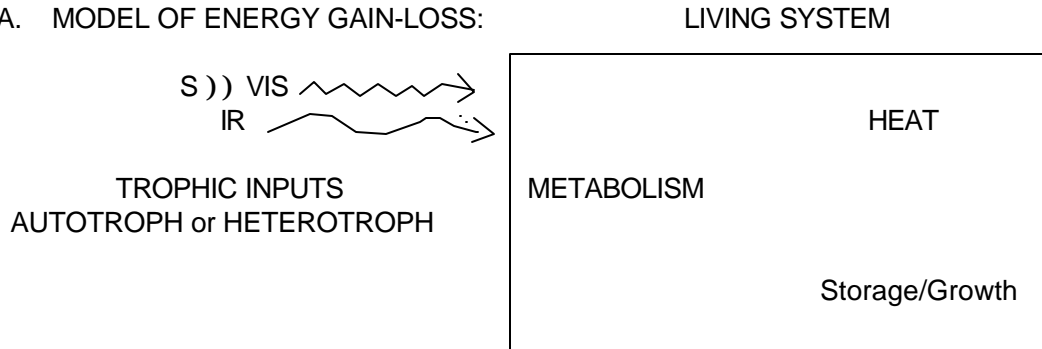
STUDY QUESTIONS:

1. What thermal properties of water cause it to manifest great thermal stability? Use Figure 4.7 to discuss the temporal and spatial factors that influence aquatic microclimate.
2. What do biochemical and physiological studies of rainbow trout, a boreal moss, a desert shrub, and a thermophilic bacterium suggest to be the reason that individual animal and plant species can only tolerate a small range of temperatures?
3. Distinguish the following terms within pairs, then relate all to their context:

Homeostasis	--	Static	
Acclimation	--	Adaptation	Poikilotherm -- Homeotherm
Conduction	--	Convection	Endotherm -- Ectotherm
4. How were Percy's experiments with *Atriplex* designed to distinguish acclimation from genetic effects?

I. HOMEOSTATIC REGULATION

A. MODEL OF ENERGY GAIN-LOSS:



B. THE PROBLEM

1. ENVIRONMENTAL CONDITIONS _____.

2. LIVING SYSTEMS HAVE RELATIVELY NARROW _____.

Note: Liebig's Law of the Minimum: _____

3. LIVING SYSTEMS MUST HAVE _____.

HOMEOSTASIS = maintaining internal conditions WITHIN a TOLERANCE RANGE amid environmental fluctuations.

C. REQUIREMENTS FOR HOMEOSTATIC CONTROL:

1. Energy Exchange with Environment -- "open system"

2. Sensory System to Monitor Environment – e.g. _____

3. Set Point – e.g. in humans, approx. _____ °F

4. Negative Feedback Mechanisms – to reverse drift away from set point

II. CLASSIFICATION OF ORGANISMS:

A. Based upon MECHANISM for HEAT GAIN or LOSS

1. _____ =

2. _____ =

B. Based upon PATTERN of body temperature

1. _____ =

2. _____ =

COMPARING ECTOTHERMS and ENDOTHERMS

ECTOTHERMS

ENDOTHERMS

EXAMPLES:

METABOLISM:

THERMAL
CONDUCTIVITY:

ENERGY
PRODUCTION:

CONSIDERATIONS:

- | | |
|---------------------------------|-------------------------------|
| a. Save energy for _____ | a. Minimum energy for _____ |
| b. Survive on limited resources | b. High energy requirement |
| c. Sluggish at extreme temps. | c. Active at low temperatures |
| d. No minimum _____ | d. Has minimum _____ |

Application Questions:

1. At which stage of development are endotherms most vulnerable to fluctuating temperatures?
2. If your answer to #1. is true, how then do you explain the low thermal insulation at this stage of development?