Study Questions -- Temperature Lectures

Describe some evolutionary factors (e.g., latitude, age) that alter the low (or upper) thermal tolerance of ectotherms?

How are extremely low (or high) temperatures physiologically detrimental to animals?

What is the difference between freeze tolerance and freeze avoidance? Which of these two adaptations would an animal use if it needed to be active in cold weather?

What is a $Q_{10}$? Does a given animal have a single $Q_{10}$ for all physiological activities and across temperature ranges? Can $Q_{10}$s be negative?

How does physiological performance typically change in animals between the C Tmin (critical thermal minima) and C Tmax temperatures? (Draw a graph).

Why is developmental temperature such an important variable to organisms? How do the thermal tolerances of juveniles and adults compare?

Write out a heat balance equation (include radiation, convection, conduction, metabolism, evaporation) and use symbols (+, -, or ±) to indicate whether the heat exchange can be to or from (or both) the animal. What are the various mechanisms of heat exchange that cause heat gain or heat loss? What are the basic principles involved in heat transfer?

What is the difference between conduction and convection?

Why is it hard for a tiny ectotherm to gain heat by basking in the sun? How does wind influence the rate of heat gain (and equilibrium temperature) of a small versus large ectotherm basking in sun?

How does the amount and the wavelengths of emitted radiation change as a function of skin temperature on an animal? Could you use this knowledge to estimate the skin temperature of an animal?

Why is color more influential to the thermal balance of a large than a small animal?

A small and a large lizard begin basking early in the morning. Graph how their body temperatures will change as they warm to an equilibrium temperature. Assuming that both have same thermal preference, which will seek shade sooner and why?

Imagine a lizard and a mouse sitting in the sun on a cool day. Then graph how the lizard's body temperature will change (and the mouse's metabolic rate) change as wind speed increases?

Why is the lower critical temperature of an endotherm (see Fig. 7.1 in the text) inversely related to body mass? [In other words, larger mammals have a lower critical temperature – or equivalently a larger thermal neutral zone.] Think of how size influences the thickness of a mammal’s fur and also the boundary layer.

Why is using evaporative cooling a dangerous strategy for most desert animals? Given this problem, would you expect to see many desert animals running around in sun at high noon in summer?
Consider a basic biophysical model of heat transfer, and consider the concept of “balance” in physiology. Why would one say that an animal’s heat balance is **coupled with** (in other words, interacts with) its water balance and also with its mass balance (i.e., whether it gains or loses water or mass)? Recall the basic reaction for aerobic metabolism.