Review Questions –Temperature

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. Understand the basic principles involved in heat transfer by each mechanism

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?

One lecture described various behavioral and physiological mechanisms that animals use to thermoregulate (for example, basking in sun). *For each, be able to describe the primary mechanism of heat exchange is involved.* Think in terms of the equations for heat flux. For example, dogs roll up into a ball on very cold nights, because they are reducing their *surface areas* exposed to cold, and hence reducing *convective* heat loss.

Where is the thermostat of most vertebrates? Basically how does it work?

Understand how fever works in terms of changing set-points. Know the thermoregulatory mechanisms that come into play when fever starts, and when a fever breaks. What is the "nutrient insufficiency hypothesis"? How does it work?

Locomotion

What metabolic pathways generate ATP are used at rest, during "cruising" activity, and during burst activity? What are the physiological advantages and disadvantages of each source?

Why is stamina inversely related to work level?

If animal A has a higher resting metabolic rate than animal B, and if both have the same factorial scope, would they also have the same maximal aerobic speed? Be able to defend your answer

Would they also have the same metabolic scope? Again, defend your answer.

What physiological activities take place during the period of the oxygen debt

Do you think that the oxygen debt would last longer for ectotherms compared with endotherms? For warm ectotherms vs. cold ectotherms? At high elevation vs. low elevation for an endotherm?

If lizards and mammals have similar factorial scopes, why is it that mammals have higher levels of sustained activity?

If runners are jogging at with a metabolic rate 5X that of rest, what is happening to their heat balance and food requirements?

Vertebrates can increase aerobic metabolism by only 10X or so, but some insects have much much larger factorial scopes. Why are lowly insects so much better than we are in this regard?

Studies with doubly labeled water show that workers (e.g., lumberjacks) doing physically demanding tasks for long periods typically work at about 4X resting levels. Offer a physiological explanation as to why they can't sustain work at a higher level.

Migration in vertebrates is common in aquatic animals (e.g., fish, sea turtles) and in birds, but is relatively rare in mammals (only large ones migrate). Use your knowledge of the cost of transport to give a physiological explanation for the above observation.