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Withers chapter 5 (or HWA chapter 10). Watch the podcasts. Look over the Homework, the handout, and discussion questions below. Skim the chapter, reading anything that was not clear or you need to know.

## Heat Transfer, Temp reg, Q10 and Iterative method, Heterothermy

### Discuss:

1. Looking at the equations for **conduction**, **convection**, and **evaporation** (see handout), how does each mode of heat transfer vary with changes in each parameter? Identify the driving force for each mode of the flux (heat transfer). The expression for the flux here is a “diffusion” or “resistance” parameter times a driving force (a gradient in mass or energy). Think about examples to illustrate each mode, considering variation in the environment and the strategies of different animals. For example, how does a wetsuit protect a diver from hypothermia? Explain in terms of heat transfer. Would fur do the same thing for animals? Does it matter in air or water? Summer or winter? (think direction of heat transfer and relative importance of each mode).
  
  2. How do endotherms raise or lower their  $T_b$ ? What is a fever and how is it induced? What kinds of animals does it occur in? Why?
  
  3. Explain to your group members how counter-current heat exchange works. Bonus: Why does it work only to prevent excessive heat loss? Why can't it work in reverse to “air condition” animal tissues in hot environments?
  
  4. What is the difference between regional and temporal heterothermy? Are heterotherms only ectotherms? or only endotherms? or not? Give Examples. How can these strategies be used for surviving extreme environments? Do ectotherms have different limits than endotherms? Why?
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