Discussion Week2

Metabolism & Activity

Read/Skim Withers pg. 92 Aerobic Metabolism; pp. 105-pg. 112. Supplements 4-1, 4-2, 4-3.
Read/Skim HWA ch. 7 pg 163— 170.

- [ ] (HWA) Understand the components of an animal's energy budget.
- [ ] (HWA) Understand the ways in which MR (Metabolic Rate) is measured.

Discuss:

1. How do we measure the cost of being alive?

   a. What is BMR and SMR? Why do we need both? What is the difference between BMR/SMR and RMR? What is AMR and MMR?

   b. What is absolute aerobic scope and factorial aerobic scope? Is it specific to an activity? Why? What are the rough rules of thumb for how much higher RMR, AMR, and MMR are above BMR or SMR for active endotherms vs ectotherms? (Look in Withers). If you knew an animal's RMR and the types of activity it did, what strategy could you use to estimate DMR (Daily Metabolic Rate)?

   c. We know that MR varies by animal size and taxonomic group. If we knew the cost of running in a 70kg human (let's say approximately 10x BMR), how can we use this information to estimate the cost of the same activity in a different animal? What is the justification?

   d. What is direct and indirect calorimetry? Why can we metabolism by measuring an animal's heat production (think thermodynamics)? When we try to measure metabolism by measuring heat, or O_2, or CO_2 -- which methods are good for aerobic vs. anaerobic metabolism?

2. Does temperature affect the metabolic rate of endotherms, ectotherms, or both? Why? Make sure to explain whether you are in the thermoneutral zone or not.

3. What happens to your metabolism when you eat a large meal (What is Specific Dynamic Effect)?
   a. Are carbs evil? Why do some fad diets focus on protein? Is this a good idea? What is a rough rule of thumb as to what it does to your metabolism? What is the relative importance of total caloric intake, breaking it up into smaller meals, type of nutrient?

   b. Is SDA larger in endotherms or ectotherms more? Why?

Anaerobic Metabolism

Read Withers Chapter 3 the section on Anaerobic Metabolism. If you are not familiar with aerobic metabolism (Krebs cycle, electron transport chain, etc. then you may want to skim the first half of the chapter. Be aware of what the pathways generally do, their substrates, the rate-limiting steps and where these are located (mitochondrion, membrane, cytosol, etc.; we do not need to know the details of molecular interactions for this course).

4. Aerobic or anaerobic: What is primarily used for intense activity vs. What is used for prolonged anoxia (lack of O_2)? Explain the dynamics of all-out exercise in mammals terms of O_2 consumption, activity levels, and where the ATP is coming from to fuel these phases. Is anaerobic metabolism needed here? Why?

5. What are the major mechanisms of anaerobic metabolism in vertebrates? Why are different pathways needed? Are certain fish constantly drunk? What is this about?

Size and Scaling Practice

Read Withers pp. 93-pg. 103 (structural support). mass-specific metabolism on 104.
Read HWA figures 7.7, 7.8, 7.9, 7.10, Table 7.4, fig 7.11 (see website under "Readings")

6. Based on Withers Fig. 4-6: What evidence do you see for or against the argument that birds and mammals have the same oxygen consumption rate for their mass? Where would you expect lizards and amphibians to fall? Why? What does the figure tell you about which factors most influence metabolic rate? How would you rank them?

7. You are responsible for keeping the mice and elephants healthy at the Honolulu Zoo, but you only know how much the mice eat (assume they are herbivores and have the same diet). Let's approximate the mouse's mass at about 100g and the elephant about 10,000 kg, how would you use your knowledge of mass-dependence of metabolic rate, and how could you predict how much the elephant needs to eat? (If it helps, you can make up some numbers or draw the relationship to help you explain).

8. Look at table HWA 7.4 and fig. 7.11. Explain the relationship between O_2 demand, heart size, and heart rate. Pound for pound, who has the higher O_2 demand? The elephant or the mouse? How is the higher O_2 demand delivered? What evidence can you point to to back up this hypothesis?

9. Explain the logic behind Rubner's surface law. What are the arguments for and against it? (see HWA pg. 178) What is the most convincing argument that it is false?