# STUDY QUESTIONS FOR EXAM 1 – 2005

**Below are some questions to help guide your preparation for the first exam. Note also that I've placed last year's exam on the web, so you can anticipate kinds of questions I might ask. We will have a review session on Tuesday at 5 - 6 pm or so. At that time you can ask me to explain answers to questions below. HOWEVER, I EXPECT THAT *YOU WILL HAVE ALREADY MADE AN EFFORT TO ANSWER THEM YOURSELF FIRST* – THAT IS THE POINT OF PROVIDING "STUDY" QUESTIONS.**

If scientists were credited by name for a physiological concept or finding, you are responsible for knowing their names.

## General principles lectutre

Review the general principles lecture.

What is meant by "levels of analysis" in physiology?

Be able to discuss an example of the idea that "there's no free lunch" in physiology.

Understand the Principle of Allocation. A lactating ground squirrel must allocate huge amounts of energy to her pups. If the Principle of Allocation holds, why doesn't she lose lots of weight?

Be able to draw a graph for body temperature versus time for a warm ectotherm that jumps into a cold environment. Be able to explain the shape of the line.

Be familiar with the general equation for flux and be able to apply it.

## Experimental design

Be familiar with the concept of (and rationale for) a control, repeatability, paired design, a blind experiment, power analysis, factorial experiment, interaction effect, dose-response experiment, randomization.

Why do sloppy measurements make it harder to show a statistically significant effect?

Be sure to read Platt's classic paper on strong inference. Why is a strong inference approach advantageous? Can you think of a situation in which strong inference might not work as Platt outlined (other the obvious case of not having valid hypotheses)?

## Metabolism Lectures

### Metabolism: the basics

Review the SI system of units (Appendix A in Schmidt-Nielsen) especially as regards **base** versus **derived** units, and joules and watts.

You should understand the various ways (direct, indirect) to measure aerobic metabolic rate. *Moreover, you should understand the* ***rationale*** *for being able to convert data on oxygen consumption (**or** $CO_2$ production) to units of heat (joules) or watts.*

Why is knowledge of the metabolic fuel (e.g., protein, carbohydrate) of an animal useful to someone measuring $O_2$ consumption as an index of metabolic rate? Explain why physiologists usually use $O_2$ rather than $CO_2$ as an indirect measure of metabolic rate. (see the text for clarification).

What is the "specific dynamic effect" and what physiological activities are thought to cause this effect? Do you think the magnitude of SED might differ between animals that feed daily vs. those that feed intermittently?

What is the difference between BMR and SMR?

**Metabolism: relationship to body size**

Be able to draw graphs of metabolic rate vs. body mass for endotherms and for ectotherms on both arithmetic **and** log-log plots. What is the average exponent for metabolic scaling? What are some of the ecological consequences of those relationships (i.e., for endotherms vs. ectotherms, or for large vs. small animals) – for example, food requirement?

How do resting and field metabolic rates compare and why are they so much higher in nature? What are some of the physiological and ecological implications of these differences? How does doubly labeled water estimate metabolic rate?

What are some of the physiological or anatomical correlates of high "mass-specific" metabolic rates for small animals? What are the physiological reasons for those correlates (e.g., why functionally is capillary density greater in small animals)?

Why is the concept of "one" mass-specific metabolic rate for an organism physiologically naive? (in other words, do all tissues have the same metabolic rates per gram of tissue? Or does a given tissue always have the same metabolic rate?)

What are some of the physiological or anatomical correlates of high metabolic rates of endotherms?

Why is it important to think about metabolic scaling when adjusting doses of medicines to people (or animals) of different size?

**Allometry:**

You should understand the basics of allometry. In particular, you should be familiar with allometric equations and graphs. For example, you should be able to draw (**without** a calculator or computer) the general shapes of curves for a given equation (on both arithmetic **and** log·log scales). Examples:

$Y = 3 M^{.74}$ $Y = 3 M^{-.25}$ $Y = 3 M^{1}$

Conversely, you should be able to go from graphs to equations (roughly, of course). Thus, if you were shown a graph of metabolic rate vs. body mass for two different taxa of animals, you should be able to state whether the exponents are parallel and positive and which taxon has the higher "a" value. You should be able to look at a graph and tell whether it is on an arithmetic or log scale.

If you are given an equation for the allometry of some whole-animal rate, you should be able to write down the equation for a mass-specific rate, and draw its graph (as you might guess, on **both** arithmetic and log-log plots).

Consider two mammals, one 3 times the mass of the other. Write out a general equation that will enable you to predict how many times greater the metabolic rate is of the large mammal vs. the small animal. (met rate larger / met rate smaller).

How does metabolic scaling differ for intraspecific vs. interspecific comparisons?

What are the basic ecological and physiological advantages and disadvantages of endothermy versus ectothermy?

Understand how doubly labeled water is able to estimate field metabolic rates (see handout on web). Does it estimate $O_2$ consumption or $CO_2$ production?