

Allometry Study Questions

1. Suppose that lung volume scales to body mass^{1.0} in some group of animals.
 - (a) what will it scale to volume?
 - (b) If you were to write equations from these two proportionalities (*i.e.*, lung vol. to body mass and lung SA to mass), would the constants of proportionality (a, not the scaling factor exponent, b) be the same for both? Explain.
2. Suppose that lung volume actually scales to body mass^{1.0}. Furthermore, suppose that in this group of animals metabolism also scales to body mass^{1.0} (note: this is true of many individual groups of animals --- it is just not true overall).
 - (a) If metabolic rate is primarily constrained by respiratory surface area, give the value of the scaling exponent for lung surface area to body mass.
 - (b) Would animals with this type of scaling relationship be scale models of each other? Explain.
3. Generally, as terrestrial animals get larger, the skeletal mass increases at a faster rate than total body mass. Assume that this is the relationship:

$$\text{skeletal mass} = a * \text{body mass}^{1.2}$$

Assume that a = 0.1 for this and 1.0 for any other scaling equations you use in this problem;

Assume that for the same group of animals metabolism (in watts) scales to body size (mass) to the 0.75 power;

Assume that the skeleton makes no metabolic contribution to the animal.

- (i) Using a piece of graph paper, draw two boxes such that one is 10X the size of the other to represent the body masses of two different animals.
- (ii) Starting at the bottom of each box, draw another box inside that represents the mass of the skeleton. (Calculate the values first).
- (iii) The remainder of the box therefore represents the difference in metabolically active tissue in these animals. If metabolism scales isometrically to active tissue, what should the change in metabolism be? Is that the same value as is predicted by the metabolism to body mass exponent of 0.75? What do you conclude from all of this?