Biology 390 **Problem: Evaporative Water Loss and Temp Reg.**

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The purpose of this problem is to illustrate, on a comparative basis, the potential difficulty encountered by small organisms living in hot environment.

Consider the following data: T_a = 37°C
latent heat of vaporization: 575 Kcal/kg H_2O at 37°C

a. Calculate the amount of water lost by evaporative cooling during one day by a 70 kg mammal whose rate of metabolism is 3,000 Kcal/day. Assume evaporative cooling is the only mode of heat exchange this mammal can use to regulate its body temperature, *i.e.*, no temperature differential exists between the organism and its external thermal environment. Express you answer as a percentage of original body mass.

The animal needs to get rid of 3000 Kcal each day. Since the latent heat of evaporation of water at 37° C is given as 575 Kcal per Kg, then:

3000 Kcal/day * 1 / 575 Kcal / kg water = 5.2 kg water lost / day

This is 5.2 kg / 70 kg * 100 = 7.5% of total body mass lost as water, daily

b. Make a similar calculation for a 10 gram mammal whose rate of metabolism is 3.92 Kcal/day.

3.92 Kcal/day * 1 / 575 Kcal / kg water ≈ 0.0068 kg/day ≈ 6.8 g/day

= 6.8 g/d / 10 g *100 = 68% of body mass per day!!!!

c. Is comparison of you answers consistent with the observation that most small mammals living in desert regions are active at night? Explain.

Yes. The temperature is lower at night and therefore animals need rely less on evaporative cooling. Provided that they have an effective way to reduce respiratory water loss (*i.e.*, an intermittent counter-current heat/moisture exchanger) water loss will also be less since cold air holds less water when saturated. Cooling the expired breath will result in more water being kept in the body as compared to when the air is warm. (review the kangaroo rat).