FEEDING AND DIGESTION — PROBLEM SET 3

	Monosaccharide	Fat	Amino Acids (mean)
g/mol	180	256	135

1) How does coprophagy exploit the advantages of both fore- and hindgut fermentation? (5pts)

2) The CNS can only use glucose for metabolism. In foregut fermenters, where does this glucose come from? (5pts)

3) Practice question for modeling small intestine length (20pts):

Dr. Alan Richmond used to keep a very large Burmese python, *Python molurus*, as a pet. The snake weighed 230 pounds (105 kg) and was over 15 feet (5 meters) long. Reasonable assumptions about average body temperature (25°C) and activity levels (low; 1.2xSMR), combined with the allometric equation for SMR for boid snakes from Withers, indicate that this snake had a DMR of about 530 kJ/day.

a. The snake was fed rabbits, which mimic its natural diet of medium-sized mammals. (Burmese pythons have been known to feed on animals as large as tigers, but usually eat smaller prey). Calculate the overall energy density of this food in kJ/g (recall class discussion) Whole rabbits contain approximately 23% protein, 11% fat, 0% carbohydrate, 10% indigestible material (bone, fur), and 56% water (similar to lean meat from a human nutrition book, with added indigestible material). (2pts)

b. Assume for the moment that the snake is actually eating enough each day to support its metabolic rate, rather than eating one big meal and then storing the energy and not eating again for a long time (which is what they actually do). Calculate the mass (kg) of food per day that the snake must <u>assimilate</u> to support its metabolic rate. (2pts)

c. Assume an assimilation efficiency of 90%. How many kg of food would the snake have to <u>consume</u> per day? (1pts)

d. How many grams of each component would have to be <u>assimilated</u> per day? How many moles per day? (2pts)

e. This snake is eating mostly protein, so its intestine length will be limited primarily by the absorption rate of amino acids. Select an appropriate absorption rate for amino acids. Q_{10} correct this rate to a body temperature of 25°C. Convert to mol d^{-1} cm^{-2}. (2pts)

f. Calculate the nominal surface area of intestine required to absorb enough amino acids per day to support the metabolic rate. (2pts)

g. Assume that the intestine has an inner diameter of 5 cm and an outer diameter of 7 cm. Calculate the length of the intestine in meters. Does this result seem reasonable, given that snake is 5 meters long? (In snakes, the small intestine is a straight tube that runs along about 2/3 of the body length; the intestine should turn out to be too short). (2pts)

h. In fact, snakes do not normally eat enough food each day to support their metabolic rates. Instead, they eat large food items infrequently, digest and absorb the food over about a week and store the energy for later use. Dr. Richmond tells me that he fed his snake about once every 2 months (so it had to absorb 60 days worth of food in 7 days). Calculate the mass of food that must have been assimilated per feeding. About how many rabbits is this? (2pts)

i. Recalculate the intestine model to take into account that the animal must absorb 60 days worth of food in 7 days, and calculate the intestine length for a model of intermittent feeding, given the feeding strategy of this snake (macrophagy). Does this intestine length seem more reasonable? (5pts)