**Active Learning Exercise 20.2**

to accompany

*Vertebrate Life*, Tenth Edition

Pough • Janis

**How many Big Macs® does it take to keep you warm?**

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**Sources:**

Energy Consumption of The Human Body <http://large.stanford.edu/courses/2012/ph240/khan1/>

McDonald’s Nutrition Calculator

<https://www.mcdonalds.com/us/en-us/about-our-food/nutrition-calculator.html>

Seymour RS and 6 others. 2013. Scaling of standard metabolic rate in estuarine crocodiles *Crocodylus porosus*. *Journal of Comparative Physiology B* 183:491-500. <https://doi.org/10.1007/s00360-012-0732-1>

Grigg G, Kirshner D. 2015. *Biology and Evolution of Crocodylians*. Cornell University Press, Ithaca, NY. See pp. 249-252.

**Activity**

Use an allometric relationship for human metabolic rate to calculate your daily energy intake. (These calculations are approximations, so it’s okay to round the results to no more than two decimal places.)

(1) Total daily consumption in kJ = Body weight (Kg) × 4 kJ/kg × 24 hours/day.

*Although physiologists use kJ, dietary energy in the US is usually expressed in kilocalories (kcal). 1 kcal = 4.18 kJ, so divide the result of equation (1) by 4.18 to convert it to kcal. In nutrition, the symbol Cal is used instead of kcal.*

The total daily energy consumption includes the energy used for maintenance (mostly thermoregulation) and production (growth of an individual or production of young).

Figure 15.10 shows how energy intake is apportioned between maintenance and production by endotherms and ectotherms. Using the average value for endotherms, calculate the amount of energy you use for maintenance on a daily basis.

McDonalds provides nutritional information about its menu. How many Calories does a Big Mac® contain?

<https://www.mcdonalds.com/us/en-us/about-our-food/nutrition-calculator.html>

How many Big Macs® would you need to eat in a day to provide your maintenance energy?

What about Bruce, your pet estuarine crocodile (*Crocodylus porosus*)? You’ve had Bruce since he was a hatchling, and by a remarkable coincidence, he has grown to weigh exactly as much as you do. How many Big Macs® does Bruce need to meet his daily maintenance metabolic energy requirement?

Fortunately, a team of intrepid (or perhaps foolhardy) Australian zoologists (Seymour et al. 2013) measured the standard metabolic rates of estuarine crocodiles over a weight range from 0.19 kg to 389 kg, and found that oxygen consumption scales with body weight as

(2) ml O2/min = 1.01 \* (weight in kg)0.829

Hint: If you use Excel for this calculation, the formula is ml O2/min = 1.01 \* (weight)^0.829.

Calculate Bruce’s oxygen consumption per minute and convert that to his daily oxygen consumption.

The caloric equivalent of oxygen consumption varies depending on what substrate is being metabolized; 5 kcal/L of O2 is a reasonable average value; multiply Bruce’s daily oxygen consumption by 5 kcal/L.

Because 1 kcal = 1 Cal, you now have Bruce’s daily energy consumption in units of Calories.

*Check your work by calculating the ratio of your daily energy intake to Bruce’s. Does that ratio match what you would expect from Section 15.4 “Energetics of Ectotherms and Endotherms?” The ratio will vary somewhat depending on how much you and Bruce weigh, but if you are off by more than a factor of 1.5, you made a mistake somewhere along the line.*

Return to Figure 15.10 and determine the average percent of daily energy intake that ectotherms devote to maintenance, and use that percentage to calculate Bruce’s daily maintenance requirement.

How many Big Macs® does Bruce need daily?

How long would your daily Big Mac® intake sustain Bruce’s maintenance requirement?