Energy Budgets in Three Terrestrial Vertebrates
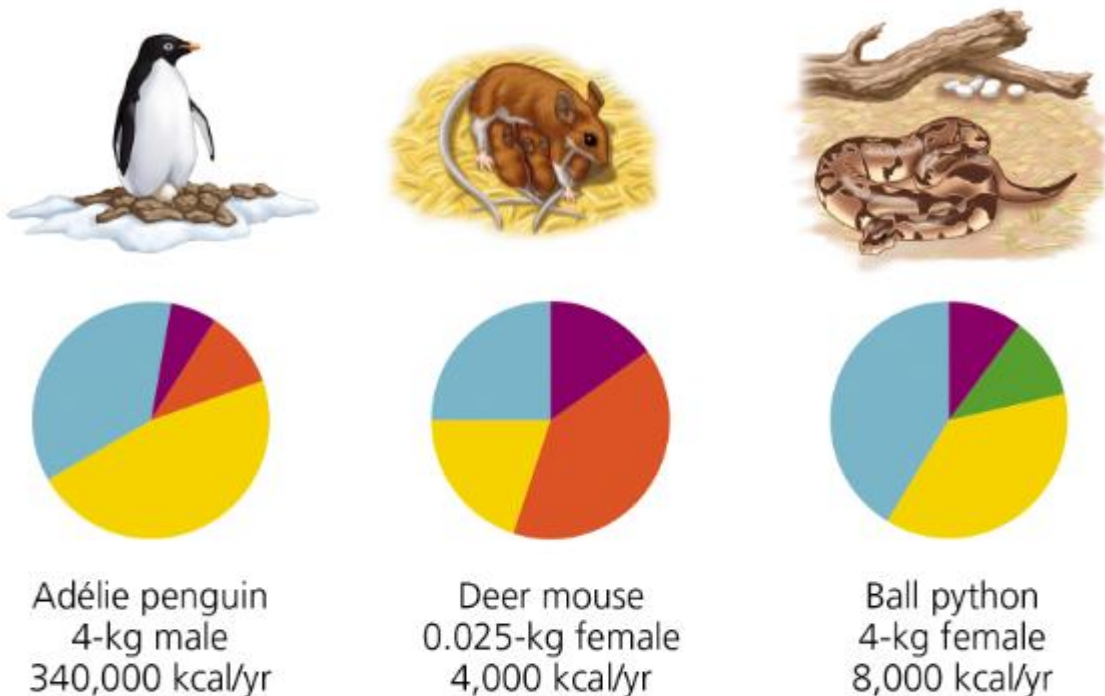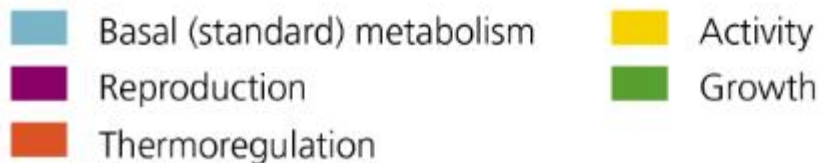
Animals must allocate their energy reserves to various activities, and the allocation strategy depends on the animal's lifestyle. Consider typical annual energy budgets for three terrestrial vertebrates that vary in size and thermoregulatory strategy: a 4-kg male Adélie penguin, a 25-g (0.025-kg) female deer mouse, and a 4-kg female ball python. The penguin is well-insulated against his Antarctic environment but must expend energy in swimming to catch food, incubating eggs laid by his partner, and bringing food to his chicks. The tiny deer mouse lives in a temperate environment where food may be readily available, but her small size causes rapid loss of body heat. Unlike the penguin and mouse, the python is ectothermic and keeps growing throughout her life. She produces eggs but does not incubate them. The pie charts below show the energy expenditures of these animals for five important functions: basal (standard) metabolism, reproduction, thermoregulation, activity, and growth.

Adélie penguin
4-kg male
340,000 kcal/yr

Deer mouse
0.025-kg female
4,000 kcal/yr

Ball python
4-kg female
8,000 kcal/yr

Key

- Basal (standard) metabolism
- Reproduction
- Thermoregulation
- Activity
- Growth

1. a) Determine the percent of the mouse's energy budget dedicated to basal metabolism.

   b) Determine the percent of the penguin's budget dedicated for activity.

2. Identify the differences between the functions included in the three pie charts. Explain the differences.

3. Identify the endotherm that expends a greater proportion of its energy budget on thermoregulation. Explain why that is.

4. The penguin and the python are similar in size. Calculate how much more energy the penguin expends each year compared to the python.

5. a) Identify the animal that expends the most kilocalories per year on thermoregulation.

   b) Identify the animal that expends the greatest proportion of its energy on thermoregulation.

6. During part of the year, fish is plentiful and penguins store body fat as they feast on the plentiful food source. If the energy allocation in the penguin had been monitored only during those few months instead of an entire year, predict how the pie chart would have been different.