Calculating energy expenditure

Question 1: What is the FMR of a honey possum that produces 0.73 L of CO_2 per day?

FMR = 0.73 x 20.8 = 15.18 kJ day^{-1}

Question 2: If the amount of CO_2 produced varies with the type of food metabolised, what else may vary?

amount of oxygen consumed

Question 3: A captured honey possum is found to feed exclusively on *Banksia coccinea*. If its FMR is 15.2 kJ day^{-1}, how many inflorescences did it visit?

energy content of nectar from Banksia coccinea = 0.096 kJ per inflorescence

number of inflorescences visited = FMR / energy content of inflorescence

= 15.2 / 0.096 = 158

Question 4: A researcher determines the average FMR of a honey possum is 2.7 times greater than its BMR. Suggest reasons for this.

Basal metabolic rate is measured in the laboratory. This is an artificial environment that influences animal behaviour and physiology, and therefore data.

Question 5: What biotic and abiotic factors might affect the FMR of a honey possum?

BIOTIC FACTORS	ABIOTIC FACTORS
food supply	*weather*
nectar energy content	*temperature*
animal size	*time in pitfall trap*
animal age	
animal sex	
reproduction (pregnancy, lactation, mating)	
competition for food	
predators	

Question 6: What might be implications of such dietary requirements for honey possum survival?

Any major disruptions to the ecosystem, such as dieback or fire, may affect survival if food sources are affected.

A tale of five possums

Question 7: Calculate the FMR in kilojoules per day (kJ day^{-1}) for each honey possum using the information provided.

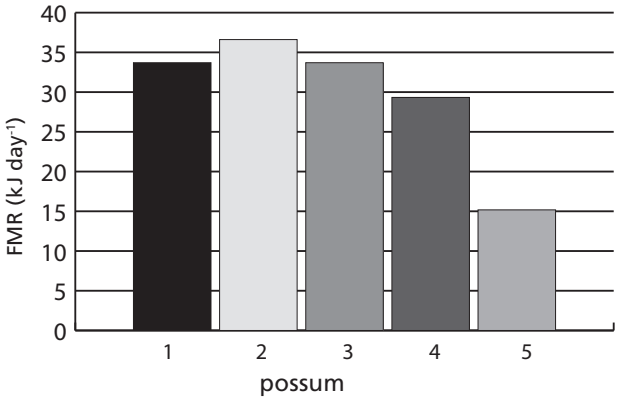
POSSUM	FMR (kJ day^{-1})
1	*32.86*
2	*36.61*
3	*33.70*
4	*29.33*
5	*15.18*

Question 8: Calculate how many inflorescences each honey possum visited to meet its energy needs. Round values to the nearest whole number.

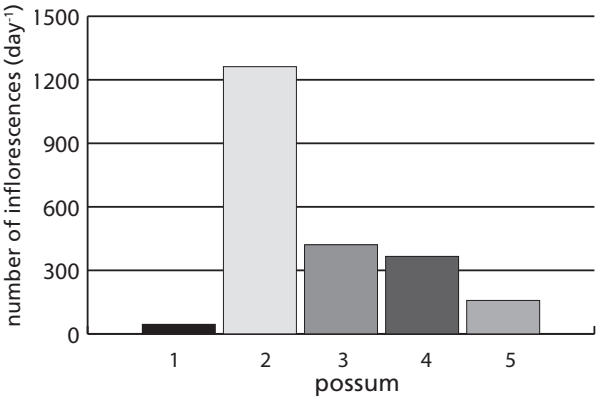
POSSUM	NUMBER OF FLOWERS
1	*45*
2	*1262*
3	*421*
4	*366*
5	*158*

Question 9: Construct a bar graph that displays information regarding:

(a) FMR (kJ day^{-1}) for each honey possum



(b) the number of inflorescences visited daily by each honey possum



Question 10: What do you notice about the approximate number of inflorescences each possum visited?

The number of inflorescences visited appears to depend on energy content of the nectar. The higher the energy content of the nectar, the fewer flowers visited.

Question 11: Comment on similarities and differences in the data for the five honey possums.

Similarities:

- *CO_2 and therefore FMR for animals 1, 2, 3 and 4 are similar.*
- *The number of inflorescences visited by animals 3, 4 and 5 are similar.*
- *All animals are male.*
- *The weights and lengths of animals 2, 3 and 5 are similar.*

Differences:

- *FMR of animal 5 is less than others.*
- *Number of inflorescences visited by animal 1 is less than others.*
- *Number of inflorescences visited by animal 2 is greater than others.*
- *Animal 5 spent a long time in the pitfall trap.*
- *Animal 1 is larger than others.*
- *Animal 4 is smaller than the others.*

Question 12: Explain how the food source of each honey possum might influence energy expenditure.

If a honey possum feeds from a species that produces low kJ content nectar, it will have to eat more, and therefore forage more, to meet its daily energy requirements. This will cause the animal to expend more energy.

Question 13: Data obtained for individual 'five' are different from the other honey possums. Discuss.

It was in a pitfall trap for an estimated 8 hours.

The number of inflorescences it visited was low.

CO_2 production and FMR are lower than average, and lower than the other animals.

It could be inferred that this honey possum went into torpor to conserve energy while it was unable to feed.

Question 14: All animals in this study are male. Using your background knowledge, explain how data might be affected by adding females to the sample.

Females are larger and therefore might have higher FMR.

Reproducing females will have greater FMR due to demands of pregnancy and lactation (research has shown that lactating females have twice the average FMR). This will not give a 'true' representation of normal daily activity for an average honey possum.

Females are dominant and have greater access to food resources.

Question 15: Using the honey possum as your reference, complete the following table:

MOLECULE	WHERE DOES IT COME FROM?	WHERE DOES IT GO?
glucose	*nectar*	*cell (mitochondria)*
oxygen	*inspired from external air*	*cell (mitochondria)*
carbon dioxide	*cells (mitochondria)*	*into blood, then lungs, then expired*
water	*cells (mitochondria)*	*excreted (via sweat, vapour, urine and faeces)*

Measuring respiration with doubly-labelled water

Question 16: Why is it important to wait for DLW to mix with body water?

Isotopes will be spread around the body evenly. The blood sample taken will give a true representation of isotope concentration.

Question 17: Why is the DLW method used?

- *Natural conditions remove laboratory bias.*
- *It is safe and non-invasive.*
- *It provides a measure of daily CO_2 production.*

Question 18: The DLW method has been used in animals as small as insects and as large as seals. It is also used in humans. However, this method is not suitable for tropical animals. Why?

They have a high water turnover, due to perspiration, so isotopes will be lost quickly. This makes it difficult to measure isotope concentration, which reduces precision of the method.

Question 19: Why wouldn't the DLW method be used in amphibians?

Amphibians have a high water turnover. Their skin is a semi-permeable membrane that allows water in and out, therefore changes in isotope concentration may not be due to cellular respiration.

Question 20: The use of the DLW method has important implications for honey possum conservation. Discuss.

DLW method enables scientists to estimate FMR and therefore daily energy requirements of honey possums. If FMR and preferred food source is known, conservation of appropriate habitat (area and vegetation) is possible.