

Food and energy 4: Honey possum respiration

Components

NAME	DESCRIPTION	AUDIENCE
	<i>Honey possum respiration</i> teachers guide	The guide shows how to explain processes scientists use to calculate a honey possum's energy requirements. Strategies to avoid student misconceptions about breathing and respiration are included.
	<i>Calculating energy requirements</i> background sheet	This background sheet provides teachers with information about scientific methods used to measure animal energy requirements. It: <ul style="list-style-type: none"> includes laboratory and field techniques, including calorimetry and the doubly-labelled water method; features techniques used to investigate energy requirements of a case study species, the honey possum; and emphasises links between metabolic activity, cellular respiration and the doubly-labelled water method.
	<i>Measuring metabolism</i> fact sheet	This fact sheet provides an introduction to techniques scientists use to investigate metabolic activity and energy requirements in humans and animals, along with their relationship to cellular respiration.
	<i>Investigating energy intake</i> worksheet	This structured worksheet guides students through calculations of animal energy requirements. It features a case study species, the honey possum, using secondhand data (that is, data collected by others). Questions allow students to make inferences about ecological outcomes, and consider limitations of scientific methodologies.

Purpose

- To help students understand the importance of conducting field-based investigations of animal metabolism.
- To introduce students to research techniques used by scientists investigating marsupial metabolism.

Activity summary

Outcomes

Students:

- appreciate metabolic requirements of animals;
- explain the use of respiration measurements in calculating animal metabolic requirements;
- investigate impacts of biotic and abiotic factors on energy outcomes of a case study species, the honey possum;
- use data provided to calculate energy requirements of a case study species, the honey possum; and
- describe the research methodologies scientists use to measure field metabolic rate in a case study species, the honey possum.

ACTIVITY	POSSIBLE STRATEGY
Teachers provide students with the fact sheet, <i>Measuring metabolism</i> .	
Students consider questions (see Using the fact sheet, below).	individually, in groups or as a class discussion
Students complete the worksheet, <i>Investigating energy intake</i> .	students complete individually

Using the fact sheet, *Measuring metabolism*

The fact sheet introduces to students the concept of measuring an organism's metabolism. It discusses differences in methods in the laboratory and the field, presents some techniques used, and also covers the need for measurement.

The fact sheet encourages students to consider questions, in groups or individually, which may be discussed as a class. Examples:

- What is a calorimeter?
- What can we determine from measuring metabolism?
- Why don't scientists just measure all animals in a laboratory?
- What is the difference between the terms 'respiration' and 'cellular respiration'?
- What examples are there of labelling with radioactive isotopes?

Using the worksheet, *Investigating energy intake*

This worksheet introduces students to methods used by scientists to calculate the metabolic rate of an animal. The context is provision of second-hand data about respiration rates of honey possums. The worksheet also provides questions that challenge students, requiring them to prioritise data, perform calculations and comment on their findings.

Teachers notes

This SPICE resource is intended to challenge students to apply their understanding of respiration and metabolism, based upon measurement of honey possum metabolism. Teachers should provide students with the fact sheet, *Measuring metabolism*, to allow them to ask class questions, as described above. Students then complete the worksheet, *Investigating energy intake*, that contains progressively more difficult questions. The last section, 'Measuring metabolism with doubly-labelled water', may be optional for some students.

Teachers may develop a mind map for students. This may be included at the beginning and end of the learning sequence. The mind map should show the role of each step in cellular respiration, and allow teaching concepts together, building on stages, rather than developing each step/process in isolation. This prevents students from merely memorising chemical steps of cellular respiration, which is a process that leads to fragmentation of knowledge and a failure to link the biochemical processes involved.

Cellular respiration is an area of difficulty for many students, and research suggests numerous misconceptions may arise.

Be mindful of the following misconceptions. The non-exhaustive list suggests methods for counteracting them.

MISCONCEPTION	SUGGESTED STRATEGIES
Students confuse breathing and gas exchange with cellular respiration.	Avoid using the term respiration when discussing breathing or gas exchange. Use the term 'cellular respiration', rather than 'respiration'. Differentiate between breathing (a physical process) and cellular respiration (a chemical process).
Students believe only some organisms perform cellular respiration.	Emphasise the role of cellular respiration in all organisms. Discuss mechanisms of photosynthesis, and differences from cellular respiration. Explain that plants respire all the time and photosynthesise when sunlight energy is available. This avoids the misconception that plants only carry out cellular respiration when not photosynthesising.
Only cells in plant roots undergo respiration.	Emphasise that all plant cells carry out cellular respiration.
Students believe the purpose of respiration is to provide oxygen and remove carbon dioxide.	Emphasise the purpose of cellular respiration in providing energy for life processes.
Students believe photosynthesis provides energy for metabolism in plants, and digestion provides energy for metabolism in animals.	Explain that neither photosynthesis nor digestion provide energy directly. Remind students that energy for life processes comes directly from the sun.

Technical requirements

The teachers guide, background sheet, fact sheet and worksheet require Adobe Reader (version 5 or later), which is a free download from www.adobe.com. The worksheet is also provided in Microsoft Word format.

Acknowledgements

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- honey possum photos by Professor Don Bradshaw
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Associated SPICE resources

Food and energy 4: Honey possum respiration may be used in conjunction with related SPICE resources to address the broader topic of how scientists determine energy requirements of a species.

DESCRIPTION	LEARNING PURPOSE
<p><i>Food and energy (overview)</i></p> <p>This learning pathway shows how a number of SPICE resources may be combined to teach the topic of food and energy.</p>	
<p><i>Food and energy 1: The honey possum</i></p> <p>In a video interview, zoologist Professor Don Bradshaw tells how he became interested in the honey possum, a rare and unusual Australian marsupial, and describes some of their unique adaptations.</p>	Engage
<p><i>Food and energy 2: Pollen</i></p> <p>Students use a virtual microscope to examine pollen from a range of plants, measure the size of pollen grains, and learn about features such as pore width and cell wall width.</p>	Explore
<p><i>Food and energy 3: Fauna surveys</i></p> <p>Students explore factors controlling abundance and distribution of organisms, and occupation of particular habitats.</p>	Explore
<p><i>Food and energy 4: Honey possum respiration</i></p> <p>Students use a worksheet to explore the process of respiration in heterotrophic organisms.</p>	Explain
<p><i>Food and energy 5: Animal release</i></p> <p>Students answer questions to identify an environment that will effectively sustain a released population of honey possums.</p>	Elaborate

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Web: spice.wa.edu.au
Email: spice@uwa.edu.au
Phone: (08) 6488 3917

Centre for Learning Technology (M016)
The University of Western Australia
35 Stirling Highway
Crawley WA 6009