BURNETT MARY

MICRO-BAT EDUCATION KIT

Investigating Insectivores

This resource has been written and designed by Kelly Coleman @ PeeKdesigns
Published by Burnett Mary Regional Group for Natural Resource Management Ltd.
This project is supported by Burnett Mary Regional Group, through funding from the Australian Government's National Landcare Program.

Cover photo - front: Eastern bent-wing bats / L.Hall
Cover photo - back: Bat box school workshop / J.Parsons.

Coleman, K. (2018) *Burnett Mary Micro-bat Education Kit: Investigating Insectivores.* Burnett Mary Regional Group Inc., Queensland.

Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (2018). However, because of advances in knowledge, users are reminded of the need to ensure that the information upon which they rely is up to date and to check the currency of the information with the relevant authorities.

Micro-bats and flying-foxes may carry bacteria and viruses which can be harmful to humans. People who are not trained and vaccinated should not handle bats. If you find an injured micro-bat or flying-fox, do not attempt to help the animal yourself or touch it in any way. Contact the RSPCA (1300 ANIMAL) or your local wildlife care group/rescuer/carer, or the Department of Environment and Heritage Protection (1300 130 372) for assistance.

Peek designs

Australian Government | National Landcare Program

Burnett Mary Regional Group
Practical Solutions for Natural Resource Management

Micro-bat education kit

About the education kit

The *Burnett Mary Micro-bat Education Kit: Investigating Insectivores* was developed to improve the long-term survival and awareness of micro-bats in the Burnett Mary region of Queensland.

The education kit introduces teachers and students to the important role that micro-bats play in our lives, such as consuming millions of insects every night - an essential part of keeping our environment healthy!

Although it has been developed to fit in with the year 4 and 5 curriculum, this resource can be used and adapted to higher year levels by individual teachers.

The All About Bats website is a key component to this education kit - www.allaboutbats.org.au

Contents

GOULD'S WATTLED BAT (L.HALL)

UNIT INTRODUCTION

All about micro-bats

Rationale

This unit introduces students to the world of micro-bats. It introduces the basic fundamentals of micro-bats, their biology, how they use echolocation to find food, their habitat and raises awareness of the important role they play in our environment regarding insect control.

It is intended to use this unit of work as an introduction at each year level for the following units, i.e. a Year 5 class completes this unit and follows through with Unit 2.

This unit consists of two activities that will take up to two hours of class time.

There are no key curriculum outcomes for this unit - it is to be used as an introduction only.

Activity A: Getting to know micro-bats

Students begin by completing a short quiz to determine a level of existing knowledge about micro-bats. They are taken through a PowerPoint presentation about micro-bats that includes the quiz answers and provides a background to micro-bat biology, habitat and conservation.

Activity B: Micro-bat fact sheet

Students use the content from the presentation, as well as their own research on the All About Bats website, to create a fact sheet about micro-bats.

EASTERN BROAD-NOSED BAT (M.PENNAY)

All about micro-bats

Overview

This lesson is an introduction to micro-bats for year levels 4-5. Students learn the basic fundamentals of micro-bats, their biology and habitat.

Background information

Bats are flying mammals that can be found throughout the world (except Antarctica). They are the second largest group of mammals in the world with in-excess of 950 species; comprising one fifth of all mammal species. In Australia, there are 79 species of bats, of which 68 are micro-bats.

Micro-bats are characterised by their small size, use of echolocation for navigation, ability to hibernate in cold temperatures and their diets largely consists of insects but can include small mammals, frogs, fish and occasionally fruit, pollen and nectar. Most Australian micro-bats will roost in tree hollows or under bark, or they can be found in caves and cave-like structures.

Micro-bats and flying foxes may carry bacteria and viruses which can be harmful to humans. People who are not trained and vaccinated should not handle bats. If you find an injured bat or flying fox, do not attempt to help the animal yourself or touch it in any way. Contact the RSPCA (1300 ANIMAL) or your local wildlife care group/rescuer/carer, or the Department of Environment and Heritage Protection (1300 130 372) for assistance.

Resources

Quiz sheets

All About Micro-bats PowerPoint presentation

Tablets or computers

Activity descriptions

Activity 1: Getting to know micro-bats

Students begin by completing a short quiz to determine a level of existing knowledge about micro-bats.

Students mark their own quiz as the class goes through the answers using a PowerPoint presentation. This will ensure that all students will have the basic facts about micro-bats.

POWERPOINT SLIDE NOTES

SLIDE 2: Welcome to the Micro-bat world

Micro-bats are small and the average body is about the size of a mouse. They are often called 'flying-mice'.

The smallest bat in the world is the critically endangered Bumblebee bat of Thailand. It is only 29-33 millimetres in length, approximately 2 grams in weight and has a wingspan of up to 15 centimetres.

SLIDE 3: All bats are mammals

Mammals are animals that care for their young after birth by feeding them milk. Most mammals give birth to live young. They all have fur or hair on their bodies. Human beings are mammals as well as dogs, cats, kangaroos and whales. Bats are the only mammal that can fly.

SLIDE 4: All bats are nocturnal

They wake up at dusk and fly out to feed and find water. They return to the roost early in the morning.

Bats sleep or rest by hanging upside down, using a special claw on their foot which ensures that they won't let go when they're asleep. By hanging upside-down they don't waste any energy.

SLIDE 5: A micro-bat's diet

A micro-bat's diet largely consists of insects but can include small mammals, frogs, fish.

Occasionally a micro-bat's diet can include fruit, pollen, nectar and blood - this is not the normal food for Australian micro-bats.

SLIDE 6: Seeing in the dark

Micro-bats do not rely on sight to find food. Instead they use a form of radar called echolocation.

Echolocation occurs by the micro-bat creating a sound that bounces off objects and the echo is detected by the micro-bat.

SLIDE 7: There's no place like home

Most Australian micro-bats will roost in tree hollows or under bark, or they can be found in caves and cave-like structures.

They can also find shelter in roofs or sheds when there aren't enough 'natural' roosts around.

SLIDE 8: Other fun facts

MATERNITY COLONIES: Micro-bats also have nurseries where the young are left in large groups while the mothers feed at night. Mothers will gather in the same area, sometimes a cave, tree hollow or building cavity. These nurseries can consist of millions of bats in some areas.

HIBERNATION: Food can be scarce in winter, so micro-bats survive by either migrating to warmer regions or they hibernate. Hibernation is a state of torpor (inactivity). Micro-bats have the ability to slow their heart rate and lower their body temperature, sometimes to as low as 2°C.

HISTORY: The oldest known bat fossil is 52 million years old. Research show it could fly, but not use echolocation. Bats have been used as food sources, they feature in Dreaming stories, found in cave paintings and in modern art, as well as being totem animals for some Indigenous groups.

CONSERVATION: Loss of habitat is the single largest threat to all bats. Bat boxes can be easily built and erected around schools and homes to provide daytime roosts for micro-bats.

Time requirement: 30 mins (approx)

Activity 2: Micro-bat fact sheet

Students are provided time (either class or homework) to create a fact sheet about micro-bats using the information from the presentation and additional online research using the All About Bats website.

Provide students with guidance on what should be included on their fact sheet – title, picture/s, minimum description of five unique facts about all micro-bats and one example of a micro-bat species, including an interesting feature of that species.

Time requirement: 60 mins (approx)

INTRODUCTION ACTIVITY A

Getting to know micro-bats quiz

1. **What type of animal is a micro-bat?**
   - [ ] A reptile
   - [ ] A bird
   - [ ] A mammal
   - [ ] A fish

2. **What covering do micro-bats have on their bodies?**
   - [ ] Fur
   - [ ] Shell
   - [ ] Feathers
   - [ ] Scales

3. **When do micro-bats sleep?**
   - [ ] At night
   - [ ] In the morning
   - [ ] At dusk
   - [ ] During the day

4. **Where do micro-bats sleep? Select all that are correct.**
   - [ ] In caves
   - [ ] In trees
   - [ ] In burrows
   - [ ] In people's roofs

5. **How do micro-bats sleep?**
   - [ ] Standing up
   - [ ] Lying down
   - [ ] Hanging upside down
   - [ ] While flying

6. **What do Australian micro-bats eat? Select all that are correct.**
   - [ ] Insects
   - [ ] Fruit, blossom and nectar
   - [ ] Blood
   - [ ] Small animals

7. **Micro-bats find their food by a type of radar.**
   - [ ] True
   - [ ] False

8. **How big is a micro-bat?**
   - [ ] As big as a football.
   - [ ] The size of a mouse.
   - [ ] As small as a bee.
   - [ ] The size of a mobile phone.

9. **Micro-bats can hibernate just like bears.**
   - [ ] True
   - [ ] False

10. **If I find an injured or dead bat I should pick it up.**
    - [ ] True
    - [ ] False

INTRODUCTION ACTIVITY A

Getting to know micro-bats quiz

ANSWERS

1. What type of animal is a micro-bat?

A mammal - All bats are mammals. Mammals are animals that care for their young after birth by feeding them milk. Most mammals give birth to live young. They all have fur or hair on their bodies. Human beings are mammals as well as dogs, cats, kangaroos and whales. Bats are the only mammal that can fly.

2. What covering do micro-bats have on their bodies?

Fur – Micro-bats are mammals that have fur. Have a look at a picture of a bat, they have fur on their bodies. Their wings are made of skin. They do not have feathers like a bird.

3. When do micro-bats sleep?

During the day - Micro-bats are nocturnal. They wake up at dusk and fly out to feed and find water. They return to the roost early in the morning.

4. Where do micro-bats sleep? Select all that are correct.

In caves, trees and even in people's roofs - Most Australian micro-bats will roost in tree hollows or under bark, or they can be found in caves and cave-like structures. They can also find shelter in roofs or sheds when there aren't enough 'natural' roosts around.

5. How do micro-bats sleep?

Hanging upside down – By hanging upside-down they don't waste any energy.

6. What does a micro-bat eat? Select all that are correct.

Insects and even small animals – A micro-bat's diet largely consists of insects but can include small mammals, frogs, fish. Occasionally it can include blood, fruit, pollen and nectar but this is not the normal food for Australian micro-bats.

7. Micro-bats find their food by a type of radar.

True – Micro-bats do not rely on sight to find food. They use a form of radar called echolocation where sound is emitted by the micro-bat, sound bounces off objects and they listen to the echo.

8. How big is a micro-bat?

The size of a mouse – Micro-bats are small and the average body is about the size of a mouse. The world's smallest bat is only 29-33 millimetres in length and approximately 2 grams in weight.

9. Micro-bats can hibernate just like bears.

True - Food can be scarce in winter, so micro-bats survive by either migrating to warmer regions or they hibernate. Micro-bats have the ability to slow their heart rate and lower their body temperature, sometimes to as low as 2°C.

10. If I find an injured or dead bat I should pick it up.

False – All Australian bats have the potential to carry diseases. If you find a sick or injured bat, do not touch the bat. Contact a local vet for details or your nearest wildlife carer. The best approach is to leave bats alone.

INTRODUCTION ACTIVITY B

A micro-bat fact sheet

Micro-bats are often misunderstood creatures. Help other people earn about micro-bats b creating your own fact sheet.

Your fact sheet will need to describe five facts about all types micro-bats and include one example of a micro-bat species.

You can use the website www.allaboutbats.org.au to help you gather the information you need for your fact sheet.

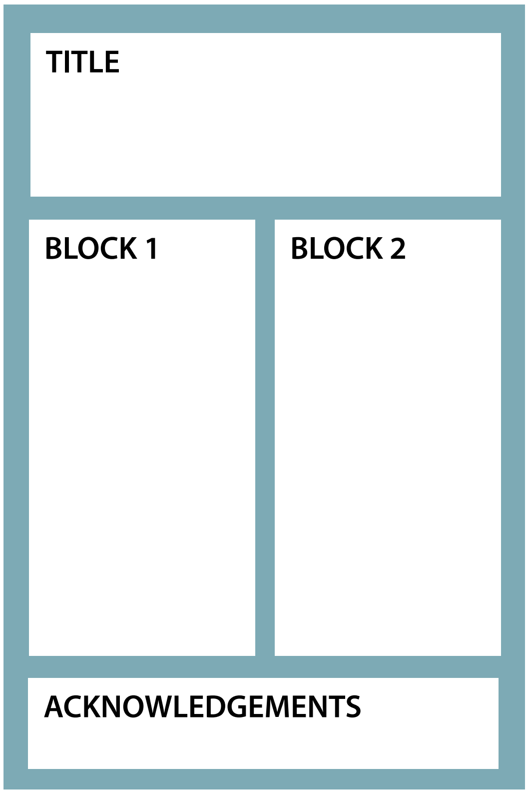
Tips for creating a fact sheet

A fact sheet is usually an A4 piece of paper with useful information that can help someone understand a topic. Fact sheets can include photos, diagrams, graphs and other artwork.

The content on a fact sheet is usually broken down into small 'chunks' that allows the reader to gather all the information they need quickly. Each block of text has a catchy sub-heading followed by the information you want to get across to the reader. This is where you include photos or illustrations.

When designing a fact sheet you need to think about what you want your reader to know, then focus on those points. Include an image or two to back up the information.

Make sure to acknowledge any sources of information you have used, such as websites. If you use photos from the Internet, acknowledge the photographer or website you got it from.



UNIT 1

Living in a micro-bat world

Rationale

This **YEAR 4 UNIT** looks at the reproduction, feeding relationships and habitat of micro-bats in Australia. It introduces the importance of looking after entire ecosystems as a micro-bat's life is embedded in a complex web of predator-prey and habitat relationships.

This unit is divided into three core lessons, some with multiple activities. The aim is that this unit will take approximately three hours of class time.

Lesson 1.1 Micro-bat life cycle

Students will investigate the similarities and differences between life-cycle of different species and learn about the eastern bent-wing bat's life-cycle.

Lesson 1. 2 Hungry, hungry bats

Students will learn the importance of food chains and how ecosystems are a complex web of feeding relationships. Students are introduced to the terms Food Chain, Producer, Consumer, Decomposer, Herbivore, Carnivore, Omnivore, Predator and Prey. Students use mathematics to calculate populations, consumption of insects and ecosystem interactions.

Lesson 1. 3 Hollows, caves and houses

Students will learn about the habitat requirements of micro-bats and the importance of looking after entire ecosystems.

Curriculum outcomes

Activity	1.1	1.2	1.3
Science Understanding			
Living things have life cycles **ACSSU072**	✓		
Living things depend on each other and the environment to survive **ACSSU073**	✓	✓	
Science as a Human Endeavour			
Science knowledge helps people to understand the effect of their actions **ACSHE062**			✓
Geography			
The importance of environments, including natural vegetation, to animals and people **ACHASSK088**		✓	✓
Mathematics			
Recognise, represent and order numbers to at least tens of thousands **ACMNA072**		✓	
Develop efficient mental and written strategies and use appropriate digital technologies for multiplication and for division where there is no remainder **ACMNA076**		✓	
Investigate equivalent fractions used in contexts **ACMNA077**		✓	
Count by quarters halves and thirds, including with mixed numerals. Locate and represent these fractions on a number line **ACMNA078**		✓	
Recognise that the place value system can be extended to tenths and hundredths. Make connections between fractions and decimal notation **ACMNA079**		✓	
Cross-curriculum priority - Sustainability			
OI.2 All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival.		✓	✓

LESSON 1.1

Micro-bat life cycle

Overview

Students investigate the similarities and differences between the life-cycle of completely different organisms to help understand that all living organisms have a life cycle. This is followed by reviewing the reproduction cycle of the eastern bent-wing bat.

Background information

All living organisms have a life cycle of birth - reproduction - death. The process on how this occurs can be similar, but also can be very different. Understanding the similarities and differences helps us to classify species, such as mammals give birth to live young and suckle young with milk, birds lay eggs etc.

Most micro-bats (in temperate climates) have a hibernation period during the colder months of the year and this makes their reproduction cycle different to many other mammals. They have to delay the development of the embryo while hibernating. Micro-bats also give birth to one or two young (depending on the species) that are 20-30% the size of the mother. This is a huge size compared to the size of the parent.

For more details on micro-bat reproduction use the 'Bats of the Burnett Mary' pocket guide book or refer to the All About Bats website: www.allaboutbats.org.au/biology/

Activity descriptions

Activity 1: Compare life-cycles

All living organisms have a life cycle of birth - reproduction - death. To illustrate this, present students with the 'Comparing life-cycles' fact sheet (either as a hand-out or on a SmartBoard).

Give students 5 minutes to examine the life-cycle and record anything that is similar or different in their workbooks. Go through all the answers as a class.

Similarities	Differences
Fertilisation Embryo Grow to an adult Death	Frog - lay eggs Frog - metamorphosis Tree - fruit and seeds Tree - seeds carried away Human - give birth

EXTENSION ACTIVITY: Combine this activity with an investigation into the life-cycle of another species, such as the flying-fox: www.allaboutbats.org.au/sqffek-year-4/

Time requirement: 20 mins (approx)

Activity 2: Micro-bat reproduction

Discuss the life-cycle stages identified in the fact sheet about micro-bat reproduction. Back up this discussion by watching a YouTube video showing a micro-bat giving birth: youtu.be/Shv1RGOzkck (pre-watch this to make sure it is suitable for your students).

Students use this information in the fact sheet to complete the micro-bat reproduction word search.

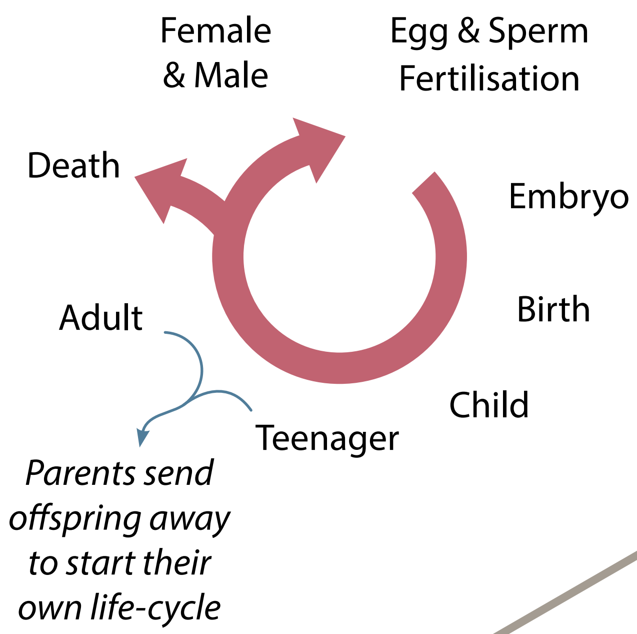
EXTENSION ACTIVITY: Students research and define all the words in the word search.

Time requirement: 20 mins (approx)

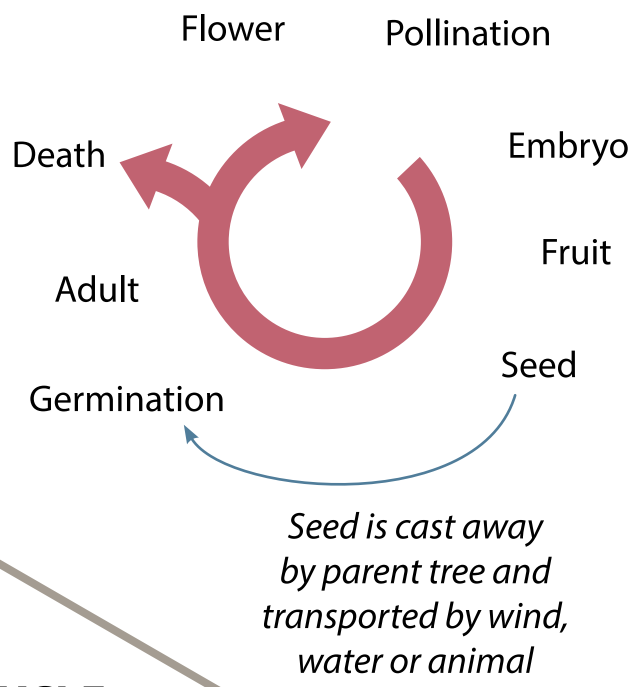
ACTIVITY SHEET 1.1A

Comparing life-cycles

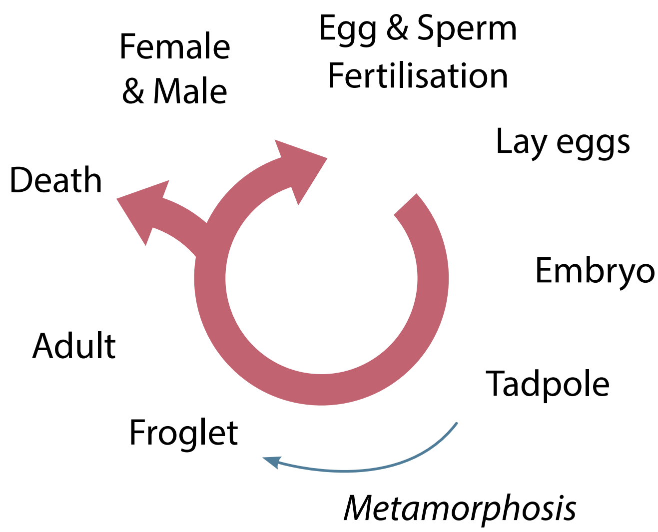
HUMAN LIFE-CYCLE



TREE LIFE-CYCLE



FROG LIFE-CYCLE



ACTIVITY SHEET 1.1B

Micro-bat reproduction

Most micro-bats have a hibernation period during the colder months of the year and this makes their reproduction cycle different to many other mammals. The example below if of the **eastern bent-wing bat** that can be found living in eastern Australia.

YEAR 1

Autumn

Mating occurs between females and males.

Winter

Fertilised egg (early embryo) will stay dormant inside the female until spring, or after hibernation is over.

Spring

When hibernation is over, the embryo will continue to develop.

The female is pregnant for 60-80 days.

Females gather in large maternity colonies before giving birth.

Summer

Single young is born. Baby bats are sometimes called 'pups'.

Young are left together in the colony while mothers feed at night.

Mothers find their young by smell and sound.

Mothers will feed their young milk from teats in their armpits.

YEAR 2

Autumn

Juveniles can fly seven weeks after birth.

Mothers leave the colony in early March.

Juveniles leave the colony a few weeks after the mothers. The colony is deserted by April.

Juveniles will be sexually mature in two years.

JUVENILES IN A MATERNITY COLONY (L.HALL)

CHURCHILL, S. (2008) AUSTRALIAN BATS (2ND EDITION). ALLEN AND UNWIN, SYDNEY.

ACTIVITY SHEET 1.1B

Micro-bat reproduction word search

R	T	T	H	B	E	F	B	L	E	T	I	A	Z	R
W	W	N	I	I	L	M	I	A	L	N	R	D	I	E
T	I	R	A	Y	B	F	B	T	A	A	R	U	D	H
K	T	N	I	N	E	E	B	R	M	M	J	L	K	T
H	G	N	T	C	G	E	R	E	Y	R	U	T	N	O
P	G	Z	Y	E	G	E	V	N	R	O	V	J	G	M
Z	C	C	O	W	R	Y	R	A	A	D	E	Y	G	B
I	L	C	O	L	O	N	Y	P	C	T	N	N	W	V
E	M	R	E	P	R	O	D	U	C	T	I	O	N	F
Y	T	I	N	R	E	T	A	M	N	R	L	O	A	E
G	N	I	T	A	M	R	T	M	P	E	E	Y	N	M
S	U	M	M	E	R	U	U	S	J	K	S	X	G	A
M	S	T	A	E	T	T	N	T	L	P	U	P	Z	L
R	L	O	A	J	U	P	Y	I	A	T	W	G	R	E
M	H	U	D	A	K	U	M	J	C	M	N	T	V	U

ADULT
AUTUMN
BIRTH
CAVE
COLONY
DORMANT
EMBRYO
FEMALE
FLYING
HIBERNATION
JUVENILES
LIFE-CYCLE
MALE
MATERNITY
MATING
MATURE
MILK
MOTHER
PUP
PREGNANT
REPRODUCTION
SPRING
SUMMER
TEATS
WINTER

LESSON 1.2

Hungry, hungry bats

Overview

Students will learn the importance of food chains and looking after entire ecosystems.

Students will be presented with a series of mathematical problems related to micro-bat consumption and population patterns.

Background information

An ecosystem is a term used to describe how a range of elements in the environment work together as a functioning system. These elements include biotic (plants and animals) and abiotic (air, water, soil) features. The ecosystem can be large or it can be small depending on the elements involved. For example a pond is an ecosystem and a rainforest is an ecosystem.

Within ecosystems there is a complex flow of energy from organism to organism. This is called a food web. A food web is made up of a series of food chains. Each organism in the chain obtains energy from the one before it. Micro-bats play an important role in many food chains as they eat an abundant amount of food and are in-turn food for other animals.

Insectivorous (insect eating) micro-bats will eat around 50-75% of their body weight each night – sometimes this can be as much as 1200 mosquitoes every hour! This makes micro-bats extremely important for keeping insect populations under control.

Resources

Calculator

Activity descriptions

Activity 1: Food chains

Draw an example of a food chain on the board (see Activity Sheet 1.2A). Discuss with the class what would happen if you were to take the bats out of the food chain. What would happen to the other links in the chain?

Introduce students to the terms **Food Chain, Producer, Consumer, Decomposer, Herbivore, Carnivore** and **Omnivore**. Using these terms, students create food chains of three different species of micro-bats using the stories on the Activity Sheet 1.2B as a guide.

Time requirement: 30 mins (approx)

Activity 2: Micro-bat maths

Introduce students to how many insects micro-bats can consume every night. Discuss why this is important for healthy ecosystems.

Using the activity sheets, ask students to solve the mathematical problems using whole numbers, decimals, percentages and fractions to determine and present statistical analysis.

Population Percentages Answers

1. (a) 25% (b) 40% (c) 75% (d) 80% (e) 30%
2. (a) 0.25 (b) 0.4 (c) 0.75 (d) 0.8 (e) 0.3
3. (a) 25/100 = 1/4 (b) 40/100 = 4/10 = 2/5
   (c) 75/100 = 3/4 (d) 80/100 = 8/10 = 4/5
   (e) 30/100 = 3/10

Consumption Calculations Answers

1. 10 hours 2. 2000 bugs 3. 10 hours 4. 2010
5. 201 6. 12:00am - 1:00am 7. 4:00am - 5:00am
8. 4 hours 9. 6 hours

Ecosystem Equations Answers

1. (a) 100,000 g (b) 100 kg (c) 15,000 kg
2. (a) 10% (b) 120 g (c) 250 (d) 5/20 or 1/4

Time requirement: 30 mins (approx)

ACTIVITY SHEET 1.2A

Food chains

A **FOOD CHAIN** is a 'chain' of organisms, through which energy is transferred. Each organism in the chain feeds on and obtains energy from the one before it. We can combine multiple chains to create a **FOOD WEB**.

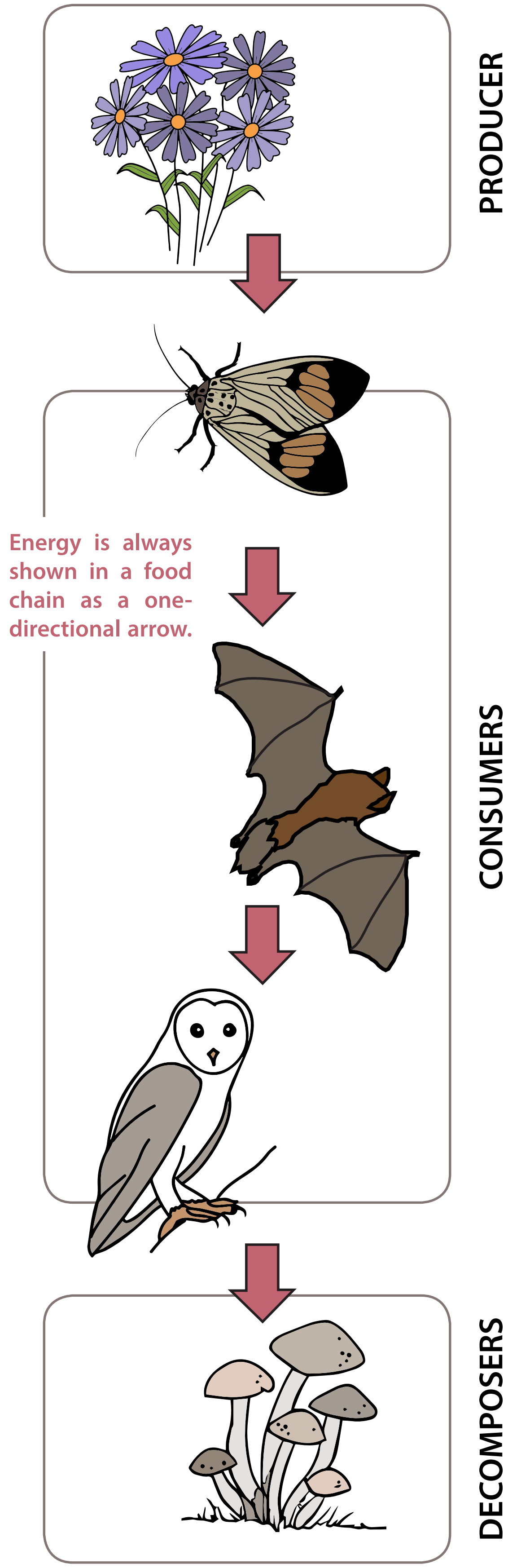
A food chain always starts with a **PRODUCER**. They produce the first level of energy in the chain. These are usually always plants, but can include microscopic organisms.

PRIMARY CONSUMERS are generally the vegetarians (*herbivores*) of the animal world. These animals eat the producers and get energy from them. Just like when we eat an apple or banana; it gives us energy. Animals that can be both primary and secondary consumers are called *omnivores*.

The next level is the **SECONDARY CONSUMERS**. These are generally the *carnivores* as they eat other animals. They get lots of energy from eating the primary consumers. There can be higher levels of consumers and this depends on how complicated your food chain is.

Lastly, we have **DECOMPOSERS**. These are the bacteria, fungi and insects that break down dead organic material (plants or animals) and return that energy back to the soil for producers to use.

What happens if a link in the chain is broken?



ACTIVITY SHEET 1.2B

Food chains

Read the following stories about three different types of micro-bat. Pay close attention to who the PRODUCERS and CONSUMERS are. Create a food chain for each story.

2. Bobby the eastern bent-wing bat

High in the forest the eucalypt flowers are blossoming. They provide a strong perfume that is attracting flying-foxes, possums and a variety of insects. As they feed on the abundant nectar, the insects are unaware of the bats that are quickly darting around them.

A flying-fox drops onto a branch and a plume of insects fly into the air - this is Bobby's chance to feast on an easy meal.

Using echolocation, Bobby the eastern bent-wing bat locates the moths and other insects that got disturbed by the flying-fox. Bobby swoops in and uses his quick movements to snatch up and eat insects while still flying about. With so much food available, Bobby will eat half his body weight in insects before finding a tree to roost in for the day.

1. Gilda the ghost bat

One day, an active little grasshopper was munching on some grass along the banks of a river. He got so full that he had to stop and rest for a while. Unfortunately, a hungry tree frog was watching and waiting for the grasshopper to finish his meal. When he saw that the grasshopper could move no more, he leaped over and ate the grasshopper up.

As night fell, Terry tree frog started looking out for more food in the tree tops. He was completely oblivious to the silent predator that was stalking him. Out of nowhere, Gilda the ghost bat flew in and captured Terry in her feet. Terry tried to get away but couldn't. Gilda took Terry back to her cave where she felt safe to focus on her tree frog meal.

The night was still early and Gilda was still hungry, this time for some moths she new flew above the river. As she started to head out of her cave she was struck by a python who was hiding in a crack on the side of the wall. The python moved so quick that Gilda had no chance of escape.

3. Milo the large-footed myotis

One dark night, with no moon about, some young fish were nibbling at patches of algae near the surface of a still stretch of river. Because there wasn't a breath of wind, the water surface was extremely still except for the fish who made tiny ripples where they were feeding.

Milo, a large-footed myotis, is a specialist in catching small fish. He darted above the water and through echolocation identified the ripples the fish were making. Because there was no moon, Milo was invisible to the fish below. Knowing where he was going to make his run, he stopped using echolocation, swooped down, dragged his large feet through the water and picked up a fish for his meal.

As Milo was making his fishing run, he didn't notice a large powerful owl that was flying above. The owl silently flew in and snatched Milo while he was in flight - still clasping his fish in his feet.

The owl landed in a nearby tree and made a meal out of Milo. Poor Milo.

ACTIVITY SHEET 1.3A

Population percentages

When people study the populations of creatures it is important to understand the different mathematical terms that help us compare them. Some useful ways of looking at the populations in micro-bat colonies are using number out of 100, percentage, decimals and fractions.

Looking at the number out of 100 allows us look at how many micro-bats out of 100 have a particular feature. This means we don't have to use ridiculously big numbers.	**EXAMPLE 1** If there are 9,000 adults in the maternity colony of 18,000 = 50 out of 100 bats are adults
Percentage is another way of looking at numbers out of 100. Percentages are out of 100 so we just have to put a percent sign (%) next to the number.	**EXAMPLE 2** 50 out of 100 bats are adults = 50%
These percentages can then be turned into decimals. Decimals change the number into parts of 1.	**EXAMPLE 3** 50% of bats are adults = 0.50 = 0.5
Numbers out of 100, percentages and decimals can also be used to change numbers into fractions.	**EXAMPLE 4** 50 out of 100 = 50% = 0.5 = 50/100 = ½

1. Convert the following numbers out of 100 into percentages.

25 out of 100	40 out of 100	75 out of 100	80 out of 100	30 out of 100
(a)	(b)	(c)	(d)	(e)

2. Convert the percentages in question 1 into decimals.

(a) (b) (c) (d) (e)

3. Convert the decimals in question 2 into fractions (or use question 1 percentages).

(a) (b) (c) (d) (e)

ACTIVITY SHEET 1.3B

Consumption calculations

Micro-bats may be little but they have enormous appetites. These hungry bats can eat up to 300 bugs in an hour.

1. If Minnie the micro-bat leaves her Maryborough home at dusk (7:00pm) and returns at dawn (5:00am) how many hours does she spend hunting?
2. On Monday night Minnie catches 200 insects every hour. What is the total amount of insects she catches for the night (using your previous answer)?

HINT = hours x insects

On Tuesday night Minnie's big insect hunt was very successful. The table below shows how many insects she caught every hour that she was out hunting.

TIME	INSECT COUNT	TIME	INSECT COUNT
7:00pm - 8:00pm	110	12:00am - 1:00am	360
8:00pm - 9:00pm	150	1:00am - 1:00am	230
9:00pm - 10:00pm	180	2:00am - 3:00am	200
10:00pm - 11:00pm	230	3:00am - 4:00am	150
11:00pm - 12:00am	300	4:00am - 5:00am	100

3. How many hours does Minnie hunt for on Tuesday night?
4. How many insects in total does Minnie eat on Tuesday night?
5. What is the average number of insects that Minnie eats in an hour on Tuesday night?

Average = total insects ÷ total hours

6. In which hour did Minnie catch the most insects?
7. In which hour did Minnie catch the least insects?
8. How many hours did she catch more than the average amount?
9. How many hours did she catch less than the average amount?

Ecosystem equations

Minnie is an eastern bent-wing bat. She is part of a huge maternity colony and all the females have given birth in the same cave. Minnie and her fellow mothers need to go hunt a lot more insects than usual to give them enough energy to produce milk for their young who stay in the cave.

1. There are 10,000 adult females in the cave and each of them eat 10 grams of insects per night

   (a) How many grams of insects are removed from the ecosystem each night?

   HINT: total females x amount of insects

   (b) How many kilograms is this?

   HINT: 1000 grams = 1 kilogram

   (c) The females stay for 150 days in the maternity cave. How many kilograms of insects are eaten over this time by the 10,000 females?

   HINT: days x amount of insects

A local farmer, Jack, installs micro-bat boxes in the trees surrounding his crops. Jack hopes that by encouraging micro-bats in the area that they will help reduce the insects that are eating his crops. This will help Jack so he doesn't have to spend more money on pesticides.

2. The mother's in Minnie's maternity colony leave the cave in March and spread out to find food elsewhere over the colder months. Minnie finds one of the bat boxes and roosts in there with 9 other eastern bent-wing bats.

   (a) If the bat box is home to 10 micro-bats, what is Minnie's percentage of the total?

   HINT: percentage is a number out-of-100

   (b) Minnie and her bat box companions are now eating 12 grams of insects each night. What is the total nightly consumption of insects (in grams)?

   (c) Jack has installed 25 bat boxes on his property. If each contain 10 micro-bats, how many micro-bats are helping the farmer?

   (d) A huge storm comes through the area and 5 of the 20 bat boxes are destroyed. What is the fraction of bat boxes that have been lost?

LESSON 1.3

Hollows, caves and houses

Overview

Students will learn about the habitat requirements of micro-bats and the importance of looking after entire ecosystems.

Background information

All organisms need a unique combination of requirements within which to live, such as food, water and shelter. The combination of these is referred to a their habitat.

The habitat of a micro-bat needs to include where it roosts in during the day (there can be many different sites every year), as well as all the locations where it finds food and water at night. A micro-bat's survival relies on the conditions, resources and community of plants and animals that form their habitat. This habitat needs to be healthy for the micro-bat to be healthy.

Resources

Micro-bat Habitat PowerPoint Presentation

Activity descriptions

Activity 1: Importance of habitat

Introduce students to the term **Habitat** (see description in the *Background information*). Brainstorm with students what they think a micro-bat's habitat would consist of.

Run through the Micro-bat Habitat presentation using the presenter's notes to talk through the slides. Go back to the brainstorm on the board and see if you need to make any changes. Students record in their workbooks the final brainstorm of micro-bat habitat.

Time requirement: 45 mins (approx)

Activity 2: Rate your neighbourhood

After learning about the importance of micro-bat habitat and the habitat features they require, take your students for a walk around the school grounds. Their job is to identify a range of features suitable for micro-bat habitat. Students record their results on the matrix activity sheet. The final rating will determine if your school grounds are micro-bat friendly.

Ask students to repeat the process at home and one other location of their choosing, such as a local park. Students report on their findings in the classroom.

Time requirement: 60 mins (approx)

Activity 3: Habitat display

Students use all the information they have learned and gathered about micro-bat habitat to create a poster, PowerPoint or other type of display to showcase the neighbourhood's micro-bat habitat rating and if anything more can be done to attract micro-bats.

Time requirement: 60 mins (approx)

ACTIVITY SHEET 1.3

Rate your neighbourhood

Have you ever seen micro-bats in your neighbourhood?
How do you know if your neighbourhood is micro-bat friendly?

Micro-bats need a number of habitat features in the environment for them to survive and thrive. These features can include bushland, open spaces, water and hollows or other structures to roost in during the day.

Your job is to identify a range of features suitable for micro-bat habitat in your local neighbourhood. Using the rating chart below, walk around three areas of your neighbourhood (with adult supervision). Site 1 is your school, Site 2 is your home and Site 3 is another location of your choosing, such as a local park. As you investigate each site, observe the micro-bat habitat features and rate them in the table below. The higher the rating, the more habitat there is for micro-bats.

For each habitat feature, you need to give a rating out of 10.

1 = none to little 2 = some 3 = many or lots

My OTHER location is: ....

Micro-bat Habitat Features	1. School	2. Home	3. Other
Old trees with hollows.	/3	/3	/3
Native trees, shrubs and grassy areas where insects live.	/3	/3	/3
Open water, creeks, rivers, dams or ponds for bats to feed over and drink from.	/3	/3	/3
Buildings with high roofs, eaves, bat boxes or other places where bats can roost.	/3	/3	/3
Other areas nearby with native plants, old trees or caves.	/3	/3	/3
Overall Rating	**/15**	**/15**	**/15**

UNIT 2

Adaptations and changing environments

Rationale

This **YEAR 5 UNIT** looks at two of the key adaptations of micro-bats - the ability to fly and use echolocation to find food. It also examines how humans have changed natural environments and that a key to protecting micro-bats is through conservation efforts such as installation of artificial bat houses.

This unit is divided into three core lessons, some with multiple activities. The aim is that this unit will take up to nine hours of class time.

Lesson 2.1 Flying mammals

Students are introduced to the term Adaptation and look at how micro-bats have adapted over time to develop specialised features that help them survive. In this lesson, students focus on one adaptation – flying.

Lesson 2. 2 Echolocation

Students learn about micro-bats most defining adaptation – the ability to navigate and find their prey using echolocation. This will be achieved through using videos and conducting fun experiments.

Lesson 2. 3 Bat houses

Students will learn about the impacts humans have had on micro-bat habitat and the importance of looking after entire ecosystems. Students will research and design a diorama of a bat box before constructing their own bat houses.

Curriculum outcomes

Activity	2.1	2.2	2.3
Science Understanding			
Living things have structural features and adaptations that help them to survive in their environment **ACSSU043**	✓	✓	
Geography			
The influence of people, including Aboriginal and Torres Strait Islander Peoples, on the environmental characteristics of Australian places **ACHASSK112**			✓
The environmental and human influences on the location and characteristics of a place and the management of spaces within them **ACHASSK113**			✓
Design and Technologies			
Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions **ACTDEP024**	✓		
Generate, develop and communicate design ideas and processes for audiences using appropriate technical terms and graphical representation techniques **ACTDEP025**	✓		
Select appropriate materials, components, tools, equipment and techniques and apply safe procedures to make designed solutions **ACTDEP026**	✓		
Develop project plans that include consideration of resources when making designed solutions individually and collaboratively **ACTDEP028**	✓		
Cross-curriculum priority - Sustainability			
OI.2 All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival.			✓

LESSON 2.1

Flying mammals

Overview

Students are introduced to the term **Adaptation** and look at how micro-bats have adapted over time to develop specialised features that help them survive. Students focus on one adaptation – flying. Bats are the only mammal to truly fly and students identify the differences between gliding and flying by looking at different species. Students look further into the structure of a bat's wing and determine the similarities and differences between humans and bats.

Background information

Adaptations identify features or characteristics that animals develop to help them survive. In the world of bats these adaptations include flying, echolocation, hibernation, being nocturnal, size, the way some species reproduce and the specialised food they eat.

Although bats can fly like a bird, they do not have feathers, build nests or lay eggs. Bats are mammals. The name given to bats is the animal order "Chiroptera", which is Greek for "Hand-wing". A bat's wing consists of bones that are very similar to the bones in a human arm and hand. Long arm bones, with extra-long extended finger bones, are covered with a double layer of thin skin called a membrane. The membrane is so thin that you can see light through it. It is made up of fine blood vessels, elastic fibres and muscle fibres.

The membrane stretches over the arm bones and extended finger bones to the sides of the body and leg. In some bats, this membrane may also extend between the legs and include the tail. The small, clawed thumbs (often used for climbing or moving across surfaces) are left free. The second and third fingers, along with the membrane in between, give the wing a stiff leading edge similar to an airplane's, while the third finger forms the wing tip.

A bat's wings act like webbed hands. The bat can move its wings like we move our fingers enabling it to change its wings' shape rapidly to dart, flip and turn quickly. Although birds use their tails to brake and steer, bats use their wings by folding one wing for a second and using one independently of the other. Many bats have also mastered hovering flight, similar to hummingbirds and helicopters, and this enables them to remain stationery in flight while other bats are able to achieve brief periods of gliding flight.

The surface area of a micro-bat's wing in ratio to its body size is small; therefore they need to increase the number of wing strokes to keep up speed and loft when flying. They raise and lower their wings from 11-18 times per second. Some micro-bats have been recorded at flying 50 kilometres per hour. These small, fast moving wings enable micro-bats to change direction quickly and sometimes even hover in flight while hunting.

Resources

Bat Wing Basics poster or PDF file
Stockings or socks - at least 12
Large tub/s filled with water
Scales - large and small
Craft materials - tape, glue, scissors
Gloves
Black fabric (e.g. poplin)
Crepe paper
Pipe cleaners
Sticks or bamboo garden stakes
Long cardboard rolls
Cardboard sheets

Flying mammals

Activity descriptions

Activity 1: Differences and similarities

Using the *Background information* about bat wings and flight, talk to the students about the difference between flying and gliding, what they think the bat wing looks like, how they fly etc... Using the 'Bat Wing Basics' poster, look at the differences and similarities between bats, birds and humans.

Students use the poster as a guide to complete the activity sheet by:

- Colouring the same bones the same colour to identify the similarities
- Recording their observations of what is similar and what is different
- Tracing their own outstretched-hand and, if they were a bat, marking where the membrane would go.

Students put a sock or stocking over their hands to create a webbed effect. When they wave their hand in the air like they were flying, do they notice anything? Repeat the exercise but without the sock/stocking – is there a difference? Next, students put their webbed hand in a trough of water and move it rapidly from side to side (like they were flying). Repeat this action but without the sock/stocking. Ask students:

- Did you notice how much easier it was to move your hand through the water without the sock or stocking?
- Imagine that the sock extended from your fingers to your ankles. How hard/easy do you think it would it be to move around?
- Imagine flapping your hand through the water 11 times per second. How much food would you need to eat to keep your energy levels up to do that all night long?

EXTENSION ACTIVITY: Wing to weight ratio – take a look at the fact sheet on the wing to weight ratio. How big a wing span do bats need to keep their bodies flying? This information may come in handy with Activity 2.

As a class - weigh different classroom items and using the Average Ratio, determine the optimal wingspan for flight. Items can include fruit, chairs, pencil boxes, etc.

Time requirement: 30-60 mins (approx)

Activity 2: Design Batman's new wings

After investigating the structure of a bat's wing, how it compares to humans and how big a wing span is needed to lift the weight of different bats, students design their own set of bat wings.

Students are given the scenario that they are to construct Batman's new wings that he needs to fly around Gotham City. First, students need to draw their wing design on paper and think about and record what materials they could use. Make this a class competition to see which designs will go through to the next phase. Wing design will be judged on ability to keep Batman in flight/glide (wingspan), ease for Batman to use and the availability of materials to make a prototype.

Next, choose up to three different designs that will go to the 'prototype' phase. In groups/teams, students make their bat wings in the classroom using available materials (students can bring materials from home if they wish). The original designer will be the 'project manager' and tasks are assigned to other team members, such as:

- 'materials officer' – in charge of sourcing the to use materials
- 'tools operator' – in charge of getting the tools and operating them (e.g. scissors, tape)

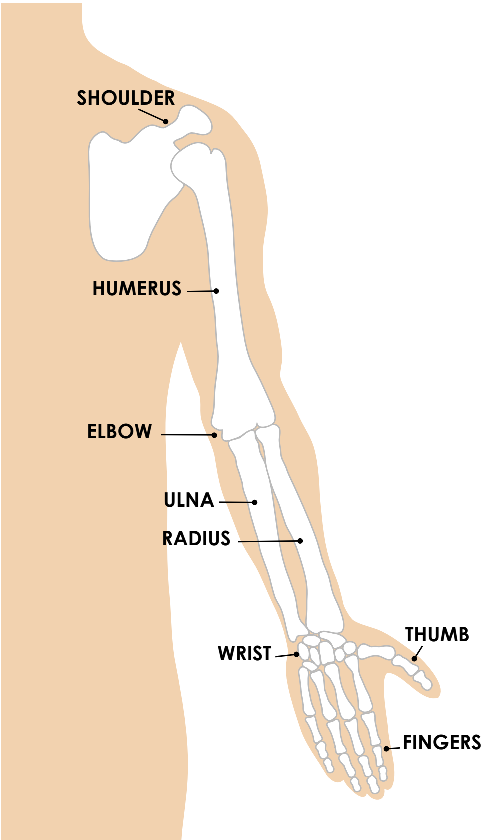
- ‘graphic designer’ – in charge of creating a design on the wings
- ‘model’ – the person who will wear and model the wings at the end

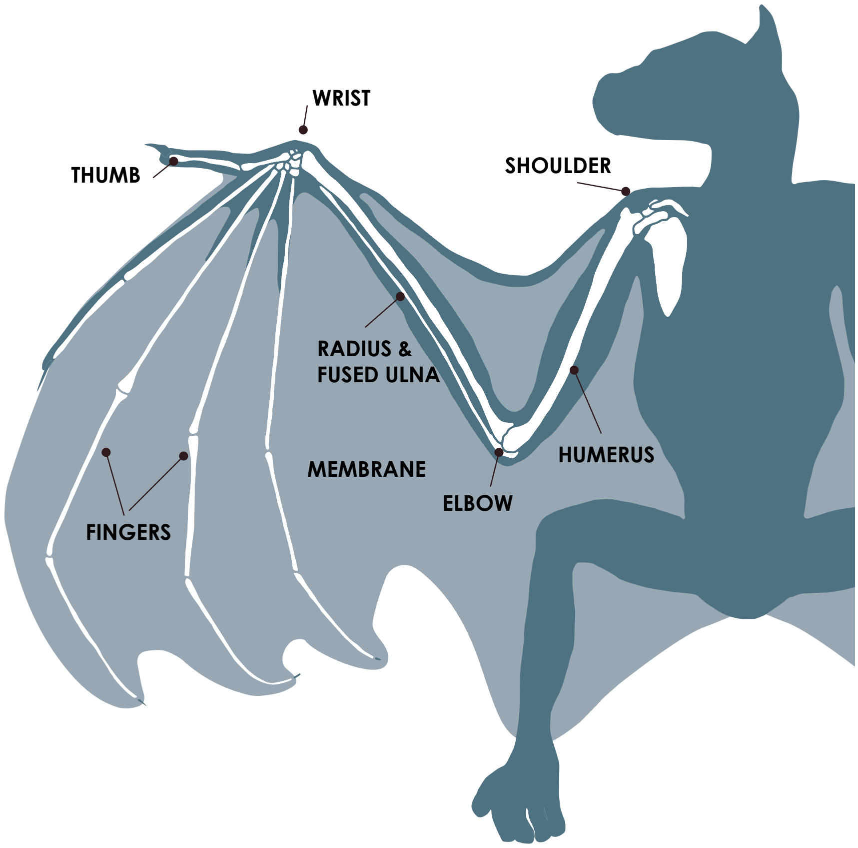
Have teams parade their Batman wings at an assembly or in front of another class. This is a good opportunity for students to talk about the design and materials chosen in front of an audience that aren’t their peers. Students need to present on: their design and how it applies to the adaptation of bats, the materials used and the overall look. With a show of hands, other students must indicate which design they like the most.

Time requirement: 2-4 hours (approx)

ACTIVITY 2.1A

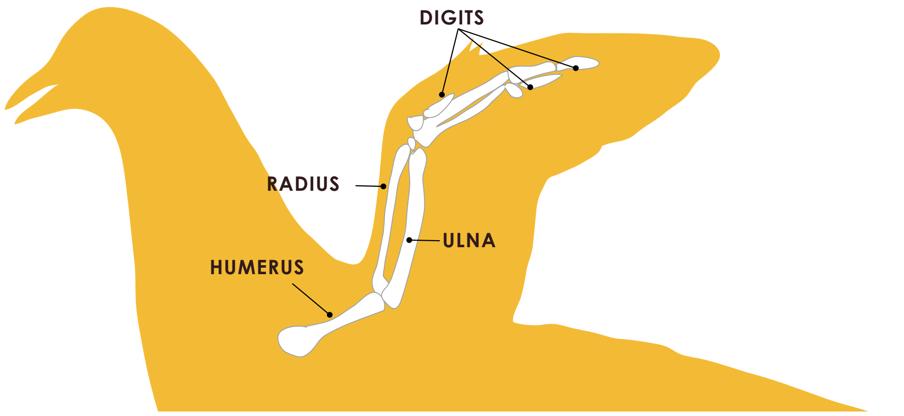
Differences and similarities





Colour the same bones the same colour.

Look closely at the bat and the bird wing structures. Record your observations of the differences and similarities in the table.



DIFFERENCES	SIMILARITIES

ACTIVITY 2.1B

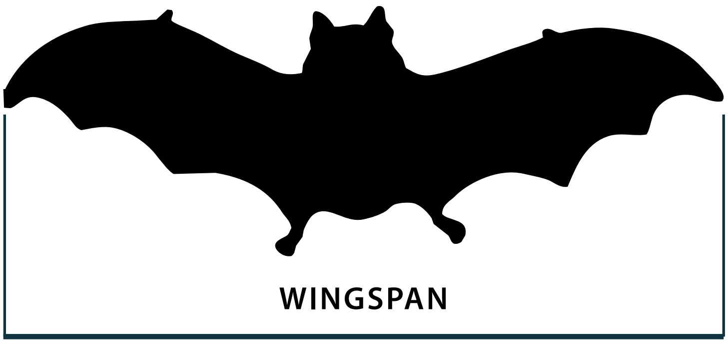
Wingspan for flight

BATTY FACT: Bats need to have wings big enough to keep their body weight in continual flight. The size of their wings can vary depending on the species and the habitat in which they live.

BATTY FACT: Bats hang by their feet with their head down because it is energy efficient. To reduce as much weight as possible for flight, the bones and muscles of the legs are very light weight compared with those of a non-flying mammal. The biggest bones and muscles are those used for flying.

Bats and their body to wingspan ratio

A ratio compares two values. In this example we are comparing weight (measured in grams) to wingspan (measured in millimetres).



In the table below we have chosen six different micro-bats and recorded their average weight and wingspan. The ratio is calculated by dividing the wingspan by body weight.

In the example of the chocolate wattled bat - for every gram of weight, the wingspan is 30 mm across. **The average for all six micro-bats is 1:33** - for every gram of weight, a bat's wingspan is 33 mm across.

Bat Species	Body Weight	Wingspan	Ratio
Eastern bentwing bat	14 grams	341 mm	1:24
Little broad-nosed bat	6 grams	234 mm	1:39
Golden tipped bat	7 grams	250 mm	1:36
Gould's long-eared bat	8 grams	276 mm	1:34
Large-footed myotis	8 grams	281 mm	1:35
Chocolate wattled bat	9 grams	271 mm	1:30
		Average	**1:33**

Translate that into human size - a person who weighs 65 kilograms would have a wingspan that is 2,145 metres or 2.145 kilometres.

ACTIVITY 2.1C

Design Batman's new wings

Batman needs some new wings to help him fight crime in Gotham City. He has asked you to develop a lightweight design that will help him fly or glide between buildings, just like a bat.

He wants the wings to mimic that of a real bat's wing structure, as it is unique to flying mammals - just like Batman.

Draw your design of Batman's new wings below. Label the length of each wing and what material you might use to make them. If your design is good enough, Batman will ask that you take it to the next stage - making a wing prototype.

LESSON 2.2

Echolocation

Overview

Students learn about a micro-bat's most defining adaptation – the ability to navigate and find their prey using **Echolocation**. This will be achieved through using videos and conducting fun experiments.

Background information

Apart from being able to fly, echolocation is probably the biggest unique adaptation that micro-bats have. Echolocation is when a sound is bounced off an object and the echo is used to determine the direction and distance of the object. This is the same way a radar or sonar works. Micro-bats use echolocation as well as dolphins, whales and porpoises.

Micro-bats emit pulses of sounds, normally at frequencies beyond the range of human hearing. We need to use a device called a Bat Detector to hear them. The sound waves are created in the bat's voice box and are emitted from the mouth or the nostrils. The echo that comes back to the bat can tell it how far away the object is, as well as its size, texture and if it's moving!

There are a couple of species that have echolocation calls that people with sharp ears can hear – the yellow-bellied sheathtail bat and the white-striped freetail bat. Their calls are a regular metallic-sounding tick… tick… tick…

Micro-bats rely on echolocation to find insects while flying quickly through the air. They do this with startling efficiency. This is why micro-bats are such great controllers of insects and should be encouraged in both the urban and rural environments.

Resources

Echolocation made easy

SmartBoard for watching videos

Echolocation Made Easy poster

How sound works

Bowls of water

Tuning forks

Slinky

Blindfolds

Stopwatches

Metal/plastic trays

Large sheets of cardboard

Cardboard boxes

Activity descriptions

Activity 1: Echolocation made easy

Reinforce the term **adaptations** with the class. Ask them to define what they remember from the previous lesson on *Flying mammals*. Inform students that echolocation is one of a micro-bats most unique adaptations.

Watch a 10 minute segment on "The Life of Mammals: Insect Hunters". It explains how micro-bats use echolocation to hunt for prey. Follow up by watching an animated music video on echolocation.
www.allaboutbats.org.au/biology/

As a class, discuss points of interest between the two videos. Complete the activity sheet.

EXTENSION ACTIVITY: Invite a local expert on micro-bats to talk to the students and show them a Bat Detector. Experts can include:

- Fraser Coast Micro-bat Group
- University of the Sunshine Coast

Time requirement: 30 mins (approx)

LESSON 2.2

Echolocation

Activity 2 - How sound works

Set-up four supervised stations, well spaced, in the school grounds. Students need to work in pairs, rotate through each station and record their answer on their activity sheets. Students are given 10 minutes maximum at each station before rotating.

Instructions are provided on each activity sheet.

At the end of the rotations, gather the class and reflect on what they learnt about how sound works, what helped them in the hearing activities and does this translate to how micro-bats have adapted to using echolocation and having large, often funny shaped, ears.

Time requirement: 60 mins (approx)

Experiment 1 – Sound waves

In part 1 of this experiment, students use a slinky with their partner to create a wave and observe how it moves. Sound travels in waves, just like when you're at the beach and you can see the waves rolling in from a long distance before they crash on the shore. The difference is, we can't normally see sound waves.

In part 2 of this experiment, students investigate the vibrations, or energy, that sound makes as it travels from an object (tuning fork). Inform students that sound is a form of energy and the waves that are created are made up of tiny atoms that vibrate at different frequencies. Some frequencies we can hear, like when we talk. Some frequencies we can't hear, like those that a micro-bat emits.

To see these vibrations of energy, students tap a tuning fork on a table, listen and observe. Then they repeat the action but this time placing the tuning fork into a bowl of water and observing the results.

Experiment 2: Megaphone hearing

Have students experiment with megaphones by rolling paper into cones. In pairs, students speak to their partners in a whisper, with and without a megaphone. Next, students hold the megaphone to their ears and listen to the sounds around them - listen to people talk, birds, cars, ocean (if close enough) etc. Conduct the listening experiments as indicated on the worksheet.

Provide students with the *Animal challenge* activity sheet.

Experiment 3: Bat-moth detection

This activity should be done outside in a flat, open area free of obstacles. Mark out an open space about three metres square. One person is a bat and is blindfolded. The other is a moth, which it trying to escape detection. The moth is the time keeper and data recorder.

Students make a predication about how quickly they will find the moth - both using sound and without sound. Even though the bat cannot see, it is easier to catch the moth with sound that without. This demonstrates the effectiveness of a micro-bat's hunting technique.

Experiment 4: Object detection

Make sure there is a good distance between groups at this station. Students will try to detect different objects that are passing in front of their face by making a sound and listening for the echo, just like a micro-bat.

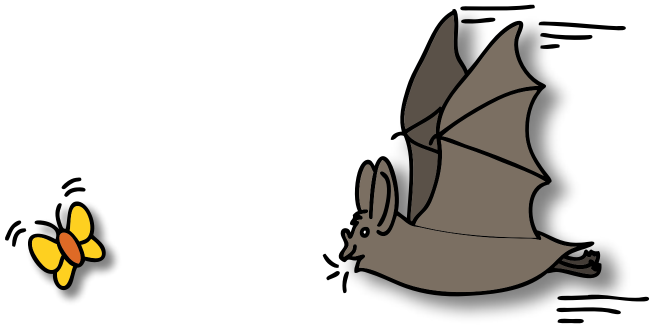
Students make a predication about which object they think they will be harder to hear the echo reflect from.

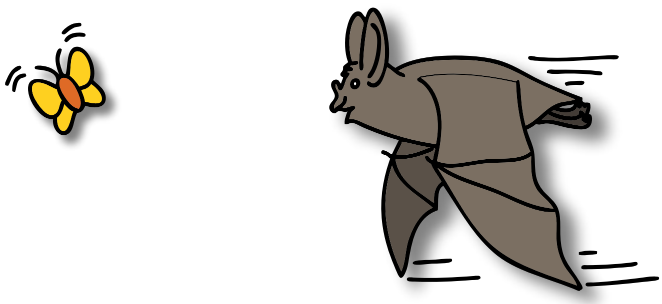
Echolocation made easy

1. In your own words, define the term ECHOLOCATION.

2. What animals use echolocation to find food and objects?

3. Complete the diagram below by adding in sound waves.
   Describe what is happening.





ACTIVITY SHEET 2.2B

Experiment 1: Sound waves

Sound travels in waves, just like when you're at the beach and you can see the waves rolling in from a long distance before they crash on the shore. The difference is, we can't normally see sound waves.

PART 1: CREATE A WAVE

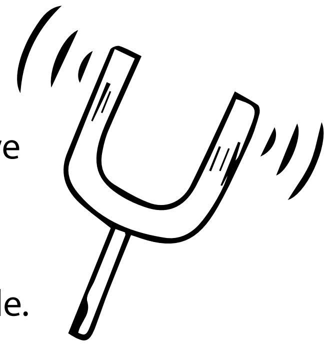
You and your partner each take an end of the slinky and walk apart, stretching the slinky. One partner starts moving the slinky end up and down.

How does the slinky move?

Does it change if you go faster or slower?

Draw the pattern it makes.

PART 2: SEE THE VIBRATIONS



Sound is a form of energy and the waves that are created are made up of tiny atoms that vibrate at different frequencies. Some frequencies we can hear, like when we talk. Some frequencies we can't hear, like those that a micro-bat emits.

To see these vibrations of energy take a tuning fork and tap it on a table.

Can you hear the sound of the tuning fork?

Can you see the vibrations?

Tap the tuning fork again and quickly put the tip into a bowl of water.

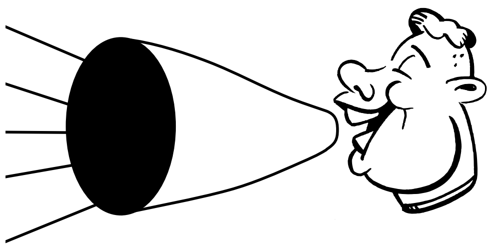
Describe what happens?

ACTIVITY SHEET 2.2B

Experiment 2: Megaphone hearing

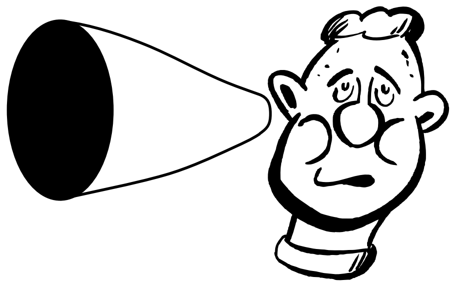
Micro-bats use their ears to hear sounds at very high frequencies. They have big, oddly-shaped ears to help them hear really high-pitched sounds. The echoes that they hear help them to locate and catch their food every night. Their ears are so sensitive they can hear the individual beats of a moths' wings.

Create your own megaphones by rolling a large piece of paper into a cone. In pairs, speak to each other in a whisper with and without your megaphone.



Is there a difference in level of sound heard?

How far apart can you still hear each other?



Hold the megaphone to your ear and listen to the sounds around you.

What does it sound like?

While outside, see if your sound can travel around the corners of buildings.

What do you notice?

Try speaking in a small confined area.

What do you notice?

Repeat the experiment in a large room such as the gym.

What happens? Do you get echoes?

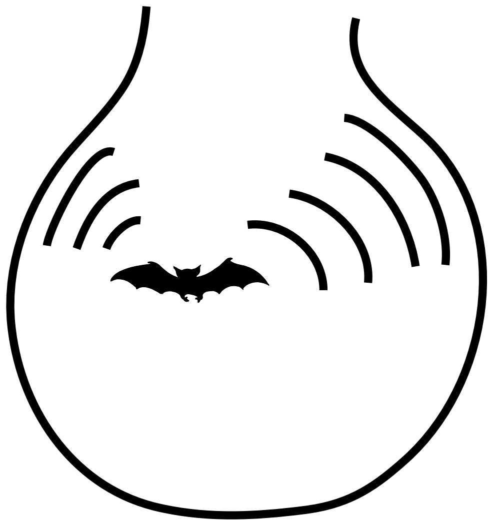
ACTIVITY SHEET 2.2B

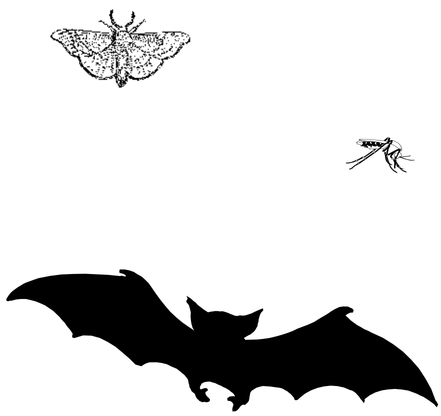
Animal challenge

Let's say your hand is a micro-bat and you're holding a ball, which is the energy in a sound wave. When you throw the ball to a wall it bounces back. The closer you are to the wall, the quicker it returns. The same thing happens when a micro-bat sends out a sound wave. It can tell how long it takes to reach an object, bounce off and return. The micro-bat uses this sonar to tell where it is. See if you can use what you learned to help the micro-bat.

Scenario A. A micro-bat is in a cave. It turns to its left and sends out a tick (sound wave). The echo returns quickly. It turns back around to the right and sends out another tick. This one takes longer to return. Which wall is closer to the micro-bat?

Scenario B. A micro-bat is trying to find its food. It turns to its right and sends out a tick (sound wave). The echo returns quickly. It turns back around to the left and sends out another tick. This one takes longer to return. Which insect is closer to the micro-bat? Draw in the sound waves that the micro-bat uses to find its food.





What is closer?

Left wall of the cave ☐

Right wall of the cave ☐

What is closer?

Mosquito ☐

Moth ☐

Name as many other animals as you can that also use echolocation.

ACTIVITY SHEET 2.2B

Experiment 3: Bat-moth detection

This activity should be done outside in a flat open area free of obstacles. Mark out an open space about 3m square. One person is a bat, blinfolded. The other person is a moth, which tries to escape being captured.

Using a stopwatch, the moth records how long it takes to be caught by the bat. Conduct each part of the experiment 3 times each.

PART 1: USING SOUND

Every time the bat says "bat" the moth must say "moth".
So if the bat says "bat-bat-bat…" in rapid succession, the moth must reply every time.

Our predication of how long it will take to catch the moth is: . . . .

	Student Name:	Student Name:
Test 1		
Test 2		
Test 3		

PART 2: WITHOUT SOUND

Repeat the same experiment, but this time the bat and moth are not allowed to make any sound.

Our predication of how long it will take to catch the moth is: . . . .

	Student Name:	Student Name:
Test 1		
Test 2		
Test 3		

Did sound help the bat find its prey? Explain how.

What was it like to be a micro-bat?

ACTIVITY SHEET 2.2B

Experiment 4: Object detection

You should conduct this in pairs/groups and have a large distance between pairs/groups. You will try to detect objects by using your ears, just like a micro-bat.

Sit blindfolded in an open space, such as an empty room, a hall, or outside on a lawn. Keeping your head facing forward make a loud, easily repeated sound, such as "peep-peep" or "ah-ah".

While you are making the sounds, have your friend hold and silently move a large object so that it passes in front of your face at a distance of about 20 cm. You need to choose at least three large objects for this experiment. They can include: piece of cardboard, plastic tray, plastic box, cardboard box, large bowl.

Put your hand up when you think the object is directly in front of you. Have your friend record whether you were successful or if you missed the object.

PREDICTION: Which objects will be harder to hear the sound echo? . . . .

	Object Material	Hit or Miss
Test 1		
Test 2		
Test 3		

How often are you right?

Repeat the experiment, but this time use your hands to cup around your ears. Record your results.

	Object Material	Hit or Miss
Test 1		
Test 2		
Test 3		

Can you locate the object better?

LESSON 2.3

Bat houses

Overview

Students will learn about the impacts humans have had on micro-bat habitat and the importance of looking after entire ecosystems. Conservation efforts used to help micro-bats include the building of artificial roosts, or bat boxes. Students will research and design a diorama of a bat box before inviting a parent or member of a woodworking group (e.g. Fraser Coast Micro-bats, Men's Shed), to construct their own bat houses for installation on the school grounds.

Background information

Micro-bats need: forests, old trees, hollows, abundant food and roosting sites where they wont be disturbed.

Habitat destruction is a major factor in causing a species population to decrease, eventually leading to its being endangered, or even to its extinction. Large scale land clearing usually results in the removal of native vegetation and habitat destruction. Bushfires and poor fire management, pest and weed invasion, cyclone and storm damage can also destroy habitat.

One of the roles of national parks, nature reserves and other protected areas is to provide adequate refuge to animals by preserving habitat.

However, there are many hectares of land in the region that are not protected and it is important that we keep native bushland for our local wildlife. Without education and awareness of the importance of remnant bushland, these areas could be developed for urbanisation or farming, and we could see the loss of more bats and other bushland species.

Resources

PowerPoint presentations:

- » All About Micro-bats
- » Micro-bat Habitat

The Nestbox Book - $19.95 (+ postage) from the Gould Group Bookshop www.gould.org.au

Graph paper

Plasticine, clay

Cardboard, paper (tissue, coloured)

Shoe boxes

Pipe cleaners, paddle pop sticks, straws

Glue, sticky tape, scissors

Activity descriptions

Activity 1: Human impacts and conservation

Discuss the benefits of micro-bats to the environment. You may want to go through the All About Micro-bats PowerPoint presentation.

Discuss the habitat requirements of micro-bats by going through the Micro-bat Habitat PowerPoint presentation with your students.

Brainstorm the different impact that humans could have on micro-bat habitat, such as habitat destruction (see *Background information*).

Students answer the worksheet questions before choosing one of three investigation activities that can be used to apply their awareness of habitat conservation. These are socially responsible actions that can be used to raise community awareness about micro-bats.

Time requirement: 30 mins (approx) + investigation project

Activity 2: Micro-bat house design

Part 1: Using the activity sheet, students need to research on the Internet about:

- What types of places do micro-bats like to roost in?
- When making a micro-bat house, what types of materials should be used?
- Where would you place your micro-bat house once it is finished?
- How would you attract micro-bats to your micro-bat house?

NOTE: Stage 1 could be a homework task

Part 2: Using their research knowledge, students must design a bat house. This will an annotated diagram that includes how the bats enter the house, where they hang and rest for the day, the materials used etc.

Part 3: Using a range of craft materials, student create their design for the ultimate bat house.

Time requirement: 60-120 mins (approx)

Activity 3: Build your own micro-bat house

This activity is best conducted with the help of a local woodworker/parent/grandparent.

Find a good nest box building book. Suggestions have been identified in 'Resources' or alternatively we have included the Backyard Buddies school fact sheet on creating a bat box (pages 40-41).

If materials can be purchased by/donated to the school, your helper may be able to cut up the wood and pre-drill holes for the construction. Students will then be able to screw the pieces together with adult supervision.

Once constructed, with your helper(s), find a suitable location in the school grounds for your bat box/house. Students should be able to help identify a location after conducting the research.

Time requirement: 90-120 mins (approx)

ACTIVITY SHEET 2.3A

Human impacts and conservation

1. What are the benefits of micro-bats to the environment and to humans?

2. List the habitat features that micro-bats need for survival.

3. List some of the threats to micro-bats and their habitat.
   Identify which threats are caused by humans and which are natural.

4. What can people do to help conserve micro-bat habitat?

5. Choose a micro-bat species from the website allaboutbats.org.au and find out as much as you can about the species. Complete ONE the following investigation tasks:
   A. Create a poster or other display about the species and how people can do their part to look after them and their habitat.
   B. Identify a local park or patch of bushland in your neighbourhood. Create a plan of action to look after this area for the conservation of micro-bats.
   C. Write a letter to the Principal outlining the actions the school can do to make it micro-bat friendly.

ACTIVITY SHEET 2.3B

Micro-bat house design

PART 1: Using the Internet, find out as much information as you can about where micro-bats roost during the day and the types of micro-bat house designs that can be used.

Use the following questions as a guide.

1. What types of places do micro-bats like to roost in?

2. When making a micro-bat house, what types of materials should be used?

3. Where would you place your micro-bat house once it is finished?

4. How would you attract micro-bats to your micro-bat house?

PART 2: Knowing what makes a good micro-bat house, you need to design the ultimate roost for your micro-bats. Draw your design on a separate piece of paper, making notes of what materials you will use, how the micro-bats will use it and where it will be located once it has been built.

PART 3: Using craft materials, see if you can build a diorama of your ultimate micro-bat house design.

Build a Microbat Roost Box

Have you ever seen a microbat? Above is the Eastern Horseshoe Bat. Photo: Doug Beckers. Below is the Goulds Wattle Bat. Photo: Steve Amesbury. Photo right: Dave (Flickr).

It's good to construct more than one roost box if you can. Three attached at the same height on a tree is ideal, as it allows your microbats to hop from box to box to find the right temperature.

Construct your own roosting box. This design is suitable for most kinds of Australian microbats. Adult help is required to make this project.

Roost box plan from Tweed Valley Wildlife Carers.

You will need

- 3 cm thick plantation pine or structural or external pine plywood. Rough-sawn or even secondhand timber is ideal, although you must make sure it is free of nails and paint.
- Screws
- 1 or 2 hinges
- A piece of old rubber tyre
- Shade cloth, mesh or bark
- Staple gun and staples
- Wire
- Old piece of garden hose or a nail and hammer

Instructions

1. Cut your pieces as the per sizes on the next page.
2. Screw your pieces together except for the top/roof.
3. Attach the top/roof piece to the box with a hinge so you can open and close it.
4. Attach the piece of rubber so that it's covering the hinged bits of wood - this will help waterproof it.
5. Screw a couple of off-cuts on the inside of the roof so that it sits snugly.
6. Staple shadecloth, mesh or bark to all inner surfaces, and your backboard.
7. Choose your location - you want somewhere shaded during the hottest part of the day, but not in full shade all day. Trim a few branches in front of the box to allow an uninterrupted flight path.
8. Thread wire through the garden hose and attach to back of box to hang from atree, or nail your box to a tree about 3-5 m high.
9. Better still, make 3 boxes and hang at the same height on 3 different sides of the tree. The bats will move between them to find the right temperature at different times of day and during different seasons.

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backyard buddies™
get more enjoyment from our native plants and animals

Sign up for **B-mail**, the Backyard Buddies newsletter, emailed on the 1st of each month at **www.backyardbuddies.net.au**

www.backyardbuddies.org.au/habitats/build-a-microbat-roost-box

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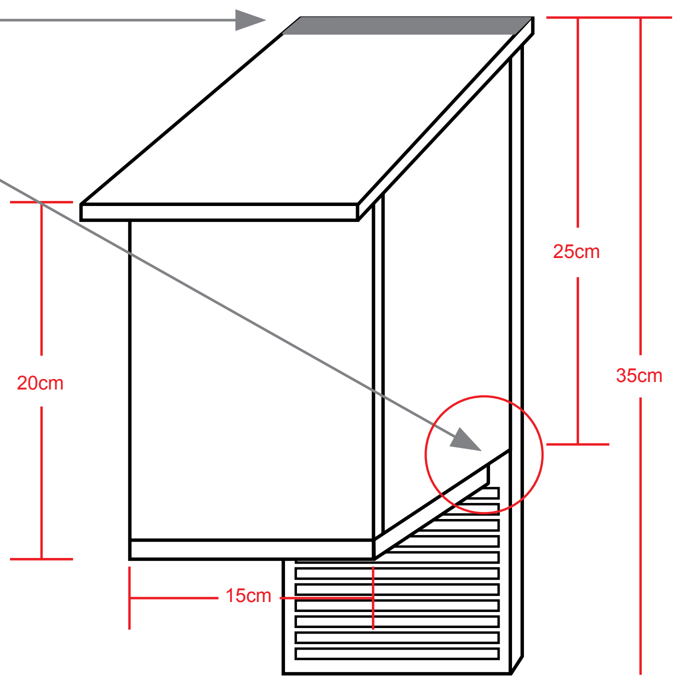
Build a Microbat Roost Box

Rubber waterproof hinge strip

15-20 mm rear entry slit to allow access



Line the inside with shade cloth stabled on to allow the bats to grip. Note: You may want to cut a third side piece to add as an internal divider. Bats like to huddle.

Backboard with either bark, grooves or shade cloth tacked on to act as a 'landing pad'.

Find out more about your buddies at
www.backyardbuddies.net.au

Find us on Facebook at www.facebook.com/backyardbuddies

www.backyardbuddies.org.au/habitats/build-a-microbat-roost-box

For more information

All About Bats ..... www.allaboutbats.org.au
Burnett Mary Regional Group ..... www.bmrg.org.au
Department of Environment and Heritage Protection ..... www.ehp.qld.gov.au
Fraser Coast Micro-bat Group ..... www.facebook.com/frasercoastmicrobats
Australasian Bat Society ..... ausbats.org.au
Bat Rescue Inc. ..... batrescue.org.au
Bat Conservation & Rescue Qld Inc. ..... www.bats.org.au
Australian Museum ..... australianmuseum.net.au/australian-bats