

# SOUTHERN QUEENSLAND FLYING-FOX EDUCATION KIT

## Year 8: Specialised flying-foxes



[www.allaboutbats.org.au](http://www.allaboutbats.org.au)



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FOR  
OUR  
COUNTRY

# Flying-fox education kit

## About the education kit

The *Southern Queensland Flying-fox Education Kit* was developed as part of the **Improving Landscape Resilience to Climate Change in SEQ: the flying-fox roost & forage conservation pilot project**. This two-year project, coordinated by SEQ Catchments, aimed to improve the long-term sustainability of flying-fox camp sites in the southern Queensland region and increasing community awareness of the intrinsic value of flying-foxes and the critical ecosystem services they provide.

The project was funded through the Australian Government's Caring for our Country program and supported by Brisbane, Logan and Redland City Councils, Moreton Bay Regional Council, Noah's Ark Wildlife Coalition, Bat Conservation and Rescue Queensland, The Hut Environment and Community Association, the Queensland



Department of Environment and Resource Management and Burnett Mary Regional Group.

The education kit introduces teachers and students to Gracie the grey-headed flying-fox. Gracie's mission is to help save my flying-foxes and get the message out about how important they are in pollinating native trees and dispersing native seed - essential things in keeping our environment healthy!

The All About Bats website is a key component to this education kit - [www.allaboutbats.org.au](http://www.allaboutbats.org.au).

## Year 8: Specialised flying-foxes

The *Southern Queensland Flying-fox Education Kit* provides schools of southern Queensland with an opportunity to study flying-foxes in the classroom while achieving outcomes (particularly Biological Sciences) under the Australian Curriculum.

The year 8 unit consists of three lessons that contain a variety of activities. Teachers may choose to complete more than the suggested lessons e.g. a teacher may choose to recap some of the year 7 activities or continue to year 9.

These activities use a range of different learning media to provide an all-round learning experience for their students. This includes printed materials, PowerPoint presentations, YouTube videos and sound files that are all found on the All About Bats website.

The year 8 unit "Specialised flying-foxes", introduces students to the digestive and reproductive cycle of the flying-fox and compares them to the human systems. It encourages students to explore how these systems have evolved to ensure their survival. Finally it encourages students to think about how the survival of flying-foxes is now in danger because of these adaptations.



# Year 8 Specialised flying-foxes



## Rationale

This unit introduces year 8 students to the digestive and reproductive cycle of the flying-fox and compares them to the human systems. It encourages students to explore how these systems have evolved to ensure their survival. Finally it encourages students to think about how the survival of flying-foxes is now in danger because of these adaptations.

This unit is divided into three lessons. The aim is that each lesson is between one and two hours.



### Lesson 8.1 Digestion and droppings

Students compare the human digestive system to the flying-fox digestive system through labeled diagrams. They complete a table of similarities and differences of the organs and functions and explore reasons for the differences. Students then look at whether flying-fox saliva and faeces pose a health risk for humans.

### Lesson 8.2 Flying-fox reproduction

Students are introduced to the flying-fox reproductive cycle and compare it to the human reproductive cycle. They explore some of the mating rituals of flying-foxes and experiment with their own sense of smell. Finally, they look at some of the reasons why the flying-fox's reproductive cycle is working against them.

### Lesson 8.3 The Bat Dilemma

Students are introduced to the issues between humans and flying-foxes. As part of a jigsaw activity, groups of students read a section of 'The bat dilemma', a report published by 612 ABC Brisbane Radio, which covers some of the issues concerning flying-foxes. Student groups are then rearranged and given a quiz. Finally, they are asked to write a letter to someone who has been using air horns to try and move flying-foxes on.

Flying-foxes have other specialisations that are not mentioned in this unit. For more information, see [All About Bats > Year 5 Adaptations of flying-foxes](#).

# Year 8 Specialised flying-foxes



## National Curriculum

Lesson	8.1	8.2	8.3	Statements
Science understanding (Biological sciences)	✓	✓	✓	Multi-cellular organisms contain systems of organs that carry out specialised functions that enable them to survive and reproduce. (ACSSU150)
Science as a human endeavour	✓	✓	✓	Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations. (ACSHE135)
Science inquiry skills	✓	✓		Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships, including using digital technologies as appropriate. (ACSIS144)
General Capabilities: Literacy	✓	✓	✓	<ul style="list-style-type: none"> <li>Interpret, analyse, evaluate, respond to and construct increasingly complex texts. (Comprehension and composition)</li> <li>Understand, use, write and produce different types of text. (Texts)</li> <li>Make appropriate word selections and decode and comprehend new (basic, specialised and technical) vocabulary. (Vocabulary)</li> <li>Use and produce a range of visual materials to learn and demonstrate learning. (Visual information)</li> </ul>
General capabilities: Critical and creative thinking	✓	✓	✓	<ul style="list-style-type: none"> <li>Apply logic and strategies to uncover meaning and make reasoned judgments.</li> <li>Think beyond the immediate situation to consider the 'big picture' before focussing on the detail.</li> <li>Reflect on thinking, actions and processes.</li> <li>Analyse information logically and make reasoned judgments.</li> <li>Evaluate ideas and create solutions and draw conclusions.</li> <li>Transfer their knowledge to new situations.</li> </ul>
Cross-curriculum priority: Sustainability	✓	✓	✓	Sustainability action is designed to intervene in ecological, social and economic systems in order to develop more sustainable patterns of living. (OI.7)



## Objectives

Students are introduced to the digestive system of the flying-fox by comparing it to the human digestive system. They explore how these systems have evolved.

Students will also look at the health risks associated with flying-fox saliva and faeces.

## National Curriculum

Activity	8.1A	8.1B	8.1C	8.1D
Science understanding (Biological sciences)	✓	✓	✓	✓
Science as a human endeavour				✓
General capabilities: Literacy	✓	✓	✓	✓
General capabilities: Critical and creative thinking	✓	✓	✓	✓
Cross-curriculum priority: Sustainability				✓

For outcome codes and descriptions of outcomes, see unit overview.

## Background information

The flying-fox digestive system is very similar to the human digestive system. The main difference is that it is much faster (12 to 30 minutes between eating and excreting). Flying-foxes have evolved for such quick digestion to allow them to stay light for flying.

Flying-foxes often don't physically chew and swallow their food – they crush it against the roof of their mouth and spit it out after swallowing the juice. This primarily liquid diet

contributes to the quick digestive system.

Flying-foxes excrete either during flight or by turning head up and holding onto the branch by their wing claws.

Flying-foxes pose a very small health risk to humans which can easily be avoided. See the fact sheet at the end of this lesson for more information.

## Activity sequence

### 8.1A The digestive system of humans

Students review the human digestive system by completing a diagram.

### 8.1B The digestive system of flying-foxes

Using a written description, and looking at videos, students create a labelled diagram of the digestive system of a flying-fox.

### 8.1C Comparing digestive systems

Students will compare the human and the flying-fox digestive systems and work out why the flying-fox's system has evolved to be so much faster.

### 8.1D Are flying-foxes a health risk?

Students read a fact sheet and answer questions to decide whether flying-foxes, their saliva or their faeces, pose a health risk to people.

*The information presented is collated from publicly available information (as at October 2011) provided by the Queensland Government. As research into flying-fox diseases is ongoing, some of this unit may need to be modified in the future depending on research results.*

- Department of Environment and Resource Management, [www.derm.qld.gov.au](http://www.derm.qld.gov.au)
- Queensland Health, [www.health.qld.gov.au](http://www.health.qld.gov.au)
- Biosecurity Queensland, [www.dpi.qld.gov.au](http://www.dpi.qld.gov.au)

# The digestive system of humans



Have a look at the human digestive system. Use these words to label each part of the digestive system.

Stomach      Anus      Mouth      Small Intestine      Oesophagus      Large Intestine

As a class, identify which organs you think use **physical** or **chemical** processes (or both) to break down or move food in the system.

.....

In this organ, food is broken by chewing with 32 teeth. Saliva softens the food as we chew. We consume only a small fraction of our body weight per day. We use our tongue to swallow the food.

Physical       Chemical       Both

.....

In this 20-30 cm tube, food is transferred to the next organ. It helps prevent stomach acid from coming up through the mouth.

Physical       Chemical       Both

.....

Food is digested by acids and enzymes that break down food into a liquid form. Food spends 30 minutes to 2 hours in the stomach.

Physical       Chemical       Both

.....

In this organ, almost all the nutrients are absorbed through the villi. Food spends 2 to 6 hours in this 6 metre long organ.

Physical       Chemical       Both

.....

In this organ, water is absorbed, fermentation takes place and faeces are formed. Food spends 6 to 72 hours in this 1.5 metre long organ.

Physical       Chemical       Both

.....

From this organ, faeces is excreted.

Physical       Chemical       Both

# The digestive system of flying-foxes



Flying-foxes are sometimes called fruit bats, but they eat much more than fruit, they eat pollen and drink nectar for all their energy and protein needs.

Food	Mechanism	Sustenance
Fruit	Eaten using teeth & tongue	Carbohydrates (sugar)
Nectar	Drunk using tongue	Carbohydrates (sugar)
Pollen	Eaten or licked using tongue	Protein

It is really important for flying-foxes to be light so that they can fly the long distances between their roosts and food. To keep their weight down, they don't swallow the fibre in their food like we do, instead they crush the fruit, suck out the juices and spit out the rest. Small seeds are swallowed but any seeds over 4 mm in diameter will be discarded while eating.

They digest their food really quickly so they are not carrying around extra weight. The time it takes from eating to excreting can be as quick as 12 minutes!

They also digest their food quickly so that they can eat more. A flying-fox can eat up to 2 and a half times its own body weight in one night. That means that an average 800 gram flying-fox can eat over 2 kilograms of fruit, nectar and pollen in a night.

To get water, they either lick the dew off leaves or they fly really low over a body of water, like a lake or river, and dip their belly in the water. Upon landing, they lick the water from their fur.

Watch the following videos on the All About Bats > Year 8 web page.

- Fruit bats and fig trees
- Flying-foxes drinking, Wolli Creek, NSW

Read the following description of the flying-fox digestive system and draw it on a separate piece of paper. Label your diagram (it is similar to the human digestive system so you can use that as an example.)

The flying-fox digestive system starts with the mouth. The mouth has 34 teeth with which the flying-fox can chew off leaves and cut the fruit. It has saliva for softening the food but the flying-fox's mouth also has a long, strong tongue and a ridged palate. These are used to crush the fruit and squeeze the juices out. The juices and small seeds are swallowed and the dry, hard pellet of fibre (called ejecta) is spat out.

The swallowed juice travels along the long thin oesophagus to the stomach.

The flying-fox stomach is relatively small and doesn't do much more than store the juices. There is not much (if any) chemical digestion required in the stomach because no fibre has been ingested so it is already in liquid form.

From the stomach, the juices travel to the small intestine which has many villi to absorb the nutrients and water required.

There is very little difference between the small intestine and large intestine in the flying-fox. The large intestine is a little thicker but much shorter than the small intestine. It also absorbs water and nutrients, it doesn't have to prepare much faeces as there is little fibre and the faeces is quite watery.

Finally, the faeces is released from the anus. The faeces contains the small seeds, pollen and any other unwanted material.

The whole process from eating to excreting takes between 12 and 34 minutes (longer if there is a lot of pollen).

***Don't forget to draw your system upside down!***



# Comparing digestive systems



The human and flying-fox digestive systems are very similar, yet they are different. Complete this table using the previous activities to compare the two digestive systems.

	Human	Flying-fox	Similar or different? Why?
Food			
Quantity			
Teeth			
Chewing			
Oesophagus			
Stomach			
Intestine			
Anus			
Timing			

# Comparing digestive systems



The human and flying-fox digestive systems are very similar, yet they are different. Complete this table using the previous activities to compare the two digestive systems.

	Human	Flying-fox	Similar or different? Why?
Food	Fruits, vegetables, meat and dairy	Fruits, nectar and pollen. Mostly a liquid diet as the fibrous part of the fruit is spit out.	Different. Meat and dairy take long to digest. Flying-foxes can't hold this much food as it would take too long and make them too heavy to fly long distances.
Quantity	Much less than a quarter of its body weight.	Can eat up to 2.5 times its body weight a day.	Different. Flying-foxes need to eat a lot more than humans because they have to digest it quickly. They don't have as much protein in their diet.
Teeth	32 teeth, incisors at the front, then canines then pre-molars and molars.	34 teeth, incisors at the front, then canines then pre-molars and molars.	The dentition of humans and flying-foxes are very similar.
Chewing	They crush all their food with their teeth, mix it with saliva, then swallow all of it.	They squeeze the juice out of the fruit by pressing their strong tongue up against the ridged palate. They swallow the juices and small seeds. The fibrous part stays behind and is spit out in pellets called ejecta.	The fibrous part of the fruits will take too long to digest and therefore make the flying-fox too heavy for flight.
Oesophagus	A long thin tube	A long thin tube	No real difference except the flying-fox oesophagus manages to get the juices to go up rather than down!
Stomach	Site of chemical digestion which breaks down the food and reduces it to a liquid form.	A storage place for the juices. Very little happens here.	Humans eat all sorts of things that need to be broken down. This takes time. The flying-fox doesn't ingest much that needs breaking down.
Intestine	Small intestine is 6 m long. Large intestine one fifth of the intestines. Large intestine is where faeces is formed.	Small intestine long. Large intestine is relatively short.	The large intestine doesn't have to be long in a flying-fox as it doesn't have much fibre in it.
Anus	Where the faeces exits.	Where the faeces exits.	The same
Timing	12 to 72 hours (vegetarian diets digest quicker)	12 to 34 minutes - longer is there is lots of pollen.	Flying-foxes can't hold too much in their digestive systems as it would make them too heavy for flight.

# Are flying-foxes a health risk?

## Fact sheet



### Safety and health issues

From a public health perspective there is no reason to be alarmed about flying-fox camps.

#### **Flying-fox droppings**

Flying-foxes have a very efficient digestive system with food passing through the gut in 12-34 minutes. This is to enable them to remain light so that they can easily fly. This means they often defecate in flight, splattering objects beneath their flight path with excrement.

Flying-fox faeces is easily removed with water and does not pose a serious health hazard. The only health hazard from faeces is related to bacteria (e.g. salmonella) which can be found in any animal's faeces, including humans.

If you come across any fruit or vegetables that have a "splattering" of flying-fox faeces, or from any other animals, you should either wash and peel the item or discard it in the bin.

In swimming pools, faeces is neutralised by normal chlorination. To avoid damage to lacquered surfaces, cars should be covered or parked under cover. To avoid the contamination of rainwater tanks with faeces from **any** animals, keep water tanks covered and chlorinate regularly. Drain and clean the tank, and areas used for water collection, on a regular basis.

#### **Australian bat lyssavirus**

In 1996, Australian bat lyssavirus (ABL) was identified in flying-foxes. However ABL is not a reason to fear flying-foxes as it is very rare and preventable through avoidance and vaccination. ABL can only be transmitted to humans when infected flying-fox saliva comes into contact with human tissue through an open wound or with mucus membrane e.g. eyes, nose and mouth. Therefore it is very important that flying-foxes are not handled.

Humans are not exposed to the virus if flying-foxes fly overhead or feed or roost in gardens. Nor is the virus spread through droppings, urine or through the air, so it is not a risk if you live, play or walk near their camps.

#### **Hendra virus**

Since 1994, there have been seven humans, 50 horses and one dog known to have contracted Hendra virus in Queensland. The risk of people contracting Hendra virus is extremely low, though the serious consequences of contracting Hendra virus cannot be over-emphasised, with four of the seven people dying.

Horses contract the virus by ingesting the saliva of infected flying-foxes via eating partially-eaten food. Humans contract the virus from coming into contact with saliva from infected horses.

There is also no evidence that humans can catch the virus directly from flying-foxes. Attempting to move a flying-fox colony could increase the stress in flying-foxes and make them more susceptible to carrying the Hendra virus.

**Biosecurity Queensland: [www.dpi.qld.gov.au](http://www.dpi.qld.gov.au)**

#### **Don't touch!**

If you come across a sick or injured flying-fox, it is essential that you do not handle the animal but report it to experts.

If you do get bitten or scratched, wash (don't scrub) the wound immediately with soap and running water for about five minutes. Saliva contact with your eyes, nose or mouth should be flushed thoroughly with running water. Seek immediate medical attention.

Please notify those who are trained to handle flying-foxes by calling the Dept. Employment, Economic Development and Innovation hotline (13 25 23), RSPCA (1300 ANIMAL) or your local wildlife care group.

# Are flying-foxes a health risk?

## Quiz



Give the students ten minutes to read the fact sheet (in pairs/small groups) and highlight the information they think is important. Ask the following questions orally while students write their answers on a sheet of paper or the back of the fact sheet.

Question	Answer
1. Is there any reason to be alarmed about the health risks of flying-fox camps?	None at all.
2. How much fruit can a flying-fox eat per night?	2.5 times its body weight.
3. How long does digestion of the flying-fox take?	12 to 34 minutes.
4. How can you protect your car from splattered faeces?	Cover it or park it under cover.
5. What health risk is associated with faeces from any animal?	Bacteria like Salmonella.
6. What should you do with fruit or vegetables splattered by faeces?	Wash it, then peel it or throw it out.
7. Do you have to worry about faeces in swimming pools?	No, the chlorine kills the bacteria.
8. Do you have to worry about faeces in rain water tanks?	Yes, all faeces in rainwater tanks is bad. Cover them, chlorinate and keep them clean.
9. Is the Australian Bat Lyssavirus (ABL) common?	No, it is rare.
10. How can you become infected with ABL?	Through contact with flying-fox saliva.
11. Can you become infected with ABL from playing near a colony?	No
12. What animal can be infected by Hendra virus from the flying-fox?	Horse
13. Can a flying-fox give you Hendra virus?	No
14. How can you get the Hendra virus?	From coming into contact with the saliva from an infected horse.
15. Is the Hendra virus common?	No
16. Should you try to move a flying-fox colony?	No, flying-foxes are more likely to carry the Hendra virus if they are stressed.
17. Should you help a sick or injured flying-fox?	No
18. Name one person or organisation who can help a sick or injured flying-fox.	Wildlife carer, RSPCA, Dept of Employment, Economic Development and Innovation hotline.
19. What should you do if you are bitten or scratched by a flying-fox?	Wash with soap and seek medical help.
20. What should you do if you get bat saliva in your mouth or nose?	Flush the area with water and seek medical help.



## Objectives

Students are introduced to the reproductive cycle of the flying-fox. They explore how their breeding behaviour can be a reason for their decline in numbers.

## National Curriculum

Activity	8.2A	8.2B	8.2C	8.2D
Science understanding (Biological sciences)	✓	✓	✓	✓
Science as a human endeavour				✓
Science inquiry skills		✓		
General capabilities: Literacy	✓	✓		✓
General capabilities: Critical and creative thinking	✓	✓	✓	✓
Cross-curriculum priority: Sustainability			✓	✓

For outcome codes and descriptions of outcomes, see unit overview.

## Background information

Flying-foxes use noise for communicating with each other. Unlike micro-bats, they do not use their hearing for finding food, they do not have echolocation.

Flying-foxes use their sense of smell to find their food but also to find each other. Mothers use it to find their babies. Males use it to attract females and mark their territory.

## Activity sequence

### 8.2A Facts about the reproduction of flying-foxes

Students watch a video of bats mating. After reviewing the fact sheet and having a class discussion, students compare the grey-headed flying-fox and human reproduction systems.

### 8.2B Using your nose

Mothers find their babies in the dark by smell. Males attract females by smell. Students conduct an experiment where they test their own sense of smell and see how far away they can get before they lose the scent. Students learn more about the human olfactory system.

### 8.2C The sounds of flying-foxes

Students listen to the sounds of a flying-fox colony and contemplate what is being communicated. As a class, discuss why being noisy could go against their survival in an urban environment.

### 8.2D One offspring could spell disaster!

Students are introduced to the idea that having only one baby a year is an adaptation that could possibly lead to the demise of the flying-fox. They are given statements for the reasons why loss of habitat and climate change will continue to target breeding females and asked to find out more information about it.

# Reproduction of flying-foxes

## Fact sheet



The flying-fox reproductive system is very similar to the human reproductive system. They too have penises, testes, vaginas, womb etc. Male genitalia looks very human-like.

Watch the video of bats mating on the All About Bats > Year 8 web page.

Below are some facts about the grey-headed flying-fox reproduction cycle.

*Grey-headed flying-foxes mate in autumn. They mate with more than one female.*



*Flying-foxes males have similar genitalia to humans.*

*Flying-foxes usually only have one baby per year. They are pregnant for 6 months.*



*Mothers carry their babies for the first month after they give birth.*



*Flying-foxes suckle young for 4 months from teats located in their arm pits.*



*Grey-headed flying-foxes give birth to their babies in spring.*

*After 4 months, young are independent and mothers are ready to mate again.*



*Males mark their mating territories with scent and actively defend. Positions are about 2 metres apart.*

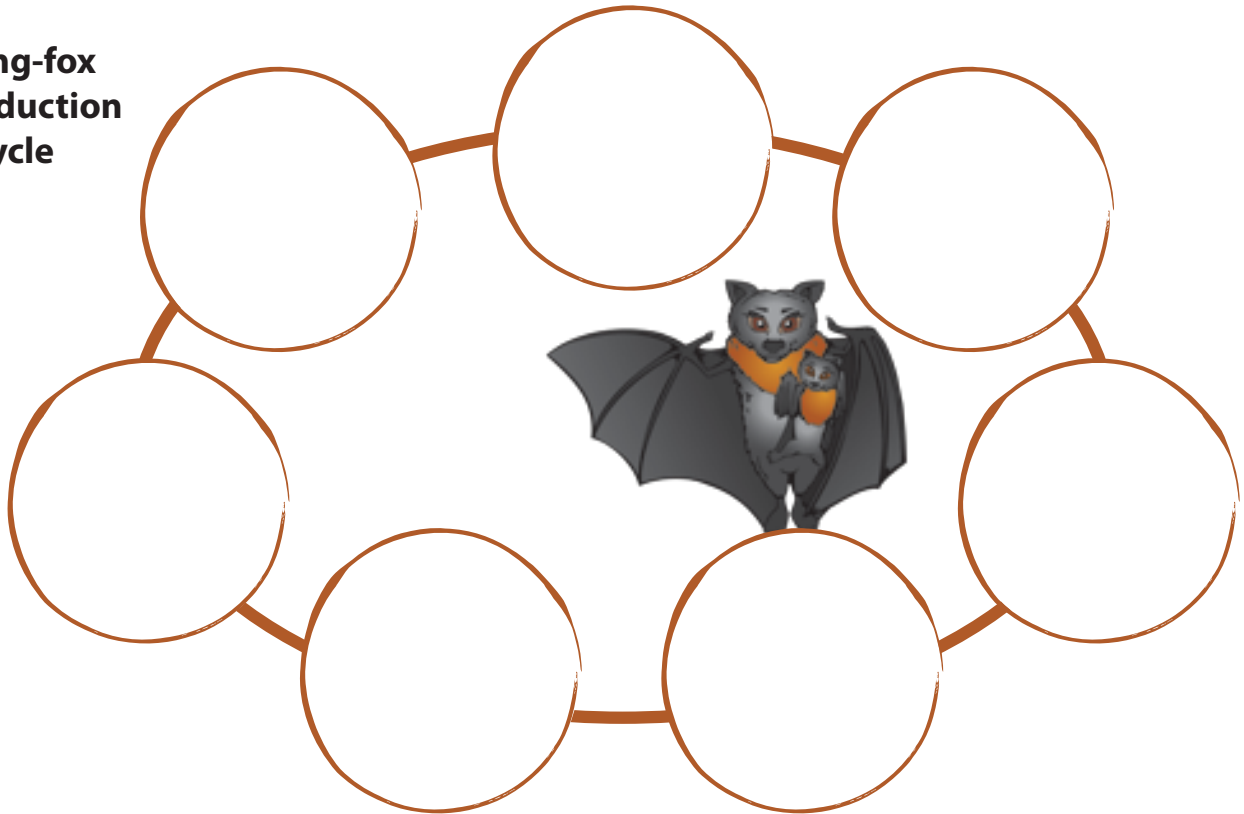
*Mothers leave the 1 to 4 month old flying-foxes in a nursery at night.*

# Comparing reproduction cycles

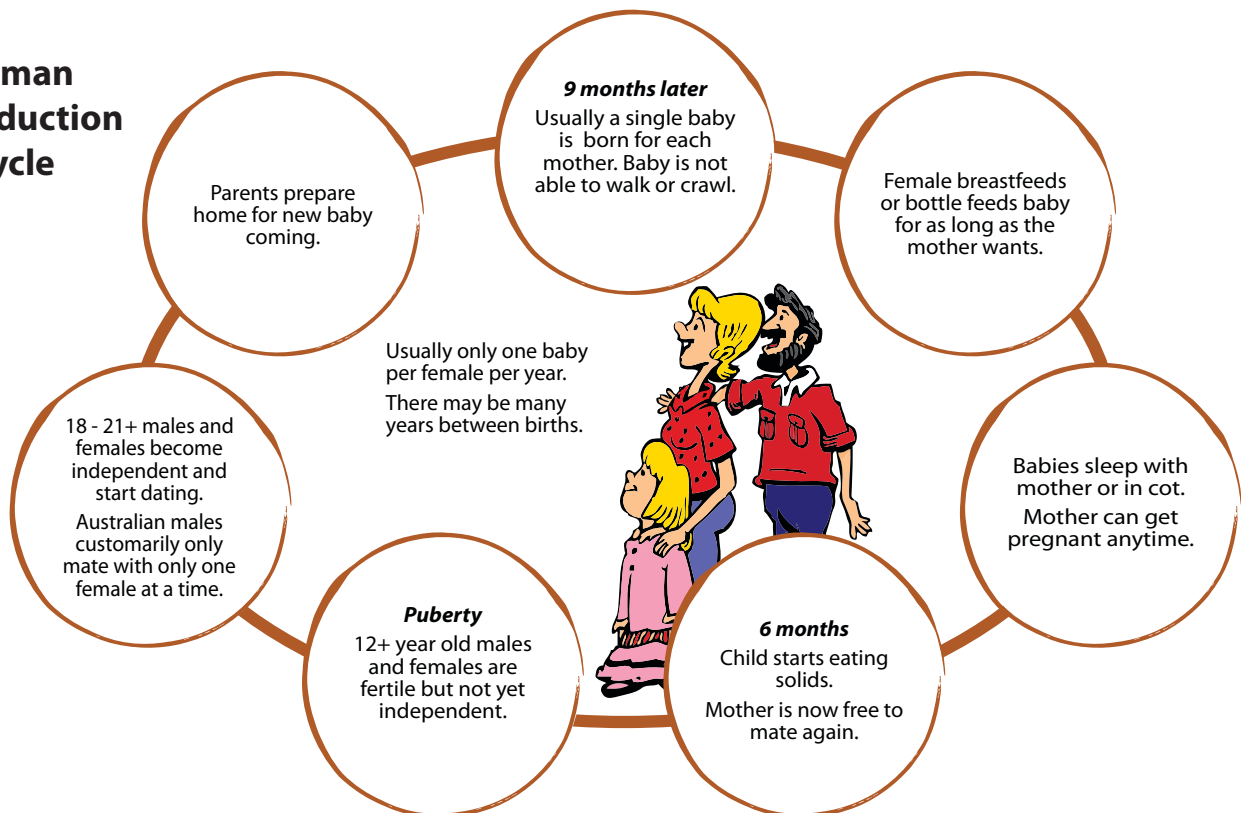


Using the "Reproduction of flying-foxes" fact sheet, complete the flying-fox reproduction cycle. Use the human reproduction cycle below as a guide. Discuss the similarities and differences with a friend.

## Flying-fox reproduction cycle



## Human reproduction cycle



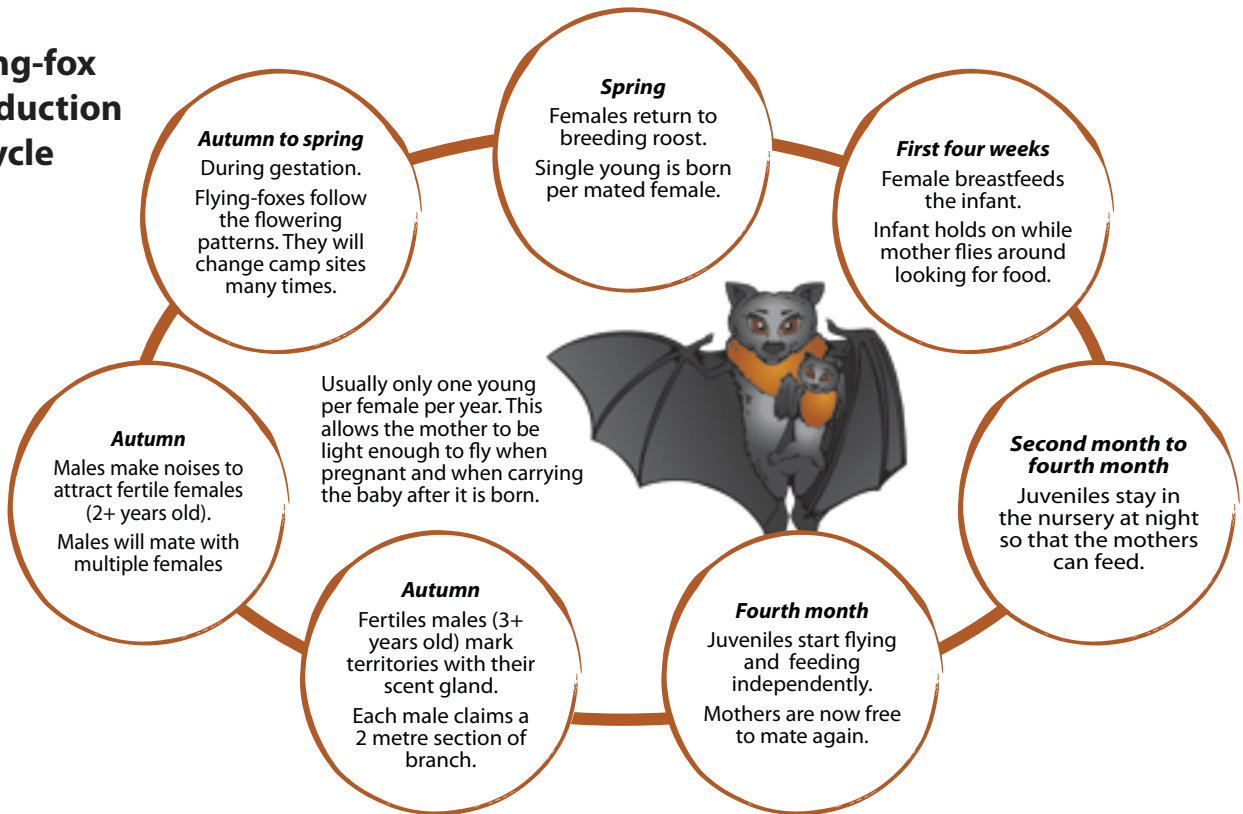
# Comparing reproduction cycles

## Answers

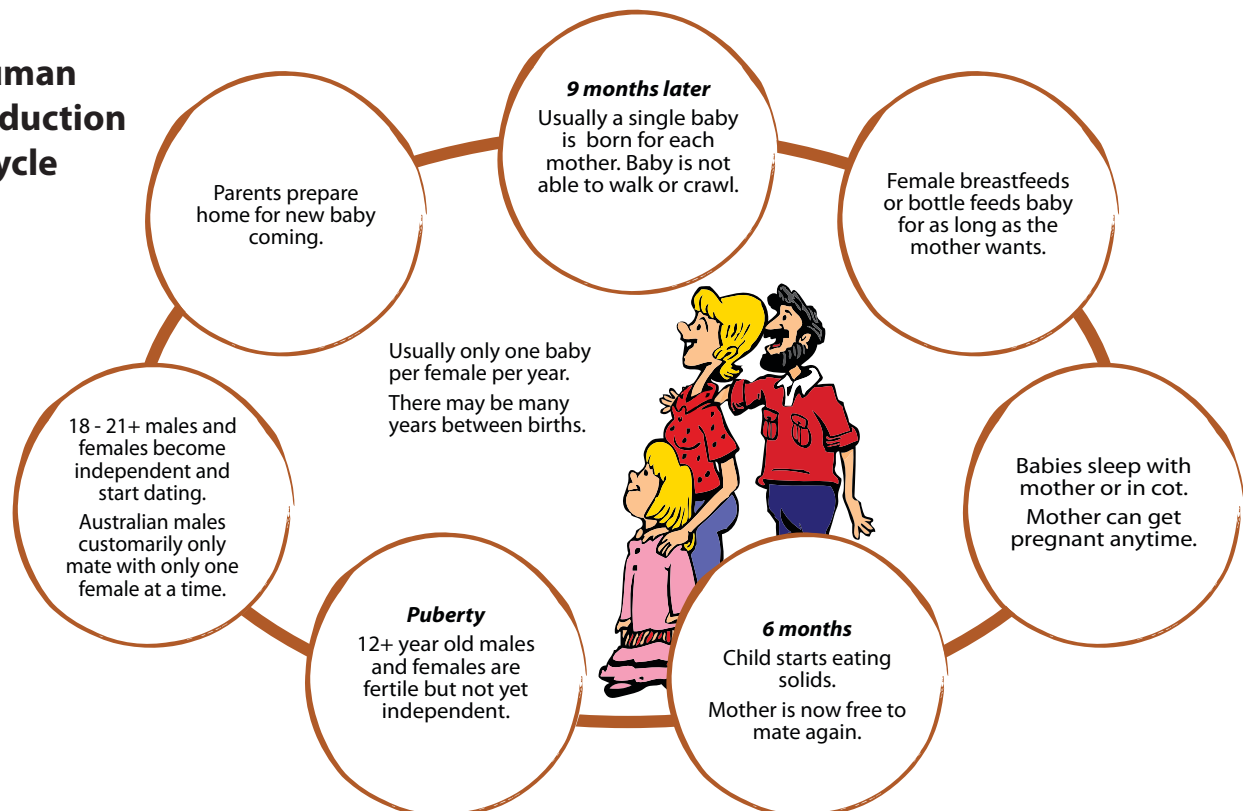


Using the "Reproduction of flying-foxes" fact sheet, complete the flying-fox reproduction cycle. Use the human reproduction cycle below as a guide. Discuss the similarities and differences with a friend.

### Flying-fox reproduction cycle



### Human reproduction cycle





# Using your nose



## Background

One of the flying-fox's most important systems in their body is their olfactory system. This is the system of smell. Smell is an incredibly important way for flying-foxes to communicate. Mothers use it to find their babies. Males use it to mark their territory and attract mates. Smell is also essential for the flying-foxes to find blossoms and ripe fruits.

Humans also have a sense of smell and use it for similar reasons. We use it to smell (and taste) food. We use it to smell if something is rotten or dangerous. We also use it to smell each other. A woman's sense of smell is best when she is ovulating! For more information about the human olfactory system, refer to the fact sheet following this activity.

## Aim

To demonstrate the effectiveness of the human sense of smell. To identify objects at various distances.

*If you are allergic to certain smells, please do not participate in this activity or choose items that do not induce an allergic reaction.*

## Materials

- 8 different scents (e.g. lemons, flowers, perfume, mango, vinegar, deodorant, tooth paste, dirty socks, eucalyptus oil or crushed leaves, vicks vapour rub and coffee.)
- Paper towel or petri dishes
- A blindfold

## Method

1. In a small group, blindfold one person while others in the group choose an item to test.
2. Hold one of the smelly items about three metres from the person's nose. Record what they can smell.
3. Move closer so that you are one metre away. Record what they can smell now.
4. Move a lot closer so that you are only five centimetres away. Record what they can smell now.
5. Repeat the test with different items and a different person in the group.

## Results

Record your results in the table below.

Scent	Close up (5 cm) Guess	1 metre distance Guess	3 metre distance Guess
1:			
2:			
3:			
4:			
5:			
6:			
7:			
8:			
Total correctly identified			

# Using your nose



## Discussion questions

1. How many different smells were correctly identified overall?  
.....
2. How many smells were identified at 1 metre?  
.....
3. How many smells were identified at 3 metres?  
.....
4. Did you find that distance affected the ability to identify the objects?  
.....  
.....  
.....
5. What smells were easier to identify?  
.....  
.....  
.....
6. Do these smells have anything in common?  
.....  
.....
7. From this, do you consider humans to have a strong sense of smell? Explain.  
.....  
.....  
.....  
.....  
.....

## Thinking about our sense of smell

The sense of smell is incredibly important to some mammals.

1. Would our lives be in danger if our sense of smell wasn't working?  
.....
2. Think of and describe what happens when you have a cold and your sense of smell isn't working.  
.....  
.....  
.....
3. What is another mammal you know of with a powerful sense of smell (maybe your pets)?  
.....
4. Do you know of any examples that humans use this animals sense of smell to their advantage?  
.....  
.....  
.....
5. Why do we have to rely on other animals' sense of smell?  
.....  
.....  
.....
6. Try to describe how you think this powerful sense helps them experience the world.  
.....  
.....  
.....

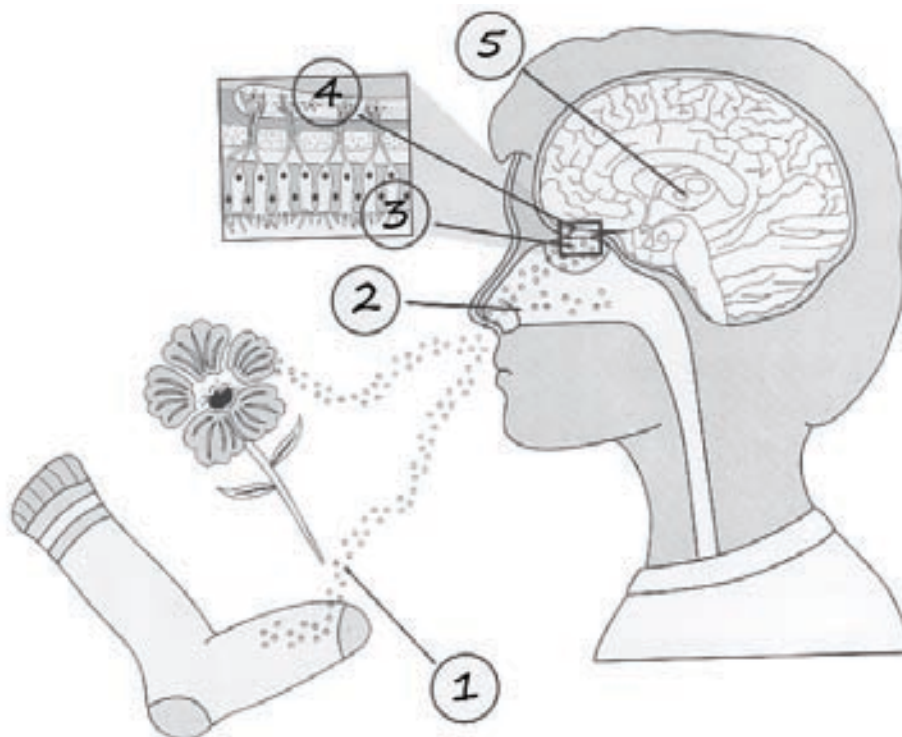
# The olfactory system

## Fact sheet



Your nose is amazing! It alerts you to danger and helps you to judge whether a piece of fruit is ripe or rotten. It helps you taste food and enjoy the fragrant world around you. The parts of your body that help you use this sense of smell are known as the olfactory system. Follow the journey of an odour from sock (or flower) to the brain.

1. Air passing by a pair of dirty old socks or a sweet flower picks up odour molecules. For example, from the socks it would pick up odour molecules from tiny pieces of dirt, sweat, or even the fabric softener on the socks. The odour molecules travel through the air to the nostrils.
2. Every nose has two nostrils. These passageways draw in the scent from the dirty socks. The molecules travel up the nostrils to an open space called the nasal cavity. You can find this space by placing your finger between your eyes at the base of your nose.
3. Here the molecules are caught in a small patch of clean mucus called the **olfactory epithelium**. It is the size of a small postage stamp. Cilia - tiny waving hairs - stick up into the mucus. At the tips of the cilia are receptors. Each receptor has an opening that makes a fit with one type of molecule. For example, some receptors have a space that is just right for a sweet smelling flower molecule and others have a space just right for dirty sock molecules!
4. The signal passes through a tiny hole in the skull to a part of the brain that collects scent signals. This is called the **olfactory bulb**. The olfactory bulb sits at the base of the brain.
5. Signals from the olfactory bulb are sent to a part of the brain called the **limbic system**. The limbic system makes sense of these signals. It identifies the scent of your stinky socks or the flower. It adds the smells it identifies to your memory bank so that you may even remember to put your dirty socks in the laundry next time!



[www.senseofsmell.org/mss/making-sense-of-sense-7-9.pdf](http://www.senseofsmell.org/mss/making-sense-of-sense-7-9.pdf)

# The sounds of flying-foxes



Flying-foxes are very vocal animals and use their vocalisations as a means of communication. Over 40 different types of calls have been recorded for the grey-headed flying-foxes, each related to a particular behavioural response. These calls include mother/young, reproductive, and warning and alarm calls. For example vocal communication between individual flying-foxes is necessary for identification and defence of territories.

A flying-fox's hearing range is similar to that of humans, thus their calls are capable of being heard by humans. Camps are particularly noisy at dawn and dusk as individuals arrive or prepare to leave. Flying-foxes may be heard at night squabbling for food in backyard trees.

Calls during daylight hours occur mainly during the mating season or as a response to disturbance. These disturbances may include roaming dogs, birds of prey, machinery noise, or people walking among the roosting flying-foxes.

## How noisy is it?

Noise at the Coffs Harbour flying-fox camp in northern NSW recorded sound levels of between 50 to 70 decibels (dB). This level of noise occurred when adult animals were returning to a camp in the early hours of the morning.

Similar results were found from a noise impact assessment at Rotary Park, Lismore with average noise levels between 52 to 68 dB at dawn and dusk.

In comparison, traffic noise is generally between 55 to 65 dB, whereas train noise is between 65 to 85 dB.<sup>1</sup>

<sup>1</sup> Roberts, B.J. (2006). *Management of Urban Flying-fox Camps: Issues of Relevance to Camps in the Lower Clarence, NSW*. Valley Watch Inc., Maclean.

Listen to the flying-fox calls on the All About Bats > Year 8 web page. Recorded at Iluka, NSW 2008.

What do you think they are trying to communicate?

Is this excessively noisy? (see "How noisy is it?")



Watch the videos on the All About Bats > Year 8 web page.

Can you work out what they are communicating now?

Why do you think that the sounds that flying-foxes use to communicate are working against them?

Why do you think flying-foxes would make even more noise when humans disturb them?

# One offspring could spell disaster



Flying-foxes only have one offspring a year. They have evolved in this way so that the mother does not get too heavy to fly during pregnancy. This has worked well for the flying-foxes.

Up to now, the survival rates have been steady. Mothers protect their young by carrying them for the first month. They then leave them at night in a “nursery” or “crèche” with other juveniles for 3 months. As a group, the young stand a better chance of survival. It is only when they can fly and have been taught to forage by their mothers are the young independent. They are protected from predators by living in big colonies.

Today, numbers are in decline because of humans. With population numbers down, it is harder for the populations of flying-foxes to recover because they only have one baby a year. This adaptation could make them more vulnerable to extinction.

Matters are due to get worse as more trees are cut down and climate change takes hold. These

two major factors could lead to the following consequences:

- Mothers abort or drop their babies during a heatwave.
- Mothers are more likely to lose their babies during a drought.
- Mothers are more likely to lose their babies during a flood or severe storms.
- Mothers with babies are more likely to come into conflict with people because they can't travel as far and are more likely to resort to eating orchard fruit.
- Mothers with babies are more likely to get caught in badly installed fruit netting.

In pairs, go onto the internet and see if you can find information on ONE of the above statements. Read the information and write a paragraph below explaining the statement.

Alternatively, read about the Passenger Pigeon on Wikipedia. Why did the Passenger Pigeon become extinct? Is the flying-fox going to go down the same path?

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## Objectives

Students will explore the reasons why flying-foxes and humans are often at odds and what we can do to help defend the flying-foxes.

## National Curriculum

Activity	8.3A	8.3B
Science understanding (Biological sciences)	✓	✓
Science as a human endeavour	✓	✓
General capabilities: Literacy	✓	✓
General capabilities: Critical and creative thinking	✓	✓
Cross-curriculum priority: Sustainability	✓	✓

For outcome codes and descriptions of outcomes, see unit overview.

## Background information

Flying-foxes play a key role in the Australian environment by pollinating and spreading seed of many native trees. Unfortunately for the flying-foxes, humans like to live in similar locations and this has started to have an impact on the flying-fox population.

Flying-foxes make a lot of noise and can be really smelly. This problem has led to residents trying to move flying-foxes on, which is illegal (without a permit) and mostly unsuccessful.

It is very easy to get a flying-fox camp to take flight, however it is always unpredictable as to where they will land. They may even spread

themselves across a greater area. The stress placed on flying-foxes, via fright and exhaustion from constant moving during the day, can also lead to non-natural deaths in the camp as well as outbreaks of disease.

This is not a situation residents want. The best solution is to maintain the camp in its currently location where it can be managed by those who know how.

Flying-foxes are nomadic species and will move from camp to camp based on the flowering and fruiting times of vegetation in the region. It is best that residents know when influxes are likely to occur so that they can be prepared.

More information about living near flying-foxes can be sought from the Department of Environment and Resource Management. [www.derm.qld.gov.au/wildlife-ecosystems/wildlife/living\\_with\\_wildlife/flyingfoxes/living-with-flying-foxes.html](http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/living_with_wildlife/flyingfoxes/living-with-flying-foxes.html)

## Activity sequence

### 8.3A The bat dilemma

Students watch a segment of video from Catalyst where they explore some of the issues faced by flying-foxes.

Students read sections of a transcript from ABC 612 Brisbane Radio and make notes. They then swap around and compete to answer questions in a trivia quiz.

### 8.3B Dear Ms. Burgess

Students write a note to Ms. Burgess informing her of what they have just learnt about flying-foxes and what she should do.

# "The bat dilemma"

## Teacher's notes



At the moment, there is some dispute about flying-foxes. Some people want to cull them or move them on because they fear for their health, the health of their horses or find them noisy and smelly. Scientists are opposed to this because flying-foxes are the only animals who can pollinate and disperse the seeds of our native Australian trees.

To introduce this dilemma to students and promote discussion, do the following:

1. Show students the Catalyst video on flying-foxes.

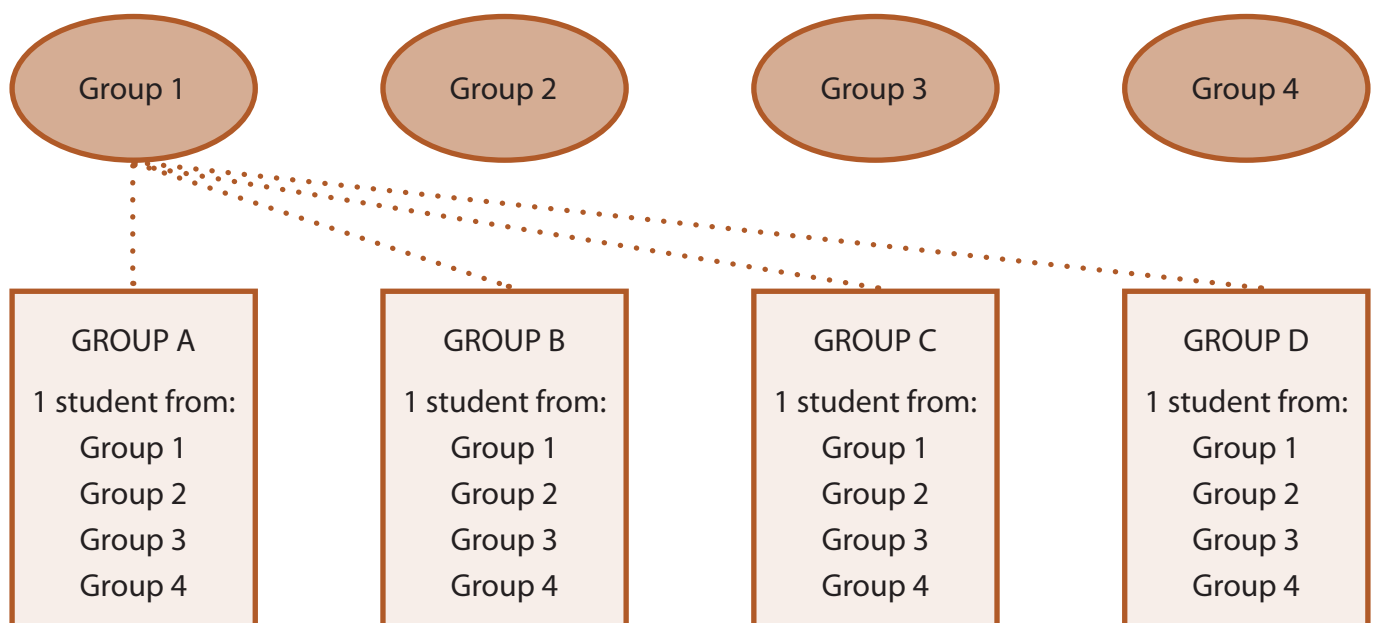
In Defence of the Flying-fox (02/09/2010)  
[www.abc.net.au/catalyst/stories/3000668.htm](http://www.abc.net.au/catalyst/stories/3000668.htm)

2. Read the transcript called "The bat dilemma" that was recorded by Ursula Skjonnemand on 612 ABC Brisbane radio on 10/08/2011. This transcript is quite long so it has been divided into 4 sections and presented as a jigsaw activity.
3. Give the students a quiz to check their understanding and stimulate discussion.

### The jigsaw activity

This jigsaw activity allows students to work in small groups but encourages all members of the group to participate. The quiz at the end should be fun.

1. Divide the students into 4 groups (Groups 1 to 4)
2. Each group is given a section of "The bat dilemma" transcript.
3. Groups read their section of the transcript and each student makes their own notes.
4. Re-group the students into new groups of 4 or 5. Each group should have at least one person from groups 1 to 4 in them. Assign these groups a letter. (A, B, C, D etc)
5. Students share the information they have learned from their section of the article with their group. Their combined knowledge should give all students an overview of the entire interview.
6. Run the quiz. Those groups whose students have taken good notes should do well.



# "The bat dilemma"

## Quiz



1. What virus has led to discussion about bats in urban areas?

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2. Why are flying-foxes protected by law?

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3. Name a flying-fox species that is nationally listed as vulnerable.

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4. Give three reasons why moving colonies is often not successful.

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5. Why do residents want to move the flying-foxes?

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6. How have residents tried to move them on?

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7. Why does stress in flying-foxes cause more spread of disease?

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8. Can you legally move flying-fox colonies?

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9. Why are bats moving into urban areas?

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10. Why is it unlikely that people will get diseases from flying-foxes?

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11. Why are flying-foxes important?

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12. Why is it important that you net trees properly?

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13. How can horses be protected from the Hendra virus?

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14. What happened to the Passenger pigeon?

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15. How are the Passenger pigeon and flying-foxes similar?

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# "The bat dilemma"

## Answers



1. What virus has led to discussion about bats in urban areas?

***Hendra virus***

2. Why are flying-foxes protected by law?

***Their numbers are dropping to dangerous levels and they might become extinct due to human actions.***

3. Name a flying-fox species that is nationally listed as vulnerable.

***Grey-headed flying-fox***

4. Give three reasons why moving colonies is often not successful.

***Answers could include:***

- ***Colonies don't move far.***
- ***Colonies often move back soon afterwards.***
- ***Expensive***
- ***More people are affected by having the old and new colonies.***
- ***They have to manage both sites.***
- ***Very stressful for the flying-foxes which could cause more disease to be spread.***

5. Why do residents want to move the flying-foxes?

***Residents claim they are noisy, smelly and there are too many of them.***

6. How have residents tried to move them on?

***With air horns***

7. Why does stress in flying-foxes cause more spread of disease?

***It lowers their immune system.***

8. Can you legally move flying-fox colonies?

***Yes, if you have a permit from the Dept. Environment and Resource Management.***

9. Why are bats moving into urban areas?

***Loss of habitat, backyards with flowering and fruiting trees.***

10. Why is it unlikely that people will get diseases from flying-foxes?

***Humans cannot get the Hendra virus directly from flying-foxes. The Australian Bat Lyssavirus can only be contracted through a bite or a scratch.***

11. Why are flying-foxes important?

***They are long range pollinators and seed dispersers.***

12. Why is it important that you net trees properly?

***Otherwise the flying-foxes, and other fruit eating animals, get caught in them.***

13. How can horses be protected from the Hendra virus?

***Keep horses away from flying-foxes by ensuring that their food and water is away from trees where flying-foxes frequent.***

14. What happened to the Passenger pigeon?

***It became extinct within 20 years.***

15. How are the Passenger pigeon and flying-foxes similar?

***Live in large colonies and produce only one young per year.***

# "The bat dilemma"

## Group 1



### The bat dilemma

The public discussion on bats in urban areas has come to a crescendo following this year's Hendra virus outbreak.

The tide of sentiment is swelling towards relocating urban bat colonies and some fed-up residents have attempted to move on flying-foxes illegally.

Why is it so difficult to find the balance between people's needs and bat conservation?

General manager of conservation strategy and planning at the Queensland Parks and Wildlife Service (QPWS), Clive Cook says bat colonies are protected for important reasons.

"The relative view that we're putting flying-foxes before humans is totally untrue," says Mr Cook.

"The law is made to try and protect the balance... to ensure that we don't have a human-induced extinction process."

All flying-foxes and their roosts are protected by law and two species, the grey-headed and spectacled flying-foxes, are nationally listed as vulnerable species.

However, bats can be moved when a Damage Mitigation Permit has been granted by the Department of Environment and Resource Management.

There are four active permits in Queensland, they are at Mackay, Bundall, Mount Ommaney and Mount Isa.

Permits are currently being considered for colonies in Gayndah, Barcaldine and the Lockyer Valley, but DERM has rejected applications for permits in Charters Towers and Nambour.

However, Griffith University researcher Billie Roberts, who has been assessing bat dispersal programs along the east coast of Australia, says they rarely have much success.

"If the animals move at all, they typically only move a very short distance... less than 500 metres from the original location," says Ms Roberts.

"And you end up with more people being affected and the management of these new sites can be difficult.

"Even if you were successful in moving the animals because they are so mobile and because they move between campsites frequently any result would only be temporary."

Ms Roberts says dispersing flying-foxes is also more difficult and costly than communities anticipate.

"For example, in Maclean in northern New South Wales, they've had ten years of dispersal attempts over a million dollars and they're continuing to relocate them on a regular basis.

"Now we have a greater number of residents affected... we have new populations, one at Iluka and one at Maclean (300 metres from the original site), that need to be managed.

# "The bat dilemma"

## Group 2



### Taking matters into their own hands

Some residents have been attempting to move bats on using any technique that works.

"We've tried everything," says Robyn Burgess, whose Gold Coast home borders a large flying-fox colony.

"It's the smell and the noise as far as we're concerned."

Ms Burgess and her neighbours have received official warnings from DERM after illegally using air horns in a bid to move the bats away.

"They are the most beautiful animals, we realise they're meant to be there but there's way too many of them," says Ms Burgess.

Clive Cook from DERM has lived near a bat colony and says he understands what residents going through.

"We totally empathise with the situation... they are noisy, they're smelly.

"But we are concerned about people taking unilateral action.

"By shifting them out of their backyard, they're just shifting them into somebody else's backyard."

There have also been attacks on bats, which the RSPCA is investigating.

The President of Bat Conservation and Rescue Queensland, Louise Saunders, says her organisation is seeing evidence of vigilante action.

"I've had members ringing up and crying because they just can't understand why people are being so awful to the animals that we consider to be beautiful," says Ms Saunders.

"I think it's because people don't understand the importance or how magnificent these animals really are."

### Stress and disease

Mr Cook says the stress caused when people try and deter the animals could lead to those residents becoming liable for the spread of bat-borne disease.

"The best advice that we've got at the moment is that stress in flying-foxes lowers their resistance and potentially increases the risk of Hendra being exuded from the animals," he says.

"If it could be demonstrated that an individual or a group that has dispersed flying-foxes that then subsequently have infected something else... there is a potential liability issue.

"This is the reason why the permits are so important.

"In us (DERM) considering an application, we potentially incur a form of liability."

There hasn't been any specific research to link habitat disturbance with increases the Hendra virus but Billie Roberts says work in the Northern Territory has shown a link with another kind of stress.

"It found that in times of nutritional stress that the prevalence of disease in flying-foxes increases," says Ms Roberts.

"(Dispersal) is a significant stress on the species and we need to be taking that conservative approach."

# "The bat dilemma"

## Group 3



### Bats in the 'burbs

Why are bats camping in suburban areas anyway?

The Department of Environment and Resource Management says as the population grows and people need more places to live, development is encroaching on bat habitats.

"One of the ironies here is that humans have come into the equation; humans have spread out and urbanised the landscape," says Clive Cook.

"We should have expected that wildlife would be affected by humans' modifications of the landscape."

Researcher Billie Roberts says backyard gardening has incidentally created attractive habitats for bats in urban areas.

"In many areas, we have actually planted food trees that are attractive to flying-foxes... we've planted a number of nectar-excreting plants such as grevillias and eucalypts.

"Many of these trees are now mature and we're not only attracting birds, we're attracting flying-foxes. We're creating a regular and reliable food source for these animals."

Louise Saunders from Bat Rescue and Conservation Queensland says there's also a seasonal factor.

"The (bat) population is all up here in Queensland, enjoying this amazing flowering of eucalypts and melaleucas.

"It doesn't mean that they're out of control and the populations are going crazy, it only means that they're here in relation to the flowering."

Food trees have already been removed in one dispersal program (under a Damage Mitigation Permit), near the Gold Coast Turf Club, resulting in the flying-fox colony moving away.

Although Mr Cook cautions such a strategy will only work when they can be certain there is a more appropriate new home and the bats will definitely move there, rather than somewhere just as troublesome.

DERM's long-term bat management plan includes preparing more appropriate habitat areas away from homes.

"Planting areas of suitable habitat to encourage flying-foxes to be there, rather than where you don't want them," says Mr Cook.

In the short-term, researcher Billie Roberts says removing nectar-producing trees would increase food pressures on flying-foxes.

"So that might be quite counter-productive, we might actually increase disease spill-overs rather than decrease them."

### The relative risk

However, Ms Roberts says the risks of living next to flying-foxes have been amplified.

"There seems to be much hysteria within the general community and much of the comments don't seem to be using science," says Ms Roberts.

Current evidence from Biosecurity Queensland shows people cannot get Hendra directly from bats or their fluids and lyssavirus can only be contracted through a bat bite or scratch that is left untreated.

Bat carers are in regular contact with flying-foxes yet Queensland Health testing showed none of them had contracted the disease.

"We flying-fox carers are the evidence that you cannot get Hendra virus from flying-foxes," says Louise Saunders from Bat Conservation and Rescue Queensland.

Flying-foxes avoid contact with humans, further reducing the risk.

# "The bat dilemma"

## Group 4



### Why bats matter

Flying-foxes are Australia's long range pollinators and seed dispersers.

Without them, eucalypts couldn't hybridise to keep up with climate change, rainforests would decline and commercial hardwoods would become weaker and more vulnerable to termites and wood grubs.

"If you were to follow the hypothesis that is 'get rid of them all', that would be an ecological catastrophe for Australia," says Mr Cook.

Billie Roberts adds they are also very important for rainforests.

"If we like forests and we like rainforests, we need to maintain flying-fox populations at reasonable numbers," she says.

### Keeping bats out legally

There are several things residents can do to discourage bats from their backyards.

Cocos palms produce a bunch of seeds with a fruity coating that attracts bats but it isn't their natural food and leads to very sticky bat poo.

The palms have been declared a weed by Brisbane City Council and a range of other local governments.

"Remove them if you can or cut the seeds off after the flowers have been pollinated," says Louise Saunders.

Using appropriate netting for fruit trees is another deterrent, but Ms Saunders warns backyard drape can be cruel to bats.

"The flying-foxes smell the fruit, they can't see the netting and they just get hopelessly entangled and it's a very cruel way to die," says Ms Saunders."

For those who own horses, keeping horses away from the bats' food trees (such as figs, eucalypts, blood woods, spotted gum and black butt) is the most simple and practical way to reduce the risk.

Mr Cook has applauded the horse industry on what he says is fantastic management of the Hendra risk.

### More about bats

Bats are the world's only flying mammal.

They are divided into the species that eat fruits and nectar (flying-foxes) and those that eat insects (micro bats).

They can travel up to 250 kilometres in one night in search of food.

Flying-foxes only have one baby per year, making them more susceptible to population demise.

### A cautionary tale

In America, the passenger pigeon declined from a population of about 50 million to extinction within 20 years.

The species had several important similarities to bats; it lived in large colonies and produced just one young a year.

# Dear Ms. Burgess



In “The bat dilemma” (Group 2) you would have read about Ms Burgess. Discuss as a class:

Why was she complaining about the flying-foxes next to her property?

Why did she receive official warnings from the Dept. Environment and Resource Management?

Would you say it is inhumane to use air horns for moving flying-foxes?

Is it easy to move colonies away from your area?

Pretend you are one of Ms. Burgess’s neighbours. You too have to put up with the noise and smells of the flying-foxes but you don’t believe it is right to try to move the flying-foxes on.

Write a note to Ms. Burgess informing her of what you have just learnt about flying-foxes and what she should do.

*Dear Ms. Burgess,*

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*Sincerely,*

## For more information

All About Bats. ....	<a href="http://www.allaboutbats.org.au">www.allaboutbats.org.au</a>
SEQ Catchments .....	<a href="http://www.seqcatchments.com.au">www.seqcatchments.com.au</a>
Burnett Mary Regional Group .....	<a href="http://www.bmrg.org.au">www.bmrg.org.au</a>
Department of Environment and Resource Management.....	<a href="http://www.derm.qld.gov.au">www.derm.qld.gov.au</a>

### Working with bats

The following organisations can be contacted for more information about bats, or individuals may be willing to speak to your class about what they are doing to help conserve our wildlife.

#### **Bat Conservation & Rescue Inc.**

[www.bats.org.au](http://www.bats.org.au)  
P: 07 0488 228 134  
E: [info@bats.org.au](mailto:info@bats.org.au)

#### **The Hut Environmental and Community Association Inc. (THECA)**

[www.theca.asn.au](http://www.theca.asn.au)  
P: 07 3878 5088  
E: [theca@hotmail.net.au](mailto:theca@hotmail.net.au)

#### **Wildlife Presentation Society Queensland**

[www.wildlife.org.au](http://www.wildlife.org.au)  
P: 07 3221 0194  
E: [wpsq@wildlife.org.au](mailto:wpsq@wildlife.org.au)

#### **Your local council.**

#### **Queensland Parks and Wildlife Services**

[www.derm.qld.gov.au](http://www.derm.qld.gov.au)  
South East P: 07 3512 2300  
Sunshine Coast and Burnett P: 07 5459 6110

#### **SEQ Catchments**

[www.seqcatchments.com.au](http://www.seqcatchments.com.au)  
T: 07 3211 4404  
E: [admin@seqcatchments.com.au](mailto:admin@seqcatchments.com.au)

#### **Burnett Mary Regional Group**

[www.bmrg.org.au](http://www.bmrg.org.au)  
P: 07 4181 2999  
E: [admin@bmrg.org.au](mailto:admin@bmrg.org.au)

### Excursion ideas

The following locations can be used to visit a flying-fox camp where there is interpretive information to learn more about the local camp. There are many more sites out there that have not been represented here. To find your nearest camp site go to:

[www.derm.qld.gov.au/wildlife-ecosystems/wildlife/living\\_with\\_wildlife/flyingfoxes/seq-roost-locations.html](http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/living_with_wildlife/flyingfoxes/seq-roost-locations.html)

#### **Cascade Gardens**

Gold Coast Highway, Broadbeach

#### **Woodend Nature Centre**

35 Williams Street, Coalfalls  
[www.discover-our-ipswich.com/woodendnaturecentre.html](http://www.discover-our-ipswich.com/woodendnaturecentre.html)

#### **Black Swamp Wetland**

Access via Queen Street, Cleveland  
[www.more2redlands.com.au/Explore/Leisure\\_Attractions/Nature%20-%20Wildlife/Mainland/Pages/Black%20Swamp%20Wetlands.aspx](http://www.more2redlands.com.au/Explore/Leisure_Attractions/Nature%20-%20Wildlife/Mainland/Pages/Black%20Swamp%20Wetlands.aspx)

#### **Tooan Tooan Creek**

Cnr Taylor Street and The Esplanade, Hervey Bay

#### **Batty Boat Cruise (Brisbane River)**

[www.wildlife.org.au/news/2011/batty.html](http://www.wildlife.org.au/news/2011/batty.html)  
P: 07 3221 0194  
Although this Batty Boat Cruise is an evening activity with a per person cost, it is recommended for teachers who may like to broaden their knowledge about flying-foxes.

[www.allaboutbats.org.au](http://www.allaboutbats.org.au)

