

Grassland Food Webs: Teacher Notes



Alan Henderson ©

Activity 1

Food chains & energy transfer in a grassland ecosystem

Objectives

After completing this activity students will be able to:

- Create a food web and identify producers and consumers.
- Assign organisms into trophic levels.
- Investigate the flow of energy through the food web.

Target audience

Year 7

Duration

Two 50-minute sessions

Materials

- Whiteboard and whiteboard markers
- Student workbook
- Pencil

Food web role play activity:

- 16 food chain role play cards, printed, laminated with a hole in the top, middle with a piece of string attached (to form a necklace)
- Printed copy of the food web role play answers
- Ball of string

Energy flow role play activity:

- 4 food chain organism cards, printed and laminated (from the previous activity: Kangaroo Grass, Southern Brown Bandicoot, Spot-tailed Quoll and the Wedge-tailed Eagle)
- 40 units of energy (pictures of the sun), printed and laminated
- Class set of computers with the BWVP Grassland Food Webs learning object and the BWVP Flora and Fauna Field Guide

Activity

All living things require energy for survival including growth, reproduction and repair. Some organisms produce their own food while others need to consume other organisms to obtain nutrients and energy. The interaction between organisms and the flow of nutrients and energy through ecosystems will be explored in this activity.

Introduction

Begin this lesson by engaging students in a brainstorming session about grassland food chains. Students should list the animals and plants that live in grasslands. Discuss how plants create energy and introduce the term photosynthesis. Discuss the diets of grassland animals and introduce the terms habitat, herbivore, carnivore, omnivore and predator. Record student responses on the board and consider these

prompts to keep the discussion lively (answers have been provided).

What is a habitat?

A habitat is the place where an animal or plant makes its home.

What plants and animals live in grasslands habitats?

Students may talk about tussock grasses, wildflowers, shrubs, trees, birds of prey, insects, wallabies, kangaroos, lizards, etc.

How do plants and animals make food?

Plants make food using a process called photosynthesis. Photosynthesis uses the sun, carbon dioxide from the air and water containing dissolved materials from the soil to make energy. Animals rely on plants or other animals for their food.

What is a herbivore?

A herbivore is an animal that only eats plants, such as leaves, grass, berries, bark, etc., e.g. a cicada.

What is a carnivore?

A carnivore is an animal that only eats other animals e.g. an Eastern Brown Snake.

What is an omnivore?

An omnivore is an animal that eats plants and animals e.g. a Southern Brown Bandicoot.

What is a predator?

A predator is an animal that hunts for food e.g. a Brown Falcon.

What is a food chain?

A food chain shows a simple pathway of the flow of nutrients in an ecosystem. It is called a chain because each living organism provides a link in the chain and each organism depends on the organisms linked to it.

What is a food web?

Food chains do not represent what typically happens in nature. The food chain shows only one pathway of energy and nutrient transfer. Most consumers feed on multiple species and are in turn fed upon by multiple other species. A network of interacting food chains is called a food web.

Food chains and food webs

Students will explore food chains and food webs in grasslands. Write the following food chain on the board.

Tussock Grass → Cricket → Lizard → Wedge-tailed Eagle

Ask students if they can explain the relationships between the organisms. If students need assistance, explain that each food chain is a possible pathway that energy and nutrients can follow through the ecosystem. For example, Tussock Grass produces its own food from sunlight. The Tussock Grass is eaten by the Cricket, the Cricket is eaten by the Lizard, and the Lizard is eaten by the Wedge-tailed Eagle. When the Wedge-tailed Eagle dies, bacteria breaks down its body, returning it to the soil where it provides nutrients for plants like the Tussock Grass. Of course, many different animals eat Tussock Grass, and Crickets can eat other grasses and plants. Lizards and Wedge-tailed Eagles can eat many different types of animals too. Each of these living things can be a part of a multitude of food chains. All of the interconnected and overlapping food chains in an ecosystem make up a food web. Ask students to complete questions 1-5 in their workbook.

Trophic levels

Next introduce students to trophic levels. Organisms in food chains are grouped into categories called trophic levels. These levels are divided into producers (first trophic level) and consumers (second, third and fourth trophic levels). There are different types of consumers. There are herbivores (primary consumers) that eat the plants or carnivores (secondary and tertiary consumers) that eat the herbivores. The consumers that are able to eat both plants and animals are known as omnivores (secondary or tertiary consumers) while the animals that only eat dead organisms are called scavengers. Bacteria and fungi that return nutrients to the soil when they decompose dead animals and plants are called decomposers. The interaction between producers and primary and secondary and possibly tertiary consumers keeps an ecosystem healthy.

Draw the following pyramid on the board and discuss trophic levels. Refer to the food chain example already discussed. Pose the following questions to the students.

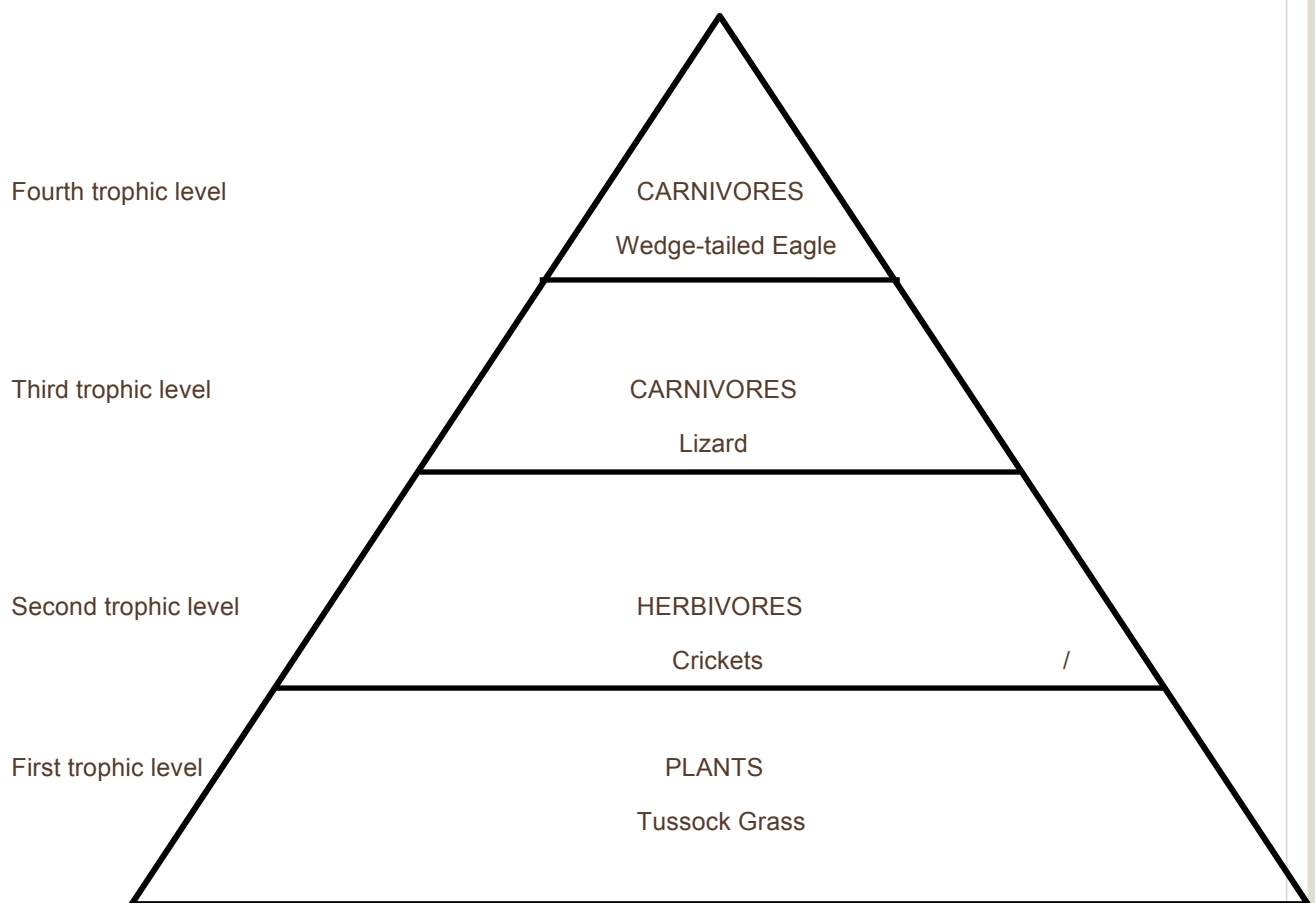
What are producers? Where do they get their energy from?

Producers are plants, algae, phytoplankton and some types of bacteria. Producers are also known as autotrophs. They make their own food through a process called photosynthesis. This process uses sunlight, carbon dioxide and water to create energy.

Consumers are divided into herbivores, carnivores and omnivores. Where do consumers get their energy from?

Consumers get their energy by consuming other plants and animals.

Below is a trophic pyramid. This shows the feeding position an organism occupies in a food chain.



Which organisms occupy the first trophic level?

Plants (producers) always occupy the first trophic level. These are also known as primary producers.

Which organisms occupy the second trophic level?

The second trophic level eats the producers. This means the animals are herbivores. These are also known as primary consumers.

Which organisms occupy the third trophic level?

The third trophic level eats the primary consumers. This means the animals are carnivores. These are also known as secondary consumers.

Which organisms occupy the fourth trophic level?

The fourth trophic level eats the secondary consumers. These animals are carnivores. These are also known as tertiary consumers.

What are top predators?

Top predators are also known as apex predators. These animals are found at the top of their food chain and have virtually no predators.

Explain to students that detritivores and decomposers complete food chains. Detritivores are organisms that eat non-living plant and animal remains. For example, scavengers such as some raptors eat dead animals. Decomposers like fungi and bacteria, turn organic waste, such as decaying plants, into inorganic materials, such as nitrogen-rich soil. Decomposers complete the cycle, by returning nutrients to the soil for use by producers. This starts a whole new food chain.

Food web role play

Students will further develop their understanding of these concepts by undertaking the following group exercise on food chains and food webs. You will need the 16 organism cards and a ball of string. The idea of this exercise is for students to visualise who eats who in the grassland and to understand how animals are linked in a food web. First, hand out all the cards, one per person (there may not be enough cards for all students however those that missed out can assist with the links). Choose a plant, and ask the student to read out what eats it. Those students with these cards stand next to the plant and then ask a student (without an organism card) to link the organisms with the string. Ensure the links are going in the correct direction. Continue until all the cards are used. Make sure you link them to one another to create a food web. The food web answers have been provided in the Teacher Resource section.

Discuss the results of the food web as a class. Ask students to identify the following in the food web:

- Producers
- Consumers
- Herbivores
- Carnivores
- Top predators

- First trophic level, second trophic level, third trophic level and fourth trophic level.

Food webs unbalanced

Each organism interacts with others in a food web and if one organism is removed, all the other organisms are affected and the food web becomes unbalanced. Use the following example to explore the effects on an ecosystem. Explain that an insecticide has been sprayed on the grassland and the cicadas have died. Ask the cicada to sit down. Explain to students that to show the impact this has on the grassland, could all the students who are directly linked to the cicada also sit down. Ask all of those students who are directly linked to also sit down and so on. Ask students who are left? Producers and a couple of insects should remain. Ask students how the death of the cicadas has affected the grassland? Also ask what would happen to the producers and the other insects? Conclude this discussion by explaining that life in any ecosystem is in a delicate balance and that changing one organism in a food chain can alter that balance. Ensure students understand that all plants and animals are linked and depend on each other and their environment.

Energy transfer

In any food chain, the energy that is trapped by the producers is passed on to the consumers. Not all the energy, however is passed on. On average, each trophic level only contains 10% of the energy as the one below it, with most of the energy being lost as heat. By the time the energy reaches the top of the food chain, only a small amount of the original energy remains. Consequently, most food chains are short, and there are rarely more than four trophic levels.

Moving up the food web or pyramid, there is less food energy at each trophic level and therefore there are fewer types of each organism. The number of plants in an ecosystem is greater than the number of herbivores and the number of herbivores is greater than the number of carnivores and omnivores that eat them. So there may be only one kookaburra and a few snakes but hundreds of frogs and thousands of grasshoppers. The trophic pyramid illustrates how the number of organisms and amount of energy decreases as it moves up the pyramid.

Energy transfer role play

Illustrate energy transfer to the students by undertaking the following role play activity. Hand out four food chain organism cards to four students. Have students sort themselves out into a food chain. Talk to students about producers at the base of the food chain. Ask them where the energy comes from? (the sun). Hand the producer 40 units of energy. NOTE: Although only 10% of the energy is transferred to the next trophic level, if we were to demonstrate this we would need thousands of tokens. This is something that can be addressed with Year 11 Biology students, however for Year 7 we are only interested in representing how energy is lost and we will do this with a manageable amount of tokens.

Ask the students how plants use energy? Here are some examples. When the producer undertakes an activity, they must forfeit some tokens. These can be given to the teacher. Make sure 20 tokens are used.

- Grow, uses eight units
- Turn its flowers to face the sun, uses four units
- Produce seeds, uses four unit
- Defend against disease, uses four units.

Then explain, that the producer is eaten by the herbivore (primary consumer) and all the energy they had left has now transferred to the herbivore. Ask the herbivore how much energy they have received? 20 tokens. Explain that they must also use energy to carry out any activity. Ask students what the herbivore will use energy for? Make sure 10 tokens are used.

- Grow, uses four units
- Move, uses two units
- Breathe, uses two units
- Reproduce, uses two units.

Then explain, the herbivore is eaten by the carnivore (secondary consumer) and all the energy they had left has now been transferred to the carnivore. Ask the carnivore how much energy they have received? 10 tokens. Explain that they must use energy to carry out any activity. Ask students what the carnivore will use energy for? Make sure five token are used.

- Hunt, uses two units
- Grow, uses two units
- Breathe, uses one units

Then explain, the carnivore is eaten by a top predator (tertiary consumer) and all the energy that they had left has now been transferred to them. Ask the carnivore how much energy they have received? Five tokens. Explain that they must use energy to carry out any activity. Ask students what the carnivore will use energy for? Make sure the remaining five tokens are used.

- Hunt, uses two units
- Grow, uses one unit
- Breathe, uses one unit
- Reproduce, uses one unit.

Ask students how many tokens remain? None. Explain that the food chain cannot support any more organisms.

BWVP Grassland Food Webs Learning Object

Students can now put their knowledge to the test by completing the Very Easy Food Chain and the Easy Food Web online activities. It is recommended that students at Level 7 complete the Very Easy Food Chain first then complete the Easy No Feral Cat Food Web, then the Easy, Feral Cat Food Web. When finished ask students to draw their food chain and food webs in their workbook and complete questions 6-14. Students may wish to complete the Medium Food Webs before attempting the Difficult Food Webs as extension activities.

Introduced species

Finally, students will explore the impact of introduced species. Explain that the introduction of an introduced species will cause a food web to become unbalanced. Discuss the effects of a Feral Cat in the food web. Consider the following questions to keep the discussion lively.

What is an introduced species?

An introduced species is a species that does not naturally occur in an area. They are also known as exotic or non-native.

Can you identify any introduced species?

Here is a list of some introduced species: European Rabbit, Red Fox, Cane Toad, Feral Cat, Brumby, Feral Pig and Black Rat.

What is the impact of an introduced species in a grassland ecosystem?

Introduced species impact on native species by:

- Competing for food and shelter,
- Predation,
- Destroying habitat,
- Spreading diseases.

How does the introduction of an introduced species affect the balance in a food web?

The introduction of an introduced species affects the balance of the food web as animals without natural predators can now be affected by predation.

Why is the Feral Cat a threat to native animals?

Feral Cats compete for food and shelter; they prey on native animals and spread diseases and parasites.

Do domestic cats pose a threat to native animals in an urban environment? How?

Yes. Shelter requirements are usually met for domestic cats so this is usually not a problem, however these animals will compete for food, prey on native animals and spread diseases and parasites.

If you are a cat owner, what could you do to reduce the impact on native animals?

Cat owners should make sure that their cat is locked up at night to reduce predation; ensure that their cat wears a bell on the collar to make native animals aware when they're close by, and provide ample food and shelter to reduce the need for them to find these in the urban environment.

Ask students to complete questions 15-19.

Conclusion

Conclude the session by engaging students in a brainstorming session about the activities. Here are some examples of discussion points to keep the discussion lively.

Give an example of a food chain?

What is a food web?

Can you give me an example of a producer?

How does a producer gain energy?

Can you give me an example of a consumer?

How does a consumer gain energy?

What does a herbivore eat?

What does a carnivore eat?

What does an omnivore eat?

Describe a top predator.

Describe the role of decomposers.

What organism always occupies the first trophic level?

How can a food web become unbalanced?

On average how much energy is passed onto the next organism in a food chain?

Why is only a small amount of energy passed onto the next organism?

Why are food chains usually no longer than four organisms?

Students will complete the conclusion questions in their workbook.

Food webs in the grassland ecosystem

1. What is a food chain?

A food chain shows who eats who.

2. Are plants always at the base of a food chain?

Yes plants are always at the base of a food chain.

3. How do plants gain their energy?

Plants make their own food by a process called photosynthesis. For this to occur, plants need water from the soil, carbon dioxide from the air and sunlight.

4. How do animals gain their energy?

Animals gain their energy by consuming other organisms.

5. What is a food web?

A food web consists of many food chains linked together and to their environment.

BWVP Grassland Food Webs Learning Object

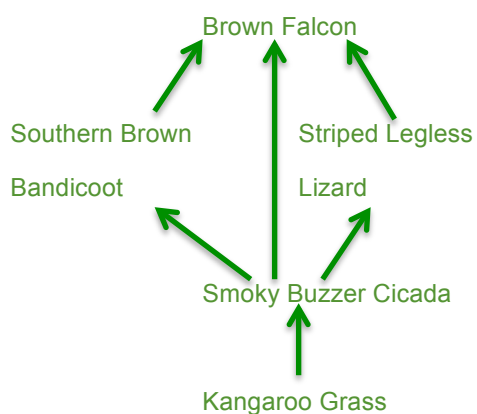
Complete the Very Easy Food Chain and Easy Food Webs using the BWVP Grassland Food Webs learning object.

6. Draw the food chain in the space below.

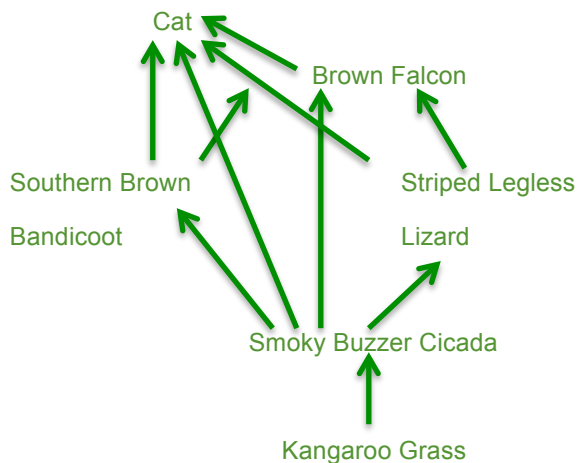
Common	→	Australian	→	Spotted	→	Growling	→	Tiger
Everlasting		Painted		Marsh		Grass		Snake
Daisy		Lady		Frog		Frog		

7. Write down your food webs in the space provided below.

Food web – no Feral Cat



Food web – with Feral Cat

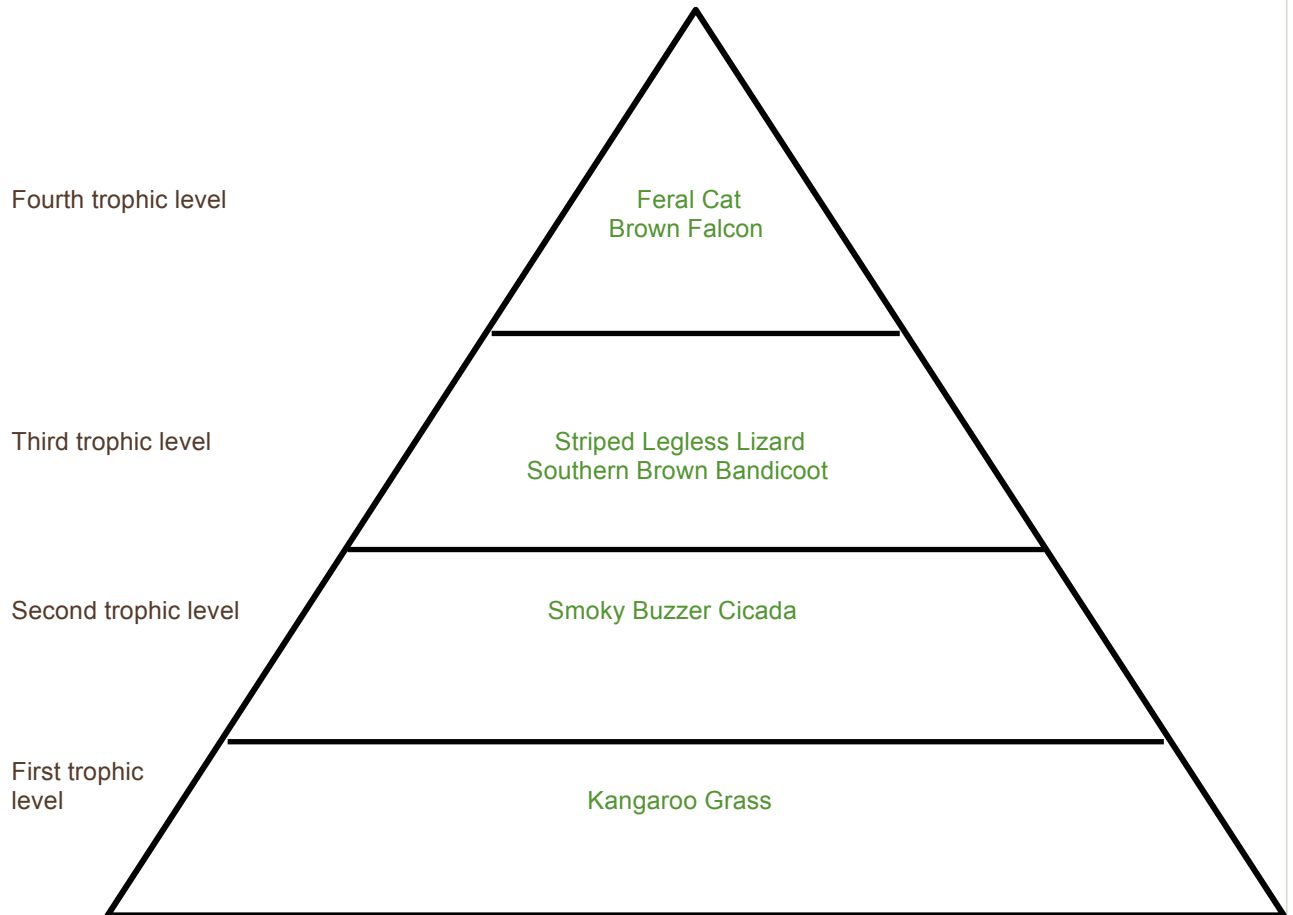


8. Complete the following table. Tick whether the organism is a producer or consumer, herbivore or carnivore.

Organism	Producer	Consumer	Herbivore	Carnivore
Common Everlasting Daisy	✓			
Australian Painted Lady		✓	✓	
Spotted Marsh Frog		✓		✓
Growling Grass Frog		✓		✓
Tiger Snake		✓		✓

Energy flow through trophic levels

9. Complete the trophic pyramid with the organisms used in the food web.



10. Which organism is greatest in abundance?

The producer, which is the Kangaroo Grass has the greatest abundance.

11. What happens to the amount of energy as you move up the pyramid?

As you move up the pyramid there is less energy available as energy is lost as heat at each trophic level.

12. Why is a food chain limited to three or four organisms?

A food chain is limited in size because of the availability of energy. Less energy is available to organisms as you move up the pyramid.

13. What is important about decomposers, like fungi?

Decomposers break down dead animals and plants into reusable elements and recycle nutrients back into the air and soil.

14. Is a food web never ending?

Yes. It continues on and on. Plants get their energy from the sun, simple chemicals and nutrients in the soil. Animals obtain their energy from plants and other animals. Decomposers eat decaying and rotting remains of plants and animals. They recycle the dead matter into nutrients in the soil. Plants then take up these nutrients and the cycle continues.

Introduced species

Explore the impact of introduced species on ecosystems. Open the BWVP Flora and Fauna Field Guide and look up Animal > Mammal > Placental.

15. There are several introduced placental animals. List these.

Black Rat, European Rabbit, European Hare, Feral Cat, House Mouse, Red Fox

16. How do these animals pose threats to native plants and animals?

These animals prey on native animals, compete for food, resources and habitat and spread diseases.

17. Look up the Feral Cat. What is the diet of the Feral Cat?

Feral Cats eat small mammals, up to the size of a Brushtail Possum, and catch birds, reptiles, amphibians, fish and insects.

18. When are cats active?

Cats spend most of the day sheltering and are nocturnal (active at night).

19. Refer to your food webs. What is the impact of the Feral Cat on this ecosystem?

The Feral Cat will cause a reduction in the number of Brown Falcons, Southern Brown Bandicoots, Striped Legless Lizards and Smoky Buzzer Cicadas.

Conclusion

20. You now know that plants are producers and animals are consumers. What is the difference between these two roles?

Producers obtain their energy by making their own food via photosynthesis. Consumers obtain their food by consuming plants and animals. Unlike a producer, consumers cannot make their own food.

21. Observe the following food chain.

Tussock Grass → Golden Sun Moth → Striped Legless Lizard → Eastern Brown Snake

The Golden Sun Moth is an endangered species. How could this effect the food chain?

As an endangered species, the Golden Sun Moth's population is reducing in size. This will affect all the animals that feed on it. As there is less food available this will also reduce the size of the Striped Legless Lizard and the Eastern Brown Snake's population.

22. Explain the energy flow in a food chain.

Producers produce energy from the sun through photosynthesis. After this, the energy flows from producers to primary consumers to secondary consumers to tertiary consumers. This is because producers will be eaten by primary consumers which in turn will be eaten by secondary consumers and so on. However, between these trophic levels energy is always lost. All of the trophic levels lose energy as heat.

23. In an ecosystem can there be more carnivores than herbivores?

No there cannot be more carnivores than herbivores because there is not enough energy to support more carnivores. There is more energy available to herbivores from the producers therefore more herbivores are found in an ecosystem.

24. What trophic level do humans occupy?

Humans are typically omnivores, which means they will be primary, secondary and tertiary consumers. Some are herbivores and will be primary consumers only.

25. How can humans cause an imbalance in a food web?

Humans can cause an imbalance in many ways, for example by hunting the top carnivores for food and using pesticides and insecticides to reduce some animal populations.