AN ACTIVE AUSTRALIAN SCIENCE 7 CURRICULUM MODULE

AUS BS7 SU STRAND MODULE 2: FOOD CHAINS AND FOOD WEBS

STUDENT'S NAME: _____ **TUTORIAL:** _____

TEACHER'S NAME: _____ **DATE:** _____

AUS Biological Sciences 7: Science Understanding Strand Module 2: Key Conceptual Understandings
• Students understand that a **food chain** is a single series of organisms, each feeding in turn on the other, thereby showing the feeding relationships between those organisms.
• Students describe the specified feeding relationships between selected organisms by constructing simple food chains, labeling each organism as a consumer (1^0, 2^0 or 3^0 order) or a decomposer.
• Students understand that **producers** are the first link in a food chain because they use the sun's energy to make their own food, i.e., glucose, by photosynthesis.
• Students demonstrate the broad understanding that both matter and energy are passed up a food chain, by referring to the rapid carbon-oxygen cycle involving photosynthesis, digestion, and respiration only.
• Students understand that **decomposers** are the last link in a food chain because they break down dead matter into organic molecules and mineral nutrients for recycling.
• Students understand that a food web shows a complex web of feeding relationships by combining all of the food chains from a particular community.
• Students link together into a food web three simple food chains each containing two different species of organisms, which are common to each food chain.
• Students correctly predict the effect on the population of an organism within a simple food web when it loses one of its food sources.
• Students understand that an organism that is part of a number of food chains in a food web is less likely to be adversely affected by the loss of one of its food sources.

An Introduction to Ecology

- **Ecology** is the scientific study of the relationships that exist between organisms and their environments.

- Science Concept: Living things depend upon other living things for their survival, i.e., for food, shelter, protection, pollination and seed dispersal.

Forward Reference: In this active Australian Science curriculum module, you will only study feeding relationships between organisms. In the Biological Sciences Sub Strand, at Year Levels 9 and 10, you will make a more, in-depth study of ecology, including how organisms interact with each other, and how they adapt to a changing environment.

- Science Concept: In order to survive in their environment, all living things need **nutrition**, which is the taking in of substances such as water, minerals and various foods. Green plants can make their own food.

- Science Concept: Each organism living in a **community** can be affected by the other organisms through feeding relationships, since all the organisms in a community are part of the one food web.

- Science concept: A **community** is the living (biological) part of an **ecosystem** and consists of all the organisms of different species living in an ecosystem at any given time.

- Science Concept: An **ecosystem** is, in the main, a self-sustaining system formed by living organisms interacting with one another, and with their physical environment.

1. What do the words **self-sustaining** mean?

[**2 marks**]

2. Could your school be considered as an ecosystem? If not, why not?

[**3 marks**]

Food Chains and Webs

- Science Concept: A **food chain** is a single series of organisms, each feeding in turn on the other, thereby showing the feeding relationships between those organisms.

- Science Concept: **Wetlands** are land areas where water covers the soil, all of the year, or only at specific times during the year, e.g., swamps, marshes, billabongs, lakes, lagoons, mudflats, mangroves, and bogs.

3. Do you have a wetland near your home or your school? If you do, what is its name?

[**2 marks**]

Wetland Organisms and Foods they Eat

Table 1, given below, lists some wetland organisms and the foods that they mainly eat, most of the time.

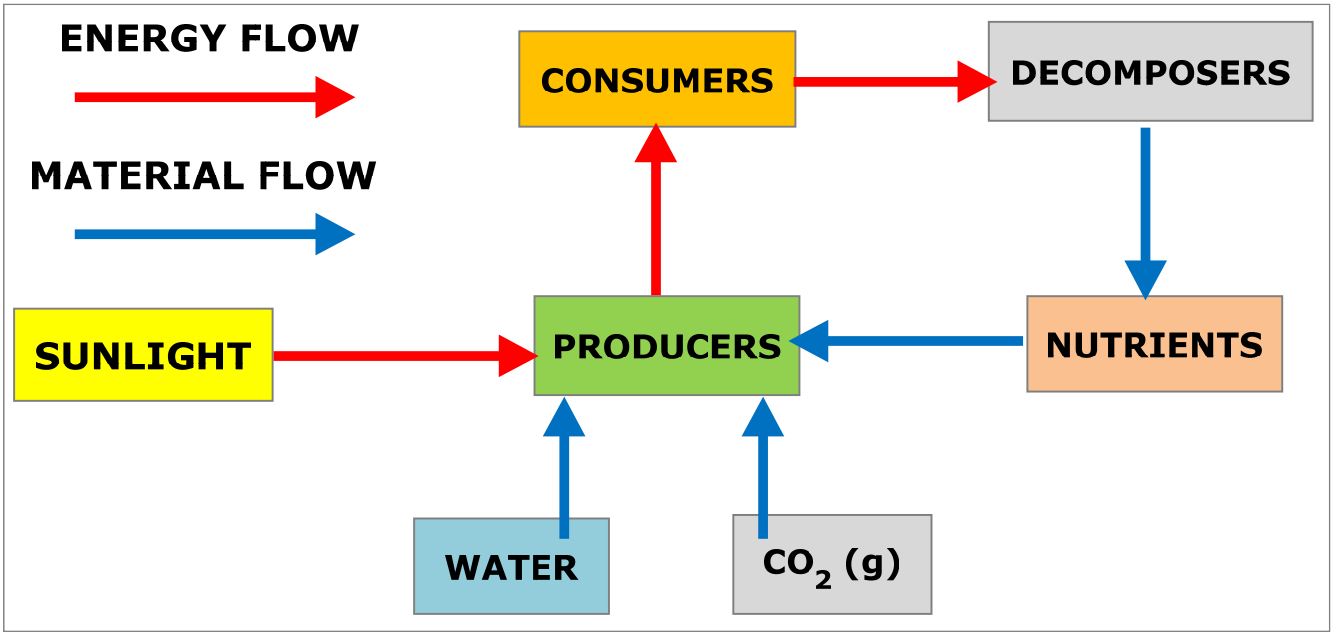
TABLE 1: Some Wetland Animals and Foods they Eat

	Common Name	Scientific Name	Information for constructing a wetland Food Web:
Green Plants: (Producers)	Fresh water algae For example:	*Actinoptychus senarius*	These listed green plants photosynthesise glucose (sugar), and oxygen, using sunlight energy, by chemically combining carbon dioxide, from air, and water, from the wetland.
	Water ribbons	*Triglochin procerum*	
	Bulrushes	*Typhus sp.*	
	Common Reed	*Phragmites australis*	
	These wetland Animals, listed below, consume these Foods:		
Animals: (Consumers)	Mosquito larvae		Algae
	Mosquito		Female mosquitoes feed on blood prior to egg laying
	Water boatman		Algae, and reeds
	Freshwater snail		Algae, and water ribbons
	Snake-necked freshwater turtle	*Chelodina longicollis*	Algae, freshwater snails, water boatman, and yabbies
	Smaller fish		Water boatman, mosquito larvae, and water ribbons
	Black swan	*Cygnus atratus*	Water ribbons, freshwater snails, and smaller fish
	Larger fish		Mosquito larvae, water boatman, and smaller fish
	Frog		Water boatman, freshwater snails, and dragonflies
	Dragonfly larvae		Water boatman, and diving beetles
	Dragonfly		Mosquitoes
	Diving beetle		Water boatman
	Purple swamphen	*Porphyrio porphyrio*	Tender growth of bulrushes
	Australian Pelican	*Pelecanus conspicillatus*	Fish, frogs, water boatman, and dragonfly larvae
	Pacific black duck	*Anas superciliosa*	Fish, dragonfly larvae, and diving beetles
	White-faced heron	*Egretta novaehollandiae*	Fish, frogs, diving beetles
	Blue-tongue lizard	*Tilqua sp.*	Dragonflies, diving beetles, and frogs
	Common yabby (A scavenger)	*Cherax destructor*	Feeds on rotting plant and animal matter
	Parasitic worms		Infests and feeds on fish, frogs, and ducks
Decomposer:	Bacteria		Break down dead material into nutrients for recycling

Source URL: http://waterwatchadelaide.net.au/index.php?page=food-chains

ICT Skill Check: Use this URL: http://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?mode=Root to access, additional, taxonomical information on those wetland organisms with scientific names as provided in Table 1.

Links in a Food Chain



- Science Concept: **Producers** (green plants) are the first link in a food chain because they use the sun's energy to make their own food, i.e., glucose, by photosynthesis.

- Science Concept: **Herbivores** that eat green plants (producers) are called **primary** (1^0) **consumers**.
- Science Concept: **Carnivores** that feed on herbivores are called **secondary** (2^0) **consumers**.
- Science Concept: **Carnivores** that feed on other carnivores are **tertiary** (3^0) [or higher] **consumers**.
- Science Concept: Each level of consumption in a food chain is called a trophic level, (e.g., Level 1, 2, 3.)

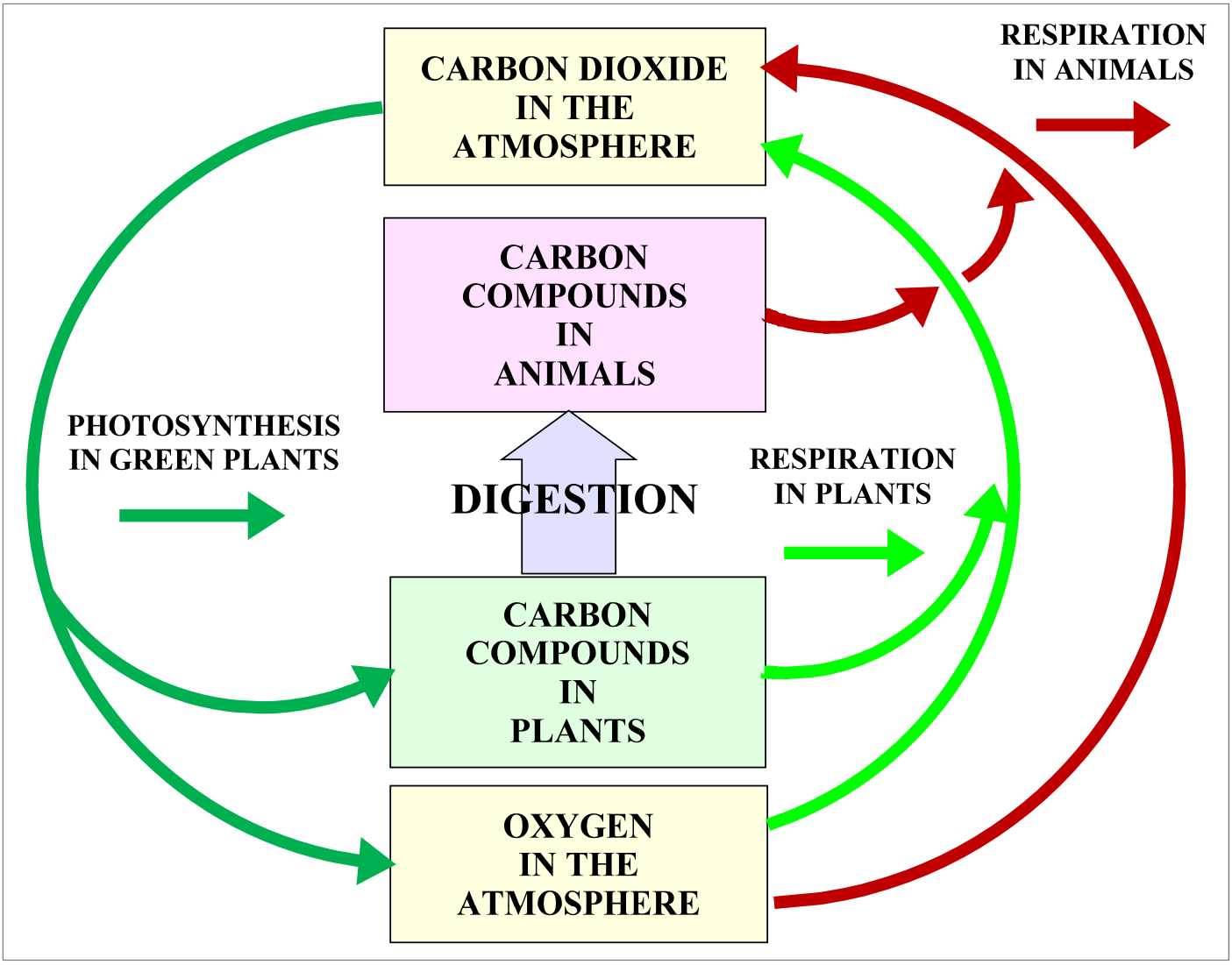
- Science Concept: **Decomposers** are the last link in a food chain because they break down dead matter into organic molecules and mineral nutrients for recycling.

The Transfer of Energy up a Food Chain

Green plants store chemical potential energy in their body cells. When herbivores eat green plants, only about 10 % of the plant's original amount of stored chemical energy ends up as stored chemical energy in the body cells of the herbivore. Of the remaining 90 % of the chemical energy, stored in the eaten plant cells, some is used by the herbivore for activities such as movement, respiration, and reproduction; and some is eliminated from the herbivore as indigestible-plant matter. Likewise, when a carnivore eats the herbivore, only about 1.0 % of the stored chemical energy in the body cells of the herbivore ends up as stored chemical energy in the body cells of the carnivore. If a third-order consumer then eats the carnivore, only about 0.1 % of the chemical energy stored in the body cells of the carnivore ends up as stored chemical energy in the body cells of the third-order consumer.

You should now understand that the transfer of energy between any two trophic levels in a food chain is only about 10 % efficient. Assume, for example, that a given food chain starts with 100 energy units of grass matter, when eaten; it will become 10 energy units of grasshopper matter; when eaten; it will become 1.0 energy unit of skink lizard matter; when eaten; it will become 0.1 energy units of wedge-tail eagle matter. As energy flows up a food chain, much of it is either used for body activity or lost as waste heat. Therefore there is a limit to the number trophic levels in a food chain.

The Rapid Carbon-Oxygen Cycle



Photosynthesis in Plants

Green plants use chlorophyll in their leaves to trap light energy. The energy is used to chemically combine carbon dioxide with water to make glucose. The glucose is used in plant respiration, or converted into starch and stored in leaves. The overall process is called photosynthesis. Oxygen gas is produced as a by-product.

The summary word equation for **photosynthesis** can be shown as:

$$\text{Carbon dioxide gas + Water} \xrightarrow[\text{Chlorophyll}]{\text{Light energy}} \text{Glucose sugar + Oxygen gas}$$

The summary chemical symbol equation for **photosynthesis** can be shown as:

$$6\,CO_2\,(g) + 6\,H_2O\,(\ell) \xrightarrow{\text{Light energy}} C_6H_{12}O_6\,(s) + 6\,O_2\,(g)$$

Respiration in Animals and Plants

Respiration is a chemical reaction that occurs in both animal and plant cells. During respiration, the energy released from glucose and oxygen is used by the cells to keep them living. Glucose and oxygen react in the cells to produce carbon dioxide gas and water. The overall cellular reaction is called aerobic respiration as oxygen from the air is needed for the reaction to occur.

The summary word equation for **aerobic respiration** can be shown as:

$$\text{Glucose sugar + Oxygen gas} \longrightarrow \text{Carbon dioxide gas + Water + energy (ATP)}$$

The summary chemical symbol equation for **aerobic respiration** can be shown as:

$$C_6H_{12}O_6\,(s) + 6\,O_2\,(g) \longrightarrow 6\,CO_2\,(g) + 6\,H_2O\,(\ell) + \text{energy (ATP)}$$

Questions on the Rapid Carbon-Oxygen Cycle

Backward Reference: To correctly answer Questions 4 to 7, you will need to refer back to the rapid Carbon – Oxygen cycle diagram given on Page 5.

4. Where do the carbon atoms in the carbon compounds found inside plant cells originate (come from)?

[**1 mark**]

5. What summary chemical process makes the carbon compounds found inside green plants?

[**1 mark**]

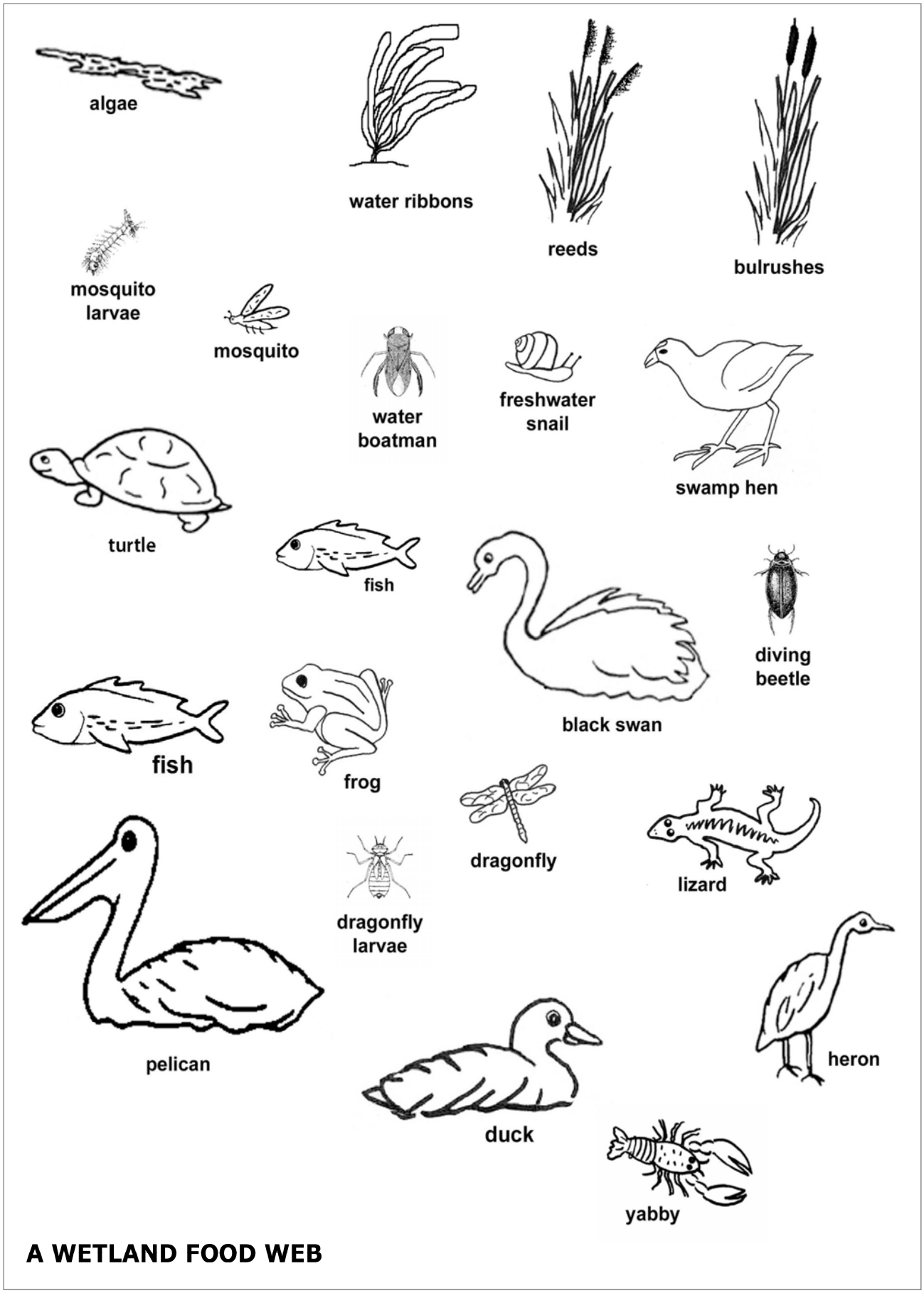
6. Do plants only respire during the day, or do they only respire at night, or do they respire all of the time? You must explain your answer.

[**2 marks**]

7. How do the carbon compounds found inside the body cells of animal omnivores enter their bodies?

[**2 marks**]

An (incomplete) **Wetland Food Web** [Source of Images] [PRINT THIS PAGE]



Constructing a Wetland Food Web

- Science Concept: A **food web** shows a complex web of feeding relationships by combining all of the food chains from a particular community living, for example, in a wetland.
- **Backward Reference:** To correctly answer Questions 8 to 12, you will need to refer back to Table 1, given on Page 3.

What you are now going to do: You are to construct the wetland food web, given on your printed copy of Page 7. To construct the food web, you will need to draw arrows to show the feeding relationships between each of the sketched and named organisms.

Remember the **tail** of each arrow starts on the organism that is eaten, and the **head** of each arrow ends on the organism that does the eating.

IMPORTANT: Now print your first and second name, your tutorial class, and date completed on the bottom, right-hand corner of your printed copy of Page 7.

8. How many arrows, linking wetland organisms, did you draw to construct your printed Page 7 food web?

[Total Marks (possible): 40 correctly drawn and located arrows = [**10 marks**], (or **0.25** marks per arrow.)]

9. Can you now pencil sketch a **parasitic worm** onto your printed copy of the Page 7 food web; and then show with correctly drawn arrows the three wetland animals, (listed in Table 1 on Page 3), they feed on?

[**3 marks**]

10. Can you now identify and name a wetland **bird** that is shown as a primary (1^0), and a secondary (2^0), and a tertiary-order (3^0) consumer in your constructed food web? Indicate, with a highlight pen, which food chains you used to arrive at your final answer.

[**3 marks**]

11. In your constructed wetland food web, how many organisms are shown eating water boatmen?

[**2 marks**]

12. What part is played by the decomposers in a food web? To correctly answer this Question, you will need to refer back to the diagram on Page 4.

[**3 marks**]

13. Would a large loss of frogs from the wetland have a greater effect on the population of freshwater snails, or on the population of pelicans? In your answer, you must explain why/how the two named populations would change?

[**5 marks**]

14. What would happen to the wetland organisms, if some house owners, living near the wetland, fertilised their lawns with a quick release, phosphate-based fertiliser followed by a number of days of heavy rain?

[**5 marks**]

Ecosystem Stability

- Science Concept: **Balance** within an ecosystem refers to the **stability of natural populations** that result from the cycling of both matter and energy within the ecosystem, and from the complexity of the food web. Food chains link together into food webs thereby giving ecosystem stability. The more complex is the food web, the more stable is the ecosystem.

An Extension and Challenge Question

15. The greater the variety of food sources available to any animal within a food web; the more complex is that food web. Why are complex food webs more **ecologically stable** than less complex food webs? You must fully explain your answer by referring to specific organisms in your completed, wetland food web.

[**6 marks**]

Extra Online Resources

You may like to access these extra URL's to learn more about food chains and food webs?

URL 1: http://www.gould.edu.au/foodwebs/australia.htm
URL 2: http://www.reec.nsw.edu.au/geo/scirrg/scrrg14.htm
URL 3: http://museumvictoria.com.au/bugs/foodchains/index.aspx
URL 4: http://www.water.wa.gov.au/PublicationStore/first/88049.pdf
URL 5: http://blossoms.mit.edu/video/vandiver/vandiver-activity-3.pdf
URL 6: http://waterwatchadelaide.net.au/index.php?page=food-chains
URL 7: http://lifesciences.envmed.rochester.edu/movies/photosynthesis.swf
URL 8: http://prof.danglais.pagesperso-orange.fr/animations/foodchain/chainreaction.swf
URL 9: http://www.classroom.antarctica.gov.au/5-southern-life/5-1-southern-ocean-food-web
URL 10: http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter25/animation__gas_exchange_during_respiration.html

Key Concepts

What new science ideas have you now learned about **food chains and food webs** by studying this AUS BS7 SU Strand Module 2? List your newly learned key Science Concepts, as dot-points, in the textbox given below.

A Self-Check Summative Assessment Table		
Now complete this assessment table by adding the 'self-check' mark achieved for your answer to each focus question. Your teacher will provide his/her 'model' answer to each question, via 'whole of class' discussion.		
Total Mark Possible = **50**	Mark Achieved =	Percent (%) Score Achieved =