CHAPTER 2 ECOSYSTEM

Learning Outcomes:

1. To learn about the flow of energy in the ecosystem
2. To learn about the nutrient cycle in the ecosystem
3. To learn about the interdependence and interaction between organisms and the environment
4. To learn about the role of human in maintaining a balanced ecosystem

2.1 Energy flow in ecosystem

1. Sun is the main source of energy in an ecosystem. The transfer of energy to living organisms begins from the Sun.
2. Green plants use solar energy to carry out photosynthesis.
3. When primary consumers eat plants, the chemical energy in plants is transferred to them and then to secondary consumers and lastly to the tertiary consumers.
4. Not all energy stored in a particular level is transferred to the next level. Some energy is lost as heat energy through respiration, excretion and defecation.
5. Hence, the amount of energy decreases along the food chain from one consumer to another.

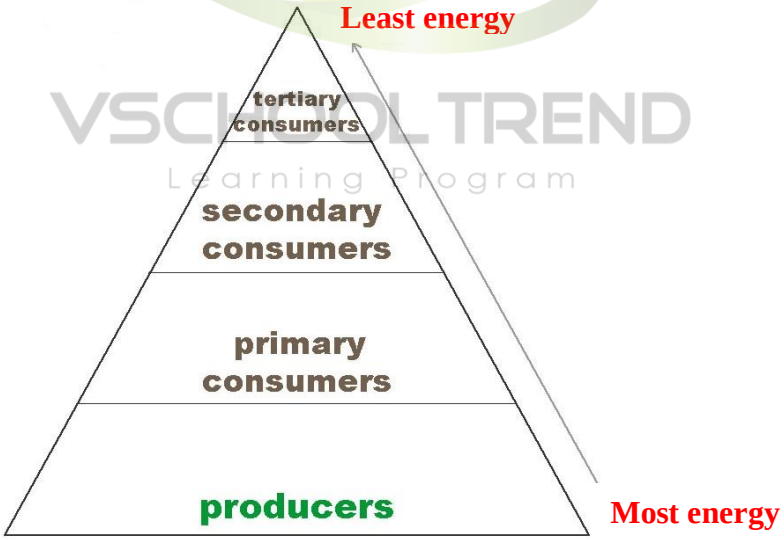

Diagram 2.1 Food Pyramid

- **Food chain**
  - ≈ Food chain demonstrates the feeding relationship and the transfer of energy from producer to consumer in a habitat.

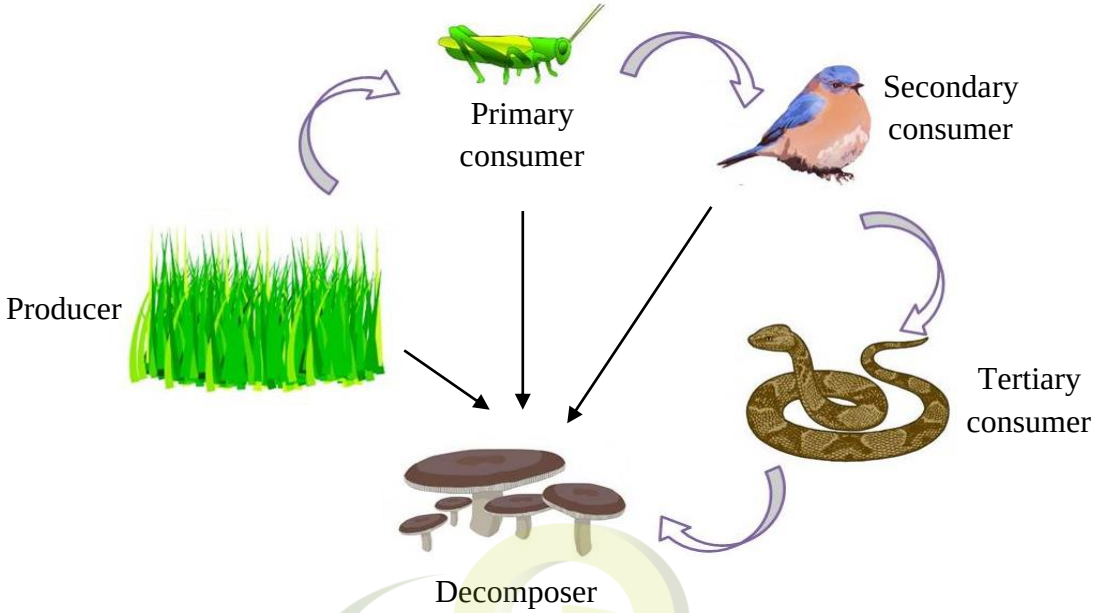

Diagram 2.2 Example of a food chain

1. Green plants are called **producers** because they produce their own food through photosynthesis.
2. **Primary consumers** are herbivores or omnivores that eat producers. For example, grasshoppers eat paddy.
3. **Secondary consumers** are omnivores and carnivores that eat primary consumers. For example, a bird eats a grasshopper and corn.
4. **Tertiary consumers** are carnivores that eat secondary consumers. For example, a snake preys on a bird.
5. **Decomposers** are organisms that decompose dead animals and plants into simpler materials or nutrients, which can be used again by green plants. This interaction is known as saprophytism.

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Food web

≈ A food web is a combination of a few food chains. It demonstrates a real situation of the feeding relationship that exists in an ecosystem.

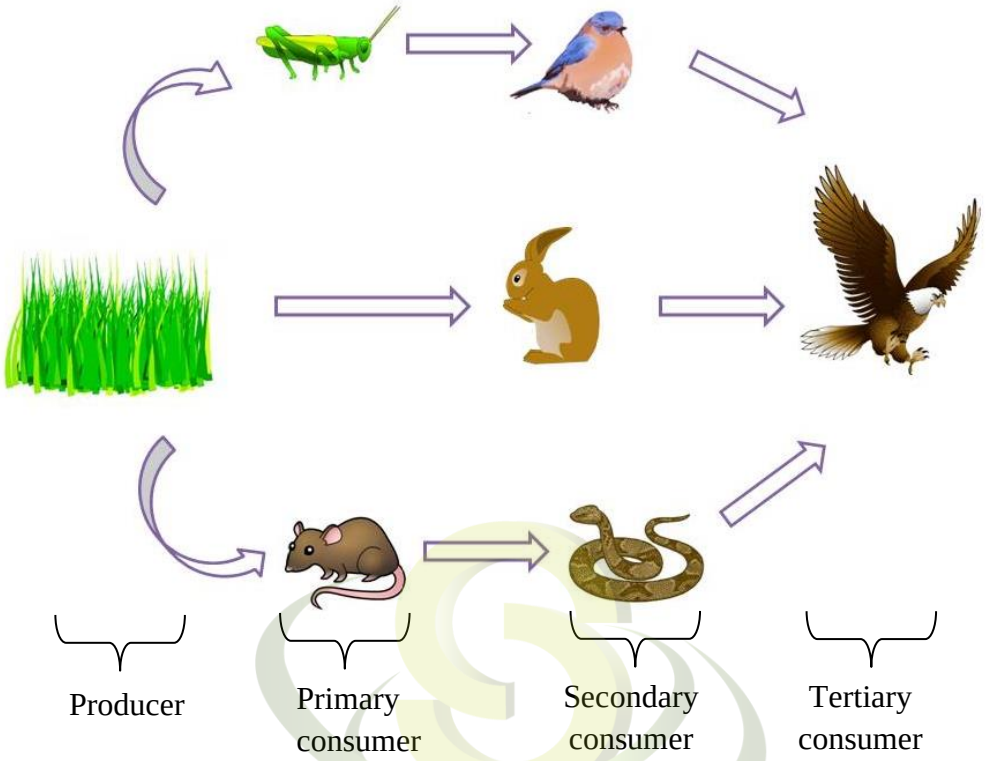

Diagram 2.3 Example of a food web

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2.2 Nutrient cycle in the ecosystem

1. Nutrient cycle is the cycle of non-organic chemical elements including mineral sources in the soil, water, oxygen, nitrogen, hydrogen and carbon dioxide.
2. The energy transfer that happens in a network of food eventually leads to nutrients being returned to the environment by the decomposer to be reused.

Carbon and oxygen cycle

1. Animals and plants carry out respiration, a process that uses oxygen and releases carbon dioxide.
2. Decomposers such as bacteria and fungi carry out decomposition, a process that also uses oxygen and releases carbon dioxide.
3. Only green plants carry out photosynthesis, a process that absorbs carbon dioxide and releases oxygen. This process maintains the content of carbon dioxide and oxygen in the atmosphere.
4. All three processes, carried out by living organisms, ensure that both carbon and oxygen are cycled continuously in the ecosystem.

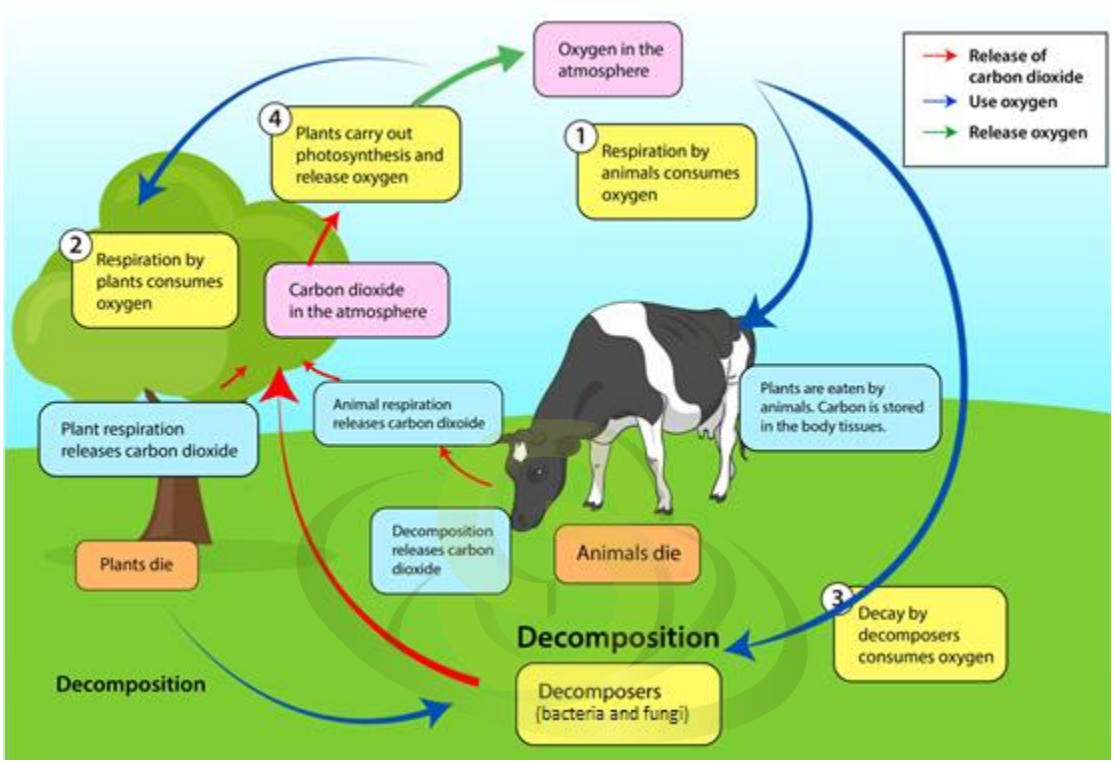

Diagram 2.4 Carbon and Oxygen Cycle

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Water cycle

1. Plants need water for photosynthesis. The roots absorb water from the soil and they will release the water back to the atmosphere through transpiration.
2. The roots grip the soil and make it compact which causes the water flow in the soil to be slow.
3. Forests that are filled with plants form a water catchment area. Leaves that fall and layer the surface of the soil will lower the rate of water evaporation by the sun.

4. Animals and humans also need water to live. Some animals immerse in water to cool their bodies besides using the water for drinking. They return water to the environment through urination, respiration and perspiration process.

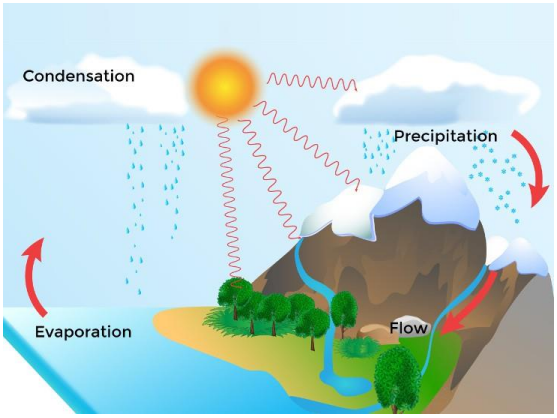

Diagram 2.5 Water Cycle

2.3 Interdependence and interaction among organisms and between organism and the environment

1. A habitat is the natural surrounding or shelter for an organism.
2. The interdependence among the living organisms and the environment creates a balanced ecosystem that is stable and does not change very much over a period of time as well as has a continuous supply of basic needs like oxygen, food, shelter and breeding partners.

Species

A group of organisms that have same characteristics and are able to breed to produce offsprings.

Population

A group of organisms from same species that live together in the same habitat.

Community

A few populations of different organisms that live together in the same habitat.

Ecosystem

An ecosystem consists of a few communities live together in one habitat and interacts with each other including non-living components such as the soil, water, air, temperature, minerals and the sun.

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- **Importance of adaptation of living things to the environment**

1. Organisms need to adapt with their habitats in order to survive.
2. Adaptation is the modification in the body or behaviour of organisms to help them keep on surviving.

Area		Adaptation	
		Animals	Plants
Desert	**Extremely hot and dry weather**	Camels store food in the hump. They have large ears to release heat.	Cactus tree have succulent stems that stores water. They have leaves with the shape like thorn to reduce water loss.
Tropics	**High distribution of rain and sunlight throughout the year**	Mammals have short fur to reduce stored heat. Some birds have big beaks to pick fruits from trees. Reptiles become inactive during a very hot day.	Trees that climb other trees to obtain sunlight. Some have buttress roots that can support trees.
Tundra	**Extremely cold weather**	Artic fox has small ears and thick fur to reduce the heat loss.	Plants have short roots to absorb water and the height of trees is not more than one metre.

Table 2.1 Adaptation of living organisms to the environment

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Interaction between organisms

Types of interaction	Definition	Example
Symbiosis	***Mutualism*** Interaction that brings benefit to both organisms.	The bee gets the food from flowers while the flowers get the pollen grains carried by the bee from other flower. 
	Commensalism Interaction between two organisms that brings benefit to commensal while the host is neither benefited nor is harmed.	The barnacle attaches to the whale to get a habitat and a free ride without harming the whale. 
	Parasitism Interaction that only brings benefits to one organism (parasite) and harms the host.	Fleas suck a cat's blood and the cat gets diseases. 

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Prey-predator	***Prey:*** Animal that is hunted by a predator. ***Predator:*** Animal that hunts.	The owl (predator) eats the rat (prey). 
Competition	Organisms compete with one another for food, water, shelter, mates or light.	Lions fight each other to get food. 

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- **Biological control**

1. Biological control is the use of natural predators to control the population of pest species in an area such as garden, farm or estate.
2. This method does not pollute the environment as predator only feeds on the specific prey (pest) without usage of pesticides.
3. However, this method takes a longer time to be effective and may cause imbalance in the food chain if the predator also feeds on animals other than the pest.

- **Factors that affect population size in an ecosystem**

Factors	Definition	Example
Diseases	It reduces the population size of plants and animals.	- Bird flu pandemic reduces the chicken population. - Panama diseases attack causes the banana trees to wilt and dry up.
Source of food	Lack of food source reduces the population size.	- The decreased population of anchovies and sardine fish that are food source for penguins cause them starve to death.
Change of climate	Prolonged drought or cold weather reduces the population size.	- The cold weather in Siberia forces many birds to migrate. - The prolonged drought causes the soil to become infertile for plants to grow.
Predators	Predators reduce the population size.	- The increased population of crown-of-thorns starfish that feeds on corals reduces the number of coral species in the deep ocean that threatens the balance of marine ecosystem.
Migration	Migration of an organism into an ecosystem changes the balance of population.	- The migration of Cattle Egrets to Perak in the month of September to April affects the size of insect population in that area.

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2.4 Role of human in maintaining a balanced nature

1. The increase of human population causes the need of food, clothing and shelter to rise. In order to fulfil these needs, forests are invaded for the purpose of building houses and roads as well as for agricultural areas to increase food supply.
2. It is important to ensure:
    a. a stable ecosystem in which the destruction of habitats does not take place;
    b. a productive ecosystem in which resources are used without depleting:
    c. a balanced ecosystem in which the population of different species has not affected.
3. Many activities carried out by human bring negative effects to the ecosystem.

Activity	Consequence	Steps to conserve and preserve the environment
Forest logging	• Destruction of habitat • Extinction of flora and fauna • Soil erosion • Greenhouse effect	❖ Maintain forest reserves ❖ Reduce, reuse and recycle waste materials ❖ Law enforcement by authorities by imposing summons and imprisonment ❖ Awareness campaigns through mass media ❖ Support the activities and efforts by organisation such as the Worldwide Fund (WWF) and the Malaysian Nature Society (MNS) ❖ Establish rehabilitation centres
Industrialisation	• Environmental pollution • Acid rain • Greenhouse effect	
Waste disposal	• Water pollution • Blocked drainage systems which then cause flash flood	
Agriculture	• Usage of pesticides causes water pollution • Non-sustainable agriculture causes the soil to lose its nutrients	

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