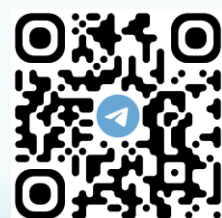


TRULY  
AMAZING  
BIO  
CLASS  
IN  
EM



# Biology

ENGLISH MEDIUM



**SAMPATH  
LANKADHEERA**  
B.Sc. (Hons), M.Sc.

f sampath lankadheera

0777 211 384  
0779 925 362

Visit : <https://advanceonlineclass.com>



ADVANCED LEVEL

# Biology

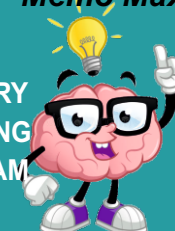
ENGLISH MEDIUM

TRULY  
AMAZING  
BIO  
CLASS  
IN  
EM



Memo Max

MEMORY  
MAXIMIZING  
PROGRAM



We offer premium  
learning experience

UNIT  
08

**Environmental Biology**  
Components of Ecosystem

**SAMPATH  
LANKADHEERA**  
B.Sc. (Hons), M.Sc.

Visit : <http://www.sampathbiology.com>

**8.1.0: Engages in a biological analysis on relationships between organisms and their environment**

**8.1.1: Investigates components of an ecosystem/Number of Periods : 02**

**Learning Outcomes:**

- States what Environmental Biology is
- Describes the importance of learning Environmental Biology
- Defines the levels of organization of the environment
- Lists the major biotic and abiotic components
- Appreciates the presence of various organizational levels of the environment

**What is environment ?**

.....

.....

.....

.....

**What is environmental biology ?**

.....

.....

.....

.....

.....

.....

.....

.....

**Why learn Environmental Biology ?**

By learning of environmental biology will be able to understand the structure and the functions of the environment we live in. Specifically to:

- 1) Understand how biotic and abiotic components of the environment are linked and interact with each other.
- 2) Recognize organizational levels of the environment.
- 3) Learn about major processes of an ecosystem.
- 4) Recognize different components of terrestrial and aquatic ecology.
- 5) Understand how human activities are altering ecological systems .



### 2019 AL

State 3 types of interactions that occur in ecosystem when abiotic and biotic components are considered and give one example for each of them

.....

.....

### 2020 AL

What is meant by primary production.

.....

### 2021 AL

(iii) What is meant by each of the following?

(a) Population : .....

.....

.....

(b) Trophic level : .....

(c) Food chain : .....

.....

.....

### 2022 AL

What is known as primary consumer and niche in an ecosystem?

(a) Primary consumer : .....

(b) Niche : .....

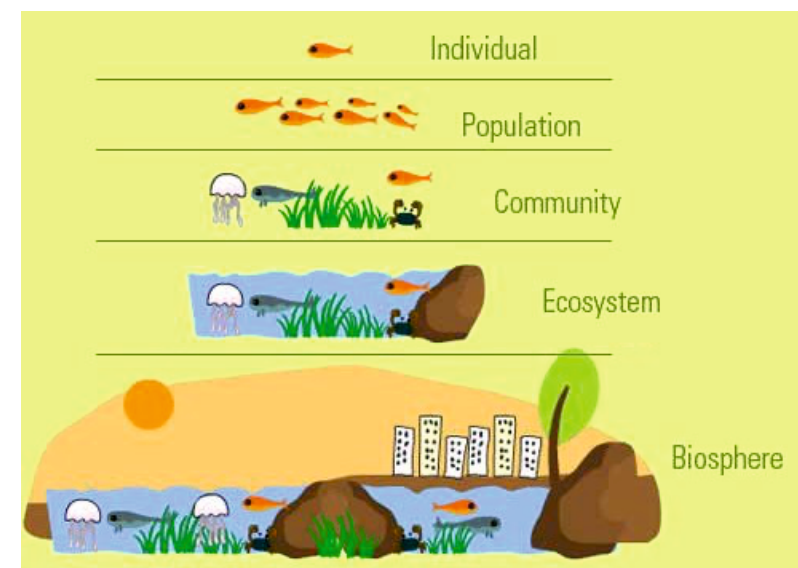
6) Understand how natural changes in the environment (such as climate change, flooding, erosion etc.) affect species and habitats.

### Organizational levels of the environment

Several levels of organization are recognized by environmental biologists.

Levels of organization include the individual/organism, population, community, ecosystem, and biosphere.

- **Individual/ Organism** - The first level is an individual. An individual is any organism or living thing. An organism has its own characters in physiology, evolution and behavior in relation to environmental factors.
- **Population** - A Group of individuals of the same species, living in the same area and producing fertile off spring through interbreeding.
- **Community** - A collection of populations of different species living in the same area interacting with each other.
- **Ecosystem** - An ecosystem is a collection of communities as well as the abiotic factors with which they interact.
- **Biosphere** - includes the entire portion of Earth that is inhabited by life.



### Major biotic and abiotic components in the environment

All organisms live in a complex environment that includes several components which are categorized under two major groups:

- **Abiotic components**

.....  
(iii) What is an ecological pyramid?

.....  
(iv)(a) What is the type of ecological that is never inverted?

.....  
(b) What is the reason for this?  
.....

**AL/2005**

B. (i) What is an ecosystem?

.....  
(ii) Name the **three** main biotic components of an ecosystem.

(1).....

(2).....

(3).....

(iii) State two unique features of the mangrove plant community which could be used in distinguishing a mangrove ecosystem from other ecosystems.

(1).....

(2).....

(iv) In the space given below draw a labelled outline diagram to illustrate the flow of carbon in the biosphere.

**AL/2004**

(B) (i) Explain why a home garden could be considered as an ecosystem.

.....  
.....  
.....

(ii) Write a food chain with four links that can be commonly seen in a home garden ecosystem.

.....  
.....



(ii) State two main functional features of an ecosystem.

.....

.....

.....

(iii) (a) Snakes, grasshoppers, toads and eagles are the animals found in a grassland ecosystem. If the amount of energy fixed at the primary producer level of this ecosystem is approximately  $800 \times 10^6 \text{ kJ ha}^{-1} \text{ year}^{-1}$ , what is the approximate amount of energy available at the trophic level to which snakes belong?

.....

(b) If eagles are removed from this ecosystem, indicate what can happen to the snake population size of grasshoppers.

2010

.....

**AL/2009**

B (i) What is an ecological pyramid?

.....

(ii) What are the three types of ecological pyramids?

.....

(iii) Which of the above pyramids could be inverted?

.....

(iv) What is meant by the following terms with regard to ecosystems?

Food chain

.....

Trophic Level

.....

Food web

.....

**AL/2007**

C. (i) What is a food chain?

.....

.....

(ii) State the trophic levels seen in a food chain.

Abiotic resources are usually obtained from the lithosphere, atmosphere, and hydrosphere. Abiotic components limit the geographic range (distribution) and the abundance of species.

- **Biotic components**

### 8.1.2 : Investigates major processes of an ecosystem

Number of Periods : 03

#### Learning Outcomes:

- Briefly describes the concept of niche and habitat
- Identifies relationships among abiotic and biotic components
- Constructs food chains and food webs in a given ecosystem
- Explains the energy loss along the food chain
- Draws a flow chart to show how materials and energy flow in the ecosystem
- Describes the types of pyramids
- Appreciates the interaction between biotic and abiotic systems

#### Structure and function of ecosystems

#### The concept of “Niche” and “habitat”

To understand how an ecosystem work, one should first look into the concepts of “niche” and “habitat.”

#### Niche

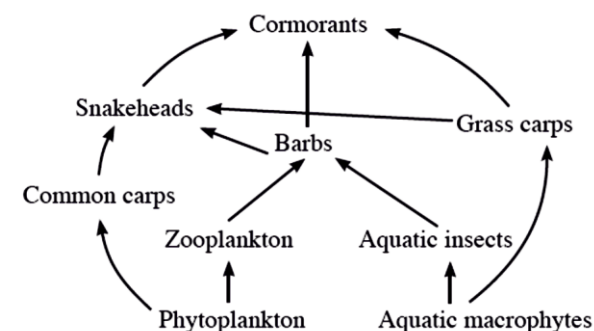
Each organism plays a particular role in its ecosystem. In other words, a niche is how an organism “makes its living.” This involves how the organism gets its energy, which usually has to do with what an organism eats, and how the organism passes that energy through the ecosystem. An organism's niche also includes how the organism interacts with other organisms, its role in recycling nutrients, tolerance to environment conditions such as temperature, soil moisture, etc. Therefore niche of an organism describes what it needs to live and what it does in a particular ecosystem.

(ii) Name two possible competitors of rabbits.

(iii) What would be the immediate effect of the hawk population decreases in large numbers?

2. (A) (i) What is an ecological niche? AL/2011 Prototype

3. Questions (ii) and (iii) are based on the hypothetical food web of a fresh water ecosystem given below.



(ii) Name the organism/organisms that occupy more than one trophic level.

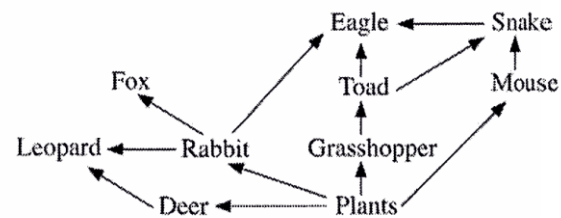
(iii) If aquatic macrophytes are removed from the above ecosystem, what will happen to the population density of the common carp?

B (i) (a) State **four** main biotic components of an ecosystem.

(b) State **four** main abiotic components of a terrestrial ecosystem.



25. The question is based on the food web given below.



In the above food web, the organisms that can be considered as in the same trophic level are  
 (A) eagle and snake. (B) leopard and fox. (C) toad and mouse.  
 (D) toad and eagle. (E) grasshopper and leopard.

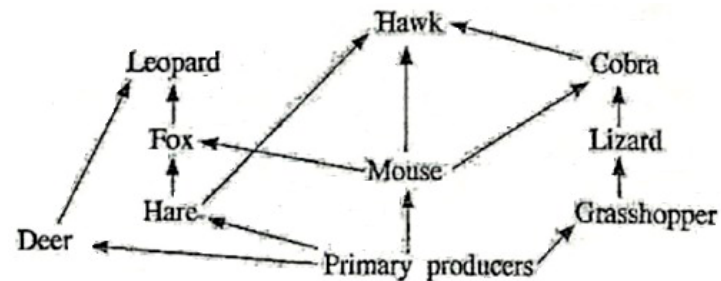
AL 2020

26. Which of the following ecological pyramids could be inverted?

- (A) Pyramid of biomass in a forest (B) Pyramid of numbers in the ocean  
 (C) Pyramid of biomass in the ocean (D) Pyramid of numbers in a parasitic system  
 (E) Pyramid of biomass in a parasitic system

AL 2021/47

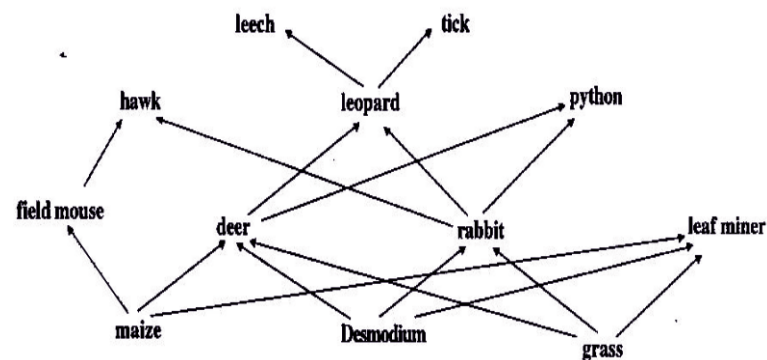
27. The food web of a terrestrial ecosystem is given below.



The number of Secondary and tertiary consumers in the above ecosystem are respectively  
 (1) five and two. (2) three and five. (3) four and three, (4) four and four, (5) five and three.  
 2022 AL/36

### Structured Essay

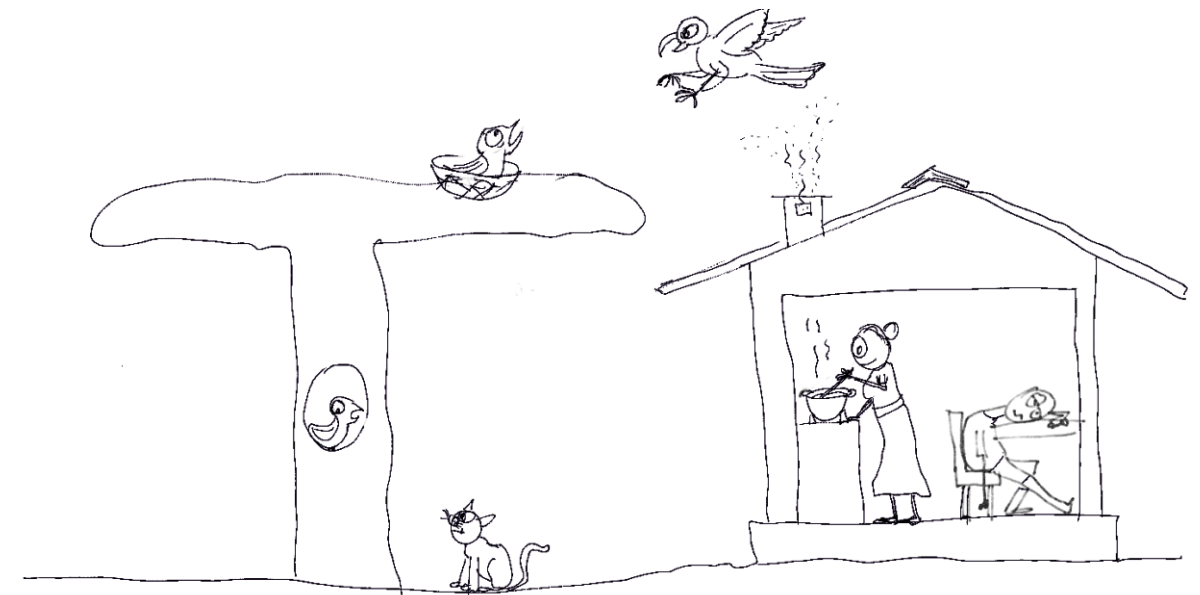
1. Questions (ii) - (iv) are based on the following diagram of a food web in a terrestrial ecosystem.  
 AL/2001



(i) Give a food chain that includes an ecto-parasite.

### Habitat

The average amount of sunlight received each day, the range of annual temperatures, and average yearly (annual) rainfall describe a habitat. These and other abiotic factors of the environment such as soil condition will determine the kind of traits an organism must have in order to survive there. A habitat should not be confused with an ecosystem: the habitat is the actual place of the ecosystem, whereas the ecosystem includes both the biotic and abiotic factors of the habitat.

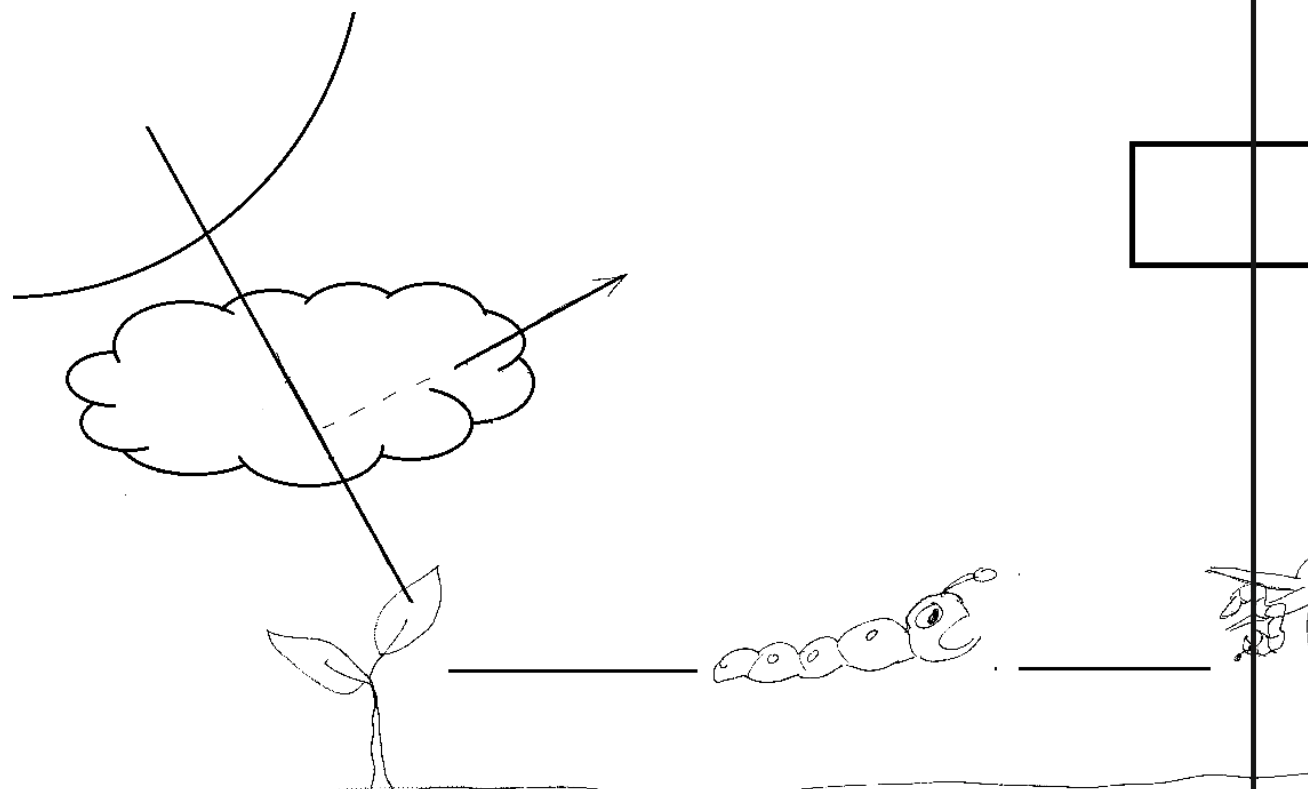


### Interactions between abiotic and biotic components of the environment

There are different types of interactions in an ecosystem. They are:

- Biotic-biotic interactions - Eg. Competition, feeding relationships, symbiotic relationships between individuals and species.
- Biotic-abiotic interactions - Eg. Water uptake of plants from soil
- Abiotic-abiotic interactions - Eg. Chemical reactions occurring in the soil.

Feeding relationships within an ecosystem develop food webs and food chains through which energy is passed from one organism to another.



Which of the following best indicates in correct order, the animals that could occupy the trophic levels A, B, C and D ?

- (1) Buffalo, jackal, toad, land monitor (2) Mouse, kite, toad, viper  
(3) Monkey, eagle, cobra, land monitor (4) Deer, snake, toad, kite  
(5) Buffalo, jackal, deer, eagle

AL/2012 old

20. Which of the following is/are a community'?

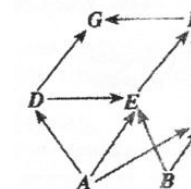
- (A) Indian carps in Udawalawe reservoir (B) Zooplankton in Beira lake  
(C) Elephants in Minneriya national park (D) Grasses in Knuckles forest reserve  
(E) Coconut palms in Puttalam district

2013 Old/57

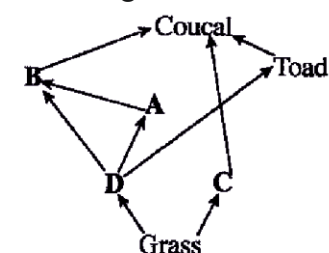
21. Which of the following statements regarding the above food web is/are correct?

- (A) Removal of E may result in an increase of D.  
(B) There are three species belonging to the third trophic level.  
(C) F may be an insectivore. (D) E is an omnivore. (E) D may be cobra.

2014/50



22. Question is based on the following food web seen in home garden ecosystem



Which of the following statements regarding the above ecosystem is correct?

- (1) There are two primary consumers and three secondary consumers in this ecosystem.  
(2) The longest food chain in this ecosystem has four trophic levels.  
(3) A is a keystone species in this ecosystem.  
(4) Removing C will reduce the population of coucals.  
(5) B may be a lizard and C may be a snail.

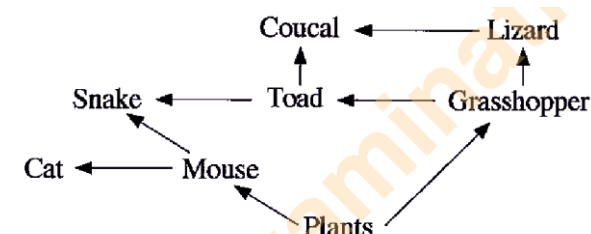
2018/34

23. In an ecosystem, gross primary productivity and the amount of energy available at the third trophic level were determined to be  $2000 \text{ kJm}^{-2}\text{year}^{-1}$  and  $11 \text{ kJm}^{-2}\text{year}^{-1}$  respectively. If 90% of energy is lost when flows from one trophic level to the next, the amount of energy used for respiration by the primary producers in this ecosystem is

- (1)  $900 \text{ kJm}^{-2}\text{year}^{-1}$  (2)  $990 \text{ kJm}^{-2}\text{year}^{-1}$  (3)  $1010 \text{ kJm}^{-2}\text{year}^{-1}$  (4)  $1100 \text{ kJm}^{-2}\text{year}^{-1}$   
(5)  $1800 \text{ kJm}^{-2}\text{year}^{-1}$

AL 2018/33

24. A food web seen in home garden is given below

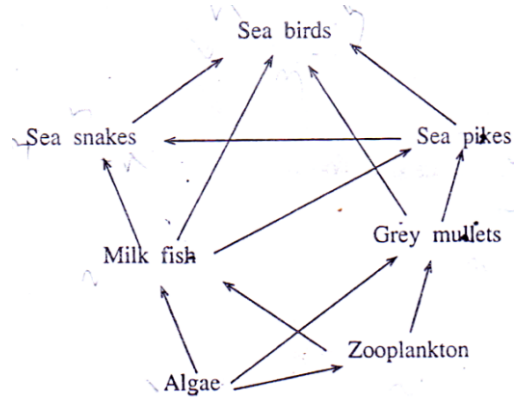


2020 Old



- (4) Number of milk fish and grey mullets will increase.  
 (5) Number of sea snakes will increase.

16. Which of the following indicates the correct trophic levels to which the sea snakes and sea birds belong



Sea Snakes

- (1) 3<sup>rd</sup> and 4<sup>th</sup> trophic levels only  
 (2) 3<sup>rd</sup> and 4<sup>th</sup> trophic levels only  
 (3) 3<sup>rd</sup> and 4<sup>th</sup> levels only  
 (4) 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> trophic levels only  
 (5) 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> trophic levels only

Sea birds

- 4<sup>th</sup> and 5<sup>th</sup> trophic levels only  
 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> and trophic levels only  
 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> and 6<sup>th</sup> trophic levels only  
 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> and 6<sup>th</sup> trophic levels only  
 3<sup>rd</sup>, 5<sup>th</sup> and 6<sup>th</sup> trophic levels only

AL/2011 old

17. Larvae of insect species A feeds only on the leaves of plant species B, Insect species C lays eggs only in the bodies of larvae of species A. The larvae of species C feeds on internal tissues of larvae of species A ultimately killing them. Bird species D feeds on species A and C. Which of the following statements regarding above information is/ are correct?

- (A) Species A and species C have a symbiotic association.  
 (B) Mode of nutrition of species A is holozoic.  
 (C) Association between species C and D is Commensalism.  
 (D) In this community, species D represents the 3<sup>rd</sup> trophic level.  
 (E) Mode of nutrition of larvae of species C is holozoic.

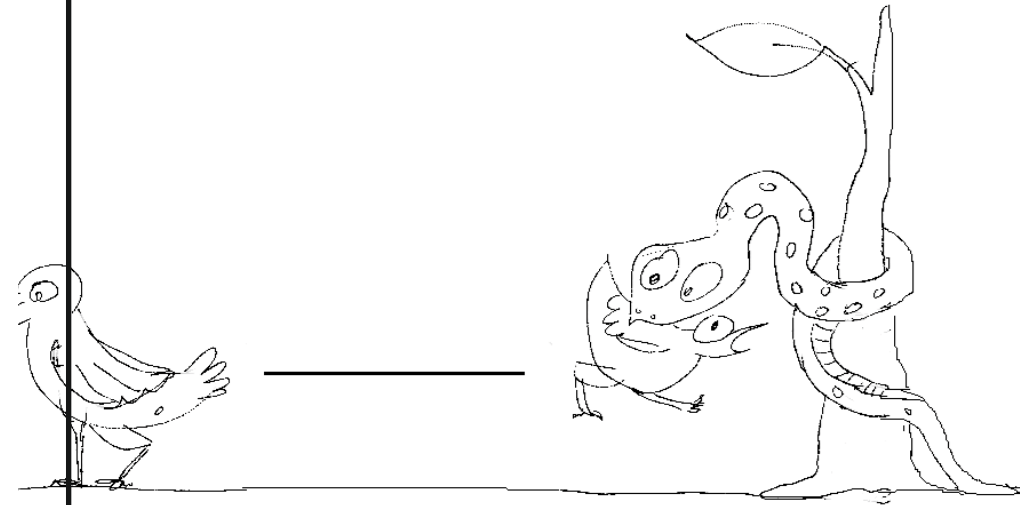
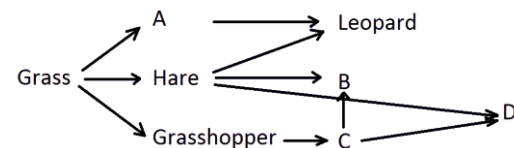
AL/2012

18. Which of the following statements regarding carbon cycle is correct?

- (1) Carbon in the earth crust does not enter the carbon cycle by natural processes.  
 (2) Carbon in dead organic residues is unavailable for cycling unless they are excavated by humans to be used as fuel.  
 (3) Since the major component of the carbon cycle is carbon dioxide, this cycle can be completed within the atmosphere.  
 (4) When carbon dioxide reaches the upper atmosphere, it becomes unavailable for cycling.  
 (5) Grazing and predation are important phenomena in the carbon cycle.

AL/2012 old

19. A food web that could be commonly seen in a national park in Sri Lanka is given below.



## Energy transfer in an ecosystem

The main energy provider for the earth is the sun. Using sunlight the green plants produce their own energy and store in tissues.

The source of energy required by all living organisms is the chemical energy of their food.

Ultimately, chemical energy in any organism is obtained by the conversion of the radiant energy of sun which are stored in tissues of plants and animals.

### Trophic level:

.....

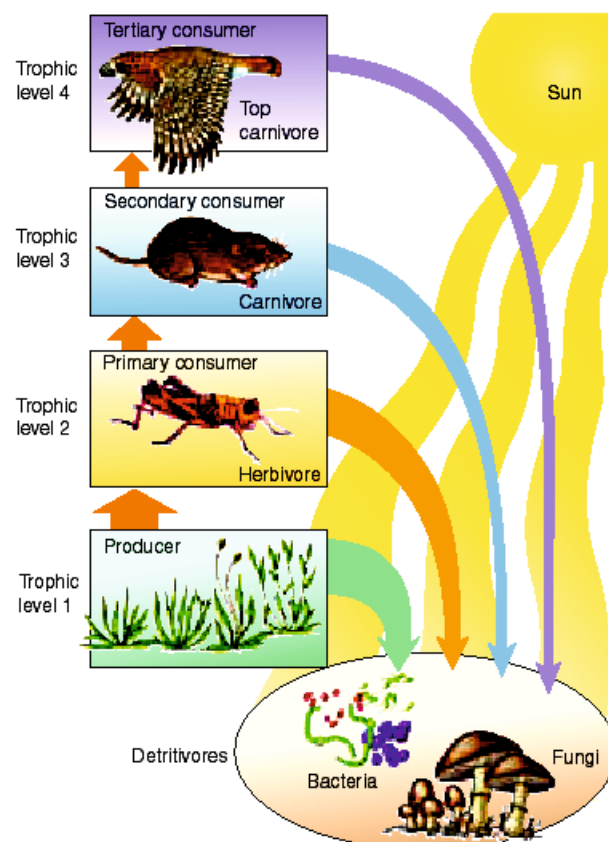
.....

.....

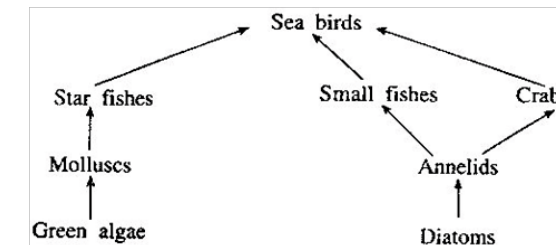
.....

.....

In any ecosystem, producers represent the first trophic level, herbivores represent the second trophic level, primary carnivores represent the third trophic level and top carnivores represent other levels.



Questions 9 and 10 are based on the simple food web given below.



9. Which one of the following would most probably happen if the population of sea birds decreases?
    - (1) The small fish and annelids would decrease in number.
    - (2) The crabs and green algae would increase in number.
    - (3) The annelids and star fishes would decrease in number.
    - (4) The Mollusks and diatoms would increase in number.
    - (5) The diatoms and green algae would decrease in number.

AL/2004
  10. Which of the following best describes the relationship between the crabs and small fishes?
    - (1) Competition (2) Symbiosis (3) Predation (4) Commensalism (5) Parasitism

AL/2004
  11. Which of the following is incorrect regarding the energy pyramids?
    - (1) They show the trophic relationships in the ecosystem.
    - (2) They are not always upright. (3) About 90% energy is lost at each trophic level.
    - (4) They are considered as best type of ecological pyramids.
    - (5) The first level of energy pyramids is mainly represented by photosynthetic organisms.

AL/2005
  12. Which one of the following ecological pyramids is most likely to be inverted?
    - (1) Pyramid of biomass in a shallow freshwater pond with dense aquatic vegetation.
    - (2) Pyramid of numbers in a well maintained paddy field.
    - (3) Pyramid of biomass in the ocean.
    - (4) Pyramid of biomass in a tropical rain forest. (5) Pyramid of numbers in the ocean.
  13. Primary productivity of the biosphere is highest in
    - (1) Tropical rain forests. (2) Oceans. (3) Grasslands. (4) Agricultural lands.
    - (5) Temperature deciduous forests.

AL/2009
  14. Which one of the following is correct regarding the energy flow in the biosphere?
    - (1) Energy is cycled in the biosphere.
    - (2) All autotrophic organisms in the biosphere do not utilize solar energy for carbohydrate synthesis
    - (3) Approximately about 90% of solar energy that falls on the biosphere is converted into chemical energy by plants.
    - (4) Energy may flow in both directions between two trophic levels
    - (5) The amount of energy fixed in the highest trophic level is higher than energy fixed at the lowest trophic level.

AL/2009
- 15 and 16 Questions are based on following food web in costal environment of Sri Lanka.
15. If sea pikes are removed from this environment, which of the following is most likely to occur in the long run.
    - (1) Amount of algae reduced. (2) Number of sea birds will reduce.
    - (3) Community will balance with different densities in remaining populations.



## MCQ

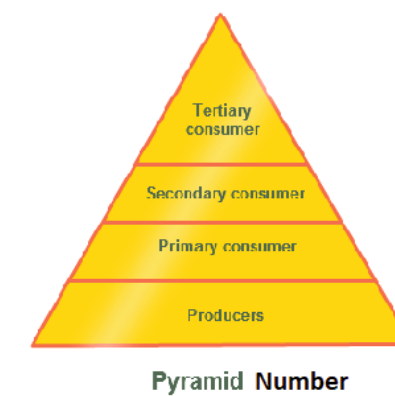
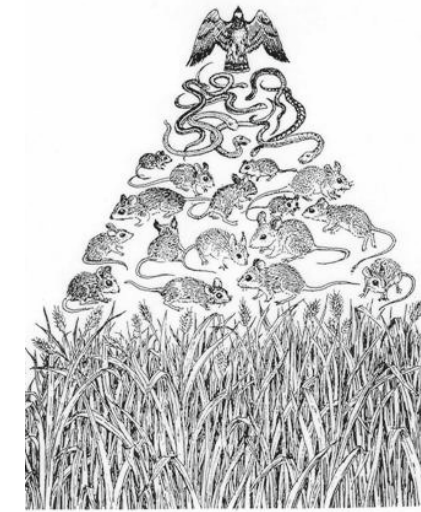
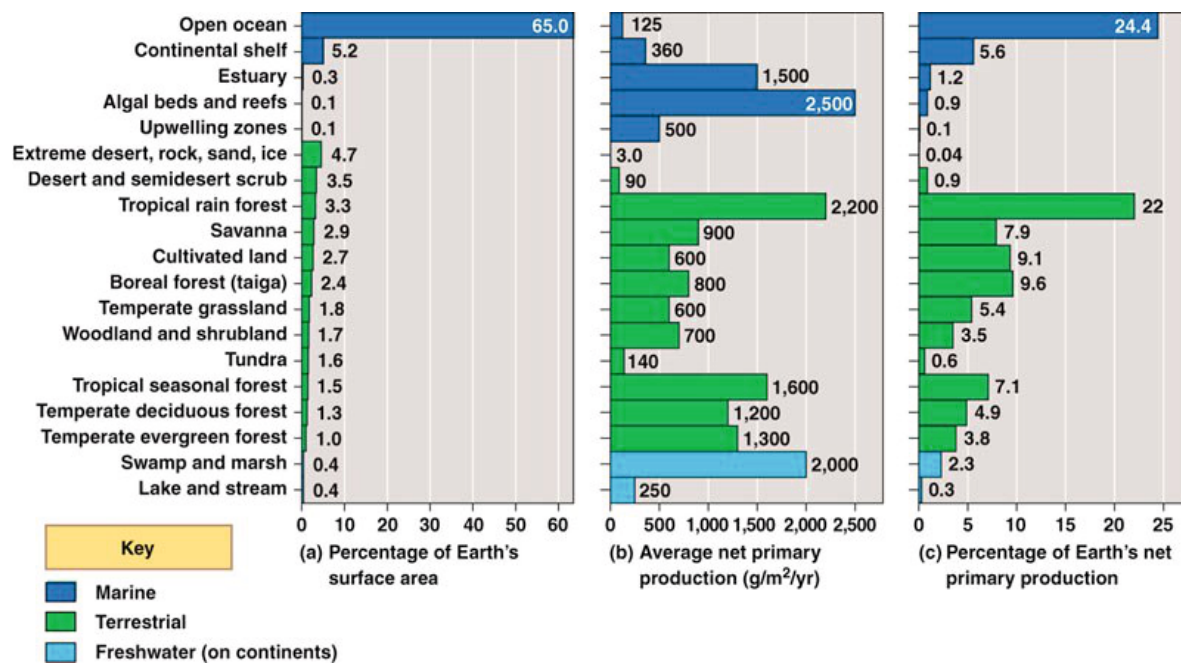
- The highest primary production of biosphere is coming from  
(1) Tropical rain forest (2) Oceans (3) Savanna (4) Agricultural lands  
(5) Tropical rain forests
- Which of the followings directly responsible for recycling of mineral elements within an ecosystem?  
(1) Primary producers (2) Primary consumers (3) Decomposers (4) Parasites  
(5) Secondary consumers
- In a pyramid of numbers based on a food chain in an aquatic environment, which of the followings show a progressive decrease in number in the ascending trophic levels? AL/2000

Primary producers	Primary consumers	Secondary consumers
(1) Phytoplankton	Zooplanktons	Fish
(2) Aquatic macrophytes	Aquatic insects	Nymphs of dragonfly
(3) Phytoplankton	Snails	Parasites of snails
(4) Phytoplankton	Bacteria	Fish
(5) Unicellular green algae	parasites of algae	carnivorous fish

Questions 4 and 5 are based on the following trophic levels of an ecosystem

A - Primary producers B - Primary consumers C - Secondary consumers D - Tertiary consumers E - Decomposers

- Which of the above trophic level is represented by edible mushrooms growing in a tropical rain forest  
(1) A (2) B (3) C (4) D (5) E AL/2000
- Which of the above trophic levels is likely to accumulate the highest concentration of non degradable insecticides  
(1) A (2) B (3) C (4) D (5) E AL/2000
- Which of the following is directly responsible for recycling of mineral elements within an ecosystem?  
(1) Primary producers (2) Primary consumers (3) Decomposes (4) Parasites  
(5) Secondary consumers AL/2001
- In every eco-system  
(1) Primary consumer level has the greatest bio mass.  
(2) Plant and animal matter is broken down into end products which can be used again.  
(3) The highest number of living beings is in the 1<sup>st</sup> producer level.  
(4) The greatest amount of energy is stored in the highest nutritional level.  
(5) Decomposers play a vital role in recycling of energy. AL/2002
- In which one of the following tropic levels of a paddy field ecosystem, the inter-specific competition is most likely to be reduced on the application of weedicides? AL/2003  
(1) Primary producer level (2) Primary consumer level (3) Secondary consumer level  
(4) Tertiary consumer level (5) Decomposer level



Upright pyramid

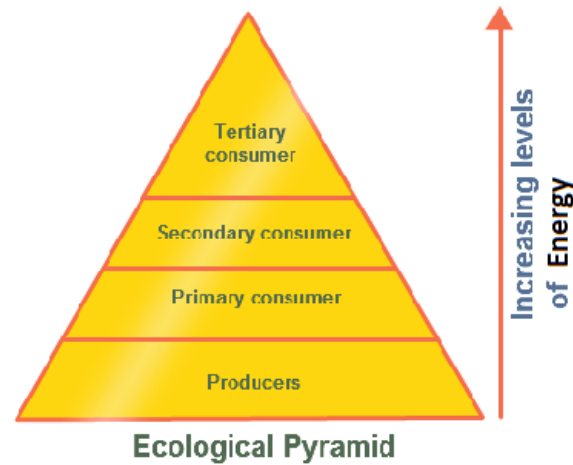
### Pyramid of Biomass

The pyramid of biomass is more fundamental. In this pyramid there is a gradual decrease in the biomass from the producers to the higher trophic levels. As the fresh weight of biomass contains a larger amount of water, dry weight of the biomass represents the amount of energy available in the form of organic matter of an organism.

### Cycling of materials in an ecosystem

The materials available for living organisms in the ecosystem is limited. Therefore these materials should be recycled. The material stock in the ecosystem is decreased when the organisms such as animals, plants, etc utilize them. Therefore when the organism is died, they are decomposed by decomposers. Thus those materials will be available for the organisms and absorb them into their body, assimilate and the excess will be removed as waste materials to the environment.

- This pyramid shows the flow of energy at different trophic levels.
- It depicts the energy is minimum at the highest trophic level and is maximum at the lowest trophic level.
- At each trophic level, there is successive loss of energy in the form of heat and respiration, etc.



### Pyramid of Numbers

The pyramid of numbers depicts the relationship in terms of the number of producers, herbivorous and the carnivores at their successive trophic levels.

In most cases there is a gradual decrease in the numbers of individuals from the lower to the higher trophic levels. The number pyramid varies from ecosystem to ecosystem.

### Food chain

- Let's look at the parts of a typical food chain, starting from the bottom (the producers) and moving upward as primary consumers, secondary consumers and tertiary consumers.

### Primary Producers

- At the base of the food chain lie the primary producers.
- The primary producers are autotrophs and are most often photosynthetic organisms such as plants, algae, or cyanobacteria.
- These organisms convert light energy to chemical energy or in other words produce organic matter.

### Primary Production

- .....
- .....  
(Unit =  $\text{gm}^{-2}\text{day}^{-1}$  or  $\text{Kg ha}^{-1}\text{ year}^{-1}$ )

### Primary consumers

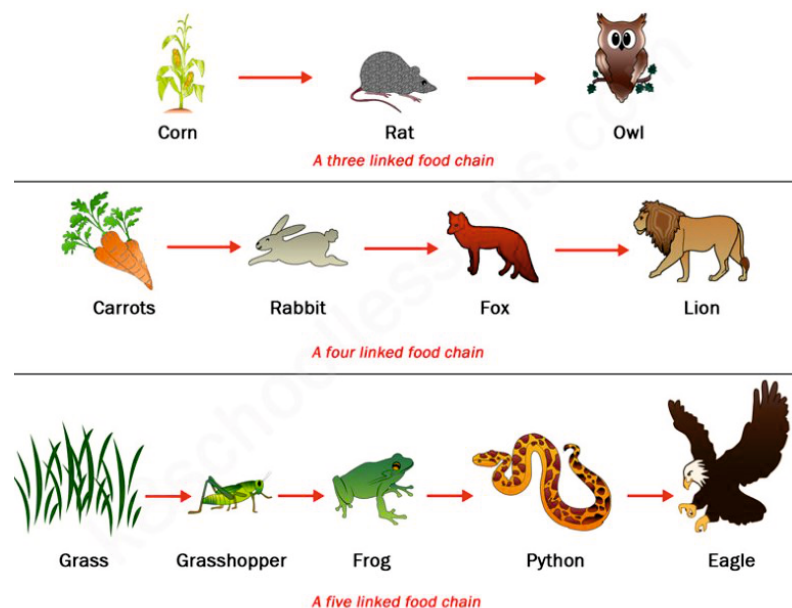
- .....
- Primary consumers are usually herbivores (plant-eaters), though they may be algae eaters or bacteria eaters.

### Secondary consumers

- The organisms that consume the primary consumers are called secondary consumers. Secondary consumers are generally carnivores (meat-eaters).

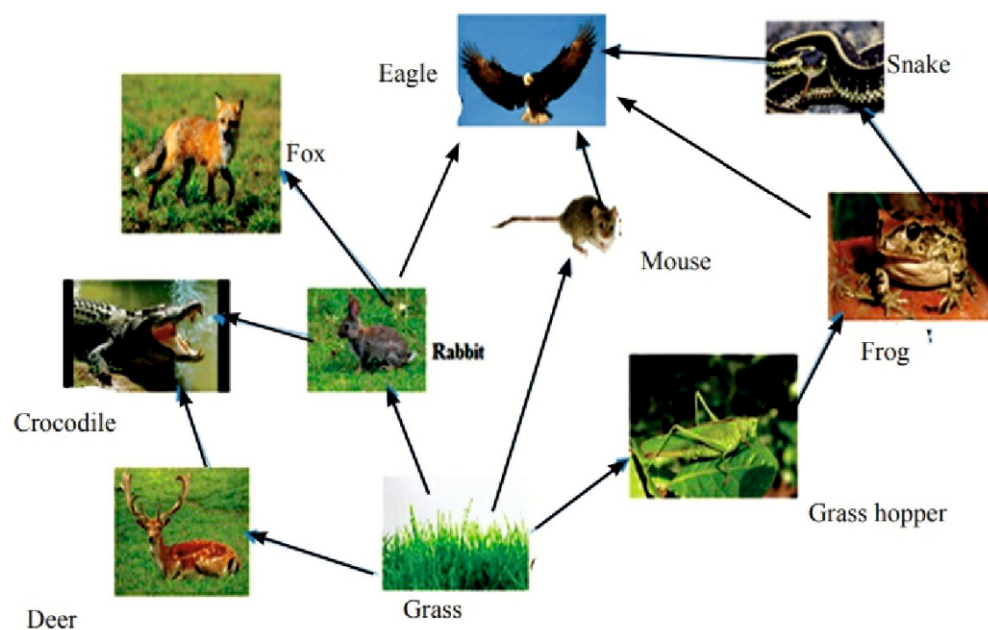
### Tertiary consumers

- The organisms that consume the secondary consumers are called tertiary consumers. These are carnivore-eating carnivores, such as Eagles or big fish species.



## Food web

- In a natural ecosystem isolated food chains do not exist. The food chains are interconnected with each other to form food webs.
- ..... (Campbell, 10th edition, 2015)



## Energy loss along food chains

At each trophic level in the food chain, a considerable fraction (about 90 %) of the potential energy is lost as heat and respiration.

As a result, organisms in each trophic level pass on lesser energy (about 10 %) to the next trophic level than they actually receive.

Longer the food chain the lesser energy is available for top members. Because of this tapering off of available energy in the food chain a pyramid is formed that is known as an ecological pyramid. Shorter food chain has more energy available even at the highest trophic level than that of longer food chain.

## Ecological pyramid:

The trophic structure of an ecosystem can be indicated by means of ecological pyramid.

The higher the steps in the ecological pyramid the lower will be the number of individuals and the larger their size.

The concept of ecological pyramid was developed by Charles Elton; these pyramids are also known as Eltonian pyramids.

All ecological pyramids begin at the bottom with the primary producers and they proceed to various trophic levels such as herbivores consume plants, carnivores prey on herbivores and so on. The highest level is at the top of the food chain. There are three types of ecological pyramids:

- Pyramid of energy
- Pyramid of numbers
- Pyramid of biomass

## Pyramid of Energy

Represents the amount of energy in different trophic levels. The pyramid of energy or the energy pyramid describes the overall nature of the ecosystem. As there is considerable loss of energy during the flow of energy from organism to other, the energy pyramid is always upright and vertical.