

# ENVIRONMENT AND BIODIVERSITY

For UPSC and State  
Civil Services Examinations



Helpful in  
**IAS Preparation**



# Environment and Biodiversity

for

**UPSC and State Civil Services  
Examinations**



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Australia • Brazil • India • Mexico • Singapore • United Kingdom • United States



**Environment and  
Biodiversity**

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# PREFACE

If you ever happen to be walking down the streets of places where preparation for Civil Services is done, it will not be uncommon for you to come across or make the acquaintance of ‘several’ starry eyed yet completely committed IAS aspirants. Yet, ‘several’ would be an understatement given the number that runs into lakhs! But when we say committed, we mean it; these young men and women are ready to sacrifice almost all their youthful follows including sleep, comfort and even a semblance of a normal life to achieve one goal—IAS!

Sadly, this dream remains a distant one for a large majority of these aspirants in spite of the endless hours of study and sleep forsaken nights. When we tried to unravel WHY, the responses were almost synchronous:

“The subject was so vast that there was too much to cover and I could never complete it.”

“I read so much but could not retain it.”

“I studied something but was quizzed on something else in the exam.”

“I kept reading but did not attempt to solve the past year papers or give a mock exam.”

“Subscribing to several sources of information/preparation such as a coaching class, the internet and books was futile; after all there are only 24 hours in a day.”

“My almirah was full of too many books, but I could barely complete a few.”

And while the candid answers stated above clearly gave us a challenging problem—we did not attempt to solve it. We instead focused on a holistic solution—the synchronizing of effort i.e. Learning and Positive Results!

It is with this aim that we—PrepMate collaborated with Cengage India—are continuously striving to develop a comprehensive learning model that is a combination of print and digital product so as to effectively address the issues that most aspirants grapple with.

## **About the Online–Offline Learning Model**

The learning model initiates the process with a series of books targeted at cracking the UPSC exam. The books stand apart from others available because of the following unique features:

- We use a conceptual approach, simple language, explain concepts with diagrams, cite sufficient examples, pose pertinent questions in a reader friendly format—to ensure that the contents of these books can be read and assimilated in a time-bound manner.

- The content is specially designed taking into account the trend in UPSC exams in recent years. We have also included the previous years' questions (with solutions) after every chapter.
- The Practice Questions at the end of each chapter are exhaustive to provide sufficient preparation to crack the exams.
- We have tried to encapsulate all that is required to be learnt for a particular subject into a single book.

Usually, an aspirant purchases a book, but never gets a chance to contact the authors. We believe that the contact among aspirants and authors is important for learning and motivation of the aspirants. That is precisely why we have developed an application and a web portal to answer your queries and provide you with continuous support during your preparation.

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Looking forward to being your partner in the journey towards achieving your dream!

In case you have any specific queries or constructive feedback you can always share the same with us via e-mail at [info@prepmate.in](mailto:info@prepmate.in).

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# ACKNOWLEDGEMENTS

“We cannot accomplish all that we want to do without working together”

The complete UPSC learning module by PrepMate has been the culmination of more than a year of ideation and brain storming by a lot of people. It is only natural that we should gratefully acknowledge their valuable contribution sincerely. I, Shubham Singla, founder of PrepMate Edutech, thank you all for being with me in this whole project. Rajinder Paul Singla, Nirmal Singla, Ramnik Jindal, Sharat Gupta, Subhash Singla and Vijay Singla—thank you for your continuous support and motivation.

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We sincerely acknowledge the initiatives and support from the entire editorial team of Cengage India in the process of publishing this book.

PrepMate



# LIST OF VIDEOS

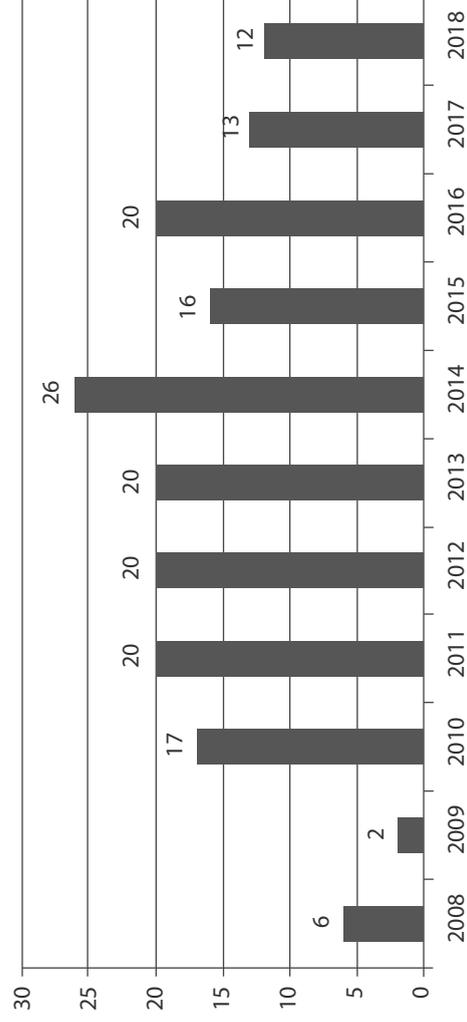
1.	Carbon (C) Cycle
2.	Tropical Evergreen Forest (or Tropical Rainforests)
3.	Coral Reefs
4.	Bioremediation
5.	Classification of Animals
6.	List of Important Animal Species Threatened in India
7.	Plant Diversity
8.	Ocean Acidification
9.	Ozone Depletion

Chapter-wise Break Up of Past Year Questions

Chapter names	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	Total
1. Ecology–Basics				1		1						2
2. Functions of Ecosystem					3	2	1	1	1			8
3. Forest Ecosystem	1		1	3	1	2		2	2		1	13
4. Aquatic Ecosystem	1	1			1	1	1		1			6
5. Environmental Degradation			1	1	2	3			1			8
6. Environment Impacts of Coal												0
7. Environment Restoration Techniques	1	1						1				3
8. Sustainable Development	4	1	3	2	2	2	2	2	3			21
9. Biodiversity							1	2				3
10. Animal Diversity		1	2	2	4	4	3	2		1	1	18
11. Plant Diversity					1	1	1	1	1			5
12. Marine Biodiversity						1	1	2				4
13. Protected Area Network	1			2	3	2	1	3	3		2	17
14. Conservation Efforts for Particular Species		2			1		3					7
15. Climate Change					1		1		2		1	5
16. Acidification						1	1		1			3
17. Ozone Hole							1	1				2
18. Carbon Mitigation Strategies	1	1	1					1				4

Chapter names	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	Total
19. India and Climate Change			1				1					2
20. International Efforts to Reduce Climate Change Effects	2	2	3	2	1			1	1	1	1	14
21. Environmental Institutions in India	1	2	2		2		2	1				10
22. International Efforts for Protection of Environment		2	6	3	4				1			16
<b>Total</b>	<b>12</b>	<b>13</b>	<b>19</b>	<b>16</b>	<b>25</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>17</b>	<b>2</b>	<b>6</b>	<b>170</b>

Number of Questions Asked under Environment Section





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**Unit - I**

**ECOLOGY**

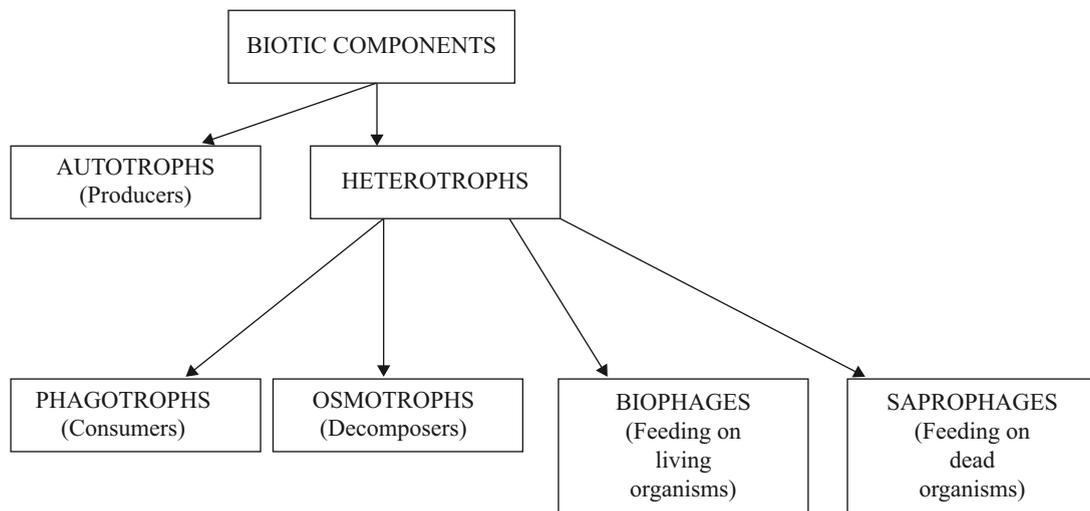
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Ecology is the analysis and study of interactions among organisms and their environment.

Ecology consists of biotic (living) and abiotic (non-living) components. Abiotic components include sunlight, precipitation, wind, topography, humidity, soil, temperature, etc.

Biotic components refer to living organisms. Biotic components can be classified as:



## 1 PRIMARY PRODUCERS (AUTOTROPHS)

Autotrophs are called so because they produce their own food. They have the ability to synthesise carbohydrates from water and carbon dioxide in the presence of sunlight, for example, green plants, algae, etc.

## 2 CONSUMERS (HETEROTROPHS)

Heterotrophs do not produce their own food. They consume either plants (primary consumers) or animals (secondary consumers). Heterotrophs are further of two types—Phagotrophs and Osmotrophs.

## Phagotrophs

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Phagotrophs digest their food either derived by plants or animals or both. Phagotrophs are also called macroconsumers.

Phagotrophs are further classified into three types:

1. **Herbivores:** Animals that feed on plants.
2. **Carnivores:** Animals that feed on other animals.
3. **Omnivores:** Animals that feed on both plants and animals.

## Osmotrophs

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Osmotrophs are those organisms which convert their food into simple substances and absorb those substances. Osmotrophs are also called microconsumers.

Osmotrophs include bacteria and fungi which decompose organic matter to gain nutrients from dead organic substances. The decomposed organic waste is called detritus. Earthworm and certain soil organisms are detritus feeders. These organisms which feed on detritus are called detritivores.

Heterotrophs can also be classified into biophages and saprophytes.

1. **Biophages:** Organisms that derive nourishment for its existence from other living organisms.
2. **Saprophytes:** Organisms that derive nourishment by feeding on dead organisms.

## 3 SPECIES

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A species is a group of organisms capable of interbreeding and producing an offspring. Organisms of a species interact with other organisms, both intra- and inter-species, in a variety of ways.

The common types of interaction among species are mentioned below.

### Competition

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Competition is described as a relationship in which different individuals attempt to use the same limited resource. Competition harms the individuals of the species. Competition can also occur within a population, since all the members require the same resources.

Competition can occur both directly and indirectly. For example, indirect competition can occur between two birds that feed on the same insect; however, one species may eat at day, and the other at night. Direct competition occurs between deer and goat in grassland for the same food sources and territory.

### Predation

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This type of interaction occurs when one organism, the 'predator' feeds upon another organism, known as 'prey'. In this interaction, one organism benefits, while the other organism is harmed. Predation is a complex web to understand, for, one predator can be the prey to another species.

### **Parasitism**

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The relationship between the parasite and the host is known as parasitism. Parasitism is similar to predation, in that it does cause harm to its host, but it does not necessarily 'kill' its host. Some common parasites are ticks, fleas, tapeworms and leeches.

### **Mutualism**

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Some species tend to rely on one another for survival, and there are times when neither of the organisms can survive without the other. This close relationship between two species in which each species provides a benefit to the other is known as mutualism.

For example, in the human body, intestinal bacteria use the warm, nutrient-rich walls of the intestine and help regulate our digestive tract by breaking down foods we cannot digest on our own.

### **Commensalism**

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Commensalism is the relationship between two species in which one species benefits, while the other species involved in the relationship is not affected. For example, vultures follow closely behind tigers in India, to feed on the tiger's kills.

### **Amensalism**

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Another type of relationship, opposite to commensalism is amensalism. Amensalism is any relationship between organisms of different species in which one organism is inhibited or destroyed, while the other organism remains unaffected.

A simple example is the shading out of certain plants under tall trees. The trees reduce the available sunshine at ground level, and numerous plants cannot find adequate light in the shade.

Antibiosis is a specific type of amensalism in which one organism produces a metabolite that is toxic to other organisms.

A common example of amensalism is the release of chemical toxins by plants that can inhibit the growth of other plant species.

### **Symbiosis**

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The interactions among many species involve a relationship in which two organisms live in close association with one another, which is also known as symbiosis. In order for an interaction to be labelled as an example of symbiosis, at least one organism must be benefitted (such as in predation, commensalism and mutualism).

### **Determinants of the Behaviour of a Species—Genotype and Phenotype**

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Genotype is the complete heritable genetic identity. The word genotype can also refer just to a particular gene or a set of genes carried by an individual. For example, if one carries a gene linked to diabetes, one may refer to his genotype just with respect to this mutation without consideration of all the other gene variants that one may carry.

In contrast, phenotype is a description of actual physical characteristics. This includes straightforward visible characteristics like height and eye colour, and also overall health, and even one's behaviour.

Most phenotypes are influenced by both genotype and by the unique circumstances in which one has lived, including one's experiences. Thus, our phenotype is a result of two inputs: 'nature', the unique genome we carry, and 'nurture', the environment in which we have lived our lives.

Many terms are used to denote different species based on their role, importance or origin.

### **Keystone Species**

A keystone species is a species that play a critical role in maintaining the structure of an ecological community. It affects many other organisms in an ecosystem and helps determine the types and numbers of various other species in the community. Without keystone species, the ecosystem would be dramatically different or cease to exist altogether. For instance, tigers are keystone species in the terrestrial ecosystem. If the population of tigers decreases in the ecosystem, the population of the deer would rise. The increase in deer population means more consumption of grass; thus, other species dependent upon grass may not be able to survive.

### **Flagship Species**

A flagship species is a species selected to act as an ambassador, icon or symbol for a defined habitat, issue, campaign or environmental cause. Flagship species are usually relatively large, and considered to be 'charismatic'.

The concept of flagship species has its genesis in the field of conservation biology. The concept of flagship species holds that by raising the profile of a particular species, it can successfully leverage more support for biodiversity conservation at large level.

### **Foundation Species**

Foundation species is used to refer to a species that has a strong role in structuring a community. A foundation species can occupy any trophic level in a food web (i.e., they can be primary producers, herbivores or predators).

The term 'foundation species' was coined by Paul K. Dayton in 1972, who applied it to certain members of marine invertebrates and algae communities. Dayton's view was that focusing on foundation species would allow for a simplified approach to more rapidly understand how a community as a whole would react to disturbances, such as pollution, instead of attempting the extremely difficult task of tracking the responses of all community members simultaneously.

### **Indicator Species**

An indicator species is any biological species that defines a trait or characteristic of the environment. For example, a species may delineate an ecoregion or indicate an environmental condition such as a disease outbreak, pollution, species competition or climate change. Indicator species can be among the most sensitive species in a region, and sometimes act as an early warning to monitoring biologists.

### **Indigenous Species**

In biogeography, a species is defined as indigenous or native to a given region or ecosystem, if its presence in that region is the result of only natural process, with no human intervention.

A species may be introduced by human activity; it is then referred to as an introduced species.

**Endemic Species**

In ecology, endemic means exclusively native to the particular region. An indigenous species may occur in areas other than the one under consideration. Thus, an indigenous species is not necessarily endemic.

The terms ‘endemic’ and ‘indigenous’ do not imply that an organism necessarily originated or evolved where it is found.

**Introduced or Exotic Species**

An introduced, alien, exotic, non-indigenous, or non-native species or simply an introduction, is a species living outside its native distributional range, which has arrived there by human activity, either deliberate or accidental. Non-native species can have various effects on the local ecosystem.

**Invasive Species**

Introduced species that become established and spread beyond the place of introduction are called invasive species. Most introduced species may have no negative effect or only minor impact. In some instances, the potential for being beneficial or detrimental in the long run remains unknown.

**Evolutionarily Distinct and Globally Endangered (EDGE) Species**

The EDGE species represent a disproportionate amount of unique evolutionary history. They have few close relatives, or often the only surviving member of their genus, and sometimes the last surviving genus of their evolutionary family. Some examples of EDGE species are elephants and pandas.

**Umbrella Species**

Umbrella species are species selected for making conservation-related decisions, typically because protecting these species indirectly protects many other species that make up the ecological community of its habitat.

**Important Terms Related to Ecology****Ecosystem**

An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system. These biotic and abiotic components are linked together through nutrient cycles and energy flows.

Ecosystems can be of any size but usually encompass specific, limited spaces (although some scientists say that the entire planet is an ecosystem).

**Ecotone**

Ecotone is a zone of junction between two or more diverse ecosystems. It can be local or regional, narrow or wide. Here, the conditions are intermediate between the two adjacent systems and hence it is also a zone of tension.

For instance, the coastal areas represent an ecotone between marine and terrestrial ecosystem.

### **Ecocline**

Ecocline is a variation of the physico-chemical environment dependent of one or two physico-chemical factors of life (say, temperature), and it leads to presence or absence of certain species. It can be understood as 'physical transition zone'.

For example, an ecocline can be a thermocline, chemocline (chemical gradient), halocline (salinity gradient) or pycnocline (variations in the density of water induced by temperature or salinity).

### **Niche or Ecological Niche**

A *niche* refers to the unique functional role or place of a species in an ecosystem. A species' *niche* includes the physical, biological and chemical environment to which it is adapted as well as its role as producer and consumer of food resources.

### **Niche Construction**

Niche construction is the process by which an organism alters its own (or another species') environment. These alterations can be a physical change to the organism's environment or even encompass when an organism leaves one habitat to another.

### **Habitat**

A habitat is an ecological or environmental area that is inhabited by a particular species of animal, plant or other type of organism. The term typically refers to the zone in which the organism lives and where it can find food, shelter, protection and mates for reproduction.

### **Home Range**

A home range is the area in which an animal lives and moves on a periodic basis. An associated concept is the utilisation distribution which examines where the animal is likely to be at any given time. Earlier, data for mapping a home range was used to be gathered by careful observation, but nowadays, the animal is fitted with a transmission collar or similar GPS device.

Home range includes the territory of an animal. Territory is an area in which an animal, or group of animals, is protected from incursions by others of its species. Territorial boundaries may be marked by sounds such as bird song or scents such as pheromones secreted by the skin glands of many mammals.

### **Biosphere**

The biosphere (from Greek word *bios* = life and *sphaira* = sphere), is the layer of the planet Earth where life exists. This layer ranges up to the height of 10 km above the sea level, used by some birds in flight, to ocean depths of more than 8 km such as the Puerto Rico trench. However, in

general, the layer of the Earth containing life is thin. The upper atmosphere has little oxygen and very low temperature; similarly, ocean depths greater than 1 km are dark, cold and lack oxygen.

### Biome

Biome refers to enormous regions sharing similar climatic conditions, soil type, flora and fauna. Five biomes in India are:

- a. **Tropical humid forests:** These are found in the Western Ghats and the Eastern Himalayas.
- b. **Tropical deciduous forests:** Majority of forests in India are of tropical deciduous type.
- c. **Deserts and semi-desert vegetation:** This is found in the Western Rajasthan.
- d. **Coniferous forests:** These are found in the Middle Himalayas.
- e. **Alpine meadows:** These are found at Higher Himalayas.

## 4 PRODUCTIVITY (IN ECOLOGY)

In ecology, productivity or production refers to the rate of generation of biomass in an ecosystem. It is usually expressed in units of mass per unit area (or volume) per unit time, for instance, grams per square metre per day. Productivity of autotrophs such as plants is called primary productivity, while that of heterotrophs such as animals is called secondary productivity.

### Primary Production

Primary production is the synthesis of new organic material from inorganic molecules such as water and carbon dioxide. It is dominated by the process of photosynthesis which uses sunlight to synthesise organic molecules such as sugars. Organisms responsible for primary production include plants, algae and some bacteria (including cyanobacteria).

### Gross Primary Production (GPP)

It is the amount of organic matter synthesised by producers. In other words, it refers to the total production including the energy utilised for respiration by the producers. Mathematically,

$$\text{GPP} = \text{Rate of increase in body weight or rate of organic matter synthesised by producers} \\ + \text{the rate of respiration (R) and other utilisation of mass by primary producers.}$$

### Net Primary Production (NPP)

It is the amount of organic matter stored by producers. In other words, it refers to the gross primary production that is converted to organic matter excluding the energy utilised for respiration and other purposes by the producers.

Mathematically,

$$\text{NPP} = \text{Organic matter synthesised by producers} \\ - \text{energy utilised for respiration and other purposes.}$$

### Secondary Production

Secondary production is the generation of biomass by heterotrophic (consumer) organisms in a system. This is driven by the transfer of organic materials between trophic levels, and represents the quantity of new tissue created through the use of assimilated food.

Organisms responsible for secondary production include animals, protists, fungi and many bacteria.

## Practice Questions

- The biomass available for consumption by the herbivores is called:
  - Gross primary production
  - Net primary production
  - Secondary production
  - None of the above
- Amensalism is an association between two species where:
  - One species is harmed and the other is benefitted.
  - One species is harmed and the other is unaffected.
  - One species is benefitted and the other is unaffected.
  - Both the species are harmed.
- A high density of tiger population in an area can result in:
  - Predation on one another
  - Mutualism
  - Intra species competition
  - Inter species competition
- Which one of the following terms is related to the impact of an organism on biotic and abiotic components of its ecosystem?
  - Ecotone
  - Ecological niche
  - Ecocline
  - Trophic level
- A transition zone or region separating two biomes is known as:
  - Ecocline
  - Ecological niche
  - Ecotone
  - Ecotype
- Which of the following statements correctly explains the phenomenon of Antibiosis?
  - One species kills to feed on the other species.
  - An organism benefiting from the other organisms.
  - Production of secretions by an organism which is harmful to other organisms.
  - Competition between organisms of the same species.

7. Which among the following correctly describes 'homeostasis'?
- (a) It refers to the gradual process by which communities in the ecosystems change and develop over time.
  - (b) It is the process by which an organism maintains a stable internal environment despite changes in external conditions.
  - (c) It is the process of transfer of energy from one trophic level to another in a grazing food chain.
  - (d) It is the gradual process through which energy requirement in an ecosystem is balanced with the energy available to the ecosystem.
8. Which of the following best describes an indicator species?
- (a) It is a species that has a disproportionately large effect on the ecosystem in which it occurs.
  - (b) It is a species which is of invasive nature.
  - (c) It is a species which is introduced to balance the species composition in an ecosystem.
  - (d) It is a species whose presence, absence or abundance reflects a specific environmental condition.
9. Which one of the following is the best description of the term 'ecosystem'?
- (a) Flora of a particular geographical area.
  - (b) Flora and fauna of a geographical area.
  - (c) Flora and Fauna along with their environment.
  - (d) Flora and fauna of a continent.
10. The ability of an ecosystem to self regulate itself is
- (a) Accommodation
  - (b) Adaptation
  - (c) Homeostasis
  - (d) Evolution
11. In an ecotone, the species which is expanding to other ecosystems on its own are called:
- (a) Invasive species
  - (b) Edge species
  - (c) Keystone species
  - (d) Adaptive species
12. Two animals can be conclusively said to belong to the same species if they:
- (a) Have same biological evolution
  - (b) Have similar genetic makeup
  - (c) Look similar and possess similar physical makeup
  - (d) Can reproduce freely with each other
13. Which of the following is **not** an example of mutualism?
- (a) Algae and fungus
  - (b) Rhizobium bacteria and leguminous plants
  - (c) Coral polyps and Zooxanthellae algae
  - (d) Leech and cattle

14. Consider the following pairs:

	Interaction	Explanation
1	Mutualism	Both the species are benefitted
2	Competition	Both the species are harmed
3	Commensalism	One species is harmed and the other is unaffected
4	Amensalism	One species is benefitted and the other is unaffected

Which of the pairs given above is/are correctly matched?

- (a) 1 and 2 only    (b) 3 and 4 only  
 (c) 1, 2 and 3 only    (d) 1, 2, 3 and 4
15. With reference to keystone species, consider the following statements:
1. A keystone species exhibits disproportionately large effect on its environment relative to its abundance.
  2. Tigers are keystone species as they determine the species composition in a forest.
- Select the correct answer using the codes given below:
- (a) 1 only    (b) 2 only  
 (c) Both 1 and 2    (d) Neither 1 nor 2

16. Which of the following is/are the types of positive interaction in a biotic community?

1. Colonisation
2. Competition
3. Protocooperation

Select the correct answer using the codes given below:

- (a) 1 and 2 only    (b) 2 and 3 only  
 (c) 3 only    (d) 1 and 3 only



**Note:** Colonisation or colonization is the process in biology by which a species spreads to new areas. Colonisation often refers to successful immigration, where a population becomes integrated into a community, having resisted initial local extinction.

Protocooperation refers to the manner of interaction between organisms which is beneficial to both of them.

17. Consider the following statements with reference to primary productivity of ecosystem:
1. Net primary productivity is gross primary productivity minus the amount of biomass consumed by the primary consumers.
  2. Primary productivity of water bodies is more than the terrestrial environment.
- Which of the statements given above is/are correct?
- (a) 1 only    (b) 2 only  
 (c) Both 1 and 2    (d) Neither 1 nor 2

 **Note:** Presently, 85% of biomass is produced in terrestrial environment and only 15% biomass is produced in aquatic environment.

18. Which of the following are the abiotic components of the ecosystem?

1. Water
2. Insolation
3. Winds
4. Decomposers
5. Soil

Select the correct answer using the codes given below.

- (a) 1 and 5 only
- (b) 1, 2, 3 and 5 only
- (c) 2, 3 and 4 only
- (d) 1, 3, 4 and 5 only

19. Consider the following statements:

1. Ecotone is the transitional area between two biomes or diverse ecosystems.
2. Ecological niche is the role of a species in an ecosystem.
3. Ecocline refers to the combination of all physical and chemical factors that play a role in an ecosystem.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 2 only
- (d) 1, 2 and 3

20. Consider the following statements:

1. A dominant species refers to a species which contributes to the highest percentage of biomass in an ecosystem.
2. A keystone species is one that has the greatest effect on all the other species in an ecosystem.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

21. In which of the following relationships does one species benefit by harming another species?

1. Parasitism
2. Predation

Select the correct answer using the codes given below:

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

22. Which of the following terms defines the gradual change in certain characteristics exhibited by communities along with the gradual change in one or more environmental gradients?

- (a) Ecotone
- (b) Ecocline
- (c) Ecotype
- (d) Ecological niche

## PERFECTING PAST PRELIMS

1. Which one of the following terms describe not only the physical space occupied by an organism, but also its functional role in the community of organisms? (2013)
  - (a) Ecotone
  - (b) Ecological niche
  - (c) Habitat
  - (d) Home range
  
2. Which one of the following is the best description of the term 'ecosystem'? (2015)
  - (a) A community of organisms interacting with one another.
  - (b) That part of the Earth which is inhabited by living organisms.
  - (c) A community of organisms together with the environment in which they live.
  - (d) The flora and fauna of a geographical area.



## ANSWER KEYS

### Practice Questions

1. (b)	2. (b)	3. (c)	4. (b)	5. (c)
6. (c)	7. (b)	8. (d)	9. (c)	10. (c)
11. (a)	12. (d)	13. (d)	14. (a)	15. (c)
16. (d)	17. (d)	18. (b)	19. (c)	20. (c)
21. (c)	22. (b)			

### Perfecting Past Prelims

1. (b)	2. (c)
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*Solutions for*  
**PRACTICE**  
**QUESTIONS AND**  
**PERFECTING PAST**  
**PRELIMS**

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**CHAPTER 1 ECOLOGY—BASICS****Practice Questions**

3. (c) Intra-species competition is the competition between the same species. Increase in population of tigers will lead to an increase in competition among tigers for various resources.
4. (b) An ecological niche includes all of its interactions with the biotic and abiotic factors of its environment and the impact it has on them.
6. (c) Antibiosis is a form of amensalism in which one organism produces substances that inhibit growth or even kill other organisms occurring in its close proximity.
7. (b) Homeostasis is the maintenance of a constant internal environment of a system in response to changes in the external environment.
8. (d) An indicator species is any biological species that defines a trait or characteristic of the environment.
9. (c) An ecosystem is a community of living organisms in conjunction with the non-living components of their environment (things like air, water and mineral soil), interacting as a system.
11. (a) Introduced species that establish themselves and spread beyond the place of introduction are called invasive species.
12. (d) A species is a group of closely related organisms that can interbreed freely to produce offspring.
13. (d) Leech and cattle  
Leech feeds on the blood of cattle; so cattle is harmed and leech is benefitted. Therefore, it is parasitism and not mutualism.
15. (c) Statement 1 is correct: A keystone species is a species that plays a critical role in maintaining the structure of an ecological community. Without keystone species, the ecosystem would be dramatically different or cease to exist altogether.
17. (d) Statement 1 is incorrect: Net primary productivity (NPP) is the amount of organic matter stored by producer's per unit area in unit time. In other words, it refers to the net productivity that is converted into organic matter excluding the energy utilised for respiration and other purposes by the producers.  
Statement 2 is incorrect: Presently, 85% of biomass is produced in the terrestrial environment and only 15% biomass is produced in the aquatic environment.
18. (b) Abiotic components are the non-living components; so decomposers are not included in the list.
19. (c) Statement 3 is incorrect: Ecozone is a variation in the physical and/or chemical environment dependence. It is not the combination of all physical and chemical factors.
20. (c) Statement 1 is correct: Dominant species is that which predominates in an ecological community, particularly when they are in majority or form a bulk of biomass.

### Perfecting Past Prelims

1. (b) An ecological niche refers to the unique functional role or place of a species in an ecosystem. A species niche includes the physical, biological and chemical environment to which it is adapted as well as its role as a producer and consumer of food resources.
2. (c) An ecosystem is a community of living organisms in conjunction with the non-living components of their environment.

## CHAPTER 2 FUNCTIONS OF ECOSYSTEM

### Practice Questions

2. (d) If any organism of the food chain goes missing, the population of the organism dependent on it for food (here, tiger) will decrease and the organism which the missing animal feeds upon (here grass) will increase, creating an imbalance in the ecosystem.
5. (c) Photosynthesis is not a part of water cycle.
6. (b) The air we breathe in comprises of 78% of nitrogen, 21% of oxygen, 0.03% of carbon dioxide and the remaining percent is comprised of other gases. Nitrogen is very essential in diluting the oxygen to make it available to all the cells. Remaining nitrogen is exhaled out (74% of nitrogen). Other gases are also exhaled out in negligible amounts.
7. (b) Nitrifying bacteria converts nitrogen into simple compounds which can be consumed by plants and animals, whereas denitrifying bacteria such as *Pseudomonas* convert nitrates in the soil to free atmospheric nitrogen.
9. (c) Cloud seeding is a form of weather modification which involves spraying chemicals into clouds to induce rains.
10. (c) Species at higher trophic levels are at a higher threat of extinction due to biomagnification.
12. (c) The two species through which carbon atoms have passed are producers and primary consumers, respectively. Thus, presently the carbon atoms are fixed by secondary consumer.
13. (a) For photosynthesis, plants use approximately 0.023% of solar energy. This is a very small percentage that plants need to make food when compared to the water cycle's use of solar energy, which is 23%.
14. (a) Pyramid of energy is always upright.
16. (c) Atmospheric nitrogen needs to be fixed or converted into ammonia ( $\text{NH}_4$ ), nitrites ( $\text{NO}_2$ ) and nitrates ( $\text{NO}_3$ ), before it is taken up by the plants.
17. (a) Statement 2 is incorrect: A perfect cycle is a cycle in which nutrients are replaced as fast as they are utilised. Most gaseous cycles are perfect cycles. Carbon cycle is not a perfect cycle.  
  
Statement 3 is incorrect: Nitrogen cannot be consumed directly by the plants. Nitrogen needs to be fixed or converted into ammonia, nitrites and nitrates.

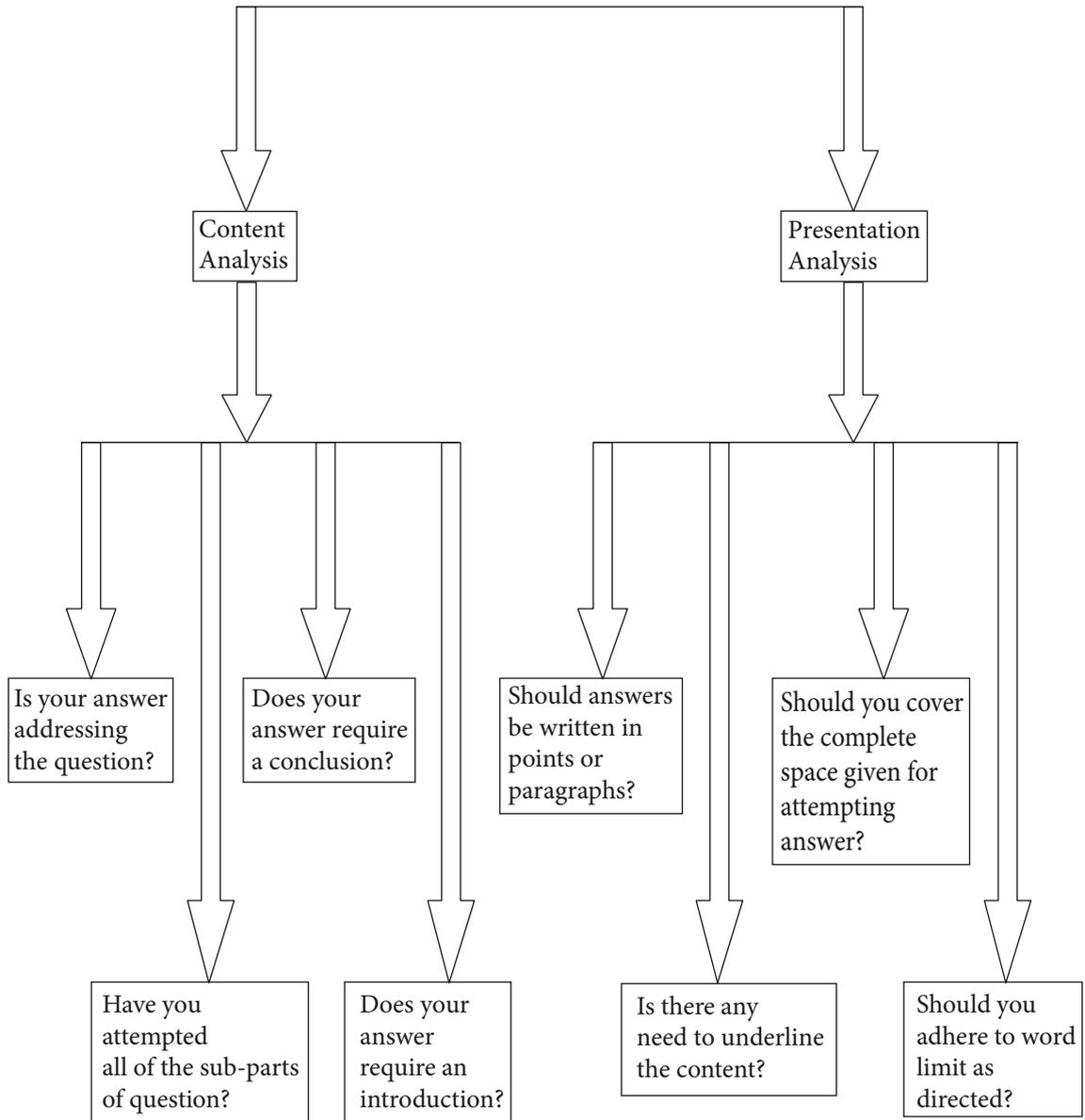
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**INTRODUCTION  
TO MAINS  
ANSWER WRITING**

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A Good answer is based on the following aspects



Let us discuss each aspect mentioned in the above diagram on one by one basis.

### 1. Is your answer addressing the question?

The most common reason to blame for a low score is lack of candidate's ability to address the question. Have you ever come across a candidate who attempted almost all (or all the questions), yet could not clear Mains examination? If yes, you have probably met the candidate who wrote answers, which did not address the questions.

To understand how to address question appropriately, we can classify each question into two parts: 'Statement' and 'Directive'.

For example:

India is well-endowed with fresh water resources. Critically examine why it still suffers from water scarcity. (12.5 marks, 200 words, 2015 Mains, GS Mains Paper I)

In this question, the Statement is 'India suffers from water scarcity despite possessing well-endowed fresh water resources' and the directive is 'Critically examine'.

Various candidates interpret 'Critically examine' in different manner. Some will attempt to provide positives and negatives and some will attempt to identify various aspects of the topic being asked. So, which one is correct here? Let us learn by going through the document.

It is to be noted that a particular directive may be attached to a sub-part of a question. In a single question, there can be as many directives as there are number of sub-parts.



## So What All Directives UPSC Can Use? What Do These Directives Mean?

Here is a simple list for you. We will further learn about their application by attempting past year questions in the coming pages.

### 1. **Enumerate:** Mention a number of things one by one or give the list of things.

Enumerate the National Water Policy of India. Taking river Ganges as an example, discuss the strategies, which may be adopted for river-water pollution control and management. What are the legal provisions of management and handling of hazardous wastes in India? (10 marks, 200 words, 2013 Mains, GS Mains Paper III)

### 2. **Highlight:** Draw special attention to something.

The frequency of urban floods due to high intensity rainfall is increasing over the years. Discussing the reasons for urban floods, highlight the mechanisms for preparedness to reduce the risk during such events. (12.5 marks, 200 words, 2016 Mains, GS Mains Paper III)

### 3. **Outline:** Give a summary of something.

### 4. **Discuss:** Write about a topic in detail, taking into account different issues or ideas.

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**MAINS SOLUTIONS:  
ENVIRONMENT AND  
BIODIVERSITY**

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1. **Bring out the causes for the formation of heat islands in the urban habitat of the world.**  
(5 marks, 100 words, 2013 Mains, GS Mains Paper I)

**Solution:**

Analysis of Question	
Bring out	To make apparent or to present in clear form
Number of Parts	One part Causes for the formation of heat islands in the urban habitat
Mode of Presentation	Point-form
Importance of Conclusion	Not Required

Causes for the formation of heat islands in the urban habitat of the world:

- a. Heavy discharge of Pollution.
  - b. Heavy discharge of greenhouse gases which trap the outgoing infrared radiation.
  - c. Infrastructure obstructs the flow of winds and thus, obstruct transfer of heat.
  - d. Lack of vegetation for conversion of carbon dioxide which is a greenhouse gas into oxygen.
  - e. Urban surfaces are made up of metal, glass and asphalt. These surfaces have high heat storage capacity and they emit out this heat during night-time.
  - f. Water cannot penetrate the concrete surface. Thus, urban landscape responds like a desert landscape and there is absence of moderating influence of water.
2. **What do you understand by run of the river hydroelectricity project? How is it different from any other hydroelectricity project?** (5 marks, 100 words, 2013 Mains, GS Mains Paper III)

**Solution:**

Analysis of Question	
Number of Parts	Two parts 1. What do you understand by run of the river hydroelectricity project? 2. How is it different from any other hydroelectricity project?
Mode of Presentation	First part in paragraph-form and Second part in Point-form
Importance of Conclusion	Not Required

The ROR is a type of hydroelectric generation plant, whereby little or no water storage is provided. The storage reservoir is referred to as pondage. A plant without pondage has no water storage and is, therefore, subject to seasonal river flows.

### Difference with Other Hydroelectricity Projects

- i. **Water storage:** Unlike other hydroelectric power projects, ROR projects do not involve large-scale storage of water. Storage of water leads to disruption in the aquatic ecosystem. Many plant and animal species submerge. Water storage leads to the submergence of many villages. Thus, there is a need to rehabilitate large population. Such rehabilitation is not required in ROR projects.
  - ii. **Obstruction of flow:** Unlike other hydroelectric power projects, the ROR projects do not obstruct river flow.
  - iii. **Suitability:** ROR projects are more suitable for perennial rivers and not seasonal rivers. During dry seasons, electricity cannot be generated in these projects.
  - iv. **Adjustments in Plant load capacity:** In ROR projects, adjustments cannot be made in the amount of electricity produced or plant load capacity, because flow of water is determined by nature.
3. **What are the consequences of illegal mining? Discuss the ministry of environment and forests' concept of "GO AND NO GO" zones for coal mining.**  
(5 marks, 100 words, 2013 Mains, GS Mains Paper III)

#### Solution:

Analysis of Question	
Discuss (Attached with 2nd part)	Write about a topic in detail, taking into account different issues or ideas.
Number of Parts	Two parts 1. What are the consequences of illegal mining? 2. Discuss the ministry of environment and forests' concept of "GO AND NO GO" zones for coal mining.
Mode of Presentation	First part in Point-form and Second part in paragraph-form
Importance of Conclusion	Not Required

Following are the consequences of illegal mining:

- a. **Over exploitation of natural resources:** Illegal mining often involves over extraction of minerals, making them non-available in the future.
- b. **Destruction of ecosystem:** Illegal mining usually causes many environmental damages. These damages include the contamination of soil and groundwater, loss of biodiversity, chemical leakages, improper waste disposal and formation of sinkholes.
- c. **Loss of revenue to exchequer:** Government fails to collect fees and taxes on illegal mining, which means loss of revenue to the government.
- d. **Generation of black money and facilitates criminal activities:** Money earned from illegal mining is not taxed. This black money further promotes corruption, muscle power and other crimes.