NCERT Exercise Answer Key

Chapter 12: Ecosystem

Medium Detailed Solutions

---

1. Fill in the blanks:

(a) Plants are called... ...carbon dioxide.

Answer: Producers/Autotrophs

Explanation: Plants fix atmospheric carbon dioxide into organic compounds through photosynthesis, converting inorganic carbon into organic matter.

(b) In an ecosystem... ...is_____type.

Answer: Inverted

Explanation: In tree-dominated ecosystems, few large trees (producers) support many insects, birds, and other consumers, creating an inverted pyramid of numbers.

(c) In aquatic ecosystems... ...productivity is_____.

Answer: Light/Sunlight

Explanation: Light penetration decreases with depth in aquatic ecosystems, limiting photosynthesis and primary productivity, especially in deeper waters.

(d) Common detritivores in... ...are_____.

Answer: Earthworms/Termites/Millipedes

Explanation: These organisms break down dead organic matter (detritus) into smaller particles, initiating the decomposition process.

(e) The major reservoir... ...earth is_____.

Answer: Atmosphere/Ocean

Explanation: Atmospheric CO_2 and dissolved CO_2 in oceans represent the largest active carbon reservoirs in the carbon cycle.

---

2. Which one of... ...a food chain?

Answer: (a) Producers

Explanation:

- Producers form the base of all food chains
- They convert solar energy into chemical energy
- Support all other trophic levels
- Have the largest biomass and energy content
- Follow the 10% energy transfer rule - each level has less energy than producers

---

3. The second trophic... ...a lake is

Answer: (b) Zooplankton

Explanation:

- **First trophic level:** Phytoplankton (producers)
- **Second trophic level:** Zooplankton (primary consumers feeding on phytoplankton)

- **Third trophic level:** Small fish (secondary consumers)
- **Fourth trophic level:** Large fish (tertiary consumers)

---

4. Secondary producers are

Answer: (d) None of the above

Explanation:

- There are **no "secondary producers"** in ecological terminology
- Only **primary producers** exist (plants/autotrophs)
- The term "secondary productivity" refers to **consumer productivity** (rate of biomass formation by heterotrophs)
- Herbivores and carnivores are **consumers**, not producers

---

5. What is the... ...solar radiation?

Answer: (b) 50%

Explanation:

- **PAR (Photosynthetically Active Radiation)** is **less than 50%** of incident solar radiation
- Wavelength range: 400-700 nm (visible light)
- Rest includes UV, infrared, and other non-photosynthetic wavelengths
- Plants capture only 2-10% of this PAR for photosynthesis

---

6. Distinguish between:

(a) Grazing food chain... ...detritus food chain

Grazing Food Chain (GFC):

- Starts with **living producers**
- Energy from **photosynthesis**
- **Herbivores → Carnivores**
- Major conduit in **aquatic ecosystems**
- Example: Grass → Rabbit → Fox

Detritus Food Chain (DFC):

- Starts with **dead organic matter**
- Energy from **decomposition**
- **Decomposers → Detritivores**
- Major conduit in **terrestrial ecosystems**
- Example: Dead leaves → Bacteria → Earthworms

(b) Production and decomposition

Production:

- **Building up** of organic matter
- **Anabolic process** (energy storage)
- Converts **inorganic → organic**
- Performed by **autotrophs**
- **Energy input** required

Decomposition:

- **Breaking down** of organic matter
- **Catabolic process** (energy release)
- Converts **organic** → **inorganic**
- Performed by **decomposers**
- **Energy released**

(c) Upright and inverted pyramid

Upright Pyramid:

- **Base larger** than apex
- **Normal condition** in most ecosystems
- Energy/biomass **decreases** with trophic levels
- Example: Grassland ecosystem

Inverted Pyramid:

- **Apex larger** than base
- **Exception** to normal pattern
- Higher trophic levels have **more biomass/numbers**
- Example: Tree ecosystem (numbers), Aquatic ecosystem (biomass)

(d) Food chain... ...Food web

Food Chain:

- **Linear sequence** of organisms
- **Single pathway** of energy flow

- **Simplified representation**
- Each organism at **one trophic level**
- Example: Grass → Deer → Tiger

Food Web:

- **Network of interconnected** food chains
- **Multiple pathways** of energy flow
- **Complex realistic representation**
- Organisms at **multiple trophic levels**
- Shows **interdependence** in ecosystem

(e) Litter and detritus

Litter:

- **Freshly fallen** dead material
- **Surface layer** of dead leaves, twigs
- **Recently dead** organic matter
- **Not yet decomposed**

Detritus:

- **Partially decomposed** organic matter
- Includes **fragmented litter**
- **Mixed with soil** organic matter
- **Undergoing active decomposition**

(f) Primary and... ...secondary productivity

Primary Productivity:

- Rate of **organic matter production** by autotrophs
- **Solar energy conversion** to chemical energy
- Measured as **GPP and NPP**
- **Foundation** of ecosystem energy

Secondary Productivity:

- Rate of **biomass formation** by consumers
- **Assimilation** of food energy by heterotrophs
- **Depends on primary productivity**
- Always **less than primary productivity**

---

7. Describe the components... ...an ecosystem.

Answer:

Abiotic Components:

Physical environment that supports life

Elements:

- **Climatic factors:** Temperature, rainfall, humidity, wind
- **Edaphic factors:** Soil pH, nutrients, texture, moisture
- **Topographic factors:** Altitude, slope, aspect
- **Chemical substances:** Water, gases, minerals

Biotic Components:

Living organisms in the ecosystem

1. Producers (Autotrophs):

- **Function:** Convert solar energy to chemical energy
- **Examples:** Green plants, algae, chemosynthetic bacteria
- **Trophic level:** First

2. Consumers (Heterotrophs):

- **Primary consumers:** Herbivores (deer, insects)
- **Secondary consumers:** Primary carnivores (snakes, frogs)
- **Tertiary consumers:** Secondary carnivores (hawks, lions)
- **Quaternary consumers:** Top carnivores

3. Decomposers (Saprotrophs):

- **Function:** Break down dead organic matter
- **Examples:** Bacteria, fungi
- **Importance:** Nutrient recycling, energy release

Interactions:

- **Energy flow:** Unidirectional (producers → consumers)
- **Nutrient cycling:** Bidirectional (recycling through decomposition)
- **Interdependence:** All components interconnected

---

8. Define ecological pyramids... ...and biomass.

Answer:

Definition:

Ecological pyramids are graphical representations showing the relationship between different trophic levels in terms of number, biomass, or energy.

Structure:

- **Base:** Producers (1st trophic level)
- **Successive levels:** Primary, secondary, tertiary consumers
- **Apex:** Top consumers

Pyramid of Numbers:

Definition: Shows number of organisms at each trophic level

Examples:

- **Upright (Grassland):** 6 million plants → 200,000 insects → 1,500 birds → 3 hawks
- **Inverted (Forest):** 1 tree → 1,000 insects → 100 birds → 5 hawks

Pyramid of Biomass:

Definition: Shows total biomass at each trophic level

Examples:

- **Upright (Terrestrial):** Plant biomass > Herbivore biomass > Carnivore biomass
- **Inverted (Aquatic):** Phytoplankton biomass < Fish biomass (due to rapid turnover)

Characteristics:

- **Base always represents producers**
- **Apex represents top consumers**
- **Shape depends on ecosystem type**
- **Reflects energy transfer efficiency**

---

9. What is primary... ...primary productivity.

Answer:

Definition:

Primary productivity is the rate of capture of solar energy or biomass production by producers (autotrophs) per unit area over a time period.

Types:

Gross Primary Productivity (GPP):

- **Total organic matter** produced during photosynthesis
- **All energy captured** by producers
- **Before respiratory losses**

Net Primary Productivity (NPP):

- **Formula:** NPP = GPP - R (where R = respiration)
- **Available biomass** for consumers
- **After plant respiratory losses**
- **More ecologically significant**

Factors Affecting Primary Productivity:

1. Environmental Factors:

- **Light intensity and duration**
- **Temperature** (affects enzyme activity)
- **Water availability**
- **CO_2 concentration**

2. Nutrient Availability:

- **Macronutrients:** N, P, K, Ca, Mg, S
- **Micronutrients:** Fe, Mn, Zn, Cu, B, Mo
- **Limiting nutrients** control productivity

3. Plant Factors:

- **Species composition** and diversity
- **Leaf area index** (photosynthetic surface)
- **Photosynthetic efficiency** (C_3, C_4, CAM plants)
- **Age and health** of vegetation

4. Geographic Factors:

- **Latitude** (solar angle and intensity)
- **Altitude** (temperature and pressure)
- **Topography** (slope and aspect)

---

10. Define decomposition and... ...of decomposition.

Answer:

Definition:

Decomposition is the process by which decomposers break down complex organic compounds of dead organisms into simpler inorganic substances like CO_2, water, and nutrients.

Processes of Decomposition:

1. Fragmentation:

- **Agent:** Detritivores (earthworms, termites)
- **Process:** Breaking detritus into smaller particles
- **Result:** Increased surface area for microbial action

2. Leaching:

- **Process:** Water-soluble nutrients dissolve and move down
- **Result:** Nutrients enter soil layers
- **Problem:** Some nutrients become unavailable as precipitates

3. Catabolism:

- **Agent:** Bacterial and fungal enzymes
- **Process:** Enzymatic breakdown of complex molecules
- **Result:** Simple organic and inorganic compounds

4. Humification:

- **Product:** Humus formation
- **Characteristics:** Dark, amorphous, colloidal

- **Function:** Nutrient reservoir, soil structure

5. Mineralisation:

- **Process:** Final breakdown of humus
- **Result:** Release of inorganic nutrients
- **Availability:** Nutrients available for plant uptake

Products of Decomposition:

- **Inorganic nutrients:** N, P, K, Ca, Mg
- **Gases:** CO_2, NH_3, H_2S
- **Water**
- **Humus** (intermediate product)
- **Energy** (released as heat)

Controlling Factors:

- **Temperature:** Higher temperature increases rate
- **Moisture:** Optimal moisture needed
- **Oxygen:** Required for aerobic decomposition
- **Chemical composition:** Lignin, chitin slow decomposition
- **pH:** Affects microbial activity

---

11. Give an account... ...an ecosystem.

Answer:

Energy Source:

Sun - Ultimate source of energy for all ecosystems (except chemosynthetic)

Energy Capture:

- **Solar radiation:** Only <50% is PAR (Photosynthetically Active Radiation)
- **Plant efficiency:** 2-10% of PAR captured
- **Conversion:** Light energy → Chemical energy (glucose)

Energy Flow Pattern:

Unidirectional Flow:

Sun → Producers → Primary Consumers → Secondary Consumers → Tertiary Consumers

Trophic Levels:

1. **Producers (T_1):** Capture solar energy
2. **Primary Consumers (T_2):** Herbivores
3. **Secondary Consumers (T_3):** Primary carnivores
4. **Tertiary Consumers (T_4):** Secondary carnivores

Energy Transfer Laws:

10% Law (Lindeman's Law):

- Only **10% energy** transferred to next trophic level
- **90% energy lost** as heat, respiration, excretion
- **Reason for limited trophic levels** (usually 4-5)

Thermodynamic Laws:

- **First Law:** Energy neither created nor destroyed
- **Second Law:** Energy transformations involve heat loss

Energy Flow Pathways:

1. Grazing Food Chain:

- **Path:** Living producers → Herbivores → Carnivores
- **Energy source:** Current photosynthesis
- **Dominant in:** Aquatic ecosystems

2. Detritus Food Chain:

- **Path:** Dead organic matter → Decomposers → Detritivores
- **Energy source:** Stored organic matter
- **Dominant in:** Terrestrial ecosystems

Energy Budget:

- **GPP:** Total energy captured
- **NPP:** GPP - Plant respiration
- **Secondary productivity:** Consumer energy assimilation
- **Decomposer productivity:** Energy from detritus

Ecological Significance:

- **Limits ecosystem size** and complexity
- **Determines trophic structure**
- **Controls population sizes**
- **Influences biodiversity** patterns