YOUR MENTOR GURU

CSIR NET Life Sciences & Biotechnology — Unit 10

Ecological Principles

Study & revision companion | Topic explanations, core facts, and active-recall questions

How to use this guide

Read each topic, explain the key mechanism in your own words, then answer the self-check prompts without looking at the notes. Use your detailed textbook or class notes for full derivations and additional examples.

Topic overview

1. 1. Population Growth and Life Tables
2. 2. Community Interactions and Diversity
3. 3. Ecosystem Productivity and Energy Flow
4. 4. Ecological Succession and Biogeography
5. 5. Animal Behavior and Learning
6. 6. Social Behavior and Kin Selection
7. 7. Conservation and Climate Change

1. Population Growth and Life Tables

Exponential growth follows dN/dt = rN; logistic growth adds the density-dependent factor (1 − N/K).

Intrinsic growth rate r depends on births and deaths; carrying capacity K varies with environment.

Life tables summarize survivorship and fecundity by age or stage.

Density dependence can arise from competition, disease or predation.

Exponential growth assumes unlimited resources; logistic growth slows as population size approaches carrying capacity K.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: logistic growth is fastest in absolute terms near N = K/2.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

2. Community Interactions and Diversity

Competition, predation, mutualism, parasitism and commensalism affect community structure.

Competitive exclusion predicts that identical limiting-niche use cannot persist indefinitely under idealized constant conditions.

Alpha diversity measures within-site diversity; beta diversity describes turnover among sites.

Keystone species have effects disproportionately large relative to abundance.

Dispersal links habitat patches; colonization and local extinction determine persistence.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: connectivity can reduce extinction risk.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

3. Ecosystem Productivity and Energy Flow

Gross primary productivity (GPP) is total photosynthetic carbon fixation; NPP = GPP − autotrophic respiration.

Energy transfer between trophic levels is inefficient and variable; the 10% rule is only a rough heuristic.

Decomposition and mineralization recycle nutrients, while energy ultimately dissipates as heat.

Carbon, nitrogen and phosphorus cycles couple biotic and abiotic processes.

Competition, predation, mutualism and parasitism shape communities; keystone species have disproportionate effects.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: keystone status reflects impact, not abundance.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

4. Ecological Succession and Biogeography

Primary succession begins where soil is absent; secondary succession follows disturbance where soil remains.

Island biogeography relates species richness to colonization and extinction rates influenced by area and isolation.

Species–area relationships are often expressed as S = cA^z.

Fragmentation changes habitat area, connectivity and edge effects.

Primary succession begins without developed soil; secondary succession follows disturbance with remaining biological legacies.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: resistance and resilience are different properties.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

5. Animal Behavior and Learning

Innate behaviors have strong developmental predispositions; learned behaviors change with experience.

Classical conditioning associates stimuli; operant conditioning links behavior with consequences.

Optimal foraging models evaluate tradeoffs among energy gain, time and risk.

Communication signals can be visual, chemical, acoustic or tactile.

Primary productivity supplies energy; carbon, nitrogen and phosphorus cycle through ecosystems.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: energy flows; matter cycles.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

6. Social Behavior and Kin Selection

Hamilton's rule rb > c gives a simplified condition favoring an altruistic allele under inclusive-fitness assumptions.

Kin selection depends on genetic relatedness and fitness effects; reciprocal altruism relies on repeated interactions and partner recognition.

Sexual selection may operate through mate choice or competition.

Game-theoretic strategies depend on payoff structure and frequencies.

Genetic, species and ecosystem diversity are conserved through in situ and ex situ approaches.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: species richness ignores evenness.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

7. Conservation and Climate Change

Small populations are vulnerable to drift, inbreeding and demographic stochasticity.

Population viability analysis explores extinction risk under stated models and uncertainties.

Climate change can shift ranges, phenology and species interactions.

Protected-area design benefits from habitat quality, connectivity and management of threats.

Climate change, land-use change and invasive species threaten biodiversity; conservation policy governs responses.

When solving a question, distinguish the underlying mechanism from its observable outcome. Compare the normal situation with the altered condition, and check whether the evidence supports a direct effect or only an association. The central distinction to retain is: distinguish ecological evidence from legal provisions.

Self-check: Explain the mechanism or relationship above; identify one common misconception; predict the effect of changing a key variable.

Active-recall practice

1. Explain the essential principles of 1. Population Growth and Life Tables and give one experimental or real-world application.

2. Explain the essential principles of 2. Community Interactions and Diversity and give one experimental or real-world application.

3. Explain the essential principles of 3. Ecosystem Productivity and Energy Flow and give one experimental or real-world application.

4. Explain the essential principles of 4. Ecological Succession and Biogeography and give one experimental or real-world application.

5. Explain the essential principles of 5. Animal Behavior and Learning and give one experimental or real-world application.

6. Explain the essential principles of 6. Social Behavior and Kin Selection and give one experimental or real-world application.

7. Explain the essential principles of 7. Conservation and Climate Change and give one experimental or real-world application.

Final revision checklist

- 1. Population Growth and Life Tables
- 2. Community Interactions and Diversity
- 3. Ecosystem Productivity and Energy Flow
- 4. Ecological Succession and Biogeography
- 5. Animal Behavior and Learning
- 6. Social Behavior and Kin Selection
- 7. Conservation and Climate Change

Further study

Use the corresponding unit notes, topic-wise detailed lessons, MCQs, practice tests and full-length mock tests on yourmentorguru.com. This compact PDF is a revision companion, not a replacement for full syllabus textbooks.