

Introduction to Ecology

Introduction to Ecology – Study Notes

1. What Is Ecology?

- **Definition:** The scientific study of how organisms interact with each other and with their physical environment.
 - **Scope:** Ranges from microscopic interactions (e.g., bacteria and nutrients) to global processes (e.g., carbon cycling).
 - **Goal:** Understand patterns and processes that shape the distribution, abundance, and diversity of life.
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2. Levels of Ecological Organization

Level	Description	Key Questions
Organism	Individual living thing	How does an animal obtain food?
Population	Group of conspecific individuals in a defined area	What regulates population size?
Community	All populations of different species interacting in a place	How do species coexist?
Ecosystem	Community + abiotic (non-living) environment	How energy and nutrients flow?
Biome	Large geographic region with characteristic climate & life forms (e.g., tundra, rainforest)	What climate factors shape life?
Biosphere	All ecosystems on Earth	How does the planet support life?

3. Fundamental Ecological Concepts

1. Energy Flow

- **First Law of Thermodynamics:** Energy cannot be created or destroyed, only transformed.
- **Trophic Levels:**

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- **Producers (autotrophs) ? Primary consumers (herbivores) ? Secondary/tertiary consumers (carnivores) ? Decomposers.**
- **Ecological Efficiency:** ~10% of energy transferred between trophic levels; the rest lost as heat, respiration, waste.

2. Nutrient Cycling

- **Biogeochemical Cycles:** Carbon, nitrogen, phosphorus, water, etc.
- **Key Processes:** Photosynthesis, respiration, decomposition, mineralization, nitrification, denitrification, fixation.

3. Population Dynamics

- **Growth Models:**
 - **Exponential (geometric) growth:** ($N_t = N_0 e^{rt}$) (ideal, unlimited resources).
 - **Logistic growth:** ($N_t = \frac{K}{1 + (\frac{K - N_0}{N_0})e^{-rt}}$) (includes carrying capacity (K)).
- **Regulating Factors:** Birth/death rates, immigration/emigration, resource availability, predation, disease.

4. Species Interactions

- **Competition:** Intraspecific vs. interspecific; resource partitioning.
- **Predation & Herbivory:** Top-down control.
- **Mutualism:** Both species benefit (e.g., pollination).
- **Commensalism:** One benefits, other unaffected.
- **Parasitism:** One benefits, other harmed.

5. Community Structure

- **Species Richness:** Number of species present.
- **Species Evenness:** Relative abundance of each species.
- **Diversity Indices:** Shannon-Wiener, Simpson's index.
- **Succession:**
 - **Primary succession:** Begins on bare substrate (e.g., volcanic lava).
 - **Secondary succession:** Follows disturbance of an existing community (e.g., fire).

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4. Major Ecosystem Types

Ecosystem	Dominant Climate	Typical Producers	Characteristic Fauna
Terrestrial Forest	Warm?moist (tropical) to cold (boreal		