

# Introduction to Ecology

## Introduction to Ecology – Study Notes

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### 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 patterns (e.g., climate change).
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### 2. Levels of Ecological Organization

| Level             | Description                                                               | Typical Scale                                | Key Questions                                         |
|-------------------|---------------------------------------------------------------------------|----------------------------------------------|-------------------------------------------------------|
| <b>Organism</b>   | Individual living entity                                                  | 1?m or less                                  | How does a single organism obtain energy?             |
| <b>Population</b> | Group of conspecific individuals in a given area                          | 10 <sup>2</sup> –10 <sup>7</sup> individuals | What controls population size?                        |
| <b>Community</b>  | All populations of different species that interact in a locale            | Hundreds of species                          | How do species coexist?                               |
| <b>Ecosystem</b>  | Community + abiotic (non?living) environment                              | Watersheds, forests, coral reefs             | How do energy and nutrients flow?                     |
| <b>Biome</b>      | Large geographic region with characteristic climate & dominant life forms | Continental scale                            | What patterns of vegetation dominate?                 |
| <b>Biosphere</b>  | All ecosystems on Earth                                                   | Planetary                                    | How do global processes (e.g., carbon cycle) operate? |

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### 3. Fundamental Ecological Concepts

| Concept        | Core Idea                                      | Example               |
|----------------|------------------------------------------------|-----------------------|
| <b>Habitat</b> | The physical environment where a species lives | A pond for amphibians |

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| Concept                      | Core Idea                                                                            | Example                                                         |
|------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| <b>Niche</b>                 | The role a species plays (resources used, behavior, interactions)                    | The niche of a honeybee: pollinator, nectar feeder              |
| <b>Limiting Factors</b>      | Anything that restricts population growth (biotic or abiotic)                        | Food scarcity, temperature extremes                             |
| <b>Carrying Capacity (K)</b> | Maximum sustainable population size in a given environment                           | K of deer in a forest depends on available forage               |
| <b>Succession</b>            | Directional change in community composition over time                                | Primary succession on volcanic lava ? lichens ? mosses ? forest |
| <b>Energy Flow</b>           | One-way transfer of energy through trophic levels (producer ? consumer ? decomposer) | Sun ? phytoplankton ? zooplankton ? fish ? shark                |
| <b>Nutrient Cycling</b>      | Recycling of elements (C, N, P, etc.) through biotic and abiotic reservoirs          | Decomposition returns nitrogen to soil                          |

## 4. Energy in Ecosystems

1. **Source:** Solar radiation (photosynthesis) ? primary production.
2. **Trophic Levels:**
  - o **Producers (autotrophs)** – capture solar energy.
  - o **Primary consumers (herbivores)** – eat producers.
  - o **Secondary & tertiary consumers (carnivores/omnivores)** – eat other consumers.
  - o **Decomposers (fungi, bacteria)** – break down dead organic matter.
3. **Energy Loss:** ~10% of energy transferred to the next level (10% rule).
4. **Ecological Pyramids:** Visual tools showing decreasing energy, biomass, or number of organisms upward through trophic levels.

## 5. Matter (Nutrient) Cycles

| Cycle           | Main Processes                                                  | Key Organisms                          |
|-----------------|-----------------------------------------------------------------|----------------------------------------|
| <b>Carbon</b>   | Photosynthesis, respiration, decomposition, combustion          | Plants, microbes, animals              |
| <b>Nitrogen</b> | Nitrogen fixation, nitrification, assimilation, denitrification | Rhizobia bacteria, nitrifying bacteria |

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## Cycle

## Main Processes

## Key Organisms

**Phosphorus** Weathering ? dissolution, uptake, sedimentation    Plants, fungi, aquatic microbes

**Water**      Evaporation, transpiration,