

Module 1: Ecology Fundamentals

Introduction to Ecology

Ecology is the study of interactions between organisms and their environment. This module introduces fundamental ecological concepts.

Levels of Ecological Organization

Individual

A single organism responding to environmental conditions.

Population

A group of individuals of the same species living in the same area.

Community

Multiple populations of different species interacting in an area.

Ecosystem

A community of organisms together with their physical environment.

Biome

Large-scale ecosystems characterized by climate and vegetation.

Biosphere

All life on Earth and the environments in which it exists.

Abiotic and Biotic Factors

Abiotic Factors

Non-living components of the environment: - Temperature - Water availability - Sunlight - Soil composition - pH levels - Wind patterns

Biotic Factors

Living components of the environment: - Predators - Prey - Competitors - Symbionts - Decomposers

Energy Flow in Ecosystems

Food Chains and Food Webs

- **Producers:** Autotrophs that capture energy (plants, algae)
- **Primary Consumers:** Herbivores that eat producers
- **Secondary Consumers:** Carnivores that eat primary consumers
- **Tertiary Consumers:** Top predators
- **Decomposers:** Break down dead organic matter

Energy Pyramids

Energy decreases at each trophic level: - Only about 10% of energy transfers between levels - Most energy is lost as heat - Limits the number of trophic levels

Nutrient Cycles

Essential elements cycle through ecosystems: - **Carbon Cycle:** Movement of carbon through atmosphere, organisms, and Earth - **Nitrogen Cycle:** Conversion of nitrogen between forms - **Water Cycle:** Movement of water through ecosystems - **Phosphorus Cycle:** Movement of phosphorus through ecosystems

Population Ecology

Population Growth

- **Exponential Growth:** Unlimited growth under ideal conditions
- **Logistic Growth:** Growth limited by carrying capacity
- **Carrying Capacity:** Maximum population size an environment can support

Population Regulation

- **Density-Dependent Factors:** Competition, predation, disease
- **Density-Independent Factors:** Weather, natural disasters