

Ch. 4 - Ecology, Ecosystems and Food Webs

What is Ecology? Is the study of relationships between organisms and their environment!

Organism – any form of life

Species – groups of organisms that resemble one another in appearance, behavior, chemistry and genetic endowment.

Wild and domesticate species

Population – a group of interacting individuals of the same species that occupy a specific area at the same time

Community – populations of different species occupying a particular place at the same time

Ecosystem – a community of different species interacting with one another and with the nonliving environment of matter and energy

Earth's Life-Support systems

Major parts of the Earth – Core, mantle, crust

Lithosphere – Earth's crust and upper mantle

Atmosphere – troposphere, stratosphere, mesosphere, thermosphere

Hydrosphere – Earth's liquid water, ice and water vapor

Geosphere –

Biosphere – all living organisms (plant and animal)

What sustains life on Earth?

The one-way flow of high-quality (usable) energy from the Sun

The cycling of matter and nutrients through parts of the ecosphere

Gravity – allows Earth to hold onto its atmosphere and causes the downward movement of chemicals in the matter cycles.

Open and closed systems:

Open: flow of energy and matter in and out of the system

Closed: only flow of energy into and out of the system. No flow of matter

Sun: Nuclear fusion

How the Sun helps sustain life on Earth

Supplies energy for photosynthesis

How the Nutrient Cycles Sustain Life

Nutrient – any atom, ion or molecule an organism needs to live, grow or reproduce

Macronutrients – nutrients needed in large amounts

Micronutrients – nutrients needed in small or trace amounts.

Natural Greenhouse Effect: greenhouse gases are water, carbon dioxide, methane, nitrous oxide and ozone.

4-3 Ecosystems:

land: Biomes (determined largely by the climate) - see Video: BIOMES

water: Aquatic Life Zones

ECOTONES - Boundaries of an ecosystem

Components of an Ecosystem:

Abiotic - nonliving (water, air, nutrients, solar energy)

Biotic - living - (plants and animals)

Range of Tolerance (Tolerance limits) The Law of tolerance: The existence, abundance and distribution of a species in an ecosystem are determined by whether the levels of one or more physical or chemical factors fall within the range of tolerance by that species.

Limiting Factor principle. Too much or too little of any abiotic factor can limit or prevent growth of a population, even if all other factors are at or near the optimum of tolerance.

Major Living components of an ecosystem

Producers (autotrophs)

photosynthesis

chemosynthesis

Consumers

Herbivores - plant eaters, primarily feed on producers

Carnivores – meat eaters -

secondary - feed only on primary consumers (herbivores)

tertiary - feed only on other carnivores

Omnivores - eat plants and animals

Other consumers:

scavengers:

Detritivores

Decomposers

Respiration

Aerobic

Anaerobic

Food Webs and Energy Flow in Ecosystems

Food Chain: high quality energy (sunlight) is converted to nutrients by photosynthesis. This energy is passed on to consumers and eventually decomposers. Low quality heat is emitted into the environment

Trophic Level: feeding level

- producers
- 1st trophic level - primary consumers
- 2nd trophic level - secondary consumers
- 3rd trophic level - etc.

Food Web is interconnected food chains (v. complex)

1. grazing food webs
2. detrital food webs

Biomass

Ecological Efficiency - the percentage of energy transferred from one trophic level to another.

a 10% efficiency means that 90% of the energy is lost.

Pyramids of Energy Flow - illustrate energy loss in a food chain help explain how the Earth can support more people if people would eat more grains, vegetables, etc., and not eat consumers of those grains (steer, deer, etc.)

Top level carnivores (eagles, hawks, tigers, sharks) are few in number and are the first to suffer when the ecosystems are disrupted. - making them especially vulnerable to extinction.

Storage of biomass at various trophic levels can be represented by a pyramid of biomass.

Pyramid of Numbers -

Gross Primary Productivity (GPP) - the rate at which an ecosystem's producers convert solar energy into chemical energy as biomass

Net Primary Productivity (NPP) - biomass that is left after producers use some for their own use.

How do Ecologists learn about Ecosystems?

- Field Research
- Lab Research
- Systems Analysis
- Systems Measurement -
- Data Analysis -
- Systems Modeling -
- Systems Simulation -
- Systems Optimization -

Ecosystem Services and Sustainability

Why is Biodiversity such an important ecosystem service?

Biodiversity the many forms of life the conditions

Genetic diversity – variability in the genetic makeup among individuals in a single species

Ecological diversity – the variety of biological communities that interact with one another and with their abiotic environment

The two Basic Principles of Ecosystem Sustainability

1. By using renewable solar energy as their energy source
2. by recycling reasonably efficiently the nutrients its organisms need for survival, growth and reproduction

These two processes are common to all ecosystems