

**Supplementary Notes (PJ Shlachtman, Miller book)
Ecology, Ecosystems and Food Webs**

Ecology – five levels of matter in nature

Organisms > Populations > Communities > Ecosystems > Ecosphere

Parts of the Earth

Core – inner and outer (iron)

Mantle – includes the asthenosphere

Lithosphere – upper mantle and crust

Atmosphere

thermosphere

mesosphere

stratosphere – ozone layer

troposphere – lower atmosphere (climate)

Hydrosphere – water

Biosphere – ecosphere

What sustains life on earth?

- one-way flow of energy
- cycling of matter and nutrients
- gravity

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

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

Ecosystems:

- land: Biomes (determined largely by the climate)
- water: Aquatic Life Zones

Components of an Ecosystem:

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

Biotic – living (plants and animals)

Ecotones – Boundaries of an ecosystem

Range of Tolerance – minimum and maximum conditions under which a species can survive

Limiting Factor – too much/little of a single factor can limit/prevent growth even though all other factors are at/near optimum levels

Major Living components of an ecosystem

Producers (autotrophs)

photosynthesis

chemosynthesis

Consumers

Herbivores

- plant eaters
- **Primary** – feed directly on producers

Carnivores

- 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 an interconnected food chains (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)
 - few in number and are the first to suffer when the ecosystems are disrupted.
 - thus 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 – go out and see/measure what's going on in nature

Lab Research – observe/model parts of nature under controlled conditions

Systems Analysis – simulates ecosystems to study structure and function

Systems Measurement – Define objectives; identify and inventory variables; obtain baseline data on variables

Data Analysis – Make statistical analysis of relationships among variables; determine significant interactions

Systems Modeling – construct mathematical models describing interactions among variables

Systems Simulation –run the model on a computer to evaluate different values for variables

Systems Optimization – evaluates best ways to achieve objectives

Ecosystem Services and Sustainability

Why is Biodiversity such an important ecosystem service?

The two **Basic Principles of Ecosystem Sustainability**

1. nature uses renewable solar energy as energy source
2. nature recycles relatively efficiently.