Chapter 3: Principles of Ecology

I) Organisms and their Environments

Nature study or natural history: ex. bird watching & identifying – learning as much as possible about living things

Ecology is a branch of biology that developed from natural history.
Ecology: is the scientific study of the interactions between organisms and their environments

- reveals inter-relationships between living and nonliving things
- combines information from many scientific fields
- use qualitative (descriptive data) & quantitative (numeric data)

The **Biosphere**: is that part of the earth that supports life.

- extends form the atmosphere to the depths of the oceans
- would be the peel on an apple (very thin in comparison to space & the size of the earth)

Biotic factors: are the living organisms that inhabit an environment

- all living things adapt to their particular environment

Abiotic factors: are the nonliving parts of the environment

- ex. temperature; light, soil, air currents

The levels of organization is termed the **Hierarchy of Life**: how organisms are grouped together….GOING FROM SMALLER NUMBERS TO LARGE NUMBERS

1) the **individual organism**
2) **POPULATION**: a group of organisms of one species living in the same place at that same time that interbreed
   - compete for food, water, mates, other resources
3) a **COMMUNITY**: is a collection of interacting populations
   - a change in one population will cause a change in another population
4) an **ECOSYSTEM**: is made up of the interactions among the populations in a community & the community's physical surrounding / abiotic factors
   - includes terrestrial communities: on land
   - aquatic ecosystems = ponds, lakes, streams, oceans
   - marine ecosystems = saltwater
5) **BIOSPHERE**: highest level of organization; entire planet & all living and nonliving things

Every organism plays a role in the community; ex. fungi breakdown the bodies of dead organisms.
NICHE = the role a species plays in a community; part of its niche are the space, food, and other conditions an organism needs to survive & reproduce; how a species uses & affects its environment

HABITAT = is the place where an organism lives out its life (much simpler than a niche)

II) How Organisms Interact:

Why are there interactions?

- organisms obtain energy & materials for life processes
- maintain homeostasis in populations, communities, ecosystems

Feeding relationships:

Autotrophs: are organisms that use energy from the sun / stored energy in chemical compounds to make food ➔ called PRODUCERS
- most common are plants; single-celled organisms
-all other organisms are dependent upon autotrophs

Heterotrophs: are organisms that depend upon autotrophs for nutrients & energy ➔ called CONSUMERS …cannot make their food, they consume it

Herbivore: consumer that feeds only on plants; ex. cows; rabbits; mice; squirrels

Carnivores: animals that kill & eat other animals = heterotrophs that eat heterotrophs

Scavengers: animals that don't kill but eat dead animals; ex. vultures
- feed on carrion, refuse, dead organisms

Omnivores: eat a variety of foods that include both plants & animals; ex. humans, coyotes; bears; raccoons

Decomposers: organisms, such as fungi, that breakdown & absorb complex compounds from dead organisms; ex. bacteria, protozoans, fungi

Relationships for survival:

Predator-prey: harmful to one species but beneficial to another
Ex. lions kill wildebeest; lion is the PREDATOR, the PREY is the wildebeest

Symbiosis: close & permanent association between organisms of different species.
- means "living-together"
- many types of symbiotic relationship

1) COMMENSALISM (SYMBIOTIC RELATIONSHIP):
- one species benefits & the other is neither harmed nor benefited

- ex. red-breasted geese & peregrine falcon; the falcon defends the territory near its nest so the geese nest near the falcon & are not harmed even though the geese are normally the prey for the falcon (smart geese!)
- the geese benefit; the falcon does not benefit nor is harmed

2) MUTUALISM (symbiotic relationship):
- both species benefit
- ex. ant & acacia tree….ant protects the tree from herbivores; tree provides nectar & home for the ants

3) PARASITISM (symbiotic relationship)
- one organism provides derives benefit at the expense of the other
- the one providing the benefit is the HOST
- ticks/fleas that live off cats/dogs
-ex. tapeworms & roundworms live in the bodies of their host

III) Matter & energy in ecosystems:

Matter & energy are constantly cycling through ecosystems

FOOD CHAIN: simply model showing matter & energy moving
- move from autotrophs → heterotrophs → decomposers
- TROPHIC LEVEL = feeding steps in the food web
- ex. algae → fish → heron

- first trophic level = autotrophs (producers)
- second trophic level = herbivores (1st order consumers)
- third trophic level = carnivores (2nd order consumers)
- fourth trophic level = carnivores that feed on 2nd order consumers

- portion of energy lost at each link
- food chains, thus, only 3 to 5 links
- by fifth link, very little energy left
- food chain represents only one route for energy transfer (there can be many)

FOOD WEB: more complex model; interconnected food chains;
- model that shows all possible feeding relationships at each trophic level
- more natural representation

ECOLOGICAL PYRAMIDS: model that depicts energy conversion in an ecosystem
- energy decreases as the pyramid goes higher
- producer → herbivore → carnivore → top carnivore

PYRAMID of ENERGY
- about 10% of energy is transferred at each level; rest is lost as heat or used

PYRAMID of NUMBERS:
- based on population sizes of organisms
- source for all ecological pyramids is the sun
- ex. grass→ grasshoppers → robins→ hawk

PYRAMID of BIOMASS:
- uses weight of living material at each level
- average weight multiplied by number of organisms

MATTER recycled in the ecosystems:
- matter recycled since not replenished as energy from the sun

WATER CYCLE:

- water absorbed by plants
- animals drink/get water in food
- water lost to atmosphere by respiration; evaporation; transpiration from plants
- precipitation sends water back to earth

CARBON CYCLE:

- CO_2 found in the atmosphere
- used by plants in photosynthesis (CO_2 + water = sugar + oxygen)
- decay & respiration return carbon to the air
- carbon returned to air when fossil fuels are burned

NITROGEN CYCLE:

- nitrogen makes up 78% of the atmosphere
- lightning & bacteria convert nitrogen as a gas into nitrogen compounds in the soil
- nitrogen fixing bacteria convert nitrates into molecules contained nitrogen
- organisms return N_2 to the air when they die & decay

PHOSPHOROUS (P) CYCLE

- P is important in energy transport in the cell
- plants use P in the soil
- animals eat the plants
- plants & animals die & P is returned to the soil
- phosphates also wash into the ocean & are incorporated in rocks