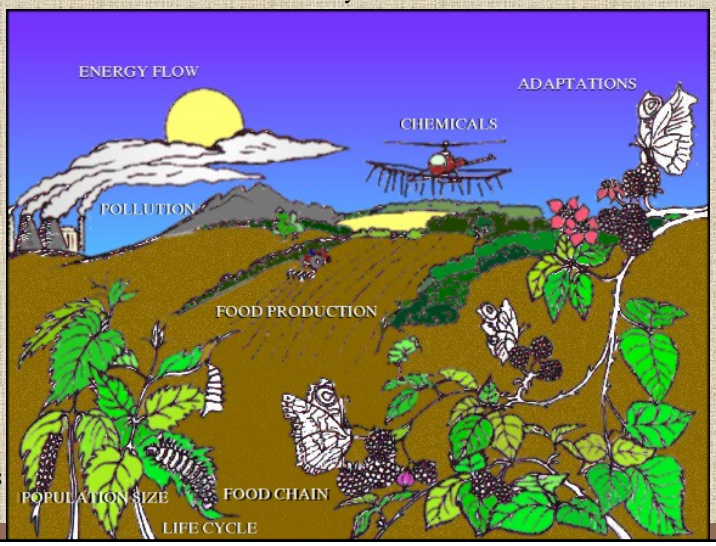
Ecology

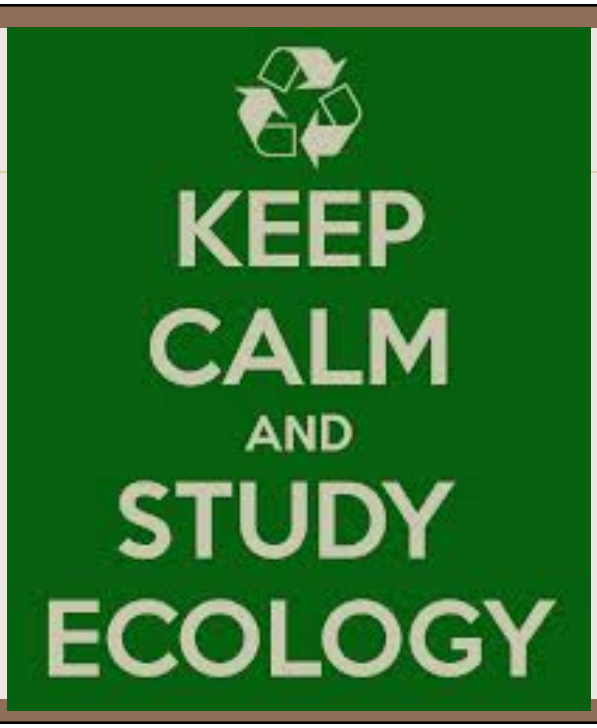
the study of the interactions between organisms & the ecosystem



1. <u>Levels of Ecological organization</u>

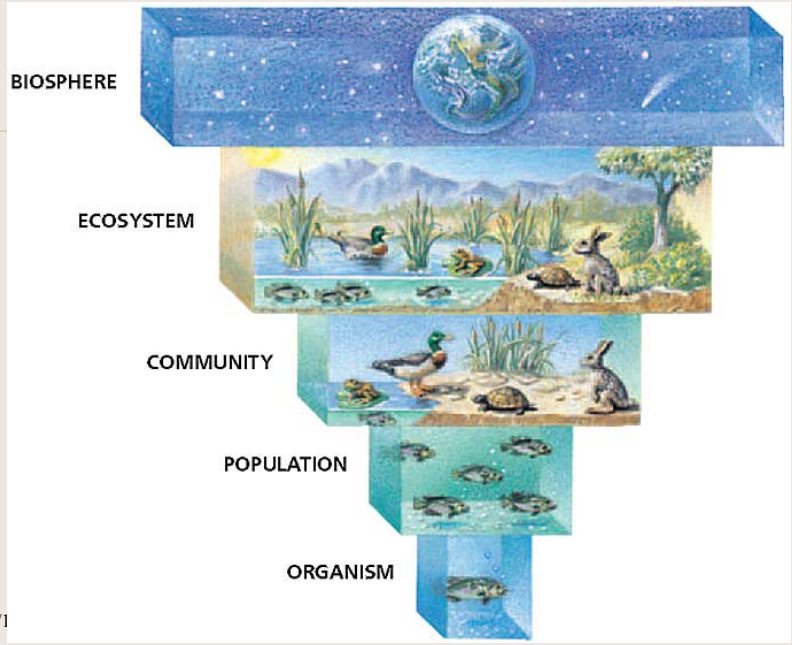
A. Biosphere- Earth, atmosphere and all life
B. Biome- region noted by climate, fauna (animals) and flora (plants)

Biomes can be aquatic /water, such as marine or terrestrial /land such as tundra or desert



1. Levels of Ecological organization

C. Ecosystem- the living & nonliving components
D. Community- all of the living components of an ecosystem
E. Population- all of the members of the same species living together in the same place (at the same time)
F. (Individual) organism
G. VS. Biological classification: KPCOFGS


BIOSPHERE
ECOSYSTEM
COMMUNITY
POPULATION
ORGANISM


ATTEMPTED MURDER

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2. Ecosystems have…

A. Abiotic factors- non living components (never were living!) wind, sun, water, rocks
B. Biotic factors- living or once living: animals, plants, dead log, rotted leaves, skeletal remains

FYI… Ecosystem boundaries are defined as a matter of convenience

What can be an ecosystem?

Lake

Rotting log

The state of PA, now you list 3

3. Trophic Levels- groupings based on feeding position

a) Producers (autotrophs)- feed all consumers
b) 1° consumers- (herbivores)
c) 2° consumers- (eat 1° consumers)
d) Chemoautotrophs- producers that make their energy from chemicals, not the sun

4. The Sun is the Earth's primary energy source

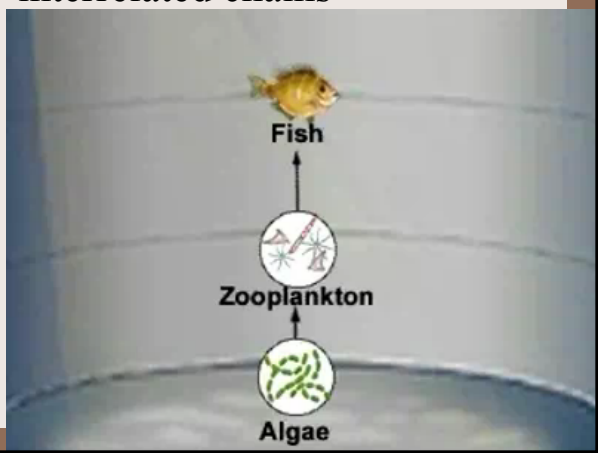
a. Herbivores eat producers, carnivores eat consumers
b. Omnivores eat producers & consumers
c. Scavengers-consume carcasses
d. Decomposers (bacteria and fungi) feed on dead organic matter, this process makes detritis
e. Detritivores- (worms, shrimp, crabs) feed on detritis- also digest decomposers

Visual Concept

5. Energy moves from one **trophic level** to the next, it is NOT recycled (water is, Carbon is, Nitrogen is, etc.)

a) Food Chain- 1 pathway

b) Food web- interrelated chains



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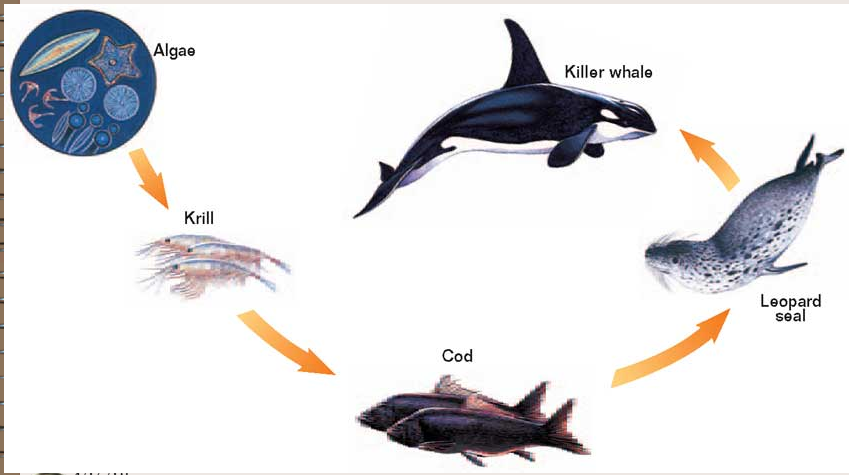
Food Chain in an Antarctic Food Ecosystem



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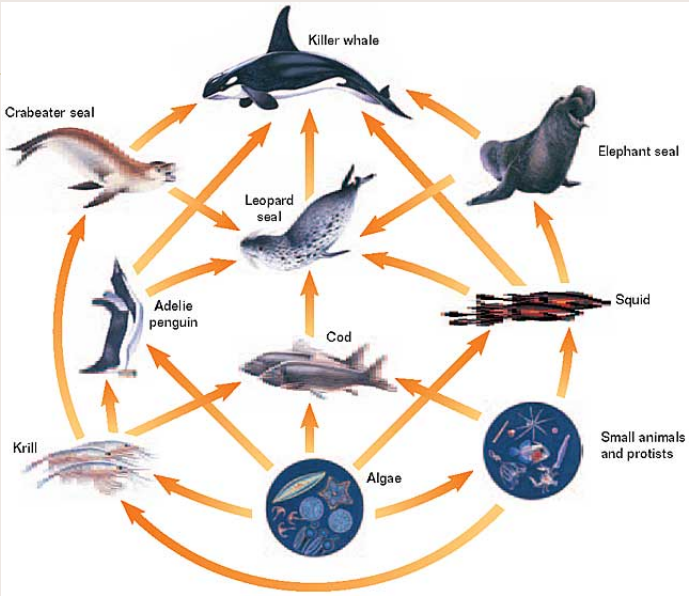
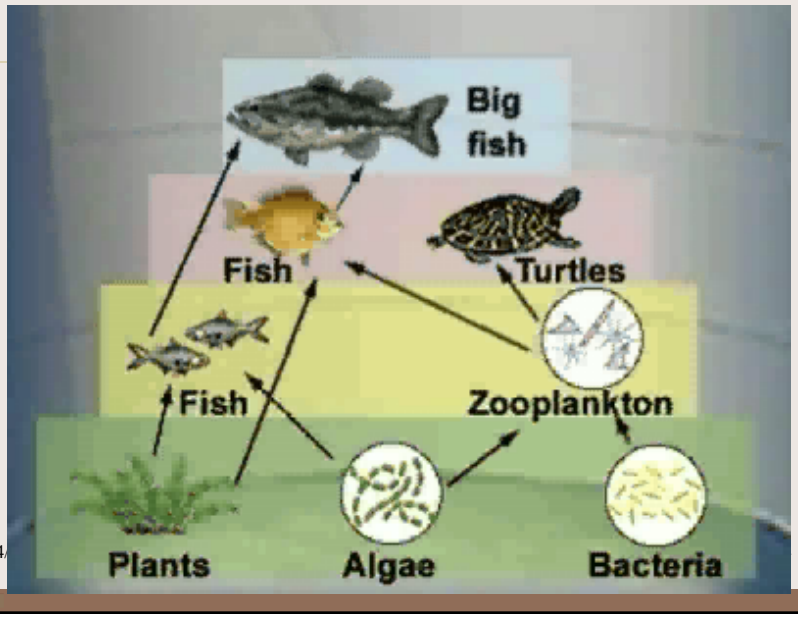
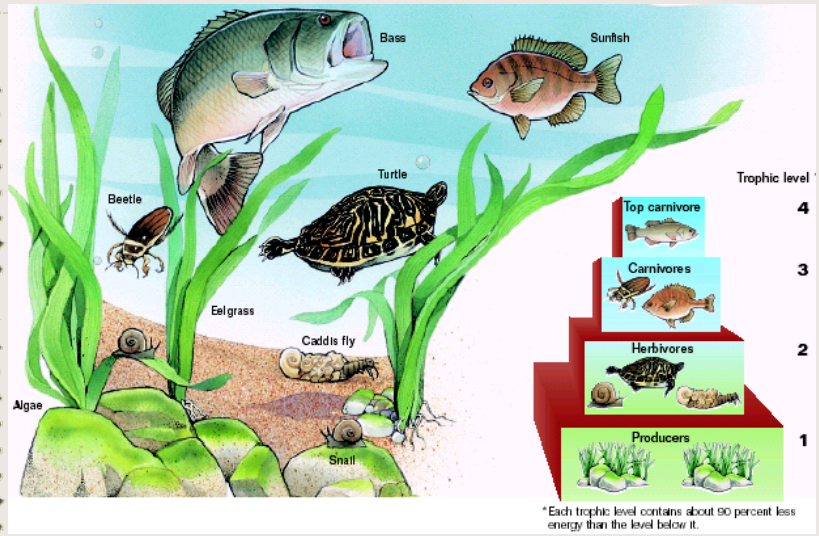
Food Web in an Antarctic Ecosystem



6. Energy transfer through trophic levels



Trophic levels in an aquatic ecosystem

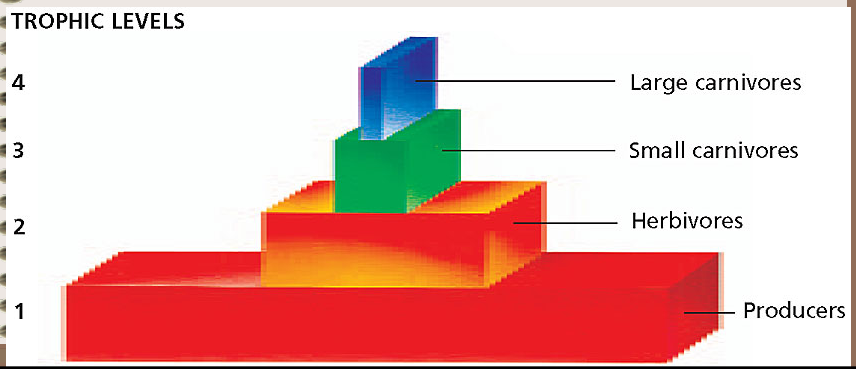


6. Energy transfer through trophic levels

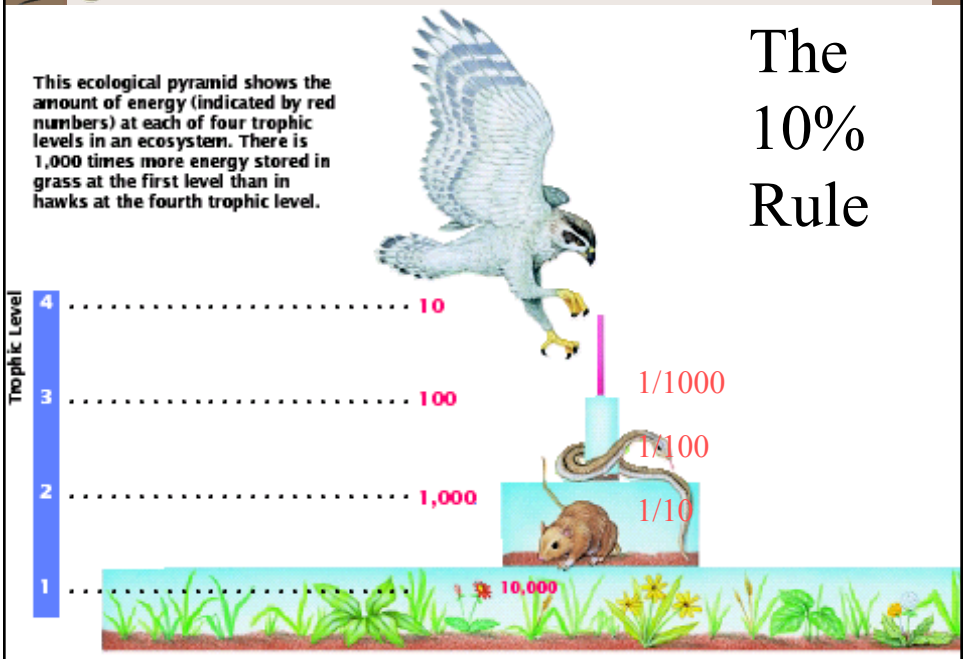
a) Pyramid shows energy stored

b) 10% transfers from one level to the next

c) Energy loss - many factors such as heat & energy to sustain its own life

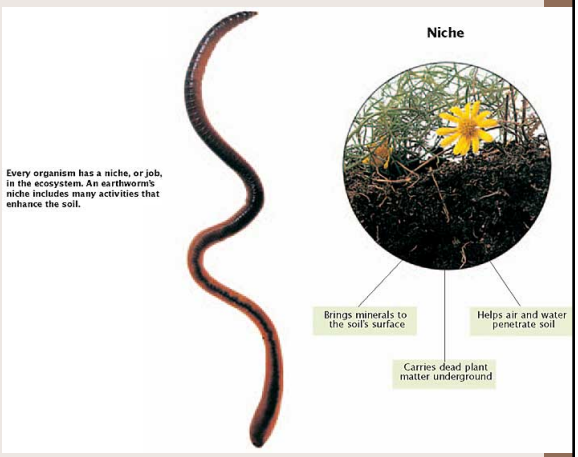


The 10% Rule



7. Niche role an organism plays, resources used, contribution to environment. More niches = more diversity

A. Competitive exclusion principle- no 2 species in the same niche, same place at the same time



8. Interspecific Competition- 2 or more species use the same limited resource

a. Symbiosis- sym together, bio life
b. Predation
c. Prey- food for the predator
d. Mutualism
e. Commensalism
f. Parasitism

9. Recycling of matter

a. Energy flows in one direction, but nonliving materials flow in a cycle/circular
b. biogeochemical cycles – the pathway that materials take from the nonliving, to the living and back again
c. 4 Cycles: Water, Nitrogen, Carbon, Phosphorus *(Note: there are more than 4 cycles, we will just cover these!)*

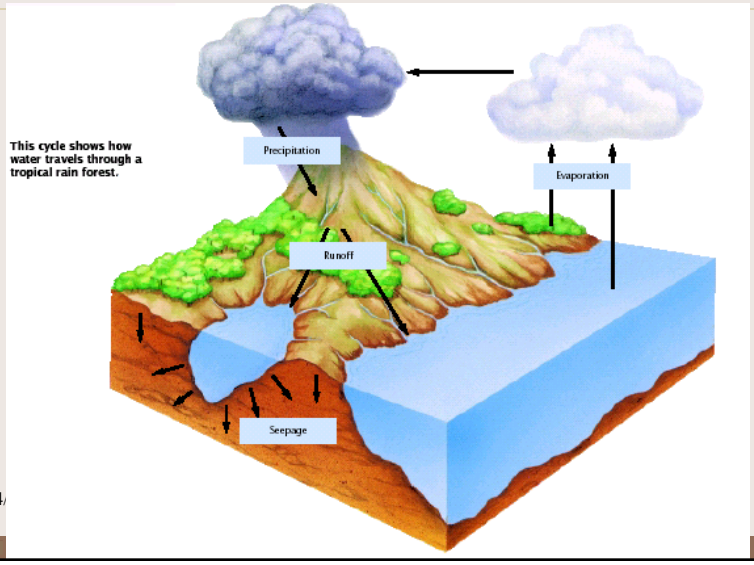
Carbon, Water, Phosphorus, Nitrogen

- Describe the cycle
- Where is it stored?
- Why is it important for life?
- How does it enter living things (the biotic world?)
- How is the cycle disrupted (what goes wrong)? Typically this is due to humans.
- Is it stored & or usable from the atmosphere?

Specific to the cycles:
Water- describe precipitation, transpiration, evaporation, condensation, runoff
Nitrogen- describe fixing, nitrification, denitrification
Carbon-how does it exit the biotic world
Phosphorus- it is part of which 3 biomacromolecules?

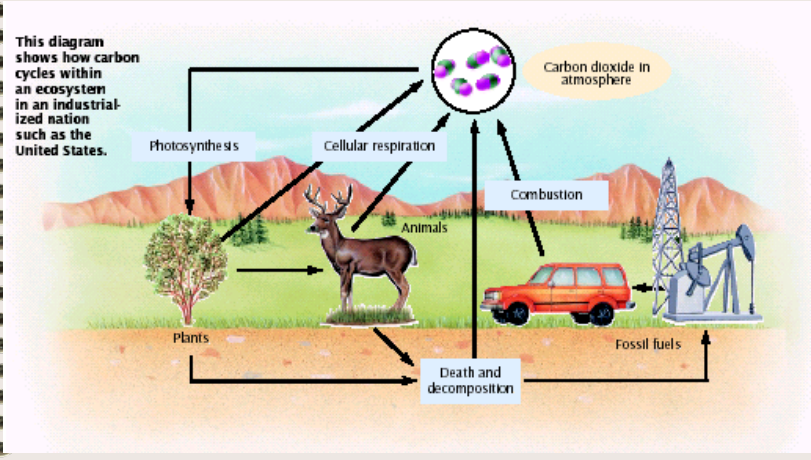
The water cycle

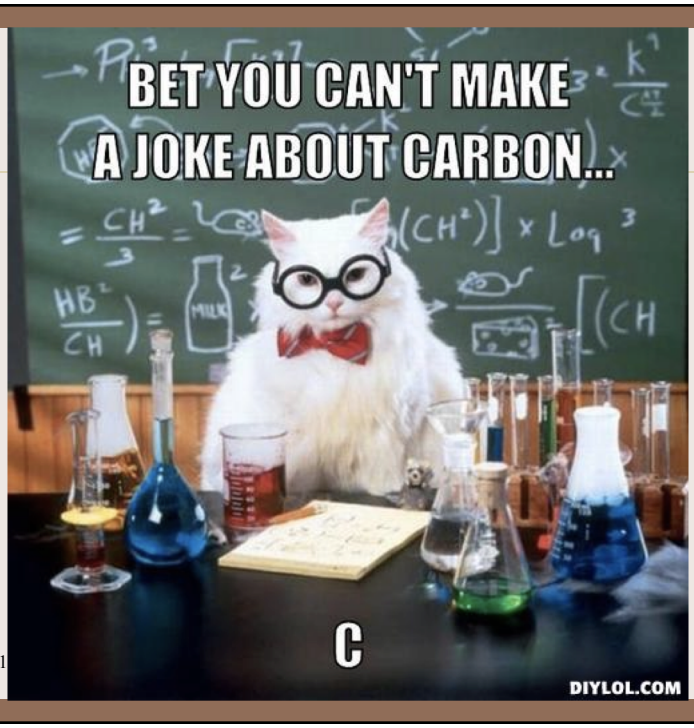
Visual Concept



The carbon cycle

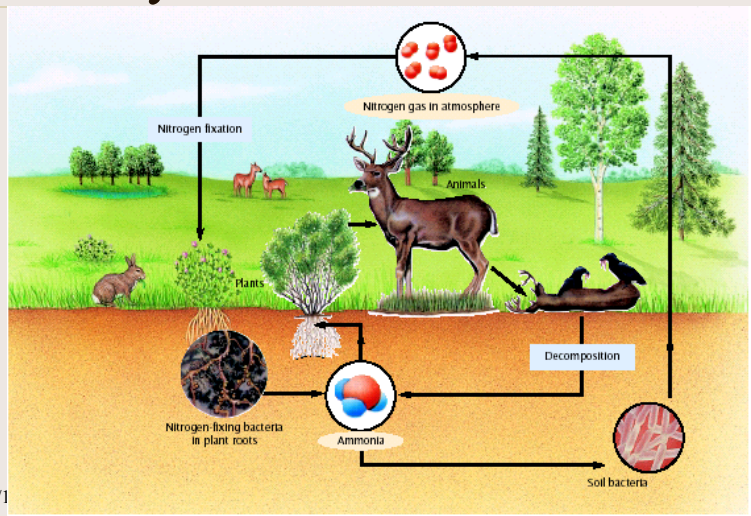
Visual Concept

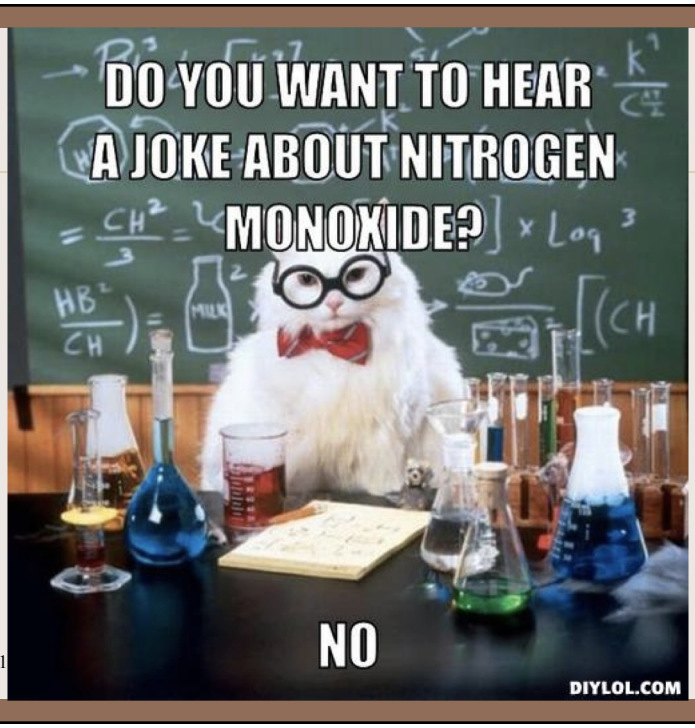




The nitrogen cycle

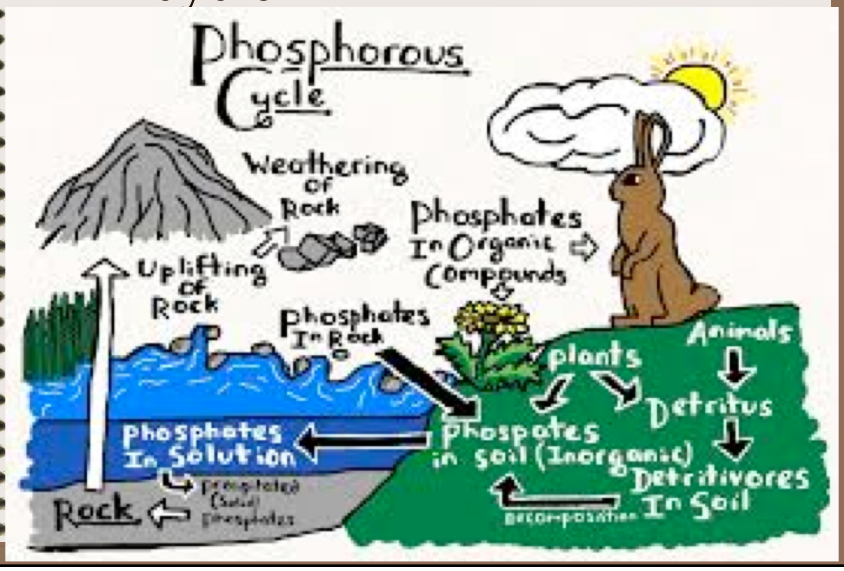
Visual Concept

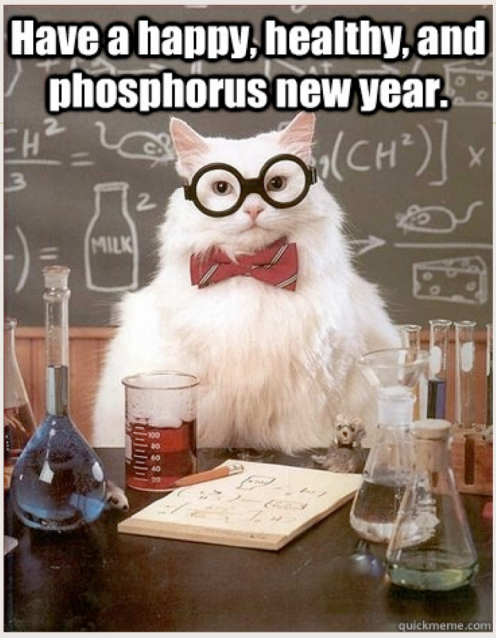




The phosphorus cycle

Visual Concept





Question: What would happen if one of these cycles stopped?

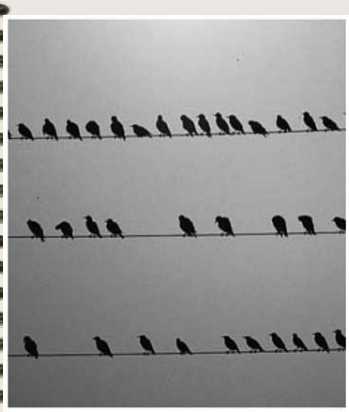
Living things would quickly lose the ability to build new material, as the effects are seen rising through the energy pyramid.

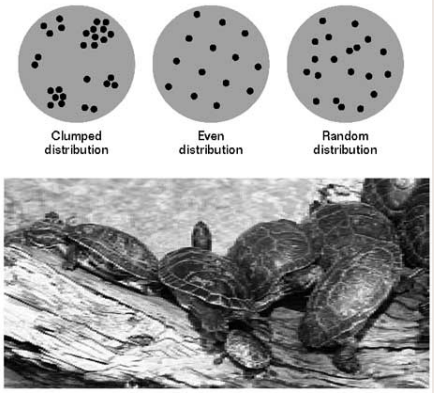
10. Population Dynamics

a) Density- how crowded (together)is the population?
b) Size (# of individuals)

10. Population Dynamics

c. Distribution- are they clumped, uniform, random?





This panel, *top right*, shows the three patterns of dispersion possible in populations. Turtles seeking the warmest basking sites form a clumped distribution, *bottom right*. Starlings arrange themselves evenly along telephone lines, *left*.

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11. Measuring Populations

a. Growth rate- birth rate minus death rate (+ indicates increase in pop)

b. Immigration, emigration (immigration > emigration indicates increase in pop)

So….. someone that comes TO the US from their native, Russia, for example is an immigrant to the US, but emigrated from Russia

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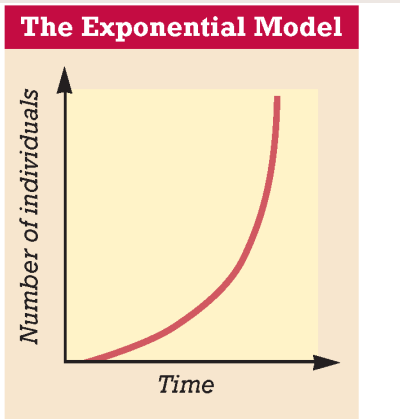
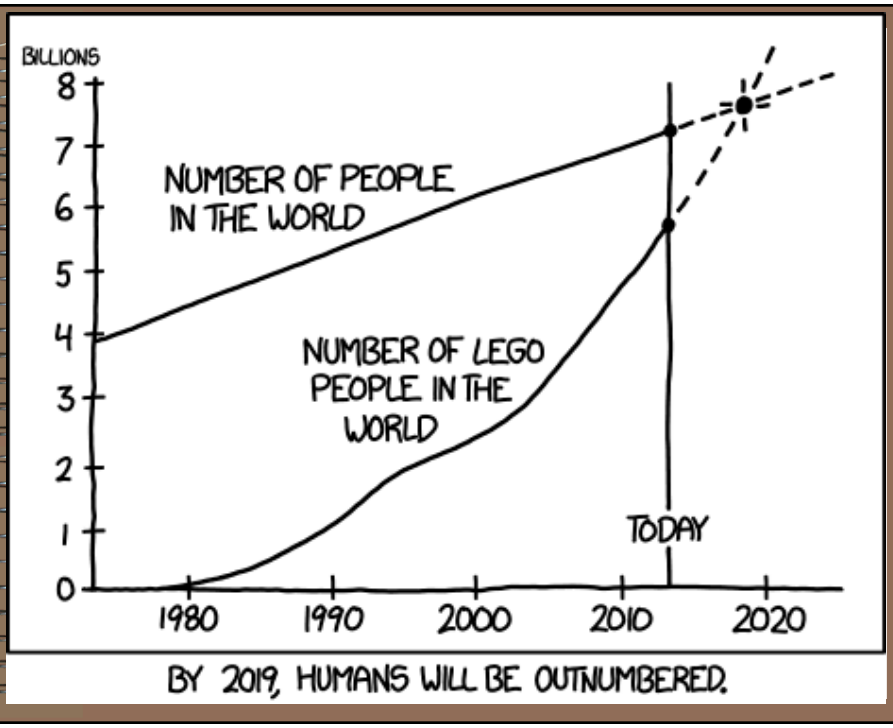
12. Two models

Visual Concept

a. Exponential- increase in number due to steady, unchallenged growth



- J shaped curve
- Constant increase
- Nothing to limit growth
- Can't continue (why?)

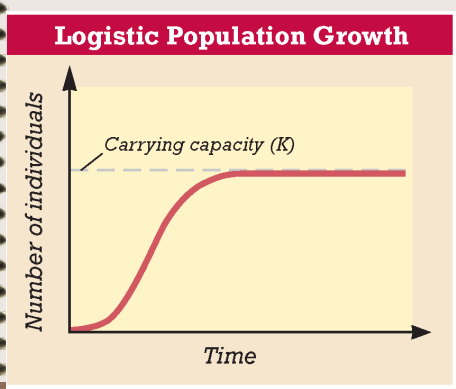


12. Two models

Visual Concept

b. Logistical- accounts for limiting factors

- Carrying capacity (K) - number of individuals the environment can support over time.



•"S" shape, but not really

•At K, birth rate=death rate

•K DOES go up and down for many reasons

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13. Regulation (of populations)

a. Density independent factors - # of organisms doesn't matter- weather, flood, forest fires (affect all populations in the same way such as clearing forests)

b. Density dependent factors- size of pop. matters- shortage of food, shelter, nesting site. Individual's chance of survival depends on its ability to be competitive (nesting space)

Visual Concept

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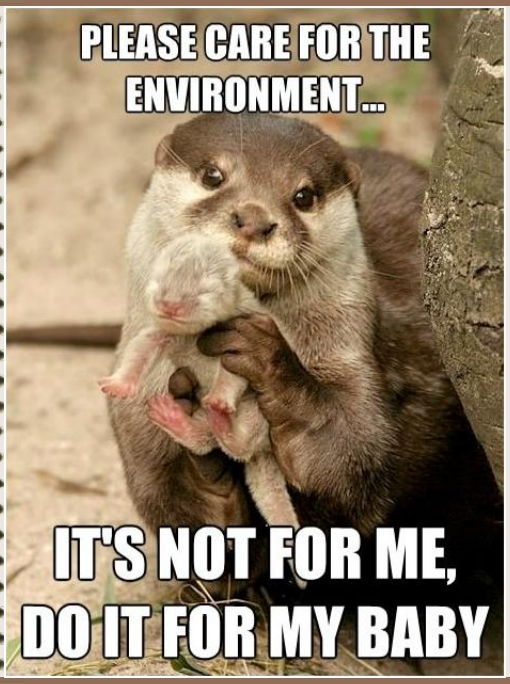

Density dependent AND density independent limiting factors can be Interrelated: loss of habitat due to man's influence

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14. Man's effect on the ecosystem

a) Healthy ecosystems provide free food and water
b) Lack of sustainability disrupts the cycle
c) Dustbowl of the 1930s- soil erosion
d) Desertification- farmland turns to desert
e) Deforestation- loss of forests
f) Water pollution- enter from a single incident (point source), or from multiple- non point source as in oil from cars, road salt, herbicide
g) Biological magnification- pollutant not broken down & gets passed on

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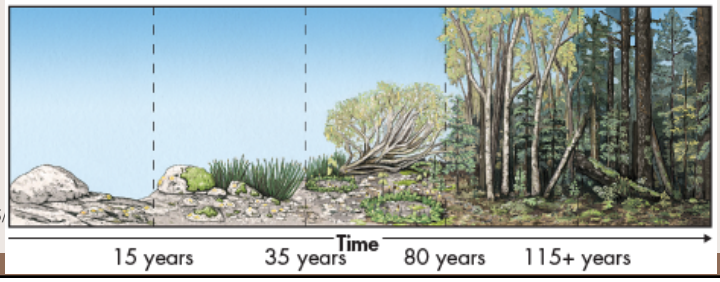
15. Ecological Succession- change in species composition in a community over time

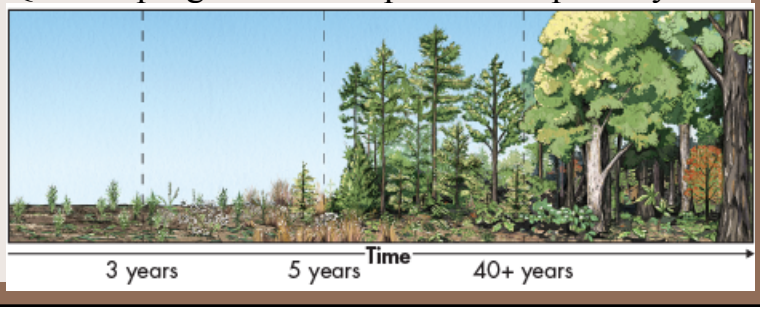
a) Primary- newly created habitat; never supported life before OR life was completely obliterated & shows no remnants of older community

b) The first species to colonize a barren landscape is a pioneer species



16. Secondary Succession- change in an existing community following a disturbance

a) Existing communities not completely destroyed
b) Leads to stable end point called a climax community
c) disturbance? Forest fire, volcano, etc.
d) Quicker progression compared with primary



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17. Controlled burns

a) Good vs. bad fires (Good actually prevents bad)
b) "Reset Button"- reduce non natives & pests
c) Improve food source for natives
d) Eliminate "fuel" buildup

18. Biodiversity

a) Important to medicine, agriculture, health of ecosystem
b) Damaged by introduced species- invasives, hunting to extinction, releasing pollutants
c) Ecological footprint
d) Hole in the ozone

Water and Nutrient Cycle Notes; minimally know the following:

a) Carbon Cycle- carbon enters the biotic world via photosynthesis and exits the biotic world through exhalation. Carbon can enter the atmosphere by burning of fossil fuels. Exists as dead organic matter, co2 in air, carbonate in rocks, fossil fuels (coal, petrol, nat gas)

- Important for all organic compounds
- It exists: in the air, water, living and once living things
- Problems: too much in atmosphere causing climate change (global warming)
- Enters the biotic world by respiration (breathing it in) OR eating (consuming it) OR plants take it up and turn CO2 to carbohydrates
- Exits the biotic world by death/decay, exhaling, or other waste products (cow farts)
- Also, burning releases CO2- manmade, or accidental burning

Water and Nutrient Cycle Notes; minimally know the following:

- Water Cycle- transpiration (water movement through plants), evaporation (liquid to gas), condensation -water vapor collects in tiny droplets (clouds form), precipitation – water falls to surface(rain, snow, etc), causes runoff (rain runs off land and moves to bodies of water) driven by the sun Needed for cell respir/photosyn, pollution disrupts the cycle, stored in ocean, land precipitation – water falls to surface(rain, snow, etc), causes runoff (rain runs off land and moves to bodies of water)
- Problems: pollution

Water and Nutrient Cycle Notes; minimally know the following:

c) Nitrogen cycle: 79% of N in air is N2 gas; nitrogen must be modified to be useful: nitrogen is fixed into ammonia by soil bacteria or can be fixed by lightning Nitrification of ammonia to nitrites and nitrates by other soil bacteria Plants take up nitrogen from the soil,Consumers consume the nitrogen - driven by bacteria and provides the soil with rich nutrients

important for amino acids (proteins) and DNA & RNA

78% of air is nitrogen, but we can't use it!

Nitrogen fixation (fixing) bacteria (from legumes, etc) convert N to ammonia (still can't use it). Lightning can also fix N

Nitrification other bacteria convert ammonia to nitrates and nitrites (plants and animals CAN use that). Producers use it to make proteins, consumers eat the producers

Denitrification- nitrates converted to nitrogen gas

Problems (N and P cycles): too much in water from runoff causes overgrowth, when overgrowth dies in water this consumes oxygen from water causing low oxygen content & death of organisms in water

Exits biotic world by excretion and decomposing matter

Water and Nutrient Cycle Notes; minimally know the following:

d) Phosphorus cycle- the only nutrient not atmospheric. needed for bones, teeth and molecules such as DNA, RNA- comes from: rocks, waste, fertilizer Phosphorus is take up by plants thorough rocks. Too much phosphorus via phosphates in water can cause algae bloom.

An algae bloom does not kill directly, but when the algae die, and decomposers move in the decomposers consume oxygen from the water depriving fish of oxygen in the water they need to survive.

Needed for ATP, DNA & RNA

Exists in the soil and rocks- NOT atmospheric

How does it enter biotic world? Plants take it up in the soil or water. Consumers eat it.

Problems: same as over-nitrification