KEYSTONE REVIEW SESSION #8

Ecology

ECOLOGY

- Keystone Standards:
- BIO.B.4.1.1 Describe the levels of ecological organization (i.e., organism, population, community, ecosystem, biome, and biosphere).
- BIO.B.4.1.2 Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.
- BIO.B.4.2.1 Describe how energy flows through an ecosystem (e.g., food chains, food webs, energy pyramids).
- BIO.B.4.2.2 Describe biotic interactions in an ecosystem (e.g., competition, predation, symbiosis).
- BIO.B.4.2.3 Describe how matter recycles through an ecosystem (i.e., water cycle, carbon cycle, oxygen cycle, and nitrogen cycle).
- BIO.B.4.2.4 Describe how ecosystems change in response to natural and human disturbances (e.g., climate changes, introduction of nonnative species, pollution, fires).
- BIO.B.4.2.5 Describe the effects of limiting factors on population dynamics and potential species extinction.

LEVELS OF ECOLOGICAL ORGANIZATION

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
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. Ecological organization is different from Biological classification: Kingdom Phylum Class Order Family Genus Species

BIOTIC VS ABIOTIC

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

TROPHIC LEVELS- GROUPINGS BASED ON FEEDING POSITION

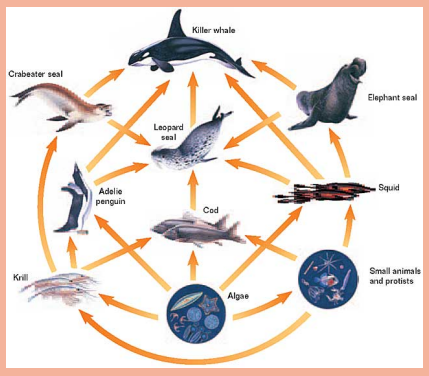
- Producers (autotrophs)- feed all consumers
- 1º consumers- (herbivores)
- 2º consumers- (eat 1º consumers)
- Chemoautotrophs- producers that make their energy from chemicals, not the sun

WHO'S WHO IN THE ZOO?

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

ENERGY MOVES FROM ONE TROPHIC LEVEL TO THE NEXT, IT IS NOT RECYCLED (WATER IS, CARBON IS, NITROGEN IS, ETC.)

- Food Chain- 1 pathway
- Food web- interrelated chains
- Energy transfers through trophic levels
  - Pyramid shows energy stored
  - 10% transfers from one level to the next
  - Energy loss - many factors such as heat & energy to sustain its own life



NICHE ROLE AN ORGANISM PLAYS, RESOURCES USED, CONTRIBUTION TO ENVIRONMENT. MORE NICHES = MORE DIVERSITY

- Competitive exclusion principle- no 2 species in the same niche, same place at the same time… speaking of competition
- Interspecific Competition- 2 or more species use the same limited resource
- Symbiosis- sym together, bio life
- Predation….Prey is food for the predator
- Mutualism both benefit- a type of fish eats the plaque off a bigger fish's teeth
- Commensalism one benefits, the other is unaffected (bird nest in a tree)
- Parasitism – one benefitted, one harmed such as a rabbit with tapeworms. Or tick on a dog

ENERGY FLOWS IN ONE DIRECTION, BUT NONLIVING MATERIALS FLOW IN A CYCLE/CIRCULAR

BIOGEOCHEMICAL CYCLES – THE PATHWAY THAT MATERIALS TAKE FROM THE NONLIVING, TO THE LIVING AND BACK AGAIN

4 CYCLES WE WILL COVER: WATER, NITROGEN, CARBON, PHOSPHORUS (THERE ARE MANY OTHERS)

WATER CYCLE

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

NITROGEN CYCLE

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

PHOSPHORUS CYCLE

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

CARBON CYCLE

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 CO_2 to carbohydrates
- Exits the biotic world by death/decay, exhaling, or other waste products (cow farts)
- Also, burning releases CO_2- manmade, or accidental burning

POPULATION DYNAMICS

- Density- how crowded (together)is the population?
- Size (# of individuals)
- Distribution- are they clumped, uniform, random?
- Measuring Populations
  - Growth rate- birth rate minus death rate (+ indicates increase in pop)
  - Immigration, emigration (immigration > emigration indicates increase in pop)

EXPONENTIAL VS LOGISTICAL GROWTH

- Exponential- increase in number due to steady, unchallenged growth- J shaped, constant increase without any limiting factors
- Limiting factors
  - Density independent factors - # of organisms doesn't matter- weather, flood, forest fires (affect all populations in the same way such as clearing forests)
    - 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)
- Logistical- accounts for limiting factors; "S" shaped, at K, birth rate=death rate, K does fluctuate
  - Carrying capacity (K) - number of individuals the environment can support over time.

MAN'S EFFECT ON THE ECOSYSTEM

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

SUCCESSION

- Primary- newly created habitat; never supported life before OR life was completely obliterated & shows no remnants of older community
  - The first species to colonize a barren landscape is a pioneer species
- Secondary Succession- change in an existing community following a disturbance
  - Existing communities not completely destroyed
  - Leads to stable end point called a climax community
  - disturbance? Forest fire, volcano, etc.
  - Quicker progression compared with primary

BIODIVERSITY

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

VIDEO REVIEW

- Amoeba sisters ecology
- Hank Green: ecology crash course
- Khan Academy Ecology