Matter

ENERGY FLOW

- First Law of Thermodynamics- Energy is conserved, not created or destroyed. It can only change in form.
- Second Law of Thermodynamics- Energy transfers lead to the energy being in a less "useful", lower form. Heat is often the result (think your car engine or incadescent lights).

Conservation of Matter- Matter is neither created or distroyed. It only can recycle itself, unlike energy. Energy always degrades to a less concentrated level.

High Quality Energy: Very concentrated, rich, intense, has high temperatures.
Low Quality Energy: Dispersed, diffused, sporadic, low temperature

Kinetic Energy- energy in motion
Potential Energy- stored energy
Heat Flow- energy is transferred from hot to cold objects

Photosynthesis: Plants convert energy from sun along with carbon dioxide and water into sugars ($C_6H_{12}O_6$) and oxygen within the chlorophyll. Only 1-2% of the sunlight ever makes it into the plant's tissue!

Aerobic Respiration: Oxygen consuming producers, consumers and decomposers break down complex organic compounds (glucose, etc) and convert carbon back into carbon dioxide. The energy stored in the glucose bonds is transformed into chemical and heat energy- it is not lost! The formulas for photosynthesis and respiration are the same but reversed!

Biotic- living components of the ecosystem
Abiotic-nonliving components of the ecosystem

Trophic Levels:

1. Tertiary Consumers- eats secondary consumers
2. Secondary Consumers- eats primary consumers
3. Primary Consumers/Herbivores -eats plants
4. Producers/Autotroph- photosynthesize energy

The biomass (organic matter) of each level is 90% less than the one below it! Only 10% of useable energy is transferred up to the next trophic level because so much is lost. Why?

- Some of the food source many be inedible or indigestible.
- Energy may be expended catching the prey
- Energy is degraded through normal metabolic processes (Second law of thermodynamics).

Food Chain- A linear list of who eats who. The arrow points to who is doing the consuming.
Food Web- A more complex interwoven diagram of which organisms prefers to eat each other. The webs are more complex the closer you get to the equator. The ocean has the most complex food

web of all!

Scavenger- Feeds on dead animals. ex. coyote
Detritivore- Eats leaf litter, dung. ex. ants
Decomposers- organsims that break down or feeds on dead organic matter. ex. Fungus or bacteria

Deep sea animals get their energy by breaking down methane and other gases emitted from deep sea vents (called chemosynthesis)- they do not photosythesize!

NUTRIENT CYCLES

Carbon Cycle: The building blocks of life.

Short cycle: Photosynthesis and Respiration. Carbon is incorporated into a sugar during photosynthesis and then released during respiration. Plants, animals and microbes all respire which send the CO_2 back into the air.

Long term cycle: Carbon can stay in one form for years to thousands of years before changing. Carbon sinks: plants, animals, ocean life (especially in plankton, coral and fish skeletons), coal, oil, atmosphere, and limestone ($CaCO_3$).

Largest storage reservoirs of carbon are in carbonate rocks.

Man is upsetting this cycle by burning fossil fuels and tearing down the jungles and woodlands of the world.

Nitrogen Cycle: Nitrogen is a critical limiting factor for plant growth.

A majority of nitrogen exists as an inert gas (N_2) the in air (78%), yet plants can't take it up. How can a plant access it?

1. Nitrogen Fixing: Atmospheric nitrogen is "fixed" or transformed by bacteria living symbiotically on plant roots of legumes or in blue green algae (cynobacteria). The bacteria change the N_2 into ammonia. (This form of nitrogen is toxic to most plants). Examples of legumes are peas, beans, soy, clover and alfalfa.
2. Nitrification- A different set of bacteria break down the ammonia by combining it with oxygen to create nitrites and then finally nitrates. Plants can absorb nitrates nicely. Nitrates can also be created directly from N_2 naturally by lightening!!!
3. Assimilation- The plants then incorporate the nitrogen into organic molecules (DNA, amino acids, proteins, etc!). Animals might then chow on the plants incorporating the nitrogen into their bodies.
4. Ammonification- Dead plants and organic waste (like cow dung) convert their stored nitrogen back into ammonia with the help of decomposers.
5. Denitrification- Some of the nitrates can be converted back into atmospheric N_2 through the help of (you guessed it)- bacteria!

Man is upsetting the natural balance of nitrogen by fixing nitrogen artifically to make fertilizers. These fertilizers as well as excess sewage rich in nitrogen (from large animal farms or crappy munipal waste systems for humans) is added to aquatic ecosystems by rain runoff or sewage overflows. This in turn destroys the health of our fresh water streams and ponds by promoting rampant algae growth, which eventually renders the aquatic environment lifeless!!! :(

Also cars and trucks burns gas which create nitric oxides a major component of acid rain.

Phosphorus Cycle: A veeerrry sllloow cycle.
Soils contain very little phosporous naturally, so it is also major limiting factor for growth.

Phosphorous does not circulate as easily as nitrogen because it does not exist as a gas, but is released by weathering of phosphate rocks. The phosphorous (PO_4) is then dissolved in water and absorbed by plants. Animals that eat plants then pass the phosphorous along to the decomposers through their waste products, or when they die and decay. The decomposers then break down the phosphorous to the soil.

The largest storage reservoir of phosphorous is in rocks.

Man is creating an imbalance in phosphorous levels by mining Guano (bird poop rich in phospates) for fertilizers and detergents. These products then make their way to our fresh waterways causing massive algae blooms and wide zones devoid of life.

Sulfur Cycle: Another slow cycle upset by mans influence. Most sulfur is bound up inside rocks (like pyrite and gypsum). On a good day sulfur can become mobile through volcanic eruptions or deep-sea vents. Unfortunately, burning coal and other fossil fuels adds massive amounts of sulfur into the air, which causes the rain to be damagingly acidic. :(

Hydrologic cycle: Water cycles from the ocean to the air (evaporates), condenses into clouds and precipitates back down to land and ocean again. Some of the water will run off while the rest infiltrates into the ground water. It can exist in all three states of matter.