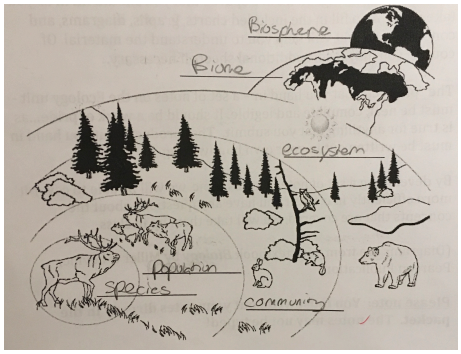
Biology Test 8

I. ECOLOGY

A. *Ecological Organization:*

- Population- group of beings belonging to the same species that live in the same area
- Community- different populations assembling to live together in a specific area
- Ecosystem- all organisms that live somewhere and their physical environments
- Biome- group of ecosystems that have similar climates and typical organisms
- Biosphere- all life on earth and all parts of earth where life exists



B. *Things that Must be True of Every Self Sustaining Ecosystem:*

- Any autotroph that photosynthesizes/chemosynthesizmers- produce food, O2 (i.e.- green plants, cyanobacteria, algae)
- Source of energy (light- usually sunlight)- not recycled because it is used up, and you need a constant source of energy
- Decomposers- get rid of dead bodies from the world and release CO_2 in the break down (and H_2O, nitrogen source [nitrates], sulphates, phosphates)
- Water- necessary for life

C. *Abiotic and Biotic Factors:*

- Biotic Factors- biological influence on an organism- any living part in environment which an organism may interact with
  - Nutritional relationships- who eats whom, or a food chain.

1. Autotrophs (AKA producers)- organisms that can catch the energy from sunlight/chemicals and convert it into energy forms usable by living cells (i.e.- plants, algae [some organisms can use chemical energy stored in inorganic chemical compounds to perform life processes])
2. Heterotrophs (AKA Consumers) eat/ingest other organisms to sustain themselves. Examples of heterotrophs include omnivores (eat both plants and animals), herbivores (eat only plants [like Davi and not Jacob Greenwald]), Carnivores- includes fungi and animals (only eat animals), Scavengers (eat carcasses of dead animals but does not typically kill them itself), and Decomposers (feed off of the chemical break down of organic matter- usually dead organisms).

- Energy flow/interactions/relations- most energy in the transfer is either used up in life activities or lost as heat.
    1. Food Chain- organisms transfer energy by eating and being eaten through a number of steps
    2. Food Web- more complicated feeding network in which organisms have various feeding relationships between others in a specific ecosystem
    3. Food Chains and food webs are related because both networks involve the transfer of energy by consumption in relation to specific organisms
    4. (There will be more information in the section “Trophic Levels”)
- Competition-
    1. Interspecies is between multiple species (reproduce faster —> species “wins”).
    2. Intraspecies- competition between the same species.
    3. Competition depends on an organism/species’ specific niche, or occupation/what it does, and/or the habitat, or location of residence of a population, in which it lives. For example, two types of birds could be fighting over the same branch to live or the same insects on a single tree.
- Symbiosis- a symbiotic relationship is when 2 species/organisms live in close association in or out of each other. Types of these relationships include
    1. Mutualism- both organisms benefit from the relationship

2. Commensalism- one benefits and the other one doesn't lose anything
3. Parasitism- one benefits and the other one loses from the relationship

- Predator/Prey-
    1. Predator- a carnivorous/omnivorous organism that hunts and kills another organism (prey) for eating
    2. Prey- the organism being hunted by the prey
    3. Specific Predators and prey usually have similar population growth
    4. Predators benefit the prey population because the areas in which the prey live which would contain food for them in order for them to survive there

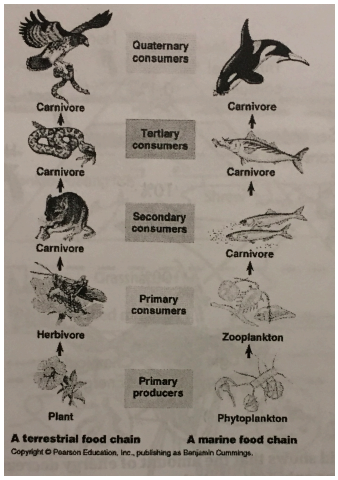
- Abiotic Factors- physical components at atmosphere (nonliving)
    - Light affects living things because it contributes to photosynthesis which provides energy for plants and algae to live which give us oxygen, so without light to partake in photosynthesis, we wouldn't get enough oxygen, and therefore die
    - Weather and Climate (difference between the 2- weather pertains to the daily conditions of the atmosphere while climate pertains to the average conditions of the atmosphere over long time periods)
    - Water
    - Soil and Minerals (Nutrient limitation in an environment)- it means that if the rate of creation of organic material by producers becomes limited by how available nutrients are, which all depends on whether the environment contains enough water and sunlight.

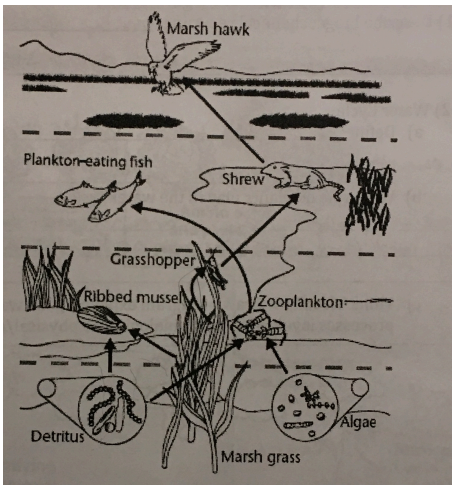
D. Trophic Levels:

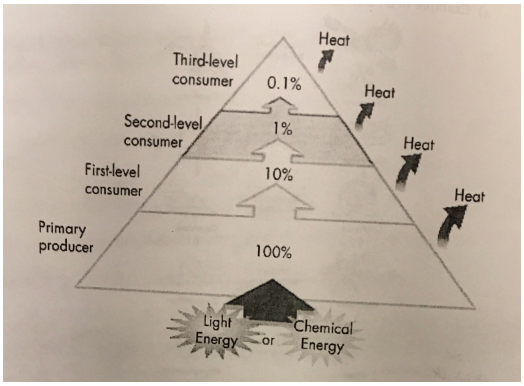
- Categories of organisms found in the food chain ~
    - Producers- at the bottom, or the first trophic level, because other organisms rely on their energy for life processes and eat them while they only require sunlight/ chemicals
    - Consumers- all of the other trophic levels above producers because they rely on on ingestion of either producers or other consumers to carry out life functions-
        1. Primary Consumers (1st level consumers)- eat the producers at the bottom of the food chain

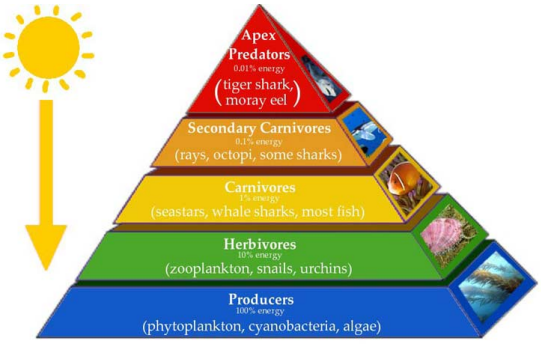
2. Secondary Consumers (2nd level consumers)- 3rd from the bottom, eat the consumers that eat the primary consumers
3. Tertiary Consumers (3rd level consumers)- 4th from bottom, eat the consumers who eat the consumers who eat the primary consumers

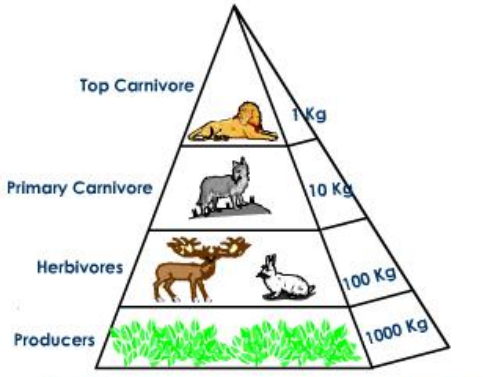
- Pyramid of Energy- show the approximate amount of energy available at each trophic level in a food chain/food web
- Pyramid of numbers- exhibits the relative number of individual organisms at each trophic level within an ecosystem
- Pyramid of Biomass- show the approximate amount of available living organic matter at each trophic level in an ecosystem





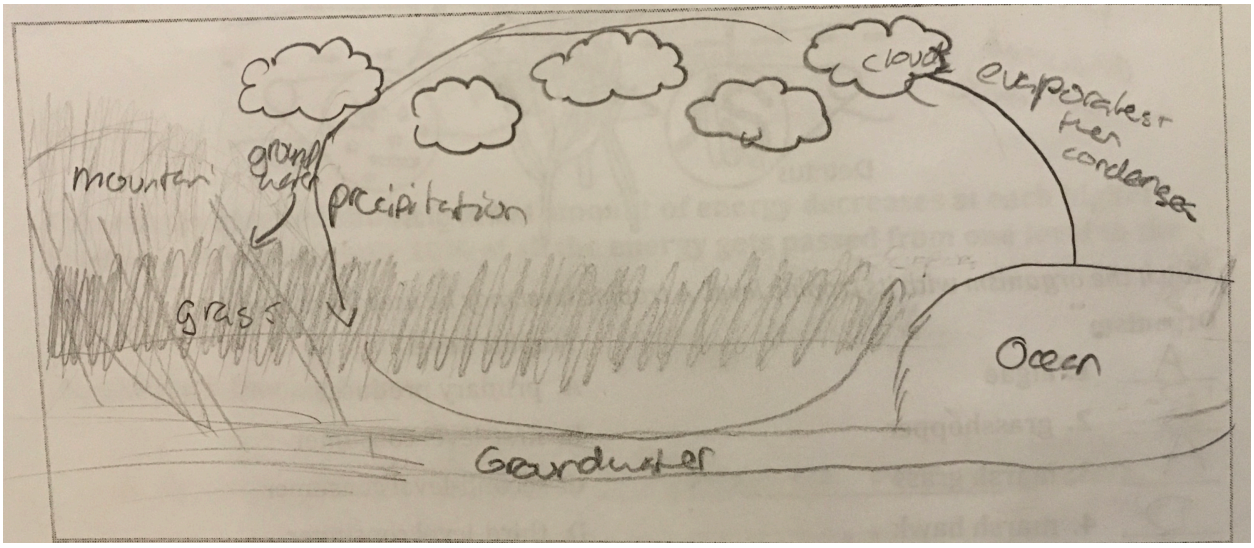




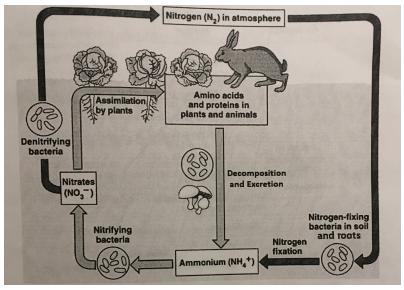


Upright Pyramid of biomass in a Terrestrial Ecosystem

E. Cycles of Matter:



- Biogeochemical Recycling- matter gets reused within ecosystems in a chemical, geological, and biological fashion
- Water cycle- process in which water transports from oceans and atmospheres and land, living both outside and inside organisms
  - Plants role in the water cycle- leaves of plants that may contain H2O that can get evaporated through the process of transpiration
- Carbon Cycle- constant network of transport of carbon through the biosphere— transferring between atmosphere and oceans through both physical and chemical processes
  - Respiration causes CO2 form of carbon to be put into the atmosphere
  - Photosynthesis uses CO2 in atmosphere and gets used to combine with sunlight to create glucose
- Nitrogen Cycle- the network of transport of nitrogen through the biosphere— through different organisms in order to create Amino Acids and Proteins



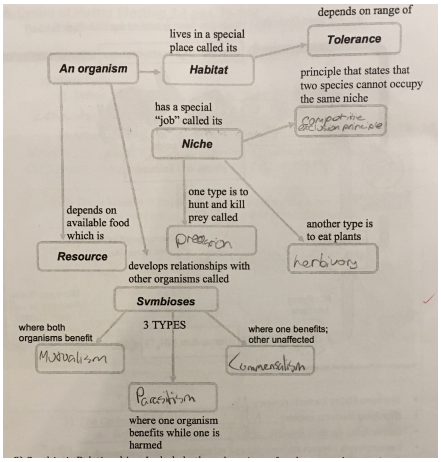
  - Nitrogen fixing bacteria convert Nitrogen in the atmosphere to Ammonium
  - Nitrifying bacteria converts Ammonium to Nitrates
  - Denitrifying Bacteria converts nitrates to nitrogen in the atmosphere
  - Decomposers convert amino acids and other nitrogenous compounds to Ammonium

- Plants obtain nitrogen by absorbing nitrates from the soil and convert it to amino acids for building proteins
- Animals obtain amino acids by digesting plant or animal proteins

- Nutrient limitation- a substance is a limiting nutrient when it is a nutrient in which the supply of said nutrient limits the productivity of the ecosystem

F. *Niches and Community Interactions:*

- Symbiotic Relationships- refer to the biotic factors
- Niche- scope of biological and physical conditions in which a species lives and the process in which said species gets what it needs to survive/reproduce
  - Niches are different than habitats because a habitat refers to the area in which the organism lives while niche refers to the process in which they live in their areas/location of residence



- Competition-
  - When 2 species are both trying to occupy the same niche, since both species need resources and there are only so many in the same niche, there is competition for those resources
  - Interspecific Competition (exclusion principle)- competition for food, mates, and habitats between members of different species
  - Infraspecific Competition (within a Species)- competition for food, mates, and habitats between members of the same species
- Refer to predator/prey relationships in biotic factors section

G. *Population Dynamics:*

- Phases of logistic growth
  - Exponential Growth- due to an abundance/unlimited amount of resources, the growth rate increases along with the population no capacity to resources
  - Growth Slows Down- rate of growth slows, which leads to a decrease in population size

- Growth Stops- eventually, rate of growth slows down so much that the population stays the same size which will cause it to remain at that size/near that size indefinitely

- Carrying Capacity- maximum amount of members of a specific species that a specific environment can support
- Factors that affect population growth-
  - Biotic Factors-
    1. Competition- competing for resources/essentials —> some get enough to live and reproduce, some et enough to just live, and others will die out due to like of resources
    2. Predation- if animals predate (eat others) too much, the animals they eat will die out; if animals don't predate too much, the prey will get an increase of population
    3. Herbivore Effects- if herbivores eat too much/ a lot of plants, the plants they eat will die out; if herbivores don't eat as much plants, the plants will grow in rate of population
    4. Humans as Predators- if humans eat/predate more, the animals will die out; if humans eat/predate less animals, the animal population will increase
    5. Parasitism and Disease- parasites/disease causing organisms can cause their hosts to die, and sometimes hit one species causing a drop in population
    6. Stress from Overcrowding- fighting can be caused by overcrowding which can lead to stress which can lead to disease/killing others, so it can contribute negatively to population growth
  - Abiotic Factors (AKA Density Independent Factors)- unusual weathers affect all populations in similar ways. Examples-
    1. Hurricanes
    2. Droughts
    3. Floods
    4. wildfires

5. Natural disasters

H. *Ecological Succession:*

- Ecological Succession- predictable changes that happen in a community over a period of time
- Primary Succession- a type of change that begins in a location without anything left behind from an older community
  - This occurs when in one area there is no plants/vegetation and then becomes a green forest with no reminiscent of lack of plants
  - Pioneer Species- the first species to occupy/colonize previously disrupted or damaged ecosystems, beginning a chain of ecological succession that ultimately leads to a more biodiverse steady-state ecosystem
    1. A pioneer species can alter the environment in a way that allows other species to compete for resources and survive in those areas (i.e.- lichens help form soil, and other plants can then colonize and grow)
- Secondary Succession- an occurrence in which a disturbance affects a community, but doesn't completely wipe it out (i.e.- if a hurricane hit a community but didn't fully destroy it
  - Secondary succession proceeds faster than primary succession because soil can survive a disturbance, resulting in more/new vegetation to rapidly grow
- Climax Communities- a community that has reached some level of stability over time and will continue to be a deciduous forest unless there is a disturbance such as a major pest infestation/natural fire. Over time, a climax community may eventually be restored after the disturbance (i.e.- a deciduous forest in lower elevations of New York State)

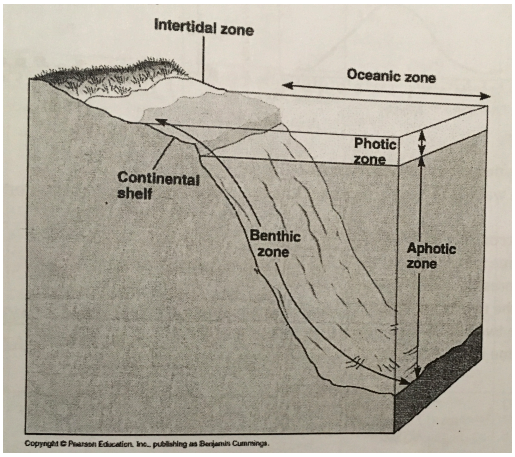
I. *Biomes:*

- Biomes- groups of ecosystems that contain similar climates and typical organisms (have these due to seasonal temperatures/precipitation [measured in climate diagrams])
- Terrestrial Biomes-
  - Tropical Rain Forest- rainy, wet, lots of plants and animals

- Desert- dry, full of mineral-rich sand, contain plants that store water in their leaf tissues, have thin leaves to cut down on water loss, some animals that can survive the heat and low water
- Temperate Grasslands- plains/prairie with fertile soil with lots of grass, eventually get converted to agriculture due to rich soil
- Temperate (Deciduous) Forest- made of coniferous trees which have seed giving cones and have leaves like needles, have cold winters, soils rich in humus which is formed by decayed leaves and organic material
- Boreal Forest- taiga (swamp land), contain forests of coniferous evergreens, cold winters, descent summers
- Tundra- full of permafrost (frozen soil), dry and cold, not lots of plants/life in general

J. *Aquatic Ecosystems:*

- Conditions that affect Aquatic Life-
  - Water depth- sunlight penetrates only a short distance through water, allowing photosynthesis to occur in the photic zone, so algae/other sea plants can produce glucose/energy
  - Temperature and Currents- temperature can change living conditions of aquatic life and currents affect the temperature by carrying water that is significantly warmer/cooler based on latitude, depth, or distance from shore
- Marine (Ocean) Ecosystems-
  - The Aphotic zone supports the least amount of life because there is a low level of available photosynthesis which causes more death of plants which causes fewer herbivores to live there which causes fewer omnivores/carnivores to live there, and so on.



- Freshwater Ecosystems-
  - 3 main categories of freshwater ecosystems are rivers/streams, lakes/ponds, and freshwater wetlands
  - An ecosystem in which water either covers the soil or is present at or near the surface of the soil is called a wetland

K. *Human Population Growth/A Changing Landscape:*

- 3 cause of overpopulation include-
  - Reliability/abundance of food
  - Improved medicine
  - Sanitation increase
- ~7 billion is the world's current population— same amount that is thought to be the carrying capacity
- Reasons that human populations is reaching its carrying capacity-
  - Because of the resources such as food, land, and water at our service, the population is near its capacity
- Human Activities' effect on the Ecology-
  - Agriculture-
    1. Positive- abundance of food
    2. Use of an abundance of land (leads to not enough room for carrying capacity), fertilizers and farm equipment —> pollution from fossil fuels
  - Development of Cities-
    1. Positive- Create more farmland work by forcing people to live in suburbs of the city—> food
    2. Negative- Waste production increase, consuming of land (especially farm), and the division of natural habitats —> fragments
  - Industrial Growth-
    1. Positive- some electronic devises can replace those that require fossil fuel energy to produce (despite having been produced by fossil fuel energy)

2. Negative- require an abundance of energy to produce/power, discarded wastes affect the environments, and burning fossil fuels —> affects environment

- Renewable Resources- resources that can be used repeatedly because it is replaced naturally (i.e.- marsh grass, pine tree, etc.)
- Nonrenewable Resources- resource of economic value that cannot be readily replaced by natural means on a level equal to its consumption (i.e.- oil, coal, etc.)
- Development can be sustainable by providing human needs while preserving the ecosystem that produce these natural resources
- Increase of people living in cities- increased waste which will require others to occupy surrounding lands, which takes up more land, and increase of pollution, ruining our planet which will cause a decrease in population

L. *Damage of Natural Resources:*

- Soil Damage-
  - Soil Erosion- removal of soil by water/wind
  - Desertification- a process in which farming, overgrazing, seasonal drought, and climate change combined will turn farmland into desert land
  - Deforestation- loss of forests due to cutting down the trees for wood, fuel, etc. and it causes soil erosion and releases more CO2 into the air
- Water Pollution-
  - Pollutant- harmful substance that can enter biosphere
  - Point source pollution- when pollutants enter water supplies from a single source
  - Non point source pollution- when pollutants enter water supplies from many smaller sources
- Pollutions effects on water-
  - Industrial- can pollute water/soil with harmful chemicals (i.e.- PCB's, zinc, mercury) that can cause harm to organisms
  - Pesticides- can pollute water with pests (i.e.- DDT) which can cause lots of danger to the organisms relying on the water

- Biological Magnification- increasing amounts/concentration of harmful substances in organisms at higher trophic levels in a food chain/web
- Fertilizers- contain large amounts of nitrogen which is required by certain bacteria in order to make more bacteria and oxygen is used by the bacteria to break down the nitrogen
- Detergents- when put in aquatic biomes, they raise phosphate levels—> algae —> prevent grass from sunlight —> deprivation of habitat by organisms, oxygen starved water when algae dies —> suffocation of organisms. Sometimes, they contain drugs which interferes with endocrine systems of some organisms which leads to the death, lack of reproduction
- Thermal- factories produce heat as a waste —> water absorbs excess heat to cool nearby plants and if the warm water is put back in the biome (aquatic), it leads to problems because of less oxygen than cold, which leads to the killing of some organisms and increased demand for it/killing because of heat
- Residential- contain lots of nitrogen and phosphates, which can be absorbed into ecosystems, sewage in ecosystems lead to bacteria and algae (raw-microorganisms), which leads to waterless oxygen
- Oil- oil from oil rings/spills can form a damaging coat on living organisms (like ducks and other water fowl) causing them to die

• Atmospheric Pollution- examples-
- Smog- formed by chemical reactions among pollutants released in the air. It produces ozone which threatens the health of people
- Acid Rain- nitrogen oxides— can form nitric acid when combined with water vapor, sulfur dioxides— can form sulfuric acid when combined with water vapor. It can kill plants by damaging leaves and changing chemistry of soil and surface water, and can release mercury and other toxic elements which can enter into other parts of the biosphere.
- Greenhouse gases- made by turning fossil fuels and gases, and excess gases can contribute to climate change/global warming when in atmosphere

- Particles- composed of ash/dust, and are released by some industrial processes/ diesel engines. The effect of these particles is when they enter the body through the nose/mouth and reach the lungs, it can cause health problems
- CFC's- used as propellants in aerosol cans, coolants in freezers/refrigerators/ AC's and in production of plastic foams, are released into the atmosphere. They could damage the ozone layer, and stay there damaging for long periods of time.

M. *Biological Control/Magnification:*

- Biological Control- something introduced in order to get rid of a specific species (very targeted)
- Biological Magnification- process whereby certain substances such as pesticides or heavy metals move up the food chain, work their way into rivers or lakes, and are eaten by aquatic organisms such as fish, which in turn are eaten by large birds, animals or humans.

N. *Biodiversity:*

- Biodiversity- more interactions between living things which leads to more stability. Types-
  - Ecosystem diversity- variety of habitats, communities, and ecological processes in biosphere
  - Species diversity- number of different species in biosphere/specific area
  - Genetic Diversity- total of all different forms of genetic information carried by a specific species/all organisms on earth
- Ways in which biodiversity is valuable-
  - Biodiversity and Medicine- wild/diverse species lead to medicine to treat diseases which prevents death
  - Biodiversity and Agriculture- gene relatives allow us to transfer pest resistance/ other useful traits
  - Biodiversity and Ecosystem Services- presence of different/diverse species can change the life of it, and benefit quality of soil, water, air, productivity
- Threats to biodiversity-

- Altered Habitats- alterations lead to species extinction/endangerment and also causes habitat fragmentation —> habitat islands (patches of habitats surrounded by a different habitat [smaller habitat—> smaller amount of species —> vulnerability to other disturbances])
- Hunting- leads to extinction which is less biodiversity, hunted species affected more from habitat fragmentation
- Introduced/Alien Species- new organisms can become invasive which threats biodiversity
- Pollution- chemicals that are harmful to organisms affect life which affects biodiversity
- Climate Change- organisms adapt to environment, but if a condition is beyond the tolerance of an organism, it has to either move to a different place (introduced species which also leads to Biodiversity), or it can become extinct
- Ecological Hot Spot- location in which there is a lot of biodiversity, so it's much better to save the entire area than 1 species at a time

- Ecological Footprint- total area of functioning land and water ecosystems that are required to provide resources to a person/population uses and to absorb/make harmless the wastes that a person/population produces
- Monoculture- is just only one species of plant growing in an area

II. PLANTS

A. Photosynthesis Reaction:

- Equation= $6CO_2 + 6H_2O$ —> sunlight (reacts in chlorophyl in chloroplasts) —> $6O_2 + C_6H_{12}O_6$
- Chloroplasts-
  - filled with membranes
  - perform the exact opposite procedures as the mitochondria during cellular respiration, as they perform photosynthesis
  - Perform ~ 22-23 steps/reactions while performing break down.
  - Chlorophyll is found here.

B. Requirements for an Organ of Photosynthesis:

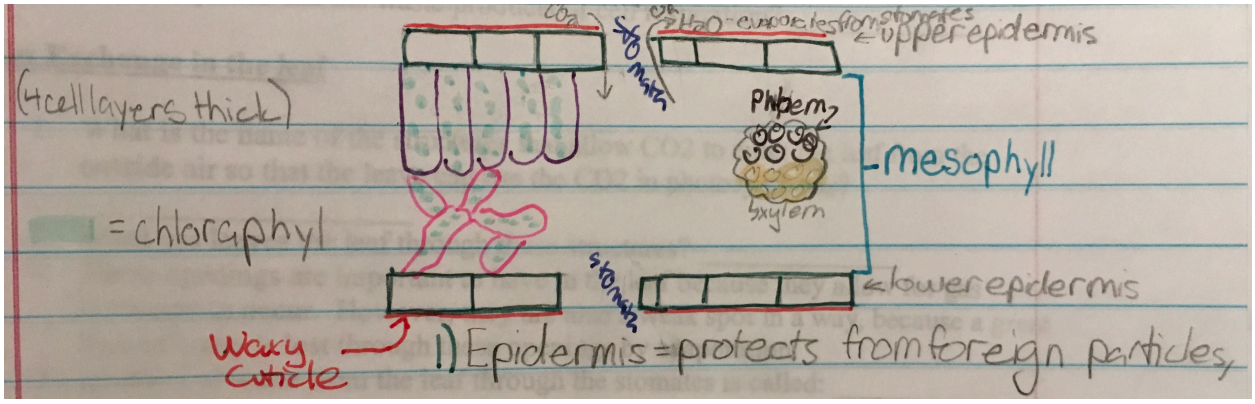
- Max exposure of a chloroplast to the light (achieve this because of flatness and surface area)
- Prevent Evaporation of water from the leaf
- Method of getting CO2 to the cells and O2 out
- Method to get water from soil to the leaves
- Method of getting glucose to other parts of the plant

C. Difference Between Respiration and Photosynthesis:

- Photosynthesis is only done by green plants, and by photosynthetic bacteria and protists, and it is only done the light
- Respiration is the opposite reaction of photosynthesis (C6H12O6 + 6O2—> 6CO2 + 6H20 + 36 ATP) and occurs in the mitochondria

A. Structure of the Leaf:

- Epidermis- protects from foreign particles and evaporation
- Waxy Cuticle- protects against evaporation
- Mesophyll- middle 2 layers of cells
- Palisade Layer- major sight of photosynthesis
- Spongy Layer- major sight of photosynthesis, enables CO2 to get all the mesophyll
- Stomata- slit like openings in the in the epidermis of the leaf, protected by guard cells. The guard cells open and close in order to allow CO2 and H2O in and O2 out of the cell.



D. Transpiration:

- Transpiration- evaporation of water from the leaf

- Effects of transpiration-
  - Too much water loss when the water cannot be replaced is very dangerous to the plant
  - Transpiration functions to help draw water up the stem/up the plant to allow photosynthesis to occur (transpiration pull)
  - Transpiration cools the leaf as the water evaporates out
- Water goes up the xylem and glucose from photosynthesis goes down the phloem to other parts of the plant

E. *Transpiration and Stomate Lab:*

- In distilled water, through osmosis, water moves into the guard cells inflating them and causing them to push away from each other so the stomata is open. In salt water, water moves through osmosis out of the cells deflating the guard cells causing them to come together, closing the stomata and not letting water go out
- Procedure- leaf is placed in distilled water for 3-5 minutes, epidermis is collected and put on slide to make a wet mount, find on low and draw guard cells on high power, and then replace the water with saline and observe and draw again
- This procedure is done to see the structural differences of guard cells/stomata in saline solution/distilled water
- Because the lower surface of a leaf reaches the underside and the upper surface is more exposed to the sunlight which causes evaporation, in order to conserve more water, the number of stomates is less on the upper surface and more on the lower surface