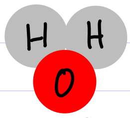
Unit 1: Chemistry of life

Lecture 1: Properties of Water...08/09/21

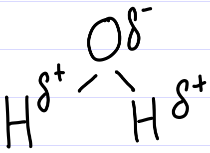
-Living systems depend on the properties of water

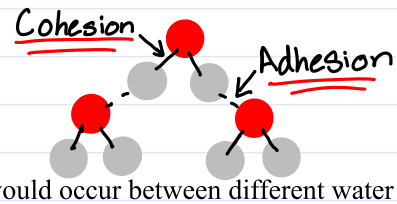
Polarity: The state of having two opposite tendencies, opinions or aspects

- Water has negative and positive charges, therefore making it polar



- Oxygen in water is highly electronegative which pulls the electrons closer to it than the Hydrogen that it's sharing electrons with.
- Electronegativity: A measure of the tendency of an atom to attract a bonding pair of electrons
- The two hydrogen atoms take on a partial positive charge while the oxygen takes on a partial negative charge





What types of bonds would occur between different water molecules?

What types of bonds would occur within water molecules?

Adhesion: Water molecules are drawn TOWARD other molecules because of the polarity of the water

Cohesion: Water molecules are drawn TOGETHER because of their polarity

- Both adhesion and cohesion allow water to move through plants through the continual flow of water through the plant from cohesion and the accumulation of this flowing water through adhesion

High Specific Heat: The amount of heat in calories needed to raise the temperature of 1 gram of water by 1 degree Celsius

- With a high specific heat, it takes a long time to heat and cool water
  - Fast temperature changing water makes it difficult for living organisms to adjust to it's environment, making this property important for aquatic life

-Ice is less dense than liquid water

- When water freezes, their molecules for a crystalline structure maintained by hydrogen bonding
- Ice is less dense than water because the orientation of hydrogen bonds causes molecules to push farther apart which lowers the density
  - This results in moderation of temperatures in aquatic habitats
  - This helps aquatic life because if ice sunk, ice would constantly freeze temperature under water, making it unfit for aquatic life

High heat of vaporization:

- It takes a lot of energy to break the hydrogen bonds between water molecules that would allow it to become a gas
  - This allows a cooling effect while sweating since water absorbs a lot of heat away from the body before it evaporates (therefore cooling the body and allowing it to achieve homeostasis)

Water is a universal solvent:

- Plays a role in metabolic processes
- Water allows diffusion and osmosis of life sustaining molecules throughout a body
  - We need this movement to fire up ions
- Water dissolves important solutes that contribute to our metabolism well which is important to the human body

Sickle cell: Misshapen, crescent shaped blood cells

- Africans have astoundingly high probability of getting sickle cell disease
- Frequencies of sickle cell her higher in Africa
    - Not all areas in Africa had high frequencies

-Existence of Malaria and Sickle cell in the same areas of Africa were apparent

- Genetic disease of sickle cell is correlated to infection of malaria
- Mosquitoes carry malaria and are located in Africa

-Sickle cell is seen to protect individuals from malaria, making it more persistent in appearance since it exists to combat another condition

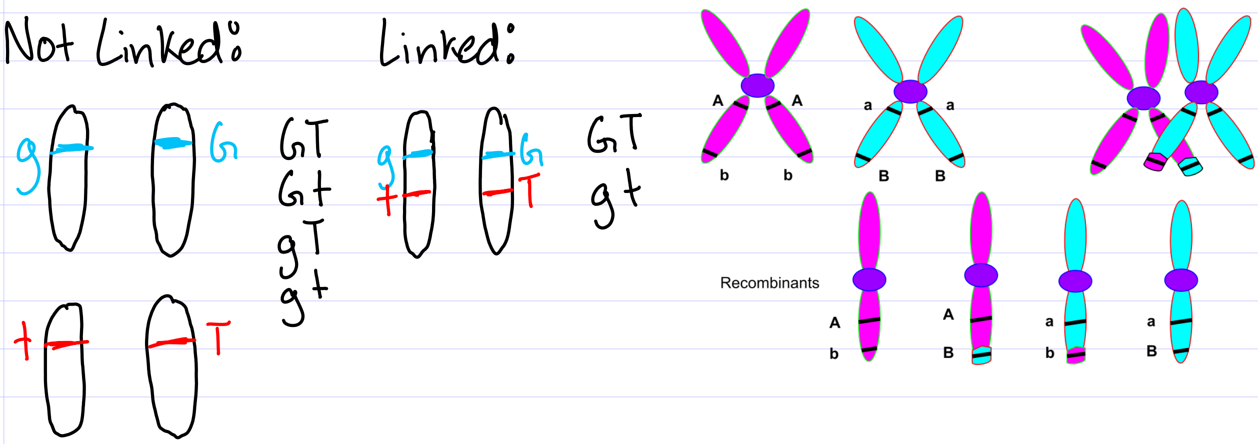
Genotype analysis:

- Sickle cell is a recessive trait
- A homozygous recessive individual at risk with their condition of sickle cell
- A homozygus dominant (normal) individual is at risk of malaria without sickle cell to combat it

Lesson 3:

Gene mapping:

- If genes are located on the same chromosome (or nearby eachother) they are linked
- Closer genes are more likely to be linked and don't assort independently
- Crossing over of chromosomes with closely located alleles can result in linked genes



Map Unit: Distance on a chromosome within which recombination occurs 1% of the time

-The rate of crossover gives no information about actual distance between genes but it tells us the order of linked genes of the chromosome

Unit 5 HW 2: Probability in Genetics

Multiplication: Occurs when we have independent events in sequence (and)

- Ex. Probability of flipping a coin on heads 3 times= 1/2*1/2*1/2=1/8
- Ex. In a cross between heterozygous parents, whats the probability of a recessive offspring...1/2*1/2=1/4
- Ex. Probability of AaBbCc x AaBBCC=AaBbCC
    - Cross each numbered allele at a time and match up the probability of each outcome
    - Aa=1/2, Bb=1/2, CC=1/2... 1/2*1/2*1/2=1/8

Addition: Occurs when we have mutually exclusive events (or)

- Ex. Probability of getting heads or tails= 1/2+1/2=1
- Ex. In a cross between heterozygous parents, whats the probability of a heterozygous offspring...1/4+1/4=2/4
- Probability of AaBbCc x AaBBCC=AABbCc or AABBCC
    - AA and AA= 1/4 each, Bb and BB= 1/2 each, Cc and CC= 1/2 each
        - 1/4*1/2*1/2=1/16*2=1/32

Ecology Equations:

Exponential Growth: Reproduction without constraints results in exponential growth of a population

$$\frac{dN}{dt} = r_{max}N$$

dt=change in time

N=Population Size

r_{max}=Maximum per capita growth rate of population

Logistic growth: As limits to growth due to density-dependent and desnity-independent factors are imposed, a logistic growth model generally ensues

$$\frac{dN}{dt} = r_{max}N\left(\frac{K-N}{K}\right)$$

dt=Change in time

N=Population size

r_{max}=Maximum per capita growth rate of population

K=Carrying Capacity

Population Growth: Many adaptations are related to obtaining and using energy & matter in a particular environment

$$\frac{dN}{dt} = B-D$$

dt=Change in time

B=Birth rate

D=Death Rate

N=Population size

Simpson's Diversity Index (Biodiversity): The structure of a community is measured and described in terms of species composition and diversity

$$\text{Diversity Index} = 1-\Sigma\left(\frac{n}{N}\right)^2$$

D=Diveristy I

n=# of individuals of a single species

N=# of individuals in a total population

-Starfish carry sensors in their legs

-Tube feet are used as muscles to devours their prey

-Small populations are more likely to decline due to natural causes

Symbiotic relationship:

- Competition(-/-)
- Parasitism(+/-)
- Mutualism(+/+)
- Commensalism(+/0)

Keystone species: A species whose presence and role in an ecosystem has a disproportionate effect on other organisms in the system

Dominant species: A plant, animal, or function group of different species most commonly or conspicuously found in a particular ecosystem. It is generally the most populous species or comprises the greatest biomass in an ecosystem.

Invasive species: A species, often introduced by humans, that takes hold outside of its native range