SAMPLE NOTES

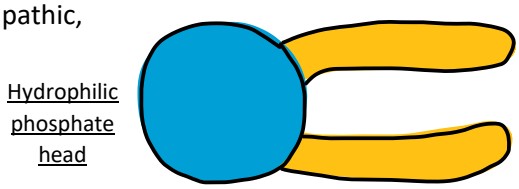
MULT10011

Microscopes and Measurements

- Robert Hooke invented microscopes – dead cell from bark
- Anthony Van Leuwenhoek constructed microscopes – diarrhoea to view microorganisms (Giada)
- mm = 10^-3, um = 10^-6, nm = 10^-9

Plasma Membrane

- The plasma membrane is a semi-permeable membrane made of a fluid phospholipid bi-layer which separates the internal contents of a cell from the extracellular fluid outside the cell
- Phospholipids are schizoid or amphipathic, meaning they are opposite at opposing ends

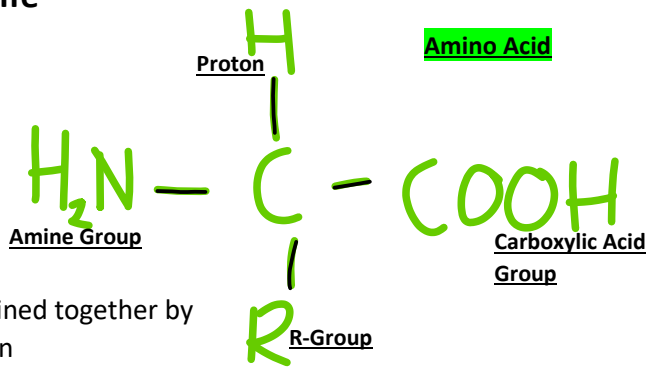


Virus

- A virus is an infectious non-cellular agent that cannot reproduce itself – needs a host to do so. It comprises a genome (DNA and RNA), capsid (protein) and sometimes a membrane (lipid) with no organelles *E.g. Polio, Ebola*
- Life cycle: injects into host and fools it into transcribing and translating more viral particles

Proteins, Enzymes and the Tree of Life

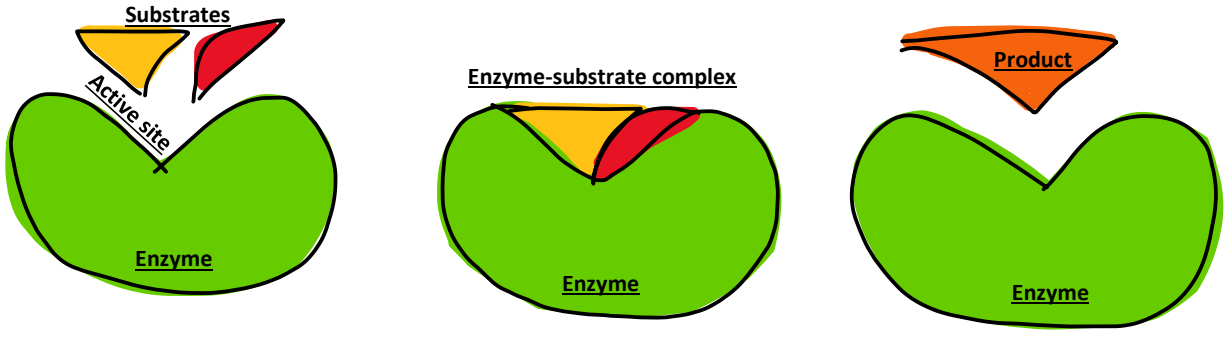
Proteins



- R-groups are the only component of amino acids that differ
  - polar, uncharged (hydrophilic)
  - charged (hydrophilic)
  - non-polar (hydrophobic)
  - form rings (both)
- Amino acids are protein monomers. Many joined together by peptide bonds form a linear polypeptide chain
- Ribosomes: site of synthesis for proteins, present in all cells, made of proteins, bacterial ribosomes are small and sensitive to antibodies

Enzymes

- Enzymes are catalysts which reduce activation energy to increase speed of reactions without disrupting equilibrium. They are typically proteins which are recyclable and regulated
- Exergonic (catabolic) and endergonic (anabolic) reactions couple to supply one another with inputs



Tree of Life

- Ernst Haeckel invented the term phylogeny. He was an illustrator and constructed the tree of life
  - Mammals *E.g. human, gorilla*
  - Vertebrates *E.g. mudfish, reptiles*
  - Invertebrates *E.g. worms, sponges*

  - Indirectly: observe properties of stars (mostly here bc of star glare)
- Up to 3952 confirmed exoplanets which are planets that orbit a star outside of the solar system
- Gravity: equal and opposite forces, orbits are stable in time, >2 bodies = chaotic, SS sun has so much mass that this isn't an issue – it's like 8 two-body systems
  - Kepler's Law of Ellipses: small object orbits larger object in an ellipses
  - Law of Harmonies: ^ radius ^ orbital period

Detecting Planets

1. Doppler method: when light from a moving object compresses and moves towards you it is blue shifted, when a moving object stretches and moves away from you it is red shifted. Smaller objects move slower, good when looking from an edge 
2. Astrometry: measures positions, motions and magnitudes of stars, requires ultra-precise measurements and stars move back and forth due to atmosphere which makes it even harder. Essential that orbital orientation is from above
3. Transit: detecting changes in star luminosity which 
dips as the planet crosses in front of the star *E.g. solar eclipse*, light curve is used that compares luminosity and time, measures period, mass and orbital radius, radius. Edge orbital orientation is essential, most found through this method 
4. Gravitational lensing: distribution of matter between a distant light source (star) and observer that is capable of bending the light from the star which distorts and magnifies the luminosity, rare
5. Pulsars: rapidly rotating neutron star, easy to measure doppler, best clock using timing of pulses – if they're moving back and forth it's orbiting a centre of mass, not habitable
6. Direct imaging: only one not related to star properties, hard to take pictures due to glare of star as planets will be very close to the star, effective for distant, large stars

Studying Exoplanets

1. What kinds of stars might support living planets?

- Requirements: energy (H) and stability (long Main Sequence (MS) phase)
- Binary star systems can form planets and potentially harbour life
- Brown dwarf: small star with incomplete fusion, photons are often infrared

ANSWER: all stars – except the most massive ones

2. Is the Solar System typical?

- Mystery 1: orbits – why aren't they circular? The nebular collapse model predicts that orbits are circular due to friction, however, they may be elliptical
  - Causes: planet encounters near collision which slings it in a weird direction
  - Importance of circular orbit: stability – elliptical orbits often result in near collisions, elliptical orbits mess with the temperature on the planet
  - Observational bias: what we have found may be due to detection technique or available resources and so should be used with caution *No. seen = true no. X chance to see*
- Mystery 2: absence of 'super-earths' in our solar system
  - Super-earth: a terrestrial planet larger than Earth but smaller than Neptune
  - Causes: fine tube disk gravity or migration or observational bias OR is the classification wrong
- Mystery 3: 'Hot Jupiters' often have low eccentricities, are tilted relative to their star's spin, do not evaporate and appear to be dry
  - Hot Jupiter: gas giant exoplanets like Jupiter with very small orbital periods and are hence close to their star and have high temperatures
  - Causes: may have migrated from friction or near collision