Week 4 Lecture 0

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1 Administrative drivel

- He's begun grading, should be done by friday
- the course (and individual exams) is curved!

2 more on biochistry: the chemistry of life

2.1 Lipids

- Review
  - triglyceride: made of 1 glycerol and 3 fatty acids
  - the kinks in the fatty acids determines the melting temp of the triglyceride
  - plants tend to store as liquid (kinkless)
  - our bodies build lipids when it has an excess of callories
- Cis- and Trans-fatty acids
  - cis: has hydrogens on either side of the double bond are on the same side of the molecule
  - trans: has hydrogens on opoosite side of the molecule
  - Trans-fatty acids are difficult for humans to break down, and so contribute to things like heart disease.
  - for the last 8ish decades food industries have used trans-fats to increase the shelf life of foods.
  - trans-fats are mostly artificial
  - bacteria also struggle to break down trans-fats, hence the longer shelf life
  - it wasn't till recently that there's been a push to get these out of foods

  - story
    * about 30 years ago
    * junk food companies spent millions to invent fats with low calories
    * they did this by creating indigestible fatty acids using alternate backbones to the standard 3 backbone glycerol, as well as some new fatty acids
    * they made all of these ads
    * after putting to market, they discovered that these new fats made people fart a lot

- Solubility
  - lipids *do not* disolve well in water
  - this can make it require more work to break them down
  - most fats are "imisable" in water, meaning they won't mix with water.
  - what makes this happen? Oils have few hydrogen bonds, so there's little charge seperation, so no poles.
  - oil is generally less dense than water, so it rises to the top

- **Phospholipids**
  - as the name suggests, there's phosphorus in these
  - parts:
    * glycerol
    * 2 fatty acids (tails)
    * phosphate bound on one of the oxygens where a fatty acid would be in a triglycoride (4 Os, 1 P, 1 R) (head)
    * has a hydrophobic an hydrophilic end (fatty acid and on the phosphorus end respectively)
      · hydrophobic - scared of water (repells water)
      · hydrophilic - loves water ("attracts" water)
      · so, it'll form hydrogen bonds.
  - also immisable in water
  - make up **biological membranes**
  - if you put them in water they'll sit with the acids in the water, and the "head" sticking out.
  - if you get enough of then together, they'll form a sphere with heads pointed out, tails pointed in
  - even more together you end up with an inner an outer sphere with water inside, folloowed by the corresponding heads, then the tails all pointing together, then the outer shell of heads

  - this last structure is what makes up cell membranes: called the **phospholipid bilayer.**
  - if you get enough phospholipids together in water and stir em up, you'll get this structure.
  - cell membranes are *not* rigid

- **Steroids**
  - e.g. cholesterol, testosterone, estradiol, cortisol
  - characterized by their rings
  - chain of carbons going off at least one end
  - in diagrams, kinks usually denote carbons
  - cholesterol is rather important in cell membranes:
    * they hang out inside the phospholipid bilayer (tail sticking out)
    * allows the bilayer to be flexible
    * too much contributes to the hardening of the arteries
  - adding or subtracting small components from colesterol gives you testosterone
    * regulates a lot of physiological activities
  - testosterone is converted into esterdiol (contains estrogen)
  - cortisol is involved in stress responses
    * in short term situations where you're stressed for minutes or hours by keeping you awake, regulating matabolism, etc
    * high for too long will cause problems
  - depth of embeding in a bilayer is determined by ** SOMTHING??? **

- fats disolve in organic solvents (like gasoline)

3 More biochemistry: Nucleic Acids and Protiens

With these 2, we have all 4 of the biological molecules
Clicker q: saturated fats don't have double bonds!

3.1 Protiens

- They do a lot
- Types: Digestive enzymes, transport, structural, hormones, defense, contractile, storage
- digestive enzymes reduce the amount of energy needed to do work help in digestion of food by catabolizing nutrients into monomeric units
  - e.g. amylase, lipase, pepsin, trypsin
- transport: carry substances in the blood or lymph throughout the body
  - e.g. hemoglobin, albumin
- structural: construcct different stuctures like cytoskeleton
  - actin, tubulin, keratin
- hormones: coordinate activity of different body systems
  - e.g. insulin, thyroxine
- defense: protect the body from foreign pathogens
  - immunoglobulins
- cantractile: effect muscle contraction
  - e.g. actin, myosin
- storage: provide nourishment in early development of the embryo and the seedling.
  - legume storage protiens
- basically infinitely many
- subunit: **Amino acids**
  - made of 2 carbons attached to a nitrogen (with hydrogens and oxygens) and a *side chain*
    - side chain determines the type
    - more specific: amino group (nitrogen and 2 hydrogens), carboxyl group (carbon, 2 oxygen, and a hydrogen), and the side chain

  - 26 different amino acids
  - 9 are the so called "essential amino acids" (can't be synthesized by the body)
  - the body can make most of these from scratch, but the essential ones cannot be made by the body

- protiens are made of chains of amino acids
- amino acids can be linked together by peptide bonds into a *polypeptide*
- the polar bonds between them cause them to fold into specific structures
- start with a beta sheet, then fold back into tertiary protein structure, then those fold into quartenary structure
- the tertiary structure is usually where it stops, and is the function
- these are called *functional protiens*