Week 1

The Molecular Level

1.1 Chemical Biology Introduction and the Central Dogma

9/27:

- Questions:
  - What edition(s) of the textbook(s) should we have?
    - Doesn't matter.
  - Will there be TA office hours?
    - No.
- CHEM 233 used to be Intermediate Organic Chemistry, and CHEM 332 was the grad class. They have been merged this year because of the overlap in content.
- Krishnan weeks 5-7; Tang otherwise.
- We will not be going through reactions. The format is slides; don't try to copy them down, just make some notes. Copy them down ahead of time?
- Goes over the syllabus.
  - No fixed textbook. Lehninger is recommended though. Whatever edition you can find.
  - No office hours (ask questions in class or ask her to meet outside).
    - Tang will show up early and stay late.
  - Midterms are 1 hour; final is 2 hours.
  - Three problem sets.
  - One in-class quiz:
    - Krishnan will give us cutting-edge literature to read one week before the quiz and 5 questions.
    - We can form study groups to discuss the questions.
    - Multiple choice quiz on that day.
  - We're not supposed to memorize things in this course; the problems won't be like that.
  - Tang may lower the exam difficulty levels from previous years.
  - Tang doesn't want us to have to fight for points; is trying to give us a big curve so that we can just focus on learning.
  - Since this is now only a twice a week class, Tang is cutting material on carbohydrates and protein design. May try to squeeze in orthogonal chemistry, though.
- The central dogma in biology. *picture*
  - DNA $\rightarrow$ RNA $\rightarrow$ protein $\rightarrow$ needed chemical transformations.

- Size in biology.
  - An activity matching biological entities (e.g., E. coli, cells, RNA) to their sizes in microns.
  - Uses the world zoom website.
  - We may be tested on sizes, but only relative not exact (e.g., E. coli vs. a ribosome).
- Red blood cells are smaller than normal cells because they don't have nuclei, and they don't need meat to divide.
- Concentrations in biology.

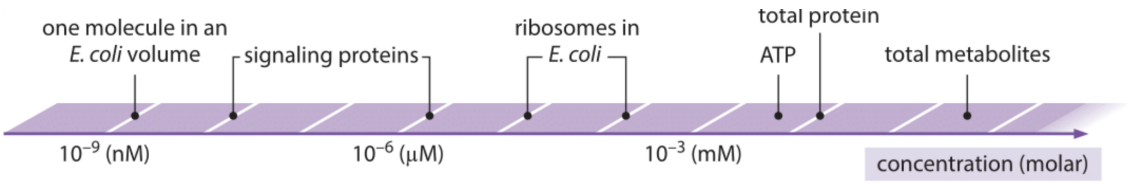

Figure 1.1: Concentrations in biology.

  - You need a couple of copies of signaling proteins.
  - Cells dedicate a lot of resources to building ribosomes.
  - Different ions have different concentrations in different parts of the body. Additionally, different types of cells have different concentrations.
- *Bound* divalent ions such as Mg^{2+} help cancel the charge of ATP; that's why we need them in solution.
- What is left after we remove all of the water from our cells?
  - Largely protein, lipid, rRNA.
  - Far more mRNA and proteins in mammalian cells than bacterial cells.
- Time for protein diffusion within a cell.
  - Time scale τ to traverse distance R given diffusion coefficient D:

$$\tau = \frac{R^2}{6D}$$

  - For a protein in cytoplasm, $D \approx 10\,\mu m^2/s$.
- The molecular hierarchy of structure.
  - The cell and its organelles are made of supramolecular complexes (e.g., the plasma membrane, chromatin, and the cell wall), which are made up of macromolecules (e.g., DNA, proteins, cellulose), which are made up of monomeric units (e.g., nucleotides, amino acids and sugars).
- We will be expected to know how to draw the amino acids and nucleic acid bases.
- We will not talk much about lipids and sugars.
- Chirality and isomers review.
- Thalidomide.
  - Was only distributed in Germany; the FDA is very proud of having picked up on the scientific malpractice and barred it from ever entering the US.
  - Just selling one isomer doesn't work because it racemizes so quickly.
  - Now used to treat cancer; you have to sign a bunch of paperwork saying that you won't get pregnant before you use it.