Lecture 1a Introduction

Wednesday, 8 July 2015
5:15 pm

Bring to pracs

- hard cover bound notebook
- Marker pen
- Safety glasses
- Calculator

Carbon based IT

- DNA to RNA to Protein -- Transcription and translation
- DNA to DNA -- replication

Genome	DNA	Same in every cell of your body (exc. germ line)
Transcriptome	RNA	Cell specific mRNA, tRNA, ribosomal RNA, small nuclear RNA
Proteome	Protein	Cell specific Ion channels, receptors, antibodies, enzymes, transcription factors

The central dogma

- DNA to RNA to Protein -- Transcription and translation
- DNA to DNA -- replication
- The flow of genetic information
- Found that RNA can reverse to DNA -- reverse transcription, reverse transcriptase
- You cannot go from protein to RNA
- You cannot go from DNA to protein or protein to DNA

Big 4 polymers:

1. Fat
2. Carbohydrates
3. Proteins*
4. Nucleic acids*

General biopolymer properties:

- All linear biopolymers have a (chemically) defined beginning and end
- Biopolymer synthesis is an anabolic process (making bigger molecules requires energy input)
- All biopolymers are synthesized in one direction only
- Some of the monomer is lost in polymerization, leaving a "residue" incorporated in the growing chain
    - Lost monomer, eg water in condensation polymerisation
    - Residue is added to chain

Elements of life must form strong covalent bonds to be stable

- Carbon to carbon bond is resistant to oxidation AND hydrolysis AND have a high activation energy
- Carbon can bond with itself and form long chains -- catenation
- Has 4 valance electrons, balanced and can form side chains
- Its desire to bond with itself is stronger than its desire to bond with oxygen
  - Consider silicon: Si and O bonds (such as silicon dioxide) are stronger than Si and Si bonds
- Larger atomic radius = weaker covalent bond

For the above points, carbon is relatively inert (kinetically stable) to hydrolysis and oxidation

- In general, organic reactions tend to me under kinetic control, rather than thermodynamic control
- This is attractive to enzyme control

Lecture 1b Biopolymers

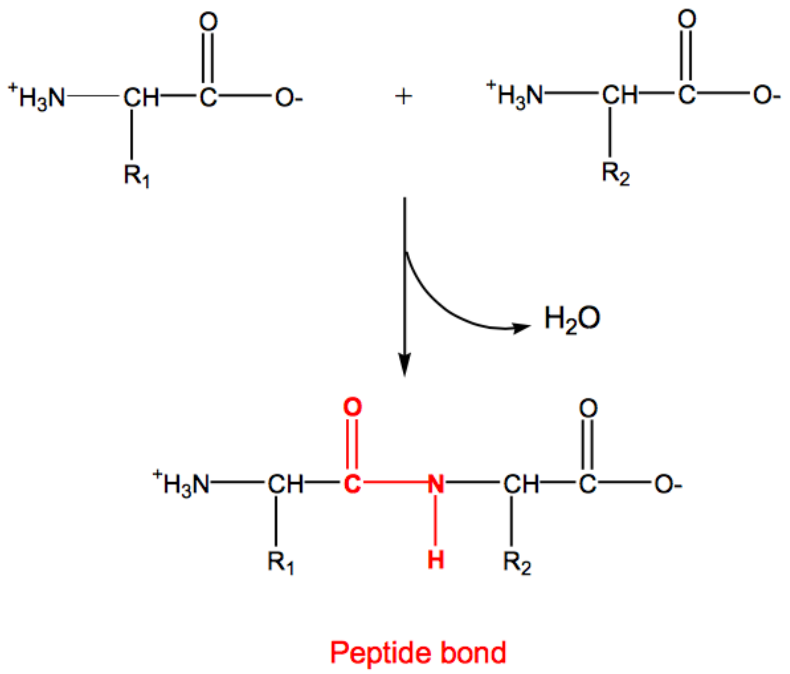
Tuesday, 28 July 2015
7:16 am

Fats (lipids) have the general formula	(-CH2-)n	Non-polar covalent
Carbohydrates or hydrated carbon has the general formula	(H-C-OH)n	Polar covalent
Carboxylic, amine, phosphate groups	COOH NH3 PO3	Ionic

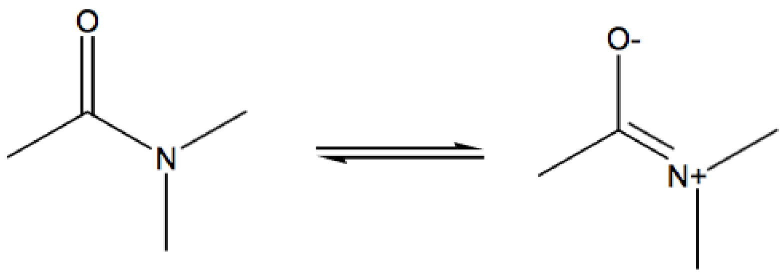
Proteins

- 20 amino acids
- Differ in their side chain
- Can be acidic, basic, polar, non-polar

Peptide bond formation is a condensation reaction -- water is a product.
Forming peptide bonds in cells is (thermodynamically) unfavourable -- due to water environment -- so peptide bond formation occurs via **translation**.



The double bond resonates between C=O and C=N

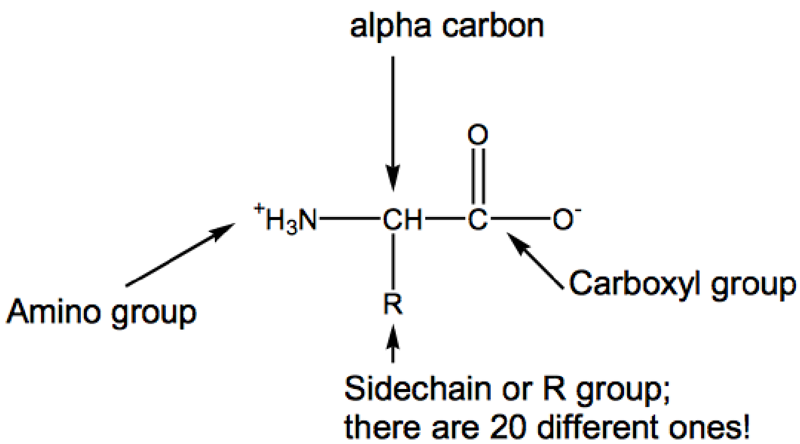


Peptide bond formation: Translation

- On ribosomes
- Water is excluded on the active site
- Catalysed by RNA
- Amino acids activated by ATP first

In proteins, the alpha carbon has hanging off it:

1. Carboxylic group
2. Amino group
3. Variable side chain / R group



Protein groups

1	Aliphatic	Hydrophobic, no dipoles
2	Aromatic	Aromatic ring Hydrophobic Absorb light in the UV range
3	Polar non-ionic	Polar / hydrophilic Non ionic
4	Acidic amino acids	Mostly carboxylic acid group, can give away protons Acidic, ph < 7
5	Basic amino acids	Can grab protons? Basic, ph > 7

Chirality
- Organic chemicals have one isomer
- They are all L isomers (other group is D isomer)

You will not be asked to draw amino acids
You will be asked to identity the properties of an amino acid, given their chemical structure

Kinases will phosphorylate proteins.
This switches the protein on and off.

Aromatic rings AND disulfide bonds
Will absorb UV radiation

Lecture 2a

Monday, 3 August 2015
12:04 pm

Chirality: mirror molecules

- Cannot be superimposed on one another
- Only chiral when carbon has 4 different groups attached to it
- All amino made naturally are L isomers

Which amino acid has no chiral carbon?

- Glycine. Two hydrogens

Which amino acids have 2 chiral carbons?

- Threonine
- isoleucine

pH and charge are invariably linked! Changing the pH, will change the charge.
Think of the following just like you would with chemical equilibriums.

pH

- --log10[H+]
- Scale from 0 to 14

Acidic side chains	Low pH (excess H ions), molecule is neutral High pH (excess OH-) , OH- rips H from molecule and molecule is negative
Basic side chains	Low pH (excess H ions), H reacts with base and molecule is positive High pH (excess OH-), OH- rips H from conjugate acid and molecule is neutral

Acid = positive end (think H+)
Base = negative end

pKa

- The median pH of dissociation.
- Equal concentration of acid and conjugate base
- Flat parts of titration curve
- Amino acid will act as buffer around the pKa's

pI

- Isoelectric point
- Average (mean) of the pKa poles
- pH when molecule has charge 0
- Steepest part between the flats on a titration curve

Formation of peptide bonds will neutralize the carboxyl and amino group charges on the alpha carbon BUT not the charges on the side chains. Not all amino acids have charged side chains.

The overall charge of a protein will depend on:

1. The sequence of amino acids
2. The pH