Notes 10/5

Friday, October 05, 2007
10:00 AM

From Your TA's:

"Fair Game" quiz topics will be announced Fridays before quiz week

- Next week:
  - Amino Acids
    - Structure
    - 3 letter code
    - 1 letter code
    - Side chain pKa (for midterm)
  - Henderson-Hasselbalch
    - Will be possible to do w/o calculator, but calculator allowed
  - Main terms from lecture

Proteins: Primary Structure

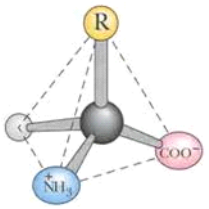
Oct. 4, 2007

Review

- Stereochemistry of glyceraldehyde and "generic" aa (amino acid)
- Non-standard aa are physiologically important
- 2 cysteines can oxidize into cystine
- aa are weak polyprotic acids
- Ionizable R-groups
- Titration of glycine (G), glutamic acid (E), lysine (K)

Amino Acid Stereochemistry

- D/L configuration, R/S designation
  - Tells us geometry of chiral carbon
  - Does not imply optical rotation → must be obtained experimentally

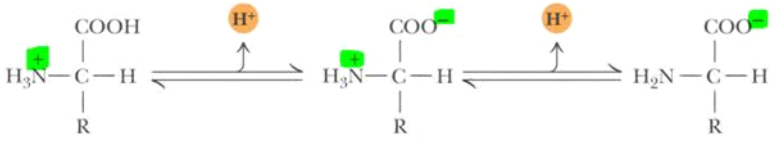


Amino acids are tetrahedral structures

Acid Base Properties of AA

- aa commonly written w/ intact α-carboxyl group and α-amino group
- Actually ionic at physiological pH
  - —COOH ⇔ —COO^-
    Carboxyl group carboxylate ion
  - —NH_2 ⇔ —NH_3^+
    amino group ammonium ion

Zwitterion

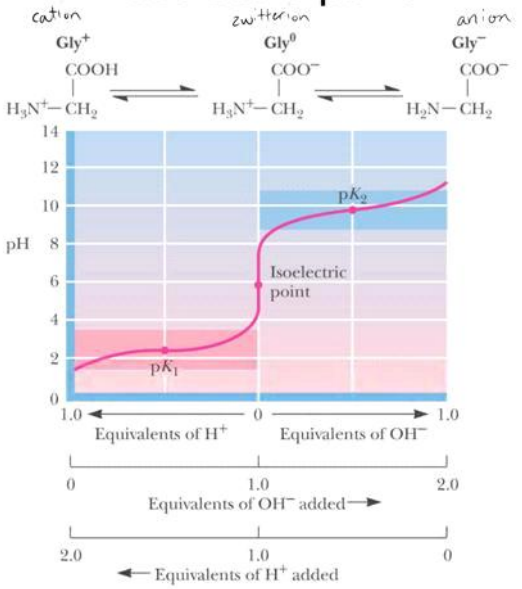


Cationic form
+1 charge

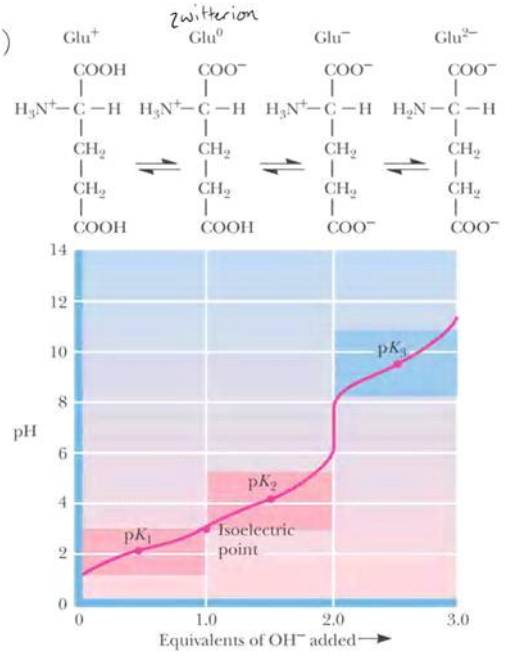
Zwitterion (neutral)
↳ german for double

Anionic form
-1 charge

Isoelectric point



$pI = \frac{1}{2}(pK_{a_1} + pK_{a_2})$ Isoelectric point



$pI = \frac{1}{2}(pK_a\ Glu^+ + pK_a\ Glu^-) = \frac{1}{2}(2 + 4.1) = 3.1$

Extra credit next week (1.0 pt)

- R-groups of Thr and Ser have a pK_a ~ 13
- Cys R-group has a pKa of ~ 8.4
- Why do Ser and Cys have such different pK_a's?
- Warning: I will NOT answer this during office hours and the answer is very hard to find online (I've tried)

More Extra Credit Next Week (0.5 pt)

- Ten essential amino acids
- Humans don't synthesize these
- HMKRVFTILW - memorize for extra credit
- **H**amburger, **M**ayo, **K**etchup, **R**elish, **V**ery **F**resh **T**omato, **I**ceberg **L**ettuce, **W**hite (or Wheat) bread

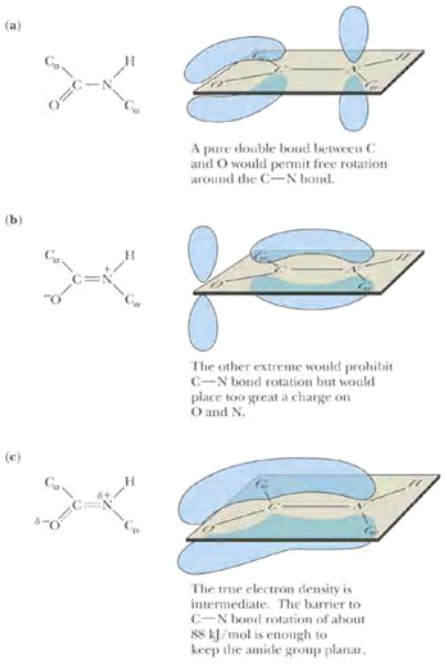
New Material Outline

- Primary structure
- The peptide bond
- Torsional angles
- Coplanar nature
- Naming peptides

What Architectural Arrangements Characterize Protein Structure?

- Proteins can be classified by shape, solubility
- Shape - globular or fibrous
- The four levels of protein structure
    - Primary - sequence
    - Secondary - local structures
    - Tertiary - overall 3-D shape
    - Quaternary - subunit organization

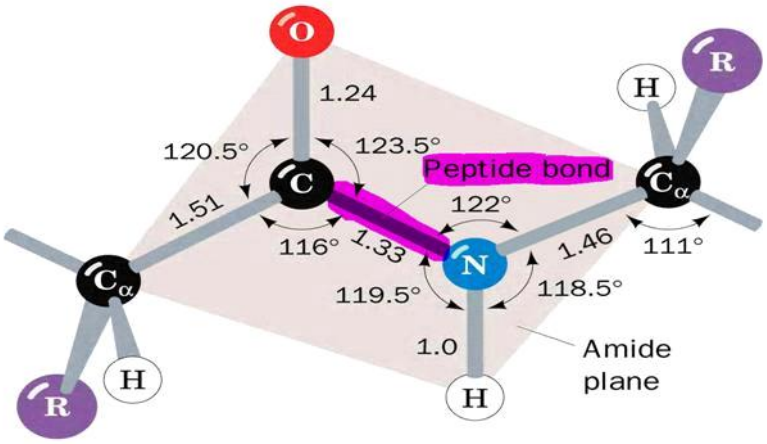
The α-COOH and α-NH_3^+ groups of two amino acids can react with the resulting loss of a water molecule to form a covalent amide bond.



The Peptide Bond

- usually found in the *trans* conformation
- has partial (40%) double bond character
- about 0.133 nm long - shorter than a typical single bond but longer than a double bond
- Due to the double bond character, the six atoms of the peptide bond group are always planar
- N partially positive; O partially negative

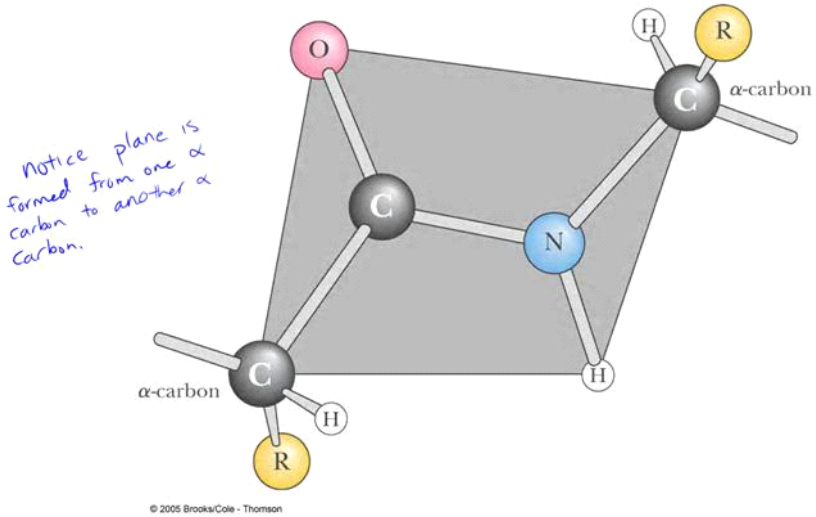
The trans-peptide group



Anatomy of an amino acid. Except for proline and its derivatives, all of the amino acids commonly found in proteins possess this type of structure.

The Coplanar Nature of the Peptide Bond

Six atoms of the peptide group lie in a plane



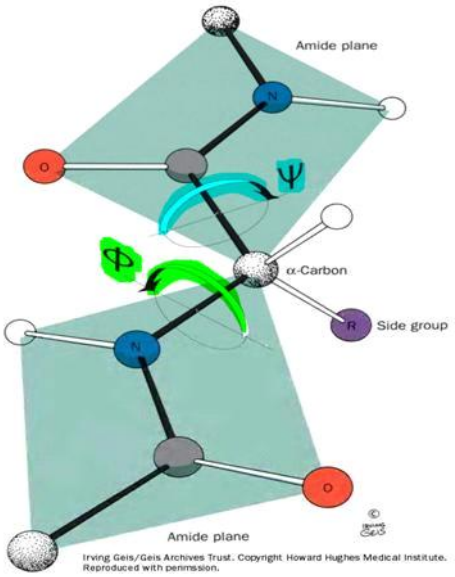
Notice plane is formed from one α carbon to another α carbon.

The torsional degrees of freedom in a peptide unit

C_α-N bond Φ

C_α-C bond Ψ

should know how to draw amide plane.



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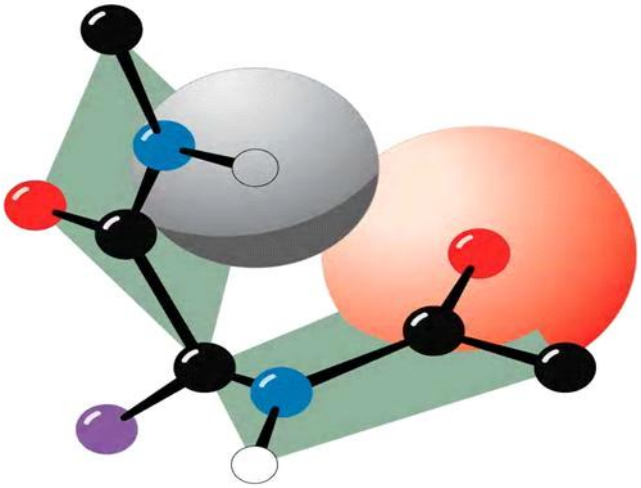
Steric interference between adjacent residues.



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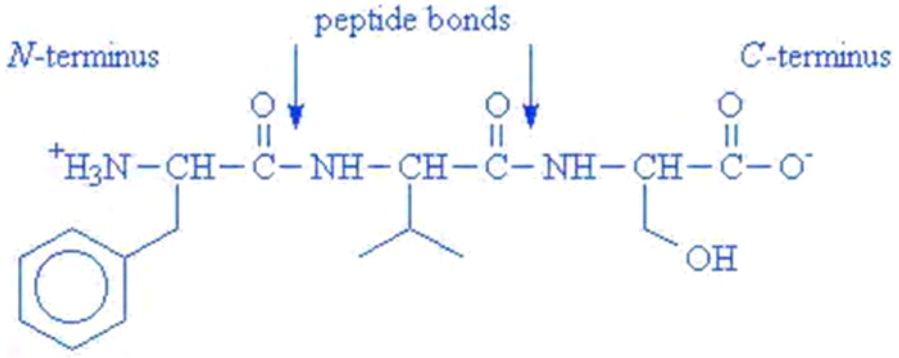
"Peptides"

- Short polymers of amino acids
- Each unit is called a residue
- 2 residues - dipeptide
- 3 residues - tripeptide
- 12-20 residues - oligopeptide
- many - polypeptide

The Sequence of Amino Acids in a Protein

- is a unique characteristic of every protein
- is encoded by the nucleotide sequence of DNA
- is read from the amino terminus to the carboxyl terminus

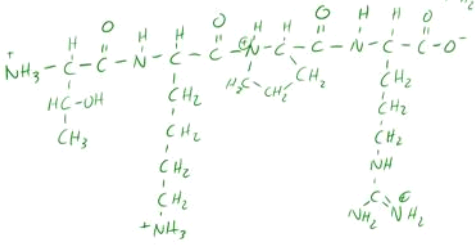
Example of a tripeptide



Tufstin is a tetrapeptide
Thr-Lys-Pro-Arg

Threonine T Lysine K Proline P Arginine R

Draw it:



"Protein"

One or more polypeptide chains

- One polypeptide chain - a monomeric protein
- More than one - multimeric protein
- Homomultimer - one kind of chain
- Heteromultimer - two or more different chains
- Hemoglobin, for example, is a heterotetramer
- It has two alpha chains and two beta chains

Bovine pancreatic ribonuclease A contains 124 amino acid residues. Four intramolecular disulfide bridges (S-S) form crosslinks in this polypeptide These disulfides are depicted by yellow bars.