AMINO ACIDS

- normally found in proteins, and are the building blocks thereof
- some are not found in proteins, but are still important
- Normally, in higher animals, the amino acids are the L-isomers
- Generally, for amino-acid hormones, the L-isomers are much more effective than the D-isomers

THERE ARE 20 AMINO ACIDS used in proteins in humans

NON-PROTEIN AMINO ACIDS
- ornithine
- 5-hydroxytryptophan
- L-dopa
- Taurine
- Thyroxine (yes, T4 is an amino acid)

ESSENTIAL AMINO ACIDS:
- valine
- leucine
- isoleucine
- threonine
- methionine
- phenylalanine
- lysine

CONDITIONALLY ESSENTIAL AMINO ACIDS:
- Arginine
- Histidine

AMINO ACID POOL

- proteins in the gut are destroyed, and their component amino acids absorbed.
- Body constituent proteins are also being constantly hydrolysed back into amino acids, and resynthesised
- 80-100g of body proteins are turned over this way every day, the rate being highest in the intestinal mucosa

PROTEINS

- amino acids joined by peptide bonds
- some contain carbohydrates (GLYCOPEPTIDES)
- some contain lipids (LIPOPROTEINS)
- there is no real defining point where a peptide becomes a polypeptide or when a polypeptide is large enough to earn the title “protein”. Lets just say that 2-10 amino acids make a peptide, 11-100 amino acids make a polypeptide, and anything over 100 amino acids is a protein.

PRIMARY STRUCTURE: the sequence of amino acids
SECONDARY STRUCTURE: the arrangement of twisting and folding, eg. alpha-helices or beta-pleated sheets
TERTIARY STRUCTURE is the arrangement of twisted chains into layers, crystals, globules etc
QUARTERNARY STRUCTURE is the arrangement of subunits into a functional protein, eg. the 4 subunits forming the greater hemoglobin molecule

First, the tRNA binds an amino acid (there are several tRNAs for every amino acid)
Then, the tRNA and the amino acid attach to the mRNA template in the ribosome
Translation typically starts with Methionine, which is encoded by the sequence AUG
As the amino acids attach to each other, the tRNA moves along the mRNA like a bead on a string
Once the tRNA reaches a “nonsense” codon (UGA, UAA or UAG) it stops translating
mRNA molecules are used about 10 times before they are replaced, and there is often more than one ribosome on any one mRNA molecule.
POST-TRANSLATIONAL MODIFICATION
After the chain is formed, secondary structure is folded by a combination of
- hydroxylation
- carboxylation
- glycosylation
- phosphorilation
of the amino acid residues.
Peptide bonds ma be cleaved to break the chain into smaller molecules
The proteins usually have some “signal peptide”, or “leader sequence”, which directs them to the organelle where they function; its usually a 30-amino-acid chain with hydrophobic residues

PROTEIN DEGRADATION
Your body's crap at making proteins. Up to 30% are abnormal and improperly folded.
THE ABNORMAL PROTEINS ARE USELESS AND DANGEROUS AND MUST BE DESTROYED.
Ageing damaged proteins also need to be destroyed
- the proteins which must die are marked for degradation by binding to UBIQUITIN which is a 74-aa polypeptide
- ubiquitin is an ancient technology, and is exactly the same in bacteria as well as humans
- the ubiquitin then drags the doomed protein off to a proteosome for degradation

CATABOLISM OF AMINO ACIDS
- shreds of amino acids can get plugged in just about anywhere along the Citric Acid Cycle; thus they can be used to generate ATP like carbohydrates and fats. They need minor modification to resemble normal Krebs cycle components
- They are also subject to TRANSAMINATION reactions: where an amino acid is converted into the corresponding keto acid while another keto acid is reverse-transformed into an amino acid. These TRANSAMINASES, like aspartate aminotransferase (AST) rise when cells are damaged and start spilling their contents all over the bloodstream

UREA FORMATION
- deamination of amino acids occurs in the liver
- the result is formation of NH$_4^+$ which needs to be gotten rid of somehow
- you tend to get rid of it by turning it into urea; also happens in the liver.
- When the liver fails, there is too much NH$_3$, and thus you get NH$_3$ intoxication
- There is a whole UREA CYCLE which consumes a total of 3 ATP and ultimately results in the formation of urea, via an enzyme called ornithine carbamoyltransferase of which you can be congenitally deficient (with nightmarish consequences)

References: Ganong's Review of Medical Physiology, Chapter 1