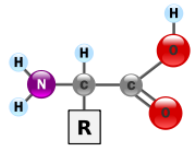
2017 jan 16 **Proteins & Structure**



In **mammals**, there are 21 variants of **a**mino **a**cids **AA**, the building blocks for **proteins**.
12 AAs are prescribed by DNA and produced on demand. All AAs are available in food.
In the chart below, ↑ indicates AA we cannot produce; we must get from food: these 9 **essential** AAs !

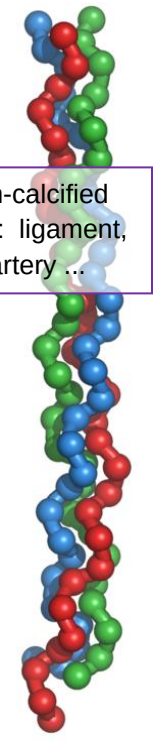
*In biochemistry and molecular biology, a **residue** refers to a specific monomer within the polymeric chain of a polysaccharide, **protein** or nucleic acid.* (preferring **monomer**: the AA core depicted above, or: NH_2-CH**R**-COOH)

The core **monomer AA base unit** pictured above allows for variant "add-ons" replacing the variable **R**.
The simplest AA is **glycine** in which **R** is simply the **H**ydrogen atom. **Glycine is the predominant AA in fiber.**

The chart below depicts variants of **R**, indicating 5 have valence: 3 **+** / 2 **-** ; 16 have no valence (neutral).
Proline, 2nd and hydroxyProline, **4th** predominant, feature the pyrrole ring with zwitterion (labile electron).
Methionine & **cysteine** sisters have **S**ulfur atoms - having only .7% occurrence in collagen; more in keratin.

During production by fibroblast cells, AA building blocks are linked end-end into peptides (sub-proteins), and finally completed for **proteins**. Depending on the sequence, in fact - **determined by the sequence**, of AA variants comprising the protein chain, the result is a 3-dimensional molecule with functional **conformation**.
Shape is functionally important in the biological and/or biochemical role served by each protein.

Generally, the human is a concerted cluster of functional colonies of cells, including organs and **structural** elements, all bounded by the skin (epidermis) - separating **inside** from outside.
The food tube enables selective nutritional uptake - from outside within tube >> into the **inside**.



atomic view of fibril - the non-calcified flexible structural element of: ligament, tendon, fascia, membrane, artery ...

Structural proteins in the human account for **1/3** of total **body mass.**
Three main types generally referred to as **collagen** have distinct roles:

1. micro - cell membrane and internal cellular matrix or "skeleton".
2. macro - membranes in the form of β-sheet: e.g. enveloping organs.
3. macro - **fibers** - arranged in the simplest of protein conformations, **linear -** each chain aligning parallel and contiguous / attached with other duplicates - linked into triple helical chain spiraling around a central, virtual, linear, uni-directional axis.

A special case is the most stable **α-helix**, the basis for the toughest bio-armor in forms of α-keratin, produced by keratinocytes near the **outside**: e.g.: hair, horns, nails and cornea.
Rigidity is increased by di-**S**ulfide bonds with cysteine AAs.
Slightly less compact (allowing for the pyrrole rings of proline), with only .1% cysteine, otherwise equally linear and uniform is the **collagen helix**, illustrated, the triple-helix basis of **fiber** comprising **ligament** and **tendon** which tie into **bone**. Tendons transition from bone to spreading fibers morphing into β-sheet formation which merges into the fascia integrating into myofascial envelopes of muscle cells - membranes enclosing muscle fibers: myofilaments comprising **myofibrils** - within muscle cells. (below)

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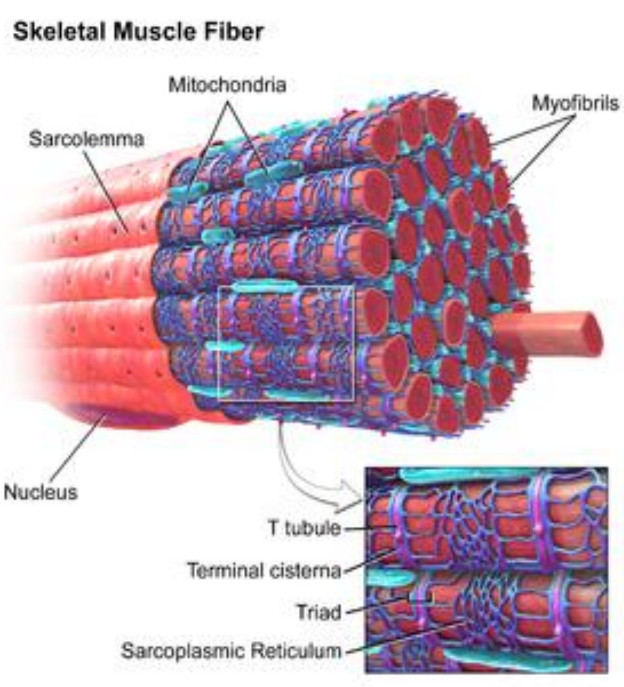
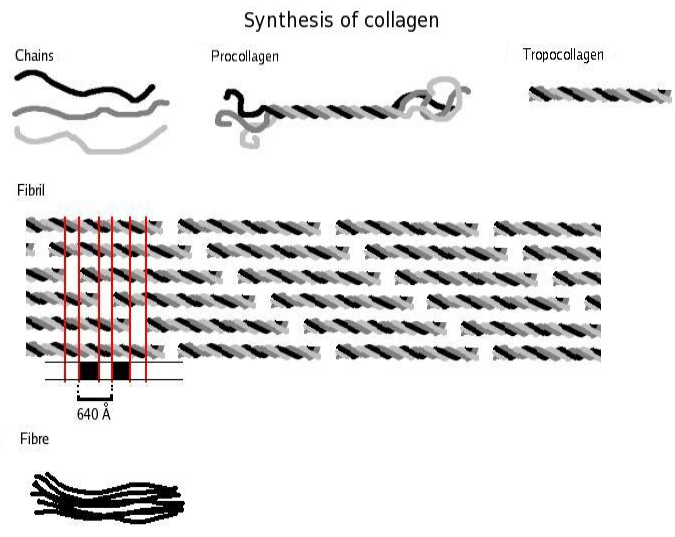
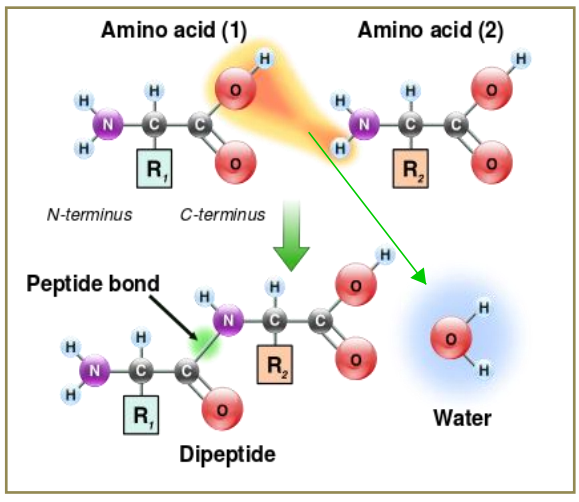
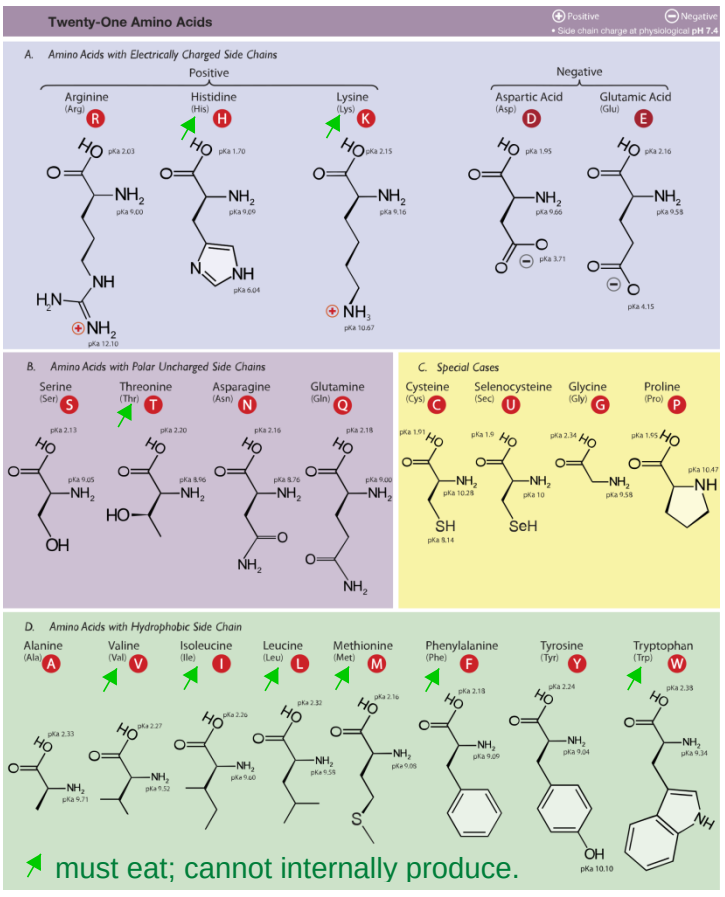


http://en.wikipedia.org/wiki/Sarcolemma
The **sarcolemma** is the cell membrane enveloping the striated skeletal muscle cell providing broad membranous merging attachment to the dense linear fibers of the tendon.





http://en.wikipedia.org/wiki/Amino_acid



↑ must eat; cannot internally produce.