Natural fibers

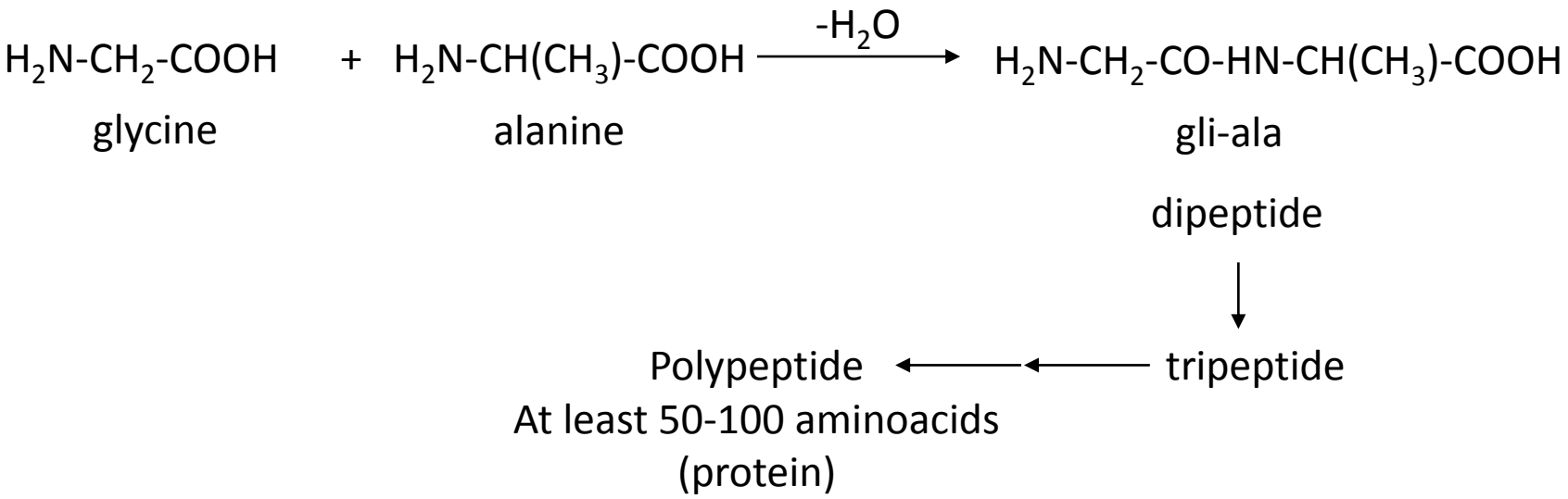
- Natural fibers are found in the fiber geometry in the nature.
- After passing froma pre-cleaning and preparation steps, these fibers are used for the weaving and other purposes.

Animal (protein) fibers

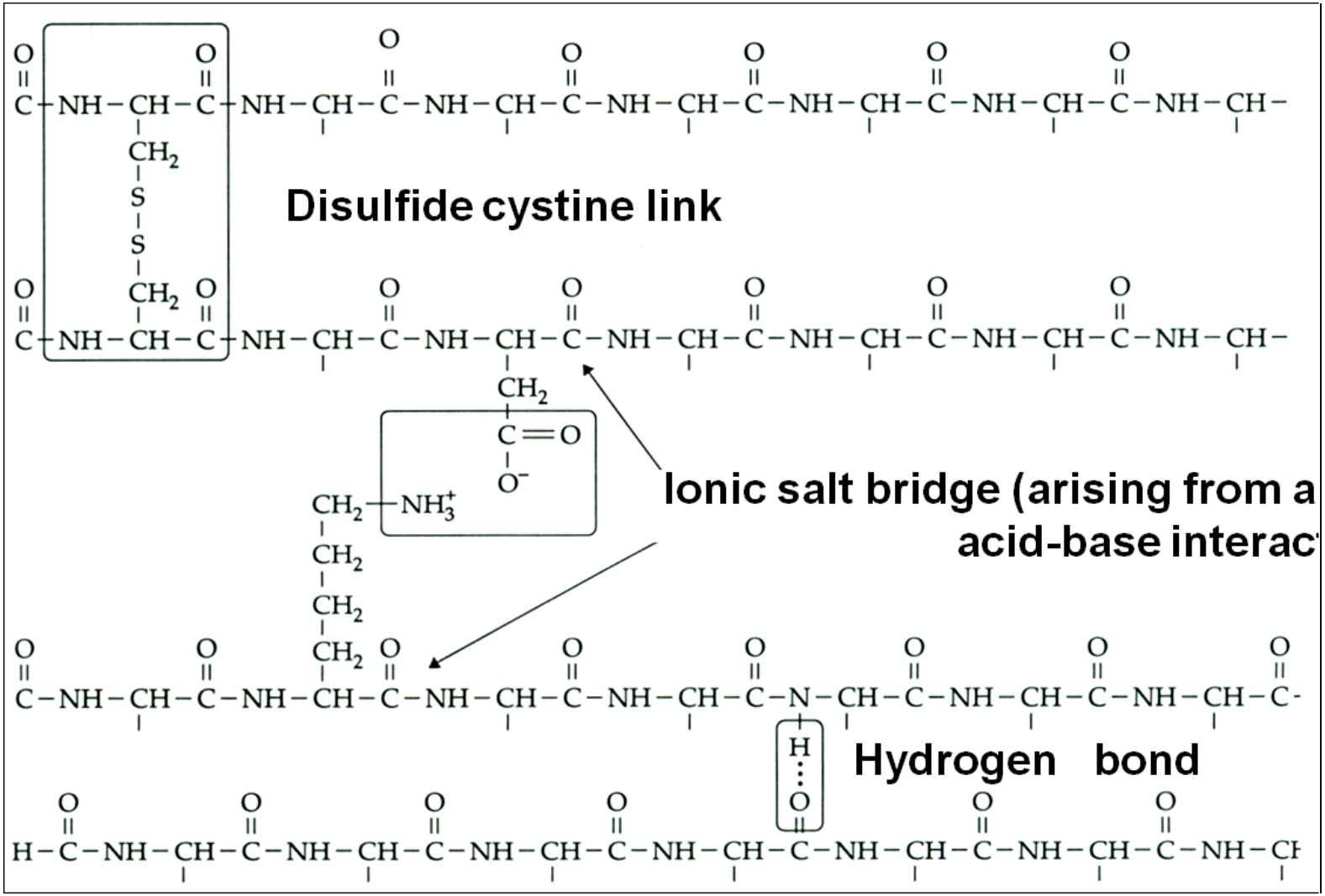
- Except natural silk, other animal fibers are belong to a protein group that is known as keratin.
- Keratin isa fibrous protein, and the main component of hair and external surface of the human body.
- It cannot be shown with a single structure and composes of the mixture of proteins.
- The proteins are the condensation products of amino acids.

$$-(C=O)-NH-C(R)-$$

Peptide bonds



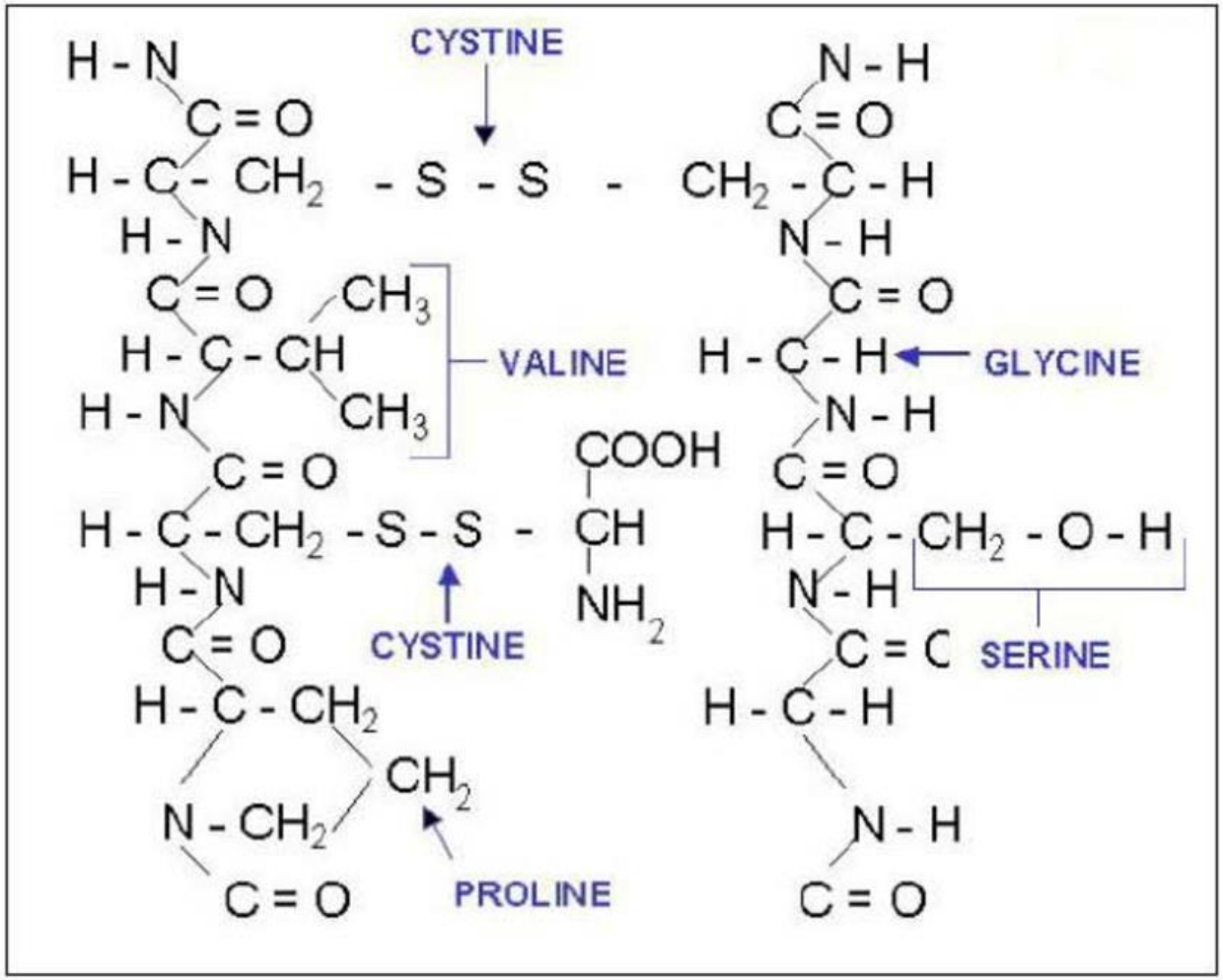
Cystine bonds



https://i.stack.imgur.com/WyTC4.png

? Homework: how the straight hair transforms to curly hair?

Write the chemicals and process.



Martínez-Hernández, Ana & Velasco-Santos, Carlos & Icaza-Herrera, M. & Castaño, Victor. (2003). Grafting of methyl methacrylate onto natural keratin. e-Polymers. 3. 10.1515/epoly.2003.3.1.209.

Wool

- Good handling property
- Feeling warm
- High reversible flexibility (Prevents shrinkage)
- Feeling dry although it contains ~30% of (per its weight) moisture
- Ability of felting (sometimes unwanted property)

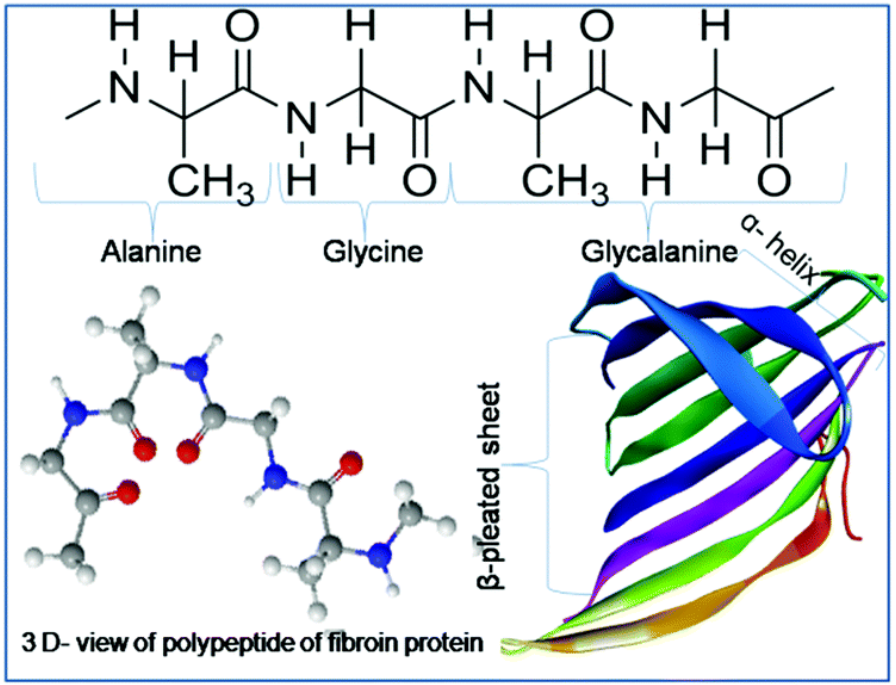
Most of the properties of the animal fibers depend on the structure of their polypeptide chains:

- Due to thier spiral structures, the protein chains Show good flexibility.
- The polar peptide bonds have the ability of inter and intra molecular H-bonding
- Some of the large side groups could hinder the orderly packaging of protein chains and this leads to a lowering in the H-bonding density.
- The protein chains are able to return their original geometries after the removal of applied stress onthe polymer, this ability imparts the animal fibers preventing shrinkage.

? Homework: what is the difference between angora, alpaka and cashmere fibers with wool?

Silk

- The silkworm wraps silk filaments around itself to form cocoons, and natural silk is obtained from these cocoons.
- The only continous fiber that is obtained fromnatural sources.
- The liquid silk secreted from the silkworm's mouth solidifies to give two filaments when in contact with air. The filaments are hold together by a substance called ***sericin***.
- With this sericin, these two filament is called ***natural silk***.
- The proteinous structure present in the silk is called fibroin.

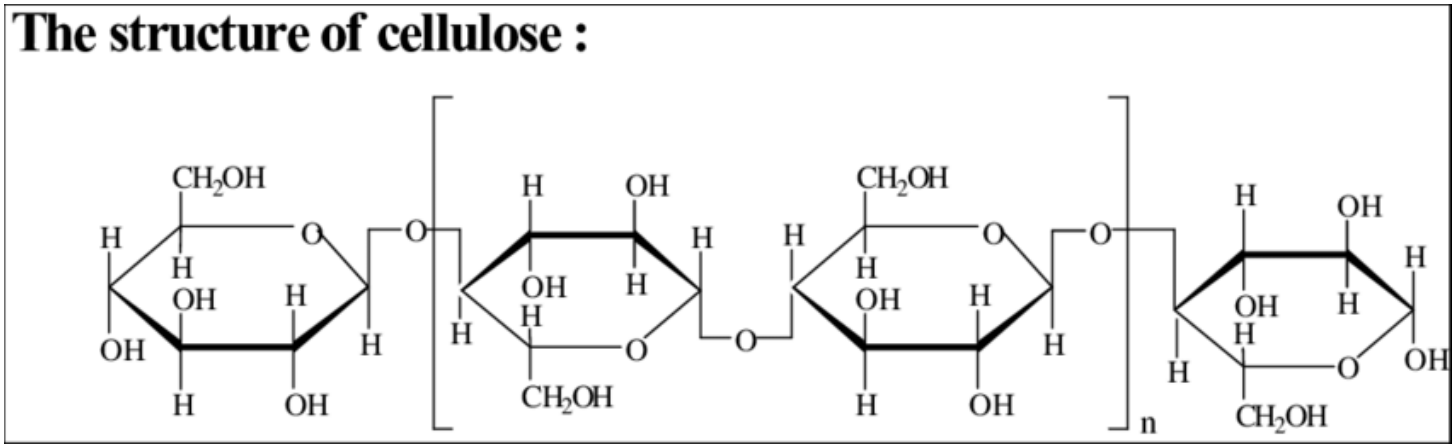


Silk fibroin–carbon nanoparticle composite scaffolds: a cost effective supramolecular 'turn off' chemiresistor for nitroaromatic explosive vapours S. Chakravarty, N. Bhardwaj, B. B. Mandal and N. Sen Sarma, *J. Mater. Chem. C*, 2016, **4**, 8920**DOI:** 10.1039/C6TC03337G

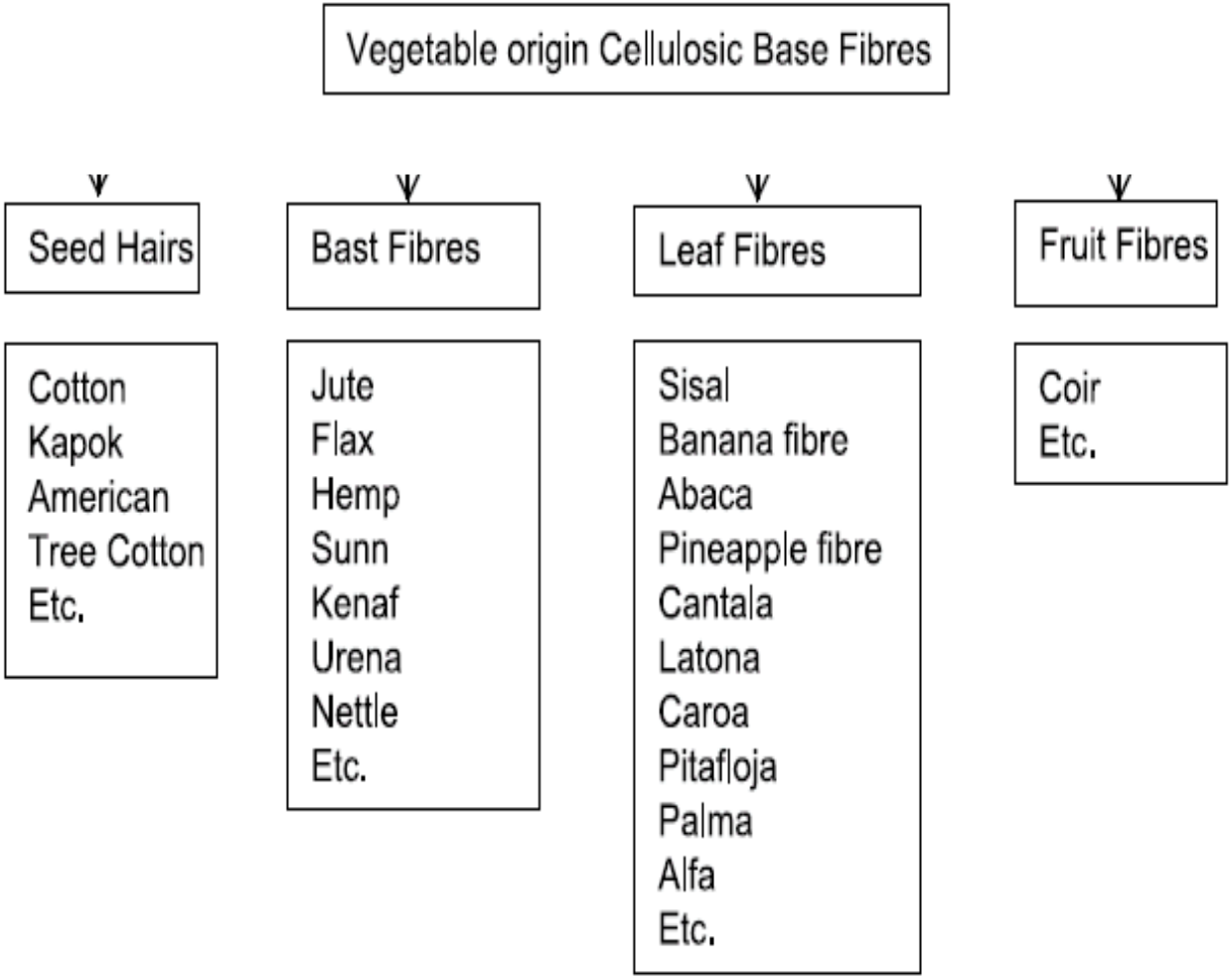
Plant fibers

Parts	Example
Seed	Cotton, Kapok
Bast/Stem	Flax, Hemp, Jute
Leaf	Sisal, Abaca, Pina

- The fibers obtained from the seed, bast/stem are called soft fibers, and leafs are called tough fibers.
- Natural component of the plant fibers are cellulose that is the most common polymer present in the nature.



Al-Mobarak, Taimur. (2010). Material Properties of Acetylated Jute-Mat Composites.

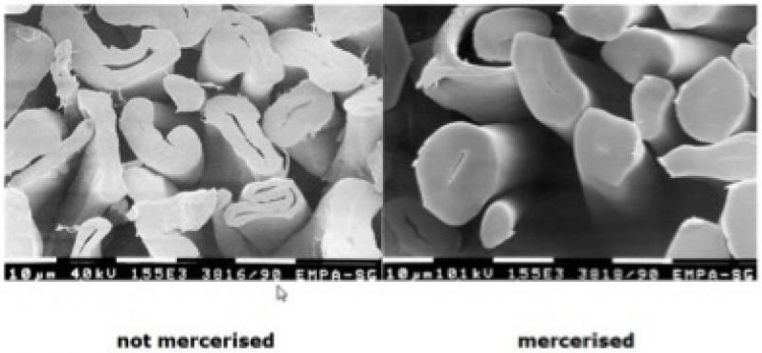

Vegetable origin Cellulosic Base Fibres
Seed Hairs
Cotton
Kapok
American
Tree Cotton
Etc.
Bast Fibres
Jute
Flax
Hemp
Sunn
Kenaf
Urena
Nettle
Etc.
Leaf Fibres
Sisal
Banana fibre
Abaca
Pineapple fibre
Cantala
Latona
Caroa
Pitafloja
Palma
Alfa
Etc.
Fruit Fibres
Coir
Etc.

cotton

- Cotton fibers are composed of 94% of cellulose.
- Dp of cellulose obtained fromcotton is 4000-5000 corresponding to a Mn of 800000.
- Cotton is frequently used after ***mercerization*** process (treating with diluted NaOH solution at 30-40^{o}C for a few min.)

This leads to;

- Increasing crystallinity
- Increasing the diameter about 25%
- Decreasing the strentgh
- Increasing the flexibility
- Decreasing the density
- Making the sectional geometry as spherical
- Shortening the legnth of a fiber about 20%.
- Increasing themoisture absorption
- Increasing the dye-uptake
- Improving the lusture



not mercerised mercerised

https://trc-leiden.nl/trc-needles/tools/fibre-preparation/mercerisation