

Periodic Graphics

A collaboration between C&EN and
Andy Brunning, author of the popular
graphics blog *Compound Interest*

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online

To see more of
Brunning's work, go to
compoundchem.com.
To see all of C&EN's
Periodic Graphics,
visit [cenm.ag/
periodicgraphics](http://cenm.ag/periodicgraphics).

THE CHEMISTRY OF TEXTILE FIBERS

Manufacturers use a range of materials in the clothes we wear. Here we look at the molecular details of these textile materials and how those properties affect our clothing.

WHAT ARE TEXTILE FIBERS?



Textiles are long, thin fibers held together by intermolecular attractions that affect their strength and flexibility. Natural fibers usually exist as short fibers called staples that are spun into a yarn. Synthetic fibers are produced as continuous-filament yarns.



Staple fibers



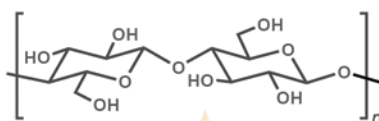
Continuous-filament yarn

Cotton and polyester are the most produced fibers worldwide by mass.

NATURAL FIBERS

CELLULOSE-BASED FIBERS

Cellulose-based fibers come from plant seeds, stems, or leaves. Cotton comes from the seeds of *Gossypium* plants.

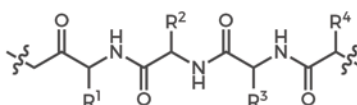


Cellulose

When you wash cotton clothes, water disrupts the hydrogen bond network that holds cellulose chains together. When the clothes dry, hydrogen bonds between chains re-form, causing creases.

PROTEIN-BASED FIBERS

Protein-based fibers come from wool, hair, and silk.



Protein (R = variable side chains)

Wool fibers have protein-based scales that align in one direction. When wool is washed, the fibers can move and the scales can interlock, causing irreversible shrinkage.

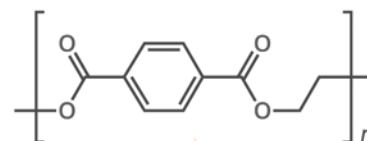
MANUFACTURED FIBERS

REGENERATED FIBERS

Manufacturers make regenerated fibers such as rayon by dissolving cellulose fibers, then purifying and extruding them.

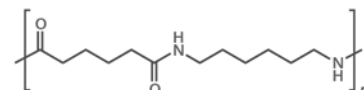
SYNTHETIC FIBERS

Manufacturers commonly make synthetic fibers such as polyester and nylon from nonrenewable petroleum derivatives.



Polyethylene terephthalate (a polyester)

Most synthetic materials don't shrink when washed and are more wrinkle resistant than cotton, but they absorb less moisture. Often, polyester and cotton are blended to combine the benefits of the two fibers.



Nylon 6,6

Nylon degrades in sunlight, so stabilizers need to be added during polymerization.