

The Science of Hair

The hair on our scalps and in our eyebrows and eyelashes are different from other bodily hairs. Long scalp hairs have an average life of 3 to 5 years, and most of us have between 100,000 and 150,000 hairs on our heads! There are three stages of hair growth: catagen, telogen, and anagen.

- Catagen is a transitional stage, and 3% of all hairs are in this phase at any given time. This phase lasts 2-3 weeks, and during this time growth stops and the outer root sheath shrinks and attaches to the root of the hair.
- Telogen is the resting phase and accounts for 10-15% of hairs. It lasts for about 100 days for scalp hair, and much longer for hairs on the eyebrows, eyelash, arms and legs. During this phase the follicle is at rest. Pulling a hair in this stage out will reveal a solid, hard, white, dry material at the root. About 25 to 100 telogen hairs are shed normally each day.
- Anagen is the active phase of the hair, in which cells in the root are dividing rapidly. A new hair is formed and pushes the club hair out. During this phase the hair grows about 1cm every 28 days, and scalp hair stays in this active phase of growth for 2-6 years.

Relaxing

Hair relaxing, or lanthionization, chemically straightens the natural curl of hair. The active agent is almost always a strong alkali, though some are based on ammonium thioglycolate instead. As with hair dye, the treated portion of the hair grows away from the scalp, so the new growth of untreated hair sprouting from the roots will require periodic application in order to maintain the desired, smooth, effect. There are two main types of hair relaxers:

- Lye relaxers consist of sodium hydroxide (also known as lye) mixed with water, petroleum jelly, mineral oil and emulsifiers. On application the caustic lye mixture permeates the protein structure of the hair and weakens its internal bonds, causing the natural curls to loosen out as the fibre swells open. The sodium hydroxide content of the lye solution varies between 5 and 10%, and the pH factor between 10 and 14.
- “No-lye” relaxers exist in three forms.
 - The first uses the same principle as lye relaxers but uses a weaker alkaline agent such as potassium hydroxide, lithium hydroxide, or guanidine hydroxide.
 - Another type uses ammonium thioglycolate, also known as perm salt for its use in permanent waves. Perm salt is a chemical reducing agent which selectively weakens the hair’s cystine bonds instead of the entire protein, but excessively strips out the natural oils.
 - Most relaxers sold for home use are the third type of “no-lye” relaxer, in which the active agents are ammonium sulphite and ammonium bisulphate, and are much weaker and work more slowly than other relaxers.

Coloring

Hair coloring is serious business in North America, with a reported 75% of women having the service done. And women aren't alone - it is becoming increasingly popular for men to color their hair, either to cover grey or to change their style completely. There are two kinds of melanin found in the hair – eumelanin, which is most common and produces brown to black shades of hair, and pheomelanin, which is responsible for yellowish, blonde, ginger, and red colors. Absence of pigment results in grey or white hair. Before any permanent color can be deposited into the hair shaft, the cuticle (outer layer) must be opened. The insoluble formula then reacts with the cortex to deposit or remove the color. The two main ingredients in any coloring process that lasts more than 12 shampoos are:

- Hydrogen peroxide - known as the developer or oxidizing agent, and helps initiate the color-forming process and creates longer-lasting color. The larger the volume of the developer, the greater the amount of sulphur which is removed from the hair. This loss of sulphur causes hair to harden and lose weight, which is why the developer is maintained at 30% or less in the majority of hair coloring.
- Ammonia. Ammonia is an alkaline which allows for lightening by acting as a catalyst when the permanent hair color comes together with the peroxide. Like all alkalines, ammonia tends to separate the cuticle and allow the hair color to penetrate the cortex of the hair.

Generally speaking, there are three “levels” of hair coloring:

- Level 1, or semi-permanent color, adds color without changing natural color dramatically. The hair color contains tiny molecules that enter the hair's cuticle (outer layer) and into the cortex. They don't interact with the natural pigment, and because the molecules are so small, eventually exit the hair shaft after several shampoos.
- Level 2, or demi-permanent color, lasts longer than semi-permanent color. Pre-color molecules penetrate the cuticle and enter the cortex where they then partner to create medium-sized molecules, and their larger size means they take longer to wash out. These products don't contain ammonia, so natural pigment can't be lightened, but they do contain peroxide which allows for subtle color enhancement.
- Level 3 is permanent color, which is needed for a more significant color change. Both ammonia and peroxide are used in this treatment. Tiny molecules enter all the way into the cortex where they react, and expand to a size that cannot be washed out. This means that the treated hair has to grow out if color removal is desired.

This information has not been verified by Science Alberta Foundation, and is for general informative purposes only. For more information about your hair, talk to your doctor or hair care professional.