BASIC CONCEPTS OF HAIR PHYSIOLOGY AND COSMETIC HAIR DYES

MACRO-STRUCTURE OF THE HAIR

The hair is formed by the shaft and the piliferous bulb. The visible part of the hair, the shaft has a diameter ranging between 40 and 120 microns; it's made of dead cells and it is completely keratinized. A cross-sectional section of the hair shows that it's formed by three concentric layers:

The cuticle (the external part)
The marrow (the core)
The cortex (the actual structure)

1. THE CUTICLE

It is the outermost layer, made up of flattened cells that overlap like the tiles of a roof. They are 45 micron long and their thickness ranges from 0.5 to 1.0 microns. In human hair the cuticle is 5 to 10 layers thick.

2. THE MEDULLA

It is the core of the hair and it is made up of overlapping cells with a low cellular density. It has a relative importance in comparison to the two other parts of the hair, as it contributes in a little way to its chemical and physical behavior.

3. THE CORTEX

The cortex is formed by cells which are 1 to 6 microns thick and 100 microns long. The cortex makes up for about 90% of the total weight of the hair fiber. The fiber is formed by long twisted protein chains which give the hair its elasticity. By stretching the hair you're straightening the coiled proteins of the cortex which coil up again when releasing the hair. The pigments that give your hair its natural color are tucked among these protein strands and protected from external agents by the translucent layer of cuticle cells.

A chemical analysis of the hair shows the presence of:

CARBON – 50 %
OXYGEN – 25 %
NITROGEN – 7 %
HYDROGEN – 6.5 %
SULPHUR – 4.5 %

HAIR NATURAL COLOR ORIGIN

The hair's natural color is due to distinctive pigments contained in the hair cortex. Hair color is provided by pigments produced by cells called "melanocytes". Those pigments are called "Melanin". In humans, all the different hair colors are due to just two types of pigment (Melanin) called Eumelanins and Pheomelanins. Eumelanins are the dark brown and black pigments while Pheomelanins are the red and blonde pigments. The different colors of hair in different people are due to a combination of these two different basic biochemical structures. Different concentrations of those two pigments form the different shades of hair color.

Eumelanins are very strong, stable proteins made from Tyrosine. The large Eumelanin biochemical structure is given by the transformation of the amino acid Tyrosine into Dopaquinone and Dopamine and the bond of several of these molecules together to form Eumelanin. The key enzyme in this process is Tyrosine. The more Tyrosine activity the more Eumelanin is formed. This is one of the reasons why we can see different shades of brown in natural hair colors. The more the Tyrosine activity, the more the pigment production and therefore darker the hair color.

Pheomelanins are also made from the same Tyrosine as Eumelanins and the process is much the same with Tyrosine playing a key role. Pheomelanins are produced when an intermediate product in the Eumelanin production pathway interacts with the amino acid Cysteine. This results in the formation of a pheomelanin molecule which contains Sulfur from the Cysteine. These molecules are yellow to orange in color and they influence a lot the different shades of hair color. The more interaction there is between Dopaquinone and Cysteine the more yellow and orange pigments are produced.

People with darker hair have a relatively higher Eumelanin production. People with true red hair produce more pheomelanin.

A study that analyzed the amount of Eumelanin and pheomelanin in human hair suggested that: A black hair contains approximately 99% Eumelanin and 1% pheomelanin, brown and blond hair contains 95% Eumelanin and 5% pheomelanin; and red hair contains 67% Eumelanin and 33% pheomelanin (Borges 2001).

Although people with dark hair may still produce the yellow - orange pheomelanin pigment, this is largely masked by the darker Eumelanin pigment and we cannot see much of it. However, the red - yellow pheomelanin is believed to cause the warm, golden, or auburn tones found in some types of brown hair.

As we get older, the Tyrosine activity increases. It is active the most during mid-age and thereafter Tyrosine activity decreases and hair slowly turn to grey. This is why we need of an artificial dye to rebuild the lost hair natural color and today's cosmetic science offers a wide range of possibilities.

BASIC COLOR LAWS

WHAT'S COLOR?

Being the subject very wide and complex, we simply want to give you a few hints to form a general notion for COLOR and COLORIMETRY applied to professional artificial hair dyes.

Definition:

COLORIMETRY IS THE QUANTITATIVE DETERMINATION OF THE DEPTH OF COLOR

What our brain perceives through the eyes is just a minimal part of visible radiation. The light coming from the sun is white and both visible and invisible radiations are classified on a single scale of values.
We can picture the sun as a radio-emitter and the eye as a radio-receiver. Any given object hit by the light acts as a mirror reflecting, partly or totally, or absorbing the radiation. These are basic concepts which will be further analyzed afterwards.

Any color in the spectral range has its own wave-length.
The shortest wave-length perceivable by human eye is violet light.
Its density is 67.000 / 3 cm.
Red light has the longest visible waves: 33.000 / 3 cm.
Medium length waves (compared with the above ones) form the yellow light.
If a body absorbs all radiant energy falling upon it, it is BLACK
If a body reflects all radiant energy falling upon it, it is WHITE

The perception of color is subjective; each person has a personal perception of colors and light. The terminations of the visual nerves in the retina play an important role in vision. These terminations are normally referred to as RODS and CONES. Rods are the elements responsible for the perception of strong light and the cones enable the sensation under poor light conditions.
Some further terms for describing vision are Lightness, Hue and Saturation. Lightness is a property characterizing the amount of light that a certain surface is emitting. Hue is another parameter of vision resulting in naming the colors as blue, yellow, green, red, purple etc. Saturation serves for the estimation where a perceived color can be located between white and the pure color (Light, Medium, Dark etc.).

COLORIMETRY

COLORIMETRY LAWS

Color is a sensation perceived by the eye
Light coming from the sun is white
White light is formed by the spectral colors

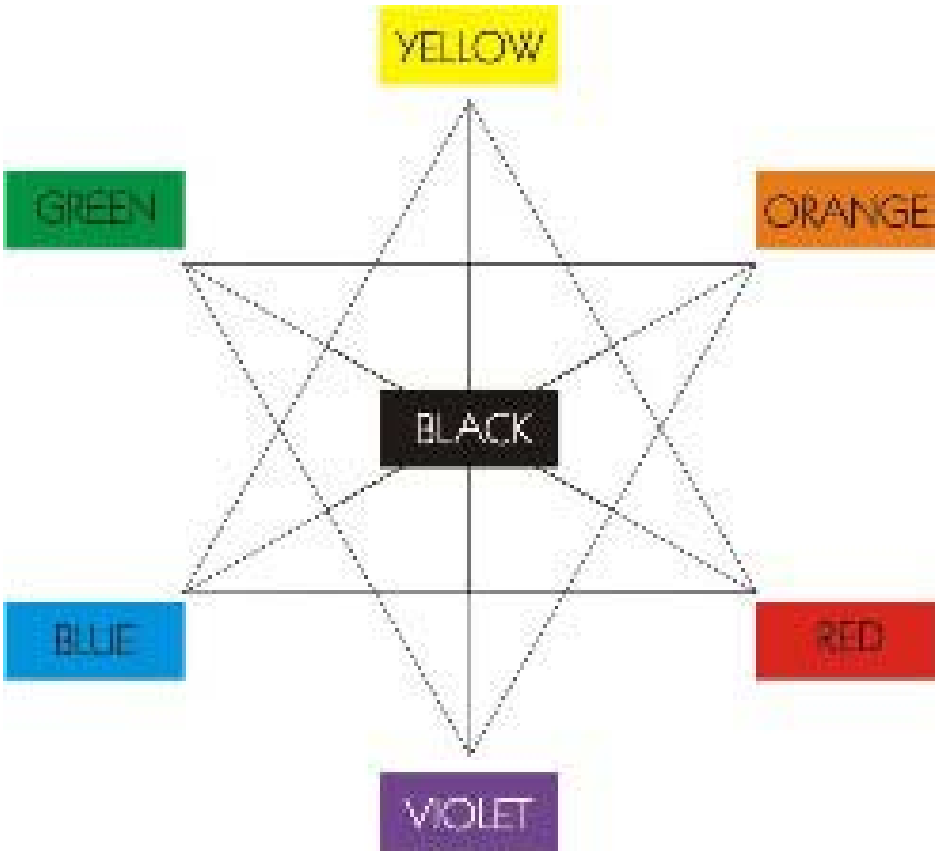
PRIMARY COLORS: BLUE – YELLOW – RED
SECONDARY COLORS: GREEN – ORANGE – VIOLET

These six colors form BLACK

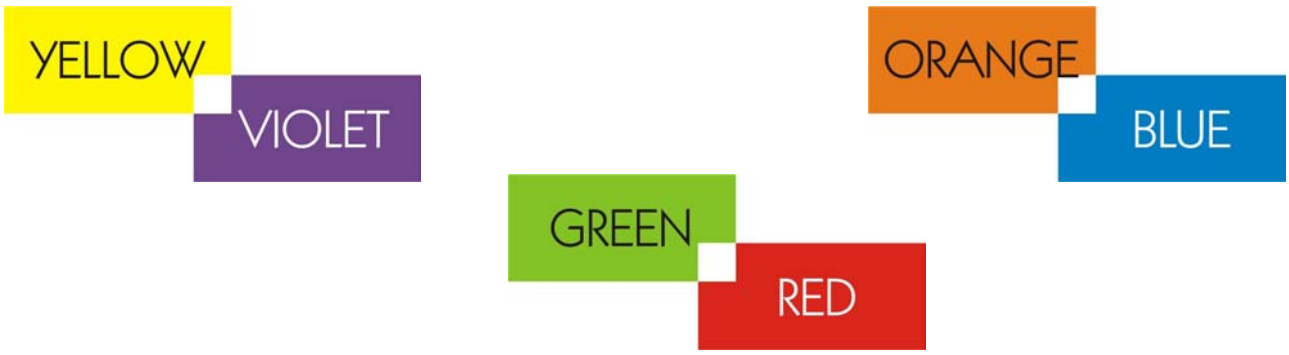
Example:
A brown color of the hair is formed by two parts of yellow, two parts of red and one part of blue.
With the help of some colored inks and an overhead projector we may verify that:

OSTWALD STAR

The Ostwald Star enables the detection of:
PRIMARY AND SECONDARY COLORS
THE PRESENCE OF AN OPPOSITE NEUTRALISING COLOR FOR EACH COLOR

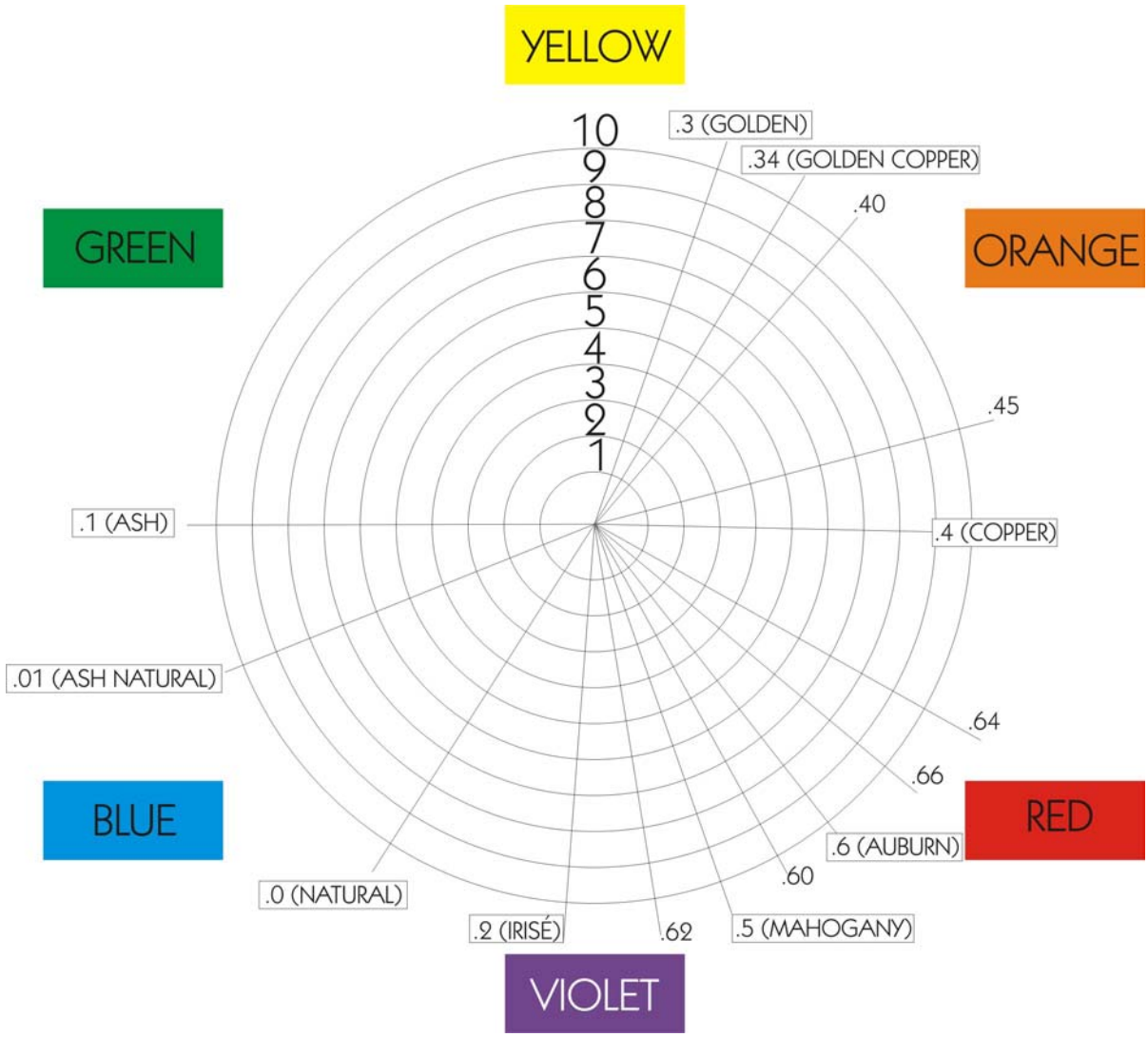


Two primary colors mixed together form a secondary color (Yellow + Blue = Green; Red + Blue = Violet; Yellow + Red = Orange) and the outcome of each mixture is an opposite color which neutralizes the remainder third primary color.



NEWTON'S DISK

The Newton's disk visualizes Fantasy look color range, confirming the theory above.



Colors in the Copper and Auburn series (x.4 e x.6), neutralize colors in the Ash Natural series (x.01) and vice-versa; Colors in the Golden series (x.3), neutralize colors in the Brilliant (irisè) series (x.2) and vice-versa; a mix of 50% Ash Natural color (x.01) + 50% Golden color (x.3), neutralizes colors in the Mahogany series (x.5) and vice-versa;

COLORIMETRY CONCEPTS IN COSMETIC DYES

The concept of color harmony is based on colorimetry laws but it's anyhow a subjective matter. Technical skills, sensibility and sense of color help to achieve a broader vision of the situation, giving useful information in order to recommend the best color for the client's features.

BASIC COLORIMETRY CONCEPTS

There are three primary colors (blue – yellow – red) and three secondary colors (green – orange – violet). These six colors form BLACK.

Natural colors, with the exception of black, are considered as more or less intense shades of brown. In the international numbering system, reflections are marked by the number following the dot as follows:

.1 ASH (blue)
.2 BRILLIANT (violet)
.3 GOLDEN (yellow)
.4 COPPER (orange)
.5 MAHOGANY (red/violet)
.6 AUBURN (red)
.7 MATTE (green)

There're a few more things to say on how colors and reflections influence one another. Colors and reflections may have warm rulers (Yellow, Orange, Red) or cold rulers (Cyan, Green, Violet). There's an opposite cold color to each warm color or reflection; when overlapped, opposite colors melt without originating any dominant color. In fact, the result will range between a light and a very dark grey / black.

SIMILAR COLORS AND REFLECTIONS INFLUENCE ONE ANOTHER

If we adjoin two cold colors such as Green and Blue, the reflection of the first one will nullify that of the second one and vice-versa. The same happens with warm colors.

On the other hand, if we adjoin two opposite colors such as Yellow (warm) and Blue (cold), the eye tends to create a separate and distinct vision: both of them will look brighter and more intense.

Good taste and sensibility are necessary to couple the colors in different ways to achieve harmonic results. In cosmetic dyes, coupling colors must be intended as the creation of that particular shade which is in harmony with the customer's features.

In the world of hairdressers we work on the hair's color, carefully deciding when to modify, soften, soothe or enhance with strong contrasts the customer's features.

The features to be harmonized are:

Eyes: when dyeing the hair in an opposite and complementary shade, a light warm reflection is enough to enhance them.

Skin: with ageing it becomes of a lighter color and a too strong contrast, with intense and dark colors, must be avoided. It is preferable to lighten-up the natural color of the hair.

BLEACHING LEVELS

On ideal backgrounds, the top degree of bleaching never exceeds the height of level of the color applied.

BLEACHING DEGREES

HEIGHT OF TONE OF THE COLOURS	BLEACHING DEGREE	IDEAL APPLICATION BACKGROUND
1 Black		1 – 2 – 3
2 Brown		1 – 2 – 3
3 Dark Brown	½ Tone	2 – 3
4 Brown	1 – 1 ½ Tones	2 – 3 – 4
5 Light Brown	1 ½ – 2 Tones	3 – 4 – 5
6 Dark Blond	2 Tones	4 – 5 – 6
7 Blond	2 – 2 ½ Tones	5 – 6 – 7
8 Light Blond	2 ½ – 3 Tones	5 – 6 – 7 – 8
9 Very light Blond	3 Tones	6 – 7 – 8 – 9
10 Platinum Blond	3 – 3 ½ Tones	7 – 8 – 9 – 10

CLASSIFICATION OF NATURAL COLORS

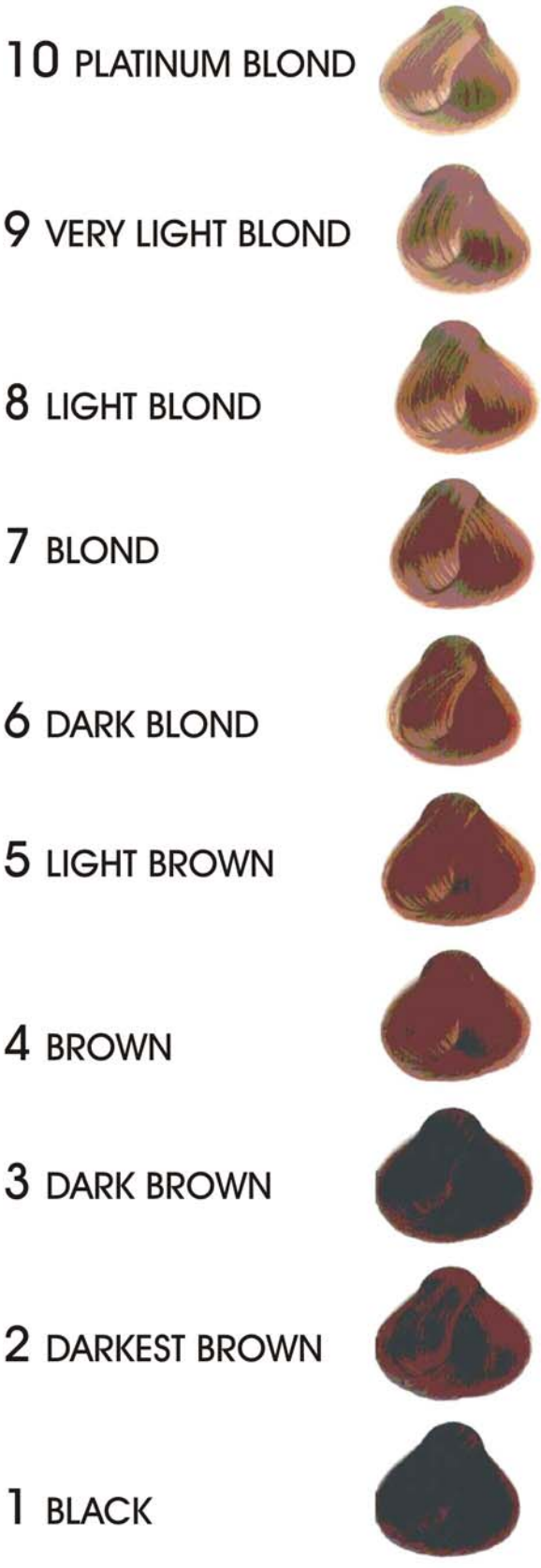
The pigment (Melanin) contained in the cortex determines the natural color of the hair, ranging from Black to Platinum Blond.

There are two types of Melanin: Eumelanins and Pheomelanins.

EUMELANINS: the dark brown and black pigments.
PHEOMELANINS: the red and blonde pigments.

The different colors of hair in different people are due to a combination of these two different basic biochemical structures. By mixing the two types together in different concentrations the many different shades of hair color are made.

Black hair contains approximately 99% Eumelanin and 1% Pheomelanin, brown and blond hair contains 95% Eumelanin and 5% Pheomelanin; and red hair contains 67% Eumelanin and 33% Pheomelanins.



HAIR DYES

HAIR DYES ARE NORMALLY CLASSIFIED IN THREE CATEGORIES:

PERMANENT DYES

TONE ON TONE DYES

SEMI-PERMANENT DYES

PERMANENT DYES:

Obtained by mixing the Coloring cream with the Oxidizing Emulsion Cream; the aim is to radically modify the natural color of the hair or its level, achieving a total coverage of grey hair.

TONE ON TONE DYES:

Obtained by mixing an Ammonia-free Tone on Tone Coloring cream with the Color Activator; the aim is to achieve a tone on tone color with natural reflections and an optimal coverage of grey hair, with no lifting power.

SEMI-PERMANENT DYES:

Obtained by using an Oxygen and Ammonia-free semi-permanent color, this makes it possible to create brilliant reflections lasting 7 to 8 shampooing.