Chapter 3: Hair Coloring at a Glance

4 CE Hours

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Audience
The target audience for this 4 CE hour course is licensed cosmetologists who desire to reinforce or expand their knowledge regarding the hair coloring process. In this module, we will learn how the pre-service client consultation lives up to its reputation of being the most important step in the service. Unravel the truth about what you see and apply it to what we know for the most impressive color service results.

Learning objectives
At the conclusion of the course the learner should be able to:
- Review the structure of the hair strand to better interpret what you observe during analysis.
- Categorize the internal bonds and calculate their impact on color in the hair strand.
- Recognize the characteristics of the types of melanin and their production process.
- Distinguish a natural hair color shade’s underlying pigment components using the law of color.
- Review and determine which pigments make up manufacturer’s tint shades according to the color wheel.
- Recognize which hair textures cause results to vary from manufacturer color swatches when tinting.
- Identify results of using specific types of coloring agents on various hair types based on their ingredients.
- Distinguish the strengths of developers for use in various hair color products.
- Maintain the integrity of the hair strand by confidently applying the appropriate type of product.
- Perform a pre-service analysis that will lock in the essential information of: What do we want, what do we have, and what are we missing?

Introduction
An estimated $42 billion annually is spent in the beauty industry in the United States. Although the most commonly requested service is a haircut, hair coloring has evolved over the last few decades as the front runner in salon service income. Hair coloring requires maintenance that keeps the client returning to the salon on a regular basis, thereby generating continuing revenue and a steady client base. Americans currently have more disposable income available for hair coloring services, even though many states are now taxing it as if it were a luxury. However, the bottom line is that the more the salon door swings open to a color client, the greater the income for the salon and staff. Many of the color clients aren’t just maintaining a current color or blend of colors, but are frequently requesting a totally different look. That is the beauty of the hair color service: it is fun, and it is changeable. If you’ve ever had difficulty getting a true color result on a specific client, you’re not alone. There are many variables in a strand of hair, ranging from texture and porosity values to underlying natural pigmentation and previous coloration in the hair. These variables may cause your results to become uncertain. Are you having off-shade or off-level results on either fine or coarse hair? Did you know that texture is a factor in color results? We will review manufacturer’s coloring agent pigment content and ingredient lists, as well as the melanin placement inside the strand to assist you in your formulation. Knowing the natural pigment present and how it behaves will support you in your product choices. Are you automatically choosing a harsh product for the sake of saving time, thereby over taxing the strand? Could you instead use a low damage product with ample capability to protect the integrity of the strand? We will explore the categories of color agents and their actions on the strand. Make hair coloring analysis fast and accurate. By doing a thorough consultation, you are more apt to have successful outcomes. Become adept at believing what you see and knowing when to either accept or discredit what you hear from your client. Some clients prefer to keep their hair color practices private or omit information regarding using non-professional color products.

Your client consultation can be an auto pilot procedure that will enable you to truly make assessments for hair coloring at a glance. Train yourself to respond to visual cues from:
- The porosity value and gloss of client’s hair strand.
- The base color, color cast or tonal value, and color variation within the length.
- Textures that vary from the manufacturer’s formulation standard of medium.
- The client’s eye color and skin tone which aid in identifying natural underlying pigment.
- The pigment combinations in manufacturers color swatch or other visual aid of desired color as indicated by the client.

Hair structure review
As a review, the elements responsible for the composition of hair are of carbon, hydrogen, oxygen, nitrogen and sulfur. Each of these elements is present in all colors of hair and performs specific tasks in relation to strength, elasticity, and coloration. Variation in natural hair color is the result of the carbon to oxygen ratio. Typically, the hair is composed of 50.65% carbon and 20.85% oxygen. Darker hair contains more carbon in the mix, whereas lighter hair contains more oxygen after the production of its melanin. Also, the disulfide bond (comprised of sulfur atoms) is responsible for one-third of the strength of the hair attracts and holds the warm tones naturally found in the strand. Excessively damaged hair with a weakened disulfide bond will appear to grab drab or ash tones when coloring.

Hair strands typically possess three layers:
- Cuticle – outermost layer of protective scale-like cells. Cells are arranged in an overlapping pattern similar to shingles on a roof with the fixed attachment toward the scalp and the movable edge facing the ends. These cells are transparent when healthy and intact, but become whitened and distorted when lifted excessively from their natural position or when exposed to extreme heat or
harsh chemicals. These cells respond to even mild chemicals as well as slight changes in pH, temperature or humidity. The cuticle layer reacts by clamping down tightly or lifting away from the internal layers of the strand. They provide only 10% of the hair’s overall weight but contribute about 20% of its strength when healthy. Cuticle cells are responsible for the shine of the hair. The amount of layers that create the protective structure varies among races and textures of hair. This layer contains keratin protein, a necessary element for strength and flexibility. Cuticle damage can reach the point of no return, where the scales are damaged beyond repair or even torn away. This results in split ends and hair strands that break and refuse to hold color. Best practice is to cut away the damaged lengths. Be cautious when evaluating the cuticle’s condition by the gloss of the hair only, since many products that contain silicone or waxes are being used that create sheen to the strand. Best evaluations are on clean, dry hair with no styling aids present.

- Cortex – the second layer of hair is the most complex layer. The cortex or cortical layer contributes about 90% of the weight to the hair strand. It consists of a multitude of fibers that are elastic in nature and provide 80% of the hair’s overall strength. Amino acids that form spiral chains make up the internal structure of these protein fibers, which are similar in structure to string cheese, are naturally bound together by various types of bonds. These bonds promote the flexibility and stretch factor to the strand. They are also responsible for maintaining the curl, wave, or straightness of the strand. By unlocking these bonds and shifting the alignment of their linkage, we can change the curl pattern or lack thereof. Although this chemical texture process is common, it can remarkably reduce the strength of the strand. When coloring hair that has been weakened by chemical texture service, a significantly weaker strand will result. We will further discuss these bonds later in this segment. Another structure in the cortex layer and the most important to hair coloring is the natural melanin or color pigment. These cells resemble a jelly like structure, similar to a jelly bean, and have also been likened to chocolate chips as baked into a cookie as to how they are imbedded into the strand. They are a permanent fixture between the fibers. Melanin will also be discussed later in the text.

- Medulla – the innermost layer of the hair. The function, if any, has not yet been uncovered. However, it is responsible for added bulk to the individual strand and to arguably provide extra strength when it is present. Typically, fine or baby fine hair is without a medulla layer.

**Internal bonds** in the hair strand: Each is responsible for 1/3 of the strength of the strand. These bonds secure together the amino acids and their linkages called polypeptide chains to give the hair its internal strength.

- Hydrogen bonds are numerous in the hair and are temporarily altered when the hair is exposed to heat and water. These bonds are reformed as the hair dries. When the hair becomes wet, it appears to be a darker color due to the presence of excess hydrogen (H2O). Be cautious in evaluating hair color when the hair is wet or oily, since the hair strand also becomes more stretchy when wet since this bond is broken, but normalizes when dry.

- Salt bonds are also numerous and are temporarily altered by changes in pH. Normal pH levels are 4.5-5.5 for the hair. Use of water, products or chemicals that have a pH that is not mildly acidic will temporarily change these levels. The salt bonds will normalize when the hair is cleared of the product. Continued exposure to harsh chemicals will weaken the salt bonds.

- Disulfide bonds are composed of two sulfur bonds and are fewest in number but are the most stable of all the bonds. They are only affected by chemicals. Weakened disulfide bonds occur from repeated use of chemical solutions such as hair color, lighteners, chemical relaxers, and permanent waves or a combination of these products. Shampoos with unduly harsh cleansing agents will also weaken these bonds from continued exposure. The harsher the product, the more damage is done. As a general statement, a lightener is harsher than hair color (tint/toner), and relaxers (sodium hydroxide) are harsher than perms (ammonium thioglycolate). But, within each category of product, there are varying levels of acids or alkalis that are incompatible with specific hair types. Refer to manufacturer’s information for the best choice of product. In most cases, the disulfide bond is reform ed either by a solution included with the service such as a neutralizer with perms, or it reverts as the product is oxidized and shampoowed from the hair as in hair coloring. But once the disulfide bond has been disrupted, it will never be as strong as it was originally.

**Melanin characteristics and production**

- In review, remember that a hair strand is constructed in a fibrous bundle. Interlaced with these fibers are the color pigment granules known as melanin. In the case of healthy hair, the melanin is held tightly between the fibers or sort of wedged in place. As previously mentioned, some references liken this placement as that of chocolate chips embedded in a cookie. In order to remove the chocolate chip, damage to the cookie will result. Coloring agents that remove or lighten natural color pigment will open the cuticle layer and break down the disulfide bond, causing swelling and separation of the fibers and thereby damage to the surrounding strands in order to disperse the melanin granule.

- In the case of long hair or hair that has been exposed to strong detergents or other chemicals, as well as the persistent heat of styling tools, damage to the melanin granules will occur over time. The cuticle layer will expand and will no longer protect the inner fibers. The disulfide bond will weaken from exposure to chemicals and heat, and the melanin will begin to break down. The natural color will then start to leave the strand. Faded ends are a sure sign of damaged hair.

- Melanin composition begins with genetics, since DNA dictates the type of melanin that is predominant in an individual. The melanin in the hair, skin and eyes is directly related and contains the same compounds. Production and distribution of melanin occurs within cells called melanocytes. It begins with the production of yellow compounds called quinones, which come from the amino acid tyrosine. The building process continues with an enzyme called tyrosinase, which is a copper-protein complex. Enzymes act as a catalyst that causes a chemical reaction to take place, and in this case, tyrosinase causes tyrosine to oxidize which results in dihydroxyphenylalanine or dopa.

Let’s make it easy: **Amino acids + enzymes = dopa color compounds.**

**Amino acid:** Tyrosine forms yellow quinones.

Copper-protein **enzyme:** Tyrosinase adds oxygen to quinones = dihydroxyphenylalanine (dopa).

Dopa is the base product or compound for melanin production. Long periods of oxidation cause the dopa to deepen in color. Remember that oxidation is a process whereby oxygen combines with an element and changes the appearance of the element. This process causes the initial oxygen present to diminish. When the tyrosinase continues to oxidize the tyrosine present in the quinones, the color goes from yellow to red. If further oxidation occurs, the color present will be purplish, indicating a deep blue base with red influence. As the compounds increase in color depth, they also gain molecular weight. This attributes to where and how they are placed inside the hair strand. This oxidation process goes through three levels and produces a new product at each level.

1. Dopa + oxidation = dopa-quinone, a yellow compound.
2. Dopa-quinone + oxidation = dopachrome, a red compound.
3. Dopachrome + oxidation = indol-quinone, a purple compound.
Consider this analogy: think of melanin production like making cookies. Combine ingredients (tyrosine and tyrosinase) to make the dough and then bake (oxidize). The cookie dough begins very pale but the longer it bakes, the darker the color of the cookies become. DNA determines how long the oxidation process continues and the resulting depth of the pigment, as well as the mixture of light, medium and dark compounds that will be present in the strand. The resulting melanin granules fall into two distinct categories known as **pheomelanin**, which is comprised of only primary red and yellow pigment, and **eumelanin**, which is black and brown pigment. Don’t forget that black and brown contain a great deal of primary blue in order to provide depth of color along with the darkest concentration of reds and yellows. The combination of pheomelanin and eumelanin contain all three of the primary colors of yellow, red and blue. The color wheel will be discussed at length further on in the text.

An individual’s hair color is often a combination of all three color compounds (dopa-quinone, dopachrome and indol-quinone), as dictated by the individual’s DNA. Natural blonde shades are the result of shorter oxidation, whereby the dopa-quinone remains a yellow compound. In natural blonde shades, there may be some darker pigmentation, but the majority is yellow. For strawberry-blonde shades there is likely a balanced mixture of dopa-quinone and dopachrome. For warm shades of deeper reds, some of the dopa may remain yellow without further oxidation, but the majority of the pigment is dopachrome. Shades that are brown and black contain mostly indol-quinone, but depending on the tone may have yellows of dopa-quinone and reds of dopachrome present.

- Melanin distribution in the strand is directly related to the size and molecular weight of the granule. Most of the pheomelanin or yellow (dopa-quinone compounds) and some red pigments are the smallest and remain clustered to the interior of the spherical strand. They are closest to the medulla if one is present. The bulk of the reddish pigment (dopachrome compound) is rather small to mid-size and located further toward the outside of the strand in an extremely scattered distribution pattern. The darkest pigment, eumelanin (indol-quinone compound) is the largest in size and molecular weight and hugs the outer edges of the cortex fibers.

Figure A1: Melanin distribution within the hair strand illustration

* Indol-quinone compound placement
* Dopachrome compound placement
* Dopa-quinone compound placement

**Underlying pigmentation and hair color levels**

As a review, remember that hair color is sorted according to the depth of shade. Levels have been assigned a range or scale of 1 through 10, where level 1 is the darkest and 10 is the lightest. In order to fully understand the level system, you must think in terms of combinations of the three pigment compounds: yellow dopa-quinone, red dopachrome, and violet indol-quinone. The variety of combinations of these pigments is responsible for the makeup of an individual’s hair color.

Since level 1 is the darkest, it has the highest concentration of eumelanin or black/brown pigment with the least amount of pheomelanin in the form of dopa-quinone. At the darkest levels, there may be quite a large amount of pheomelanin present in the...
form of dopachrome, as the reds can contribute more richness and depth of the tone. There may be some yellow or gold tones present, depending on the tone of the level. Tones are often referred to as warm, cool or neutral. Low level colors that have been described as blue-blacks which are cool, and have the highest concentration of eumelanin. Level 10 shades are the opposite of level 1 and have the most concentration of dopa-quinone, or yellow pigment, and very little or no indol-quinone for depth. An obvious redhead will have the highest concentration of dopachrome in pheomelanin. The ratio and interaction of the compounds whether yellow, red, or purple produces the resulting level. As an example, reds can occur at low levels in the shade of mahogany, through mid-levels of chestnut and higher levels of strawberry-blonde. The influence of eumelanin determines the depth of the color, while the yellow of the pheomelanin causes lightness and brightness.

As underlying pigment goes, the most influential in hair coloring is that of the dopachrome. Clients typically either embrace reds or wholeheartedly reject them.

Clients that wish to have red tones, shades or casts to their hair need a strong strand with a healthy cuticle. Red shades that are infused into weakened hair strands typically will not last and tend to fade to strange hues. Be sure the hair is reconditioned with protein based products prior to the color service appointment. Reinforcing the amino acids and overall protein in the strand will allow for better attachment of red tones.

Clients with healthy hair that insist on no red in their hair color are easily served. However, if their hair is damaged, it will require a careful pre-service evaluation and formulation of your color product. The weak hair strands tend to really grab onto the ash or drab tones. These shades can then look muddy and unnatural and may wash out their complexions. Weak hair stands with open cuticle cause oxidation of the natural color pigment and produce faded ends. Since the natural melanin is distorted, the problem lies in detecting which pigments remain and how they are going to interact with the formula to be applied. If the dopachrome has been compromised in any way, the ashy tones of the color formula will be left without a neutralizing color to act as a buffer. In turn, this causes the remaining shades to be expressed as mostly yellow, so when the bluish green hues of the drab tone are applied, it will create unnatural greens. The next section will review the color wheel and explore the interactions of pigments.

### Color wheel components

Knowledge of the components of the color wheel is something that you should be able to recall instantly. Recall and memory images are formed differently among individuals. Some people are able to visualize the color wheel in their head in exact shades and arrangement instantaneously. Some people need to physically see a graph or chart to be comfortable with the data. Others still, need to write out or draw a rendition of the color wheel or chart as an activity in order for their mind to open the file on the information. Regardless of the method, the use of the information is crucial to be a good hair colorist.

Let’s review the basic tools of color for the hair coloring process:

- The law of color: primary, secondary and tertiary levels.
- Color valuation: hues, tones and intensity.
- Complementary and/or neutralizing colors.
- Blacks and browns.
- Underlying pigmentation of the levels in the hair.

Color arrangement as seen through a prism is described with the acronym ROYGBIV, indicating placement of the colors: Red, orange, yellow, green, blue, indigo, and violet. The placement is the result of a naturally occurring phenomenon that will eternally remain the same. Red will never be next to green and blue will never come through the prism next to orange. This unchangeable arrangement is our greatest tool in the hair color industry. Many of us have experience in a color service gone awry with an off shade or unexpected result. But, if you do a careful retracing of steps including color components of the hair itself, the formula of product used, as well as the influence of any minerals present or poor health of the strand, you will unveil the miscue in your procedure. Final hair color is the result of influences from the presence or absence of other pigment on the strand.

The color wheel is the simplest device for understanding the influence of pigment on other pigments. Speaking in regard to “influences,” from a professional standpoint, the terms *green* and *yellow* are rarely discussed with regard to color formulation with clients. Even from a manufacturer’s standpoint, the term *ash* or *dread* is typically used when indicating shades with green or gray. *Gold* is the most accepted term when referring to yellow pigment. Presentation of information regarding color elements with your clients should portray a pleasing connotation in order to inspire confidence. Be sure you are aware of the pigment content of these shades. Some gold shades contain just yellow, some have an influence from primary red as well. Ash tones can be varied from manufacturer to manufacturer, some having a gray influence, while others having a green influence.

The color wheel is founded on the triangular arrangement of the primary colors: Red, yellow and blue.

If you don’t have access to a color wheel and you are a visual or kinesthetic learner and need to see or physically draw the color wheel, it can be replicated easily enough using just pen/pencil and paper. Use the triangular format and indicate the primary colors using just the first initial in the word of the color as indicated below (R=red, B=blue, Y=yellow).
The next step is to plug in the secondary colors using the same procedure (V=violet, O=orange, G=green).

Although this is not as visually stimulating as one drawn in color, it still serves its purpose. Seeing the colors in the proper line up will take the guess work out of formulation.

Think of the terms of the law of color in their hierarchy as:
- Primary–first and foremost in importance. Foundational units or baseline components.
- Secondary–second step or result of mixing two of the bases.
- Tertiary–third step or result of mixing a secondary with one of its base component primaries for a total of three units.

The primary colors are shown and connected by a black triangular line. The placement of this triangle is upright with the point at the top. This triangle represents the foundational colors that are responsible for the production of all the other colors in the spectrum. Any shades that you expect to infuse into the hair strand are under the direct influence of these primary colors. The key to getting the anticipated result is in knowing the amount of each primary color present in both the hair strand and the color formula you have mixed.

The secondary colors are shown and connected by an orange inverted triangular line. These shades are merely the result of the mixing of two primaries. The single most important fact to remember about secondary colors is that they exist only because of the interaction of the primary colors. If you’ve ever experienced a color service outcome as shown on the color wheel are not connected the primary colors. If you’ve ever experienced a color service outcome in which the hair had a greenish cast, it was undoubtedly the result of blue pigment working directly over yellow, without influence from a red primary. For example, a numerical equation of secondary green is: 1 part blue (primary) + 1 part yellow (primary) = green (secondary). An off shade is usually the result of a missing primary.

The tertiary colors as shown on the color wheel are not connected on the diagram. They, like the secondary colors, exist due to the interaction of the primary colors, but they are taken one step further than the secondary colors. Tertiary colors are created by acting on the secondary color with the addition of another unit of one of the original primaries used in that secondary. For example, let’s write out the equation of the tertiary color blue-green: 1 part primary blue + 1 part primary yellow (resulting in secondary green) + 1 part primary blue = tertiary blue-green.

Color valuation: Hues, tone, and intensity
The hue of a color is a descriptor of its shade. In the hair color arena, hue is also described a tone or tonal value. Be aware that when using these terms in the art realm as related to painting, they tend to have alternate meanings. Assigning a tone to a color gives a clear idea of which direction a formula should go on the color wheel. Tones are categorized as warm, cool or neutral.
- Red and yellow are the two warm primary colors. Warm tones gather and reflect brightness and brilliance from the reds and golds (yellow) in a formula. Warm tones offset unwanted drab or ash hues in a formula and make the color appear lighter.
- Blue is the only cool primary color. Cool tones mute the reflective quality of light and add depth or produce a matte value to the color as a result of the blue in the formula. Cool blue tones subdue any unwanted brassiness in the strand. Brassy tones are comprised of the secondary color orange.
- Neutral tones contain a balance of all primaries and leave the strand uninfluenced with warmth or coolness by their combined presence. Neutral tones assist in replacing missing pigment from gray hair.

Intensity refers to the concentration of pigment, also described as strength of color. Intensity of a tint can be adjusted. If you are limited on inventory, you can refine your available product by adding other tones within the laws of the color wheel. Formulation exercises appear in the next segment.

Color equations
Color equations are a tool whereby a value can be placed on components of color tones to assist in formulation. All color equations are formulated with primary colors only. The secondary colors are a by-product of the primaries and as a result are implied and not stated. The same is true of tertiary colors. It would be far too confusing to use the secondary or tertiary colors in a written formula. The value of a secondary is always processed as two components, one of each of the primaries present. As an example: 1 part blue + 1 part yellow imply that green will be part of the formula. It would never be stated as 1 part green. Likewise, the value of the tertiary color blue-green would be processed as three components, one for the primary, and two that are actually primaries but make up the secondary present. For this example: blue-green = 1 part blue + 1part blue + 1 part yellow. Again, green is never used as a component in color formulation since it is a secondary, and the tertiary level is just the result of a repeat of one of the primary colors present.

Let’s go another direction and lay out a visual color chart of the equation for the tertiary color blue-green.

Primary color: Blue (one component)
1 part blue

Secondary color: Green (two components)
1 part primary blue + 1 part primary yellow = green

Tertiary color: Blue-green (three components)

Primary
1 part blue + 1 part blue + 1 part yellow (=green) = 2 parts blue + 1 part yellow = blue-green

Secondary

Tertiary

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Formulation worksheet:
Ash, with no red or gold.
7 (dark neutral blond). The desired shade is going darker to a level 4

Complementary and neutralizing colors
A valuable asset to the hair coloring industry is the knowledge and use of complementary colors. Colors that complement each other are located directly across the color wheel. Recall the triangular arrangement of the primaries and the inverted triangle of the secondary colors. A secondary is placed directly across the wheel from a primary that is not part of its composition. That is to say that green, made up of blue and yellow, is directly across from red. The word “complementary” indicates that it completes the color wheel by adding the missing primaries to the equation. This process adds balance and harmonizes tonal value with the completion of all color components.

Secondary shades
Orange - R+Y
Yellow - Y+B
Blue - B

Tertiary shades
Blue-green
B+B+Y
Red-orange
R+R+Y
Blue-violet
B+B+R
Yellow-orange
Y+Y+R
Red-violet
R+R+B
Yellow-green
Y+Y+B

Neutral Brown
B + R + Y + Y + Y
Desired Tone
Ash
B + R + Y + Y
Black and brown
Black and brown are colors that have received much attention in the hair color arena. The depth of a color is categorized by levels. Regardless of the brand of hair color used, the lower the number, the greater the amount of black or brown in a shade.

What causes black to look dark is the absence of light. The important thing to remember about the production of black is that it results from the most deeply saturated pigments of red—in the form of magenta, and blue—as in cyan, along with a strict brilliant yellow. Total darkness is the result of using the greatest saturation of pigment since little if any light can penetrate. Think of it as being in a dark, closed room without windows. Since no light is available, colors cease to exist.

Creating a black colored tint at the mixing station is very difficult, if not impossible, and best left to the manufacturers. However, it is possible to manipulate the shade of the black by adding colors with various tonal values. When attempting to alter the shade of black, such as in making a blue-black, it is necessary to add pure color pigments for the best results. Most manufacturers have these additives available; some are designed to be used for specific levels of tints. For instance, one may be for low levels only, due to the intensity of the pigment. The use such a product on higher levels will distort the outcome of the level desired.

Brown shades are provided by manufacturers in a variety of levels and tones. Browns are easily manipulated. They, like black contain all of the primary colors. A slight increase in one of the three primaries will effortlessly change the brown. To add depth to the brown, use a blue base. To add richness or warmth, use a red base. To lighten or brighten, use a yellow (gold) base.

Color formulation
Color formulation is the process of choosing the appropriate shades of level and tone for the expected hair color outcome. It is rare to have a hair color client have a full head of virgin hair. So, many color services require additional steps or a combination of pigments for desired results. Manufacturer color swatches are client friendly and often prepared on synthetic strands giving a clear result on untainted samples. If a client chooses a swatch at level 7 with Red-Gold, it doesn’t mean you can choose a tube of “5RG” and expect to have a perfect result. Careful analysis of the underlying pigment and condition of the strand will assist your choices in product, proper formulation and methods of application as well as retail selections for home care.

Many manufacturers provide hair color in premixed shades; some provide only pure tones for ease of mixing. Be sure you understand the numerical and alphabetical system for the brand you use. Within each brand is a category of neutral shades with a balance of all primaries; ash categories with influence of blue and yellow primaries, and a violet category of blue and red primaries, then a tertiary category of red-violets. There are also warm categories of pure gold as well as one of red with gold, then finally a stand-alone red line.

Color formulation should be fun and exciting and not something to be feared. Knowing the color wheel and the complementary shades will provide faultless results every time if you follow the prescribed steps of: “What do we want?” “what do we have?” and “what are we missing?”

Color formulation is not just adjusting the primary colors or tones in a shade, but also involves working with levels or depth. Let’s use seasonal color as an example. Seasonal coloring tends to be lighter and brighter for summer and is darkened for winter. Whether a client...
wears a single shade or multiple levels, reducing a base color for winter by adjusting or dropping a full level may be too drastic. This is especially true in the mid-range of colors such as levels 4, 5, 6 and 7. It is possible to drop a half shade by mixing your current level with the next lower level in equal proportions. Be sure to keep accurate records.

Another method of dropping or lifting a half level is with cool or warm influence. Let’s use the example of a level 6 red tint (6 R). To lighten the depth of the level 6, add gold (yellow) 6 G, this will create an orange underlay which will allow more light to penetrate the red. To deepen, add blue 6 B, This will create a violet underlay, which will prevent light penetration. If you compare manufacturer swatches of a 6 Red-Orange and a 6 Red-Violet, it will appear that the 6 Red-Violet is closer to a level 5 and the 6 Red-Orange will appear closer to a level 7.

**Gray hair formulations** require thorough exploration of “what do we have” and “what are we missing” but are relatively simple when remembering the development sequence of natural melanin pigment in the hair. From yellow compounds develop reds, and reds develop into darker violets. If the attempt is made to tint the hair to a dark shade by jumping from zero pigment to full dark pigment, the missing elements along the way will be sure to cause a problem. In gray hair, yellows and reds must be replaced in order for the tint color to look natural. They can be primed in in a preliminary step or they can be added to the formula depending on the nature of the service. A full head of gray hair is best primed in before the tint. Dimensional color with varied strands of color in less than 50% gray hair is usually OK to add missing components of red and yellow directly into the formula.

**Developers** can also be adjusted in formulation for better results. Typically a low volume of 5 or 10 is used for full deposit of color. Twenty volume peroxide is used for equal lift and deposit of color in the strand for tinting. It can also be used in the event of gray hair to presoften the cuticle for better penetration prior to tinting. Twenty volume peroxides as well as 30 volume peroxides are commonly mixed with hair lighteners or bleaches. Thirty and 40 volume developers are used for higher levels of lift, but **should not be reintroduced** to the same areas of the hair strand. Remember that the cuticle is easily damaged and hard to resurrect. Once the cuticle has been opened and the strand lightened, a reduced level of volume in a developer is best to maintain the internal structure of the amino acid peptide chains. Typically once a strand has been lightened, the only change you would likely make is to deposit a new tone or reintroduce depth. That being the case, reduced volume is all that is necessary. An in-depth look at developers appears later in the text.

### Pre-service evaluation and analysis

Client consultation and analysis should not be a daunting task. What makes it unpleasant to some professionals is the seeming overload of information to be gathered, sorted and processed, all in a short period of time. Being insecure of your ability to determine texture variances, porosity, and evaluation of underlying pigment will hinder the gathering portion. Sorting is akin to placing information in a specific file for easy retrieval. If these issues make the process seem loathsome, ease your stress by creating a system and make it an ingrained habit. By creating a tactile routine and using your senses of touching, visualizing, speaking and hearing, your muscle memory and auto pilot processes will kick in. If your current system doesn’t include a written record, create one. Or if one exists and the document is arranged in a disorganized manner, make changes that make sense to you. Like in written math problems, they can be presented in the long form or you can use the short form. Either one is perfectly usable, but one works better for some than others. This is the key; use what works, make it work for you. If you work in a salon where there is a standard form that is mandated for all employees to use, great! But if it’s not meeting your needs to organize your analysis, why not also use your own “worksheet”? Over the years, there have been many samples of analysis forms for various salon services in textbooks that were merely copied and put into use. Most are outdated, and may contain too many line items that are check box nightmares or have unusable or poorly presented data requests. Frequent updates or review of printed documents and supplies are needed.

An example of a client consultation worksheet would contain the following statistics:

- **Client’s name and the usual demographics such as address and contact information.**
- **Standard hair analysis indicators such as form, length, texture, density and porosity.**
- **Evidence of previous color service or chemical texture service in the hair, list product used if possible.**
- **Natural color level, tone, underlying pigment and intensity. Indicate whether it varies from scalp to ends.**
- **Percentage of unpigmented or gray hair.**
- **Detailed description desired color. Indicate single or multiple shades and placement of color hues. Drawing of the head shape showing placement may be helpful.**
- **Color formulations used, include volume of developer.**
- **Processing time.**

Statistics show that activity training causes a more learned response than that of reading or listening to lecture. At the end of these segments, there will be suggestions for activities to improve the analysis process that have been used with great success.

**Analysis of hair qualities** is the single most important step in a pre-service consultation. It is after all the very fabric that you are changing. A caution to performing accurate assessments regarding hair qualities is the presence of product in the hair. The nature of styling aids is to leave behind gloss, body or texture as well as rigidity. Also, some shampoos and conditioners infuse oils or polymers onto the strand. The best analysis is done on hair that is clear of buildup. Many inaccurate conclusions are derived due to a coating on hair strands.

**Texture** is the size or diameter of the individual hair strand. Among individuals, hair texture is varied regardless of race, ethnicity or state of colorlessness. That is to say that not all Caucasian hair is fine, not all Asian or African American hair is coarse. And regardless of genetics, not all gray hair is coarse or wavy. Texture is directly related to the lack of or presence of a medulla layer, the amount of fibrous cords in the cortex as well as the mass of the cuticle layer. The concentration of the cortex fibers and the amount of layers in the cuticle provide bulk to the strand. These layers increase in size with exposure to chemicals. Therefore, it is entirely possible to alter the texture of the hair through salon services such as hair color. When judging texture, be sure to evaluate the entire strand. There may be a variance in diameter from scalp to ends. This will assist in formulation. Texture is described as: Fine, medium, and coarse. Medium texture is generally accepted as the one most commonly found.
In regard to hair coloring and hair texture, always remember this: fine hair has the least amount of internal space, therefore, coarse hair has the most. Let’s use the following facts and analogy to further illustrate:

- Hair coloring is the addition of artificial pigment to the strand. Regardless of which manufacturer’s product you choose, there are a certain amount of preset color particles in each tube or bottle. These concentration levels are known as parts per million or ppm.
- Let’s say you have two clients with hair exactly the same natural shade and condition but one has fine hair and the other has coarse hair. If you use the same color formula on each one can you expect the result to be the same? Remember, everything is identical except for texture.
- Consider this situation; you have two clear drinking glasses that contain water, one is a smaller size and diameter containing 4 ounces of water, the other is larger in size and diameter containing 8 ounces of water. Place two drops of food coloring in each glass and stir. Which is going to have a greater concentration of color and thereby be a more vivid shade?
- The smaller of the glasses will have a more dense concentration of color and look deeper in tone than the larger one.

Manufacturers produce colors to be the truest on medium textured, moderately porous hair. That is the baseline of color swatch shades. Adjustments are necessary if your goal is to achieve the exact same shade. In the event that your client has a coarse strand, you will need to adjust your formula by adding more depth as previously described. Or if your client has fine hair, you can expect your final shade to be more intense than the swatch and will need to reduce the depth.

Exercise – How to confidently identify the various textures of hair. Comparative study is great for creating a baseline of knowledge.

Materials needed: Hair cutting scissors, index card, tape, single strand of hair from multiple sources (5-7 different people). Highlighter is optional.

1. Collect a single hair sample (one hair) from various heads.
2. Arrange the hair according to texture from finest to coarsest and lay out across the card.
3. Carefully attach the hair at the top and bottom of the card with tape.
4. Observe the increase in size from the finest to the coarsest.
5. Keep the card on hand and refer to it as a guide if needed. Add to the card if necessary.
6. Compare client’s hair to the card to gauge degree of texture. *If using a white index card and some hair samples are very light in color, use a highlighter to draw a line and place the light hair over the top line of color before taping in place.

Porosity is dictated by the cuticle layer and detected through visual and tactile observation. Visual inspection reveals the shine factor or the gloss of the entire strand from scalp to ends. Oftentimes we fail to realize that porosity progressively alters in even healthy hair toward the end of a strand. Length equals age, and older hair has had more exposure to elements that detract from the natural state of a nearly closed cuticle. The more closed the cuticle, the more resistant to absorption the strand is. The following is a guide to understanding porosity classifications:

- Porosity is typically described as good, moderate, poor, and over-porous or extreme.
- Although the term good is associated with something pleasing or positive, the state of good porosity is not necessarily attuned with the hair being in good condition. In order for hair to have the quality of porosity, or the ability to absorb, the cuticle layer must be raised, which usually indicates reduced protection of the inner cortical structure. Likewise, poor porosity isn’t associated with hair in poor condition. Poor porosity is the state of a closed and robust cuticle that naturally provides protection and shine to the hair.
- Classifications of porosity rate from least or slowest absorption to the fastest are: Poor (also called resistant), moderate, good, and extreme.
- Poor porosity is oftentimes associated with ethnic, Afro-American, or Asian clients and hair that is gray. Cuticle layers are more numerous and in most cases, the virgin state of these clients’ hair would be resistant. Caucasian hair types usually have less cuticle layers that provide less rigidity, texture and resistance to absorption.
- Moderate porosity is associated with non-chemically treated hair. It’s the result of a slight lift of the cuticle from exposure to cleansing agents, heat from styling tools and general age of the strand. Hair with moderate porosity has less lift in the cuticle than that of good porosity. It, therefore, absorbs at a lesser rate or slower pace than good porosity.
- Good porosity is associated with hair that has the cuticle layer lifted as the result of chemical treatments that are mild in action and infrequent. Hair with good porosity usually needs the application of a surface active or instant conditioner to assist in closing down the cuticle after shampooing to avoid tangling. Deep conditioners should also be used regularly to preserve the strength of the strand.
- Extreme porosity or overly-porous is a circumstance of damaged hair. It is usually the result of using harsh chemical treatments or repeated chemical applications to the hair strand. Cuticle damage at this state is not reversible. Best case scenario is damage resulting in split ends and excessive tangling. But, in many cases the cuticle deteriorates leaving an unprotected cortex, which in turn can lead to the shredding of the strand.
- In the event of long hair, as previously stated, length equals age, porosity levels will vary greatly from scalp to ends. Consider the age of the hair according to average growth rates. If you are working with hair longer than 8 inches and an average rate of growth is ½ inch per month, you have hair ends that are over a year old. Even with frequent trimming, the cuticle of the bottom lengths have had quite a bit of exposure to elements such as cleansing agents, various styling products, sunshine and perhaps heat from styling tools. These elements will wear down the cuticle. When coloring longer hair, consider mixing two separate formulas and altering developer strength so as not to cause further damage to an already open cuticle on older hair ends.
- If decolorizing the strand, leave the ends bare of product until the last few minutes. Many times in the salon, we are conscious of time and busy schedules and apply from scalp to ends so we don’t have to revisit the head during processing.
- If adding color in a tinting or toning service on long hair, apply to the ends last and reduce the strength of the developer in a new mixture. Or simply add a bit of water, conditioner or shampoo to the original mixture for dilution of the developer.

Underlying pigment is a result of heredity and can affect the outcome of hair color formulation especially when lightening. Whether a client possesses an abundance of eumelanin and has dark hair or pheomelanin and has lighter tones, the color wheel and the laws of color will apply in altering their natural shades. Underlying pigment is easily discernable by observing not only the hair itself, but also the skin and the eye color.

In many cases, using the hair to evaluate the underlying pigment is truly a fool’s errand due to previous color application. If you have only a small amount of virgin color at the scalp area, the placement near the scalp leads to difficult judgement. The hair must be lifted to allow light to pass through to observe true level and tone.

- Visual cues of the skin’s pigmentation are easily detected on the underside of the forearm. Finding tones of equal balance of
warm and cool indicates neutral skin tones. Shades of ivory, beige or neutral brown indicate that the client will look well in either a warm or cool color with no impairment from underlying pigment. This presents no issue in either color deposit or lightening process.

- When detecting a color cast in the skin that is red-brown or red-blue, leaning toward a beige-violet you will have strong red undertones in the hair. Lightening the hair will have warm tones through each of the stages of decolorization. Double processing may be required for light shades and a toner with a complimentary base shade should be used.

- **Eye coloration** is an excellent tool for evaluating underlying pigment. It is a common occurrence for eye color to change on an individual. The eye is made of cells that are transparent and allow the absorption of light. And like the ocean or a body of water, they will respond to stimuli from the surrounding environment by reflecting back shades as well as hues of lightness or darkness. Eye shades also alter with emotions and illness. Even though the color of the eye’s iris may change, the base tones will still reflect the underlying pigment. There are many shades of brown, blue and green eyes. There are also eye colors that are a combination of more than one color. Hazel is one of the chameleon colors that contain a mixture of shades. There are also clients that have eyes that are totally different shades from one to the other. When looking for pigmentation in the eye, look for depth of the shade. Are they dark brown, dark blue, etc.? Next determine the tone or color cast of the iris; is it a reddish brown, a deep dark brown as in almost black, or a lighter yellowish brown? Evaluate in the same manner with blue and green eyes. Also look for flecks of yellow, brown, green, and blue within the base shade.

- The evaluation of tonal value is a direct fit to the color wheel and the presence of eumelanin and/or pheomelanin. Do you have a working knowledge of the color wheel and understand its structure?

**Exercise--Understand underlying pigment in individuals using eye color as a tool.**

This comparative study is adaptable for group size and involvement of time levels.

**Method 1:** Poll for information.

**Method 2:** Perform strand tests on samples of gathered hair.

**Materials needed for Method 1:** A group 3 or more people with previous hair color experience. Have a well-lit room with enough floor space for people to line up shoulder to shoulder.

**Materials needed for Method 2:** Index cards, hair coloring bowls, brushes, foil, pens, masking tape, hair-lightening product and developer.

A group of people with previous hair color experience, at least 3 or more. Have a well-lit room with enough floor space for people to line up shoulder to shoulder.

**Method 1:**
1. Gather the group of people.
2. Evaluate the eye color of each according to depth.
3. Arrange them in a line shoulder to shoulder according to a darkest to lightest scale of their eye color.
4. Reevaluate, specifically looking for undertones of red. Rearrange if necessary.
5. Question each of the individuals to see if they have experienced difficulty in lightening their hair. Ask specifically about red-orange tones left in the hair.
6. Compare their responses with their placement in line. Did the people with the darkest eye color having the most red, have the most difficulty with lightening?

**Method 2:**
1. Prepare materials for each person. Number index cards according to the number of participants to tape hair samples onto later.
2. Gather the group of people.
3. Evaluate each one’s eye color according to depth.
4. Arrange them bodily in a line according to darkest to lightest.
5. Reevaluate specifically looking for undertones of red. Rearrange if necessary. Assign a number to each participant beginning with #1 at the darkest eye color.
6. Collect a sample of hair from each of the individuals by weaving a tail comb lightly in the nape area.
7. Tape the hair sample near the top. Leave enough of a tab on the tape to label it according to the participant’s number.
8. Mix a small amount of lightening product and apply to the hair samples that have been arranged numerically on the foil sheet. Avoid getting product on the numbers of the tape tabs.
9. Allow for half of the time recommended for the lightening product to work and remove by thoroughly rinsing and blotting.
10. Evaluate and record the color of the underlying pigment brought to light at the half way mark. Compare the vividness of the red-gold to gold and gold to paler yellow stages present. Do they vary according to the depth of the eye color of the individual?

The individual with the red undertones in their irises oftentimes has difficulty with the hair lightening process. The visible reddish hue in the eyes and the peachy undertones in the skin indicate a strong presence of pheomelanin.

**Hair color products**

Let’s review the basic types of hair coloring products. They fall into two categories: Oxidative and Non-oxidative. Oxidative hair color agents incorporate the use of developers to increase the longevity of the color. They penetrate the hair strand and through oxidation become part of it. Non-oxidative color agents are applied without developers and stay primarily on the outside or just under the surface of the cuticle layer. They are released through the shampooing process.

- Permanent hair tint–oxidative.
- Semi-permanent hair tint–non-oxidative.
- Temporary color rinses/shampoos–non-oxidative.
- Lighteners (bleaching agents)–oxidative.

Within each category there are an abundance of products from various manufacturers with similar capabilities. Be sure to gain education from the manufacturer’s or distributor’s representatives on the particular brand that you are using for optimal results.

**Professional permanent hair coloring tints** penetrate into the interior of the hair strand and have the capability of darkening a light shade to the lowest level of darkness. Be aware of what primaries are missing in the strand so it can be reintroduced to avoid off tones in the darker levels. Permanent tints also have the ability to lift out natural pigment and lighten the shade up to three levels. For example, when looking at a color chart, going from a level 5 up to an 8 is quite a remarkable difference. Consider the ability of a tint in the event that a client has hair at a natural level of 7 or above. Using a hair lightener (bleaching agent) in this situation instead of a tint is purely overkill. High lift tints give outstanding results with perfectly toned shades in warm, neutral and cool colors. High lift tints are more gentle on the strand than lighteners. They effectively remove natural pigment and give the strands a polished tonal value in one application.

**Ingredients in a professional permanent hair tint:**

- **Lightening agents**–in permanent tints are hydrogen peroxide and ammonium persulfate based product that will diffuse natural
pigment. When the color is sufficiently lightened, only then will the deposit process of the tint pigment take place. Once pigment is removed, it will not return to that area of the strand, and tints with lightening agents should not be reapplied to that area. Re-introducing a product with lightening agent will only compromise the integrity of the hair structure, producing a much weaker strand. If fading has occurred or if a different shade is desired, consider applying a demi-permanent product.

- **Pigment**–dye ingredients derived from a coal tar product called para-phenylene-diamine, also viewed on ingredient lists as p-phenylenediamine, are known to cause sensitivity or allergic reaction. A patch, predisposition or skin test must be done on the client’s skin 24/48 hours prior to application as required by law. Pigment from this source behaves more like natural melanin than any other dye product. It penetrates into the strand and remains fixed to the internal structure through the oxidation process. As it gains entrance to the strand, it expands when it is oxidized and becomes trapped beneath the cuticle layer. Healthy hair strands keep the newly formed granules in place with little if any fading. Manufacturers use primary color pigments to create various shades of color based on a ppm (parts per million) formula. They incorporate the amount necessary to infuse an average textured hair strand for maximum coverage of existing melanin or replacement of diffused melanin. Pigments present are coordinated with lightening agents in permanent tints. In dark tints, there is far less lightening agent than pigment for deposit. In high lift tints, the opposite is true; the mixture is predominantly lightening agent with very little pigment for deposit.

- **Shampoo or cleansing agent**–activated by water at the conclusion of the service, these products are included for the easy removal of the tint. Tints are designed to be worked into a lather with the addition of warm water. This is a step most commonly skipped, colorists usually perform a thorough rinsing of the tint product and then application of a separate shampoo. This is counterproductive to the nature of the shampoo ingredient which is to release the majority of the tint product from the hair. The foaming action reduces the density of the product allowing it to lift from the hair and scalp.

- **Ammonia compounds or alkalizing agent**–Hair naturally has an acidic pH, whereas alkalizing agents are bases. During the tinting process, a change in pH opens the cuticle and shifts the internal salt bonds to expand the strand, allowing the natural melanin to disburse and give room to the newly oxidized color granules. Once the hair’s pH is restored with the removal of the tint, the hair remains slightly enlarged, which adds body to the strand.

- **Conditioning agents**–typically a form of oil is used to add shine and softness to the hair.

- **Peroxide based developers** are added to permanent tints prior to application. Many developers are a mixture of water, peroxide, ceteryl alcohol, alkalizing agents and phosphoric acids. Permanent tints perform two separate activities during their processing time: lifting of natural pigment and depositing artificial pigment.
  1. Lifting is obtained by opening cuticle layer to allow penetration of the product and breaking down natural melanin inside the strand.
  2. Deposition of color occurs inside the strand as the aniline derivatives are oxidized and form large, permanent molecules.

Best uses of permanent hair color:

- Lightening natural shades up to 3 levels.
- Depositing color on fine limp hair to add extra body.
- Creating equal coverage for hair that is gray. It removes and adds color at the same time to improve the uniformity of the overall shade.

**Demi-permanent tints** are designed to enhance the natural color and add depth or warmth to the shades. They are capable of darkening the hair from a very light shade to the lowest level. Brilliance can be obtained by using a color with a gold base, but remember there is no expectation of lifting out natural color pigment to lighten the natural level. They do contain p-phenylenediamine and therefore require a 24/48 hour predisposition test. Demi-permanent tints penetrate the hair strand and develop just inside the cortex and the area between the cuticle layers as well. Demi-permanent hair coloring is the best product for fading of previously tinted hair, since the lower levels of alkalinity will do less damage to the hair than a permanent tint.

Demi-permanent hair coloring tint ingredients are identical to permanent tints, except for the absence of lightening agents and the use of a non-ammonia alkalizing agents. These changes permit the natural melanin to remain intact, thereby causing less damage to the hair. Demi-permanent tints have their own activators or processing solutions which are a reduced volume developers containing water, peroxide and phosphoric acid.

Best uses of demi-permanent color:

- Retint services to restore natural color to the hair.
- Refresh color to ends on previously tinted hair without excessive damage.
- Deposit only hair color service for curly and coarse textured hair. The reduced levels of alkalinity and lesser volume developers do not cause over expansion of the hair shaft. This reduces the chance of a frizzy appearance commonly associated with coarse or curly hair that is chemically treated.
- Introduction to hair color for a client who fears the commitment of retouch services.
- Blending or covering gray.

**Semi-permanent tints or toners** are designed to penetrate the cuticle somewhat. They gradually release during shampooing before completely fading away after several cleansings. Semi-permanent tints are self-penetrating without the aid of developers. They do contain p-phenylenediamine and therefore require a 24/48 hour predisposition test. Like toners, they may be mixed with a packet of “balancing crystals” that are intended to neutralize the hair of any remaining alkalies in the strand that may encourage the pigment to dissipate prematurely. Semi-permanent colorings are available in a variety of forms, including mousse, gel, cream, and liquid. Shades run from dark to light in warm, neutral and cool tones as well as neon and exotic colors that are incorporated onto pre-lightened hair. These colorings have the capability of not only staining the strand, but penetrating through the cuticle into the cortex on freshly lightened hair for increased durability.

Best uses of semi-permanent color:

- Infuse pre-lightened hair with exotic colors.
- Tone pre-lightened hair to a more appealing shade.
- Low maintenance color changes with no damage to the strand and no commitment to hair coloring retouches.

**Temporary color rinses or shampoos** are meant to last until shampooed away and are most commonly available in liquid, mousse or spray form or are incorporated with a shampoo base. They contain harmless pigment that has been certified by the Food and Drug Administration (FDA). Since they are harmless agents, they do not require a patch test. The size of the molecule they are made of is fairly large and will not penetrate into the hair strand. They attract to each other and cling to the outside of the cuticle layer until they become wet. They are used to cover gray, change the tone, or enhance the shade of the hair at or near its current level of depth. Using a color rinse of a deep blue black on hair that is a natural golden blonde will cause a drab muddy result with a dull or matte appearance. Likewise, using a red-violet base on hair that is predominantly gray will result in a cool pink tone.

Best uses of temporary color agents:

- Clients that want to soften or blend their gray hair who shampoo their hair infrequently.
● Unusual or vastly different color changes for daily wear, costumes or special occasions.
● Clients that wish to tone down unwanted shades from water impurities.
● Clients that need to refresh their faded ends between color service appointments.

**Lighteners are bleaching agents that remove** natural color pigment from the hair. They break up the melanin that they come in contact with. Lighteners are a mixture of ingredients that work with 6 to 10% hydrogen peroxide to penetrate the strand. Ingredients such as ammonium persulfate, potassium persulfate and sodium persulfate provide a variety of pH reactions to adjust the strength of the product. Note that some lighteners are designed for off the scalp use only! Serious burns to the scalp could result if used incorrectly.

**Blue and violet colored lighteners** have a specific purpose. A lightener’s only job is to remove pigment. The product itself may have coloration such as blue or violet, but it is not a type of tint. Tint is useless when added to lightener, because the lightener would actually prevent the tint from oxidizing into the interior of the stand. However, in some products, the blue or violet coloration of the product will diminish or neutralize the appearance of brassy golds or yellows left in the strand during the lightening process. Choose products that contain blue or violet bases according to the underlying pigment found in the strand as follows: If your client has an abundance of underlying red in their hair and eye color, it will show up during the lightening process very early and the lightener may seem to stop working, so be sure to use a blue, as opposed to violet. The brassy golds rich in secondary orange are neutralized by blue in the levels 4 through 7. The lighter golds formed with primary yellows at levels 8 and above are neutralized from violet colored product. Choose violet for hair with little influence from underlying reds.

If lightening to extremely lighter shades, a double process may be necessary, whereby a blue based lightener is followed up by either a second application of lightener or a toner. A somewhat fragile strand will result; be sure the hair is strengthened prior to the service, and suggest frequent reconditioning treatments or provide the appropriate product for retail sale.

**Best uses of lightening agents:**

- On scalp lightening with a mild product and mid-level developer for all over the head blondes.
- On scalp lightening with quick exposure to a mild product and low level of developer to break the base of the natural shade before processing with a tint. Remove by shampooing, then dry with cool air before applying tint. If no shampooing is done, the remaining lightener in the hair will be counterproductive to the depositing of the tint pigment.
- Off scalp lightening with foils, papers, or caps. Also used during ombre services or free hand painting in a baliage technique.

**Developers** are primarily a hydrogen peroxide base (H2O2) with other additives that assist in oxidizing hair color pigment. The pH of hydrogen peroxide as a hair coloring developer ranges from 2.5 to 4.5 depending on the volume and additives present. Other additives assist in stabilizing the product and maintaining a shelf life as well as aiding in viscosity or thickness. Developers are also known as catalysts, pronators, processing solutions or oxidizing agents.

Hydrogen peroxide developers are available in a variety of volumes which allow for customizing hair coloring tints and lighteners alike. The volume of hydrogen peroxide is a rating of strength based on the amount of oxygen gas present in the liquid of the product. For example, 10 volume strength of hydrogen peroxide contains 10 times the amount of gas to liquid for a ratio of 10:1. Ten volume is considered a low strength in the hair color arena. Forty volume is an increase of 40:1 ratio of gas to liquid and considered quite strong when dealing with the hair strand. Lower volumes contain enough oxygen gas to cause oxidation of artificial pigment within the hair strand for a lasting effect. However, they are not capable of sufficiently breaking down natural melanin to lighten the natural hair color.

**General rule of thumb when choosing volume for tinting** is as follows:
- Deposit only—up to 10 volume.
- More levels of lift and deposit—use 20 volume.
- Mostly lift very little deposit—use 40 volume.

**General rule of thumb when choosing volume for lightening** is as follows:
- On the scalp lifting—use 20 volume.
- Off the scalp lifting—use 30 volume.

Some manufacturers customize to volume of developers to work specifically with a line of lighteners. It is unwise to deviate from their recommendations.

Using higher than 30 volume developers with lightening agents is not recommended as the breakdown of the disulfide bond will result and the internal structure of the hair will be compromised.

This course was designed to bring to light the often forgotten elements of the hair coloring process. At times we do things simply because that has always been the way they were done. Hopefully a fresh perspective on the importance of foundational elements will inspire greater confidence and renewed diligence in protecting the hair shaft. It is, after all, the very fabric of our profession. Happy coloring!

**References**

HAIR COLORING AT A GLANCE

Final Examination Questions
Choose the best answer for questions 1 through 15 and mark your answers online at Cosmetology.EliteCME.com.

1. Excessively damaged hair with weakened disulfide bonds will appear to grab drab or ash tones when coloring.
   ○ True ○ False

2. Melanin is removed from the hair in exactly the same order that it is created.
   ○ True ○ False

3. Color arrangement as seen through a prism is described with the acronym ROYGBIV indicating placement of the colors: Red, Orange, Yellow, Green, Black, Indigo, and Violet.
   ○ True ○ False

4. Red is the only cool primary color.
   ○ True ○ False

5. A secondary color is placed directly across the color wheel from a tertiary color that is not part of its composition.
   ○ True ○ False

6. Color formulation involves only shades of color level; tones are not involved.
   ○ True ○ False

7. To add depth to a brown tint during formulation, use a blue based product.
   ○ True ○ False

8. Performing accurate assessments regarding hair qualities is not affected by the presence of product in the hair.
   ○ True ○ False

9. These concentration levels of the amount of pigment in a tint are known as parts per million or ppm.
   ○ True ○ False

10. When coloring longer hair, consider mixing two separate formulas and altering developer strength so as not to cause further damage to an already open cuticle on older hair ends.
    ○ True ○ False

11. Permanent tints perform 2 separate activities during their processing time: Lifting of natural pigment and depositing artificial pigment.
    ○ True ○ False

12. Temporary rinses are best for clients who shampoo their hair infrequently and want to soften or blend the gray in their hair.
    ○ True ○ False

13. When lightening the hair, the lighter golds formed with primary yellows at levels 8 and above are best neutralized from green based product.
    ○ True ○ False

14. The volume of hydrogen peroxide is a rating of strength based on the amount of oxygen gas present in the liquid of the product.
    ○ True ○ False

15. Using higher than 30 volume developers with lightening agents is a perfectly acceptable practice.
    ○ True ○ False