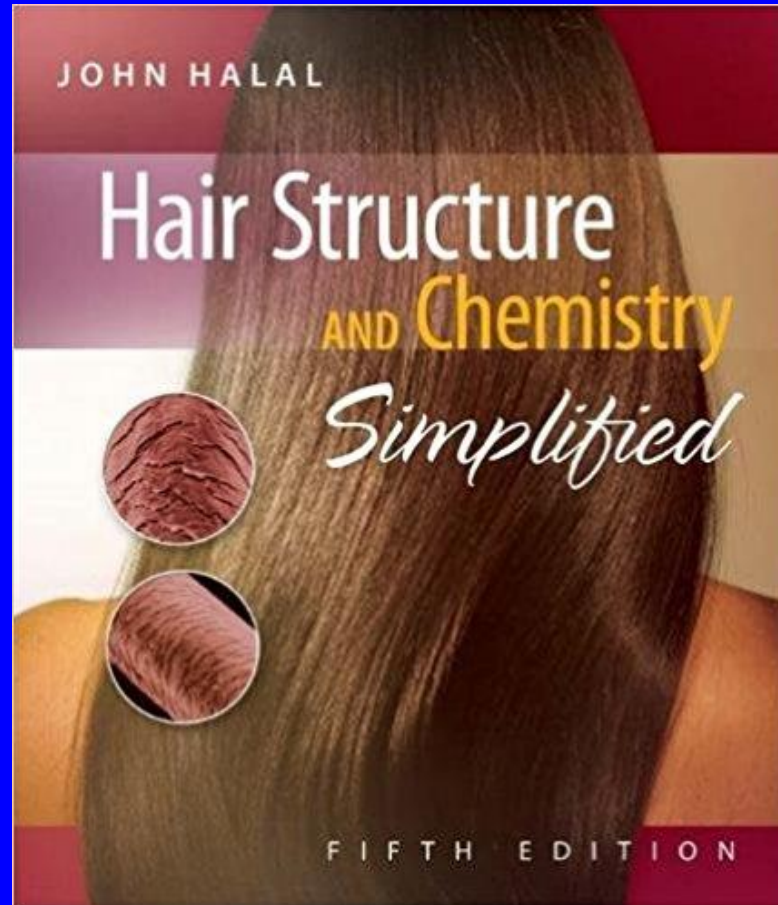


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www.chemistrysimplified.com
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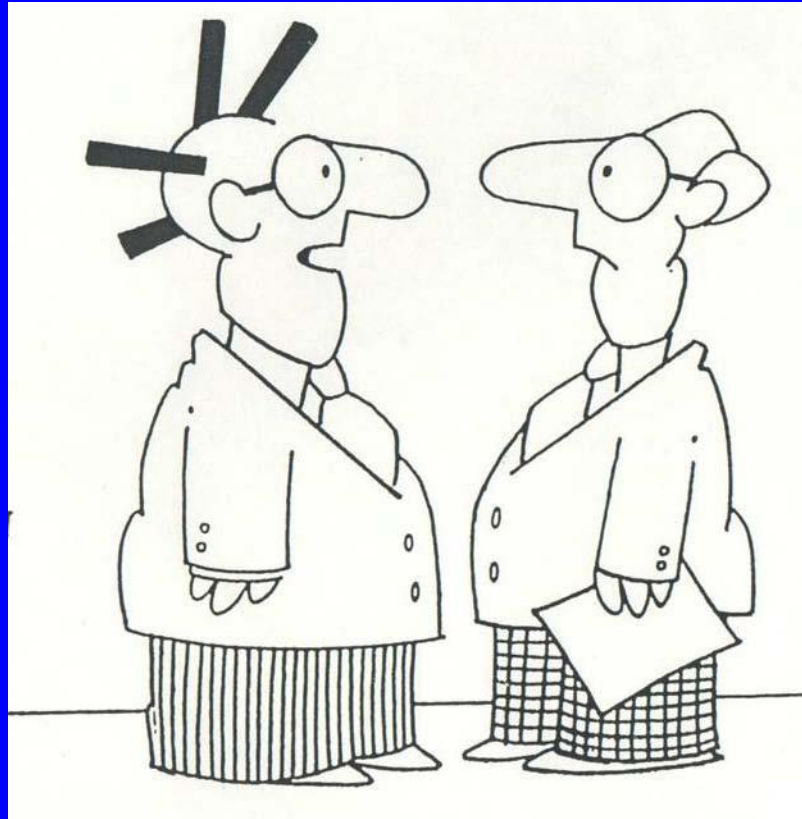


[Amazon.com : hair structure and chemistry simplified](#)



[Hair-Care Product and Ingredients Dictionary \(Milady's Hair Care Product Ingredients Dictionary\): Halal, John: 9781562539191: Amazon.com: Books](#)

I don't have much hair left, but my special shampoo fortifies each strand and makes the remaining hair look thicker and fuller.



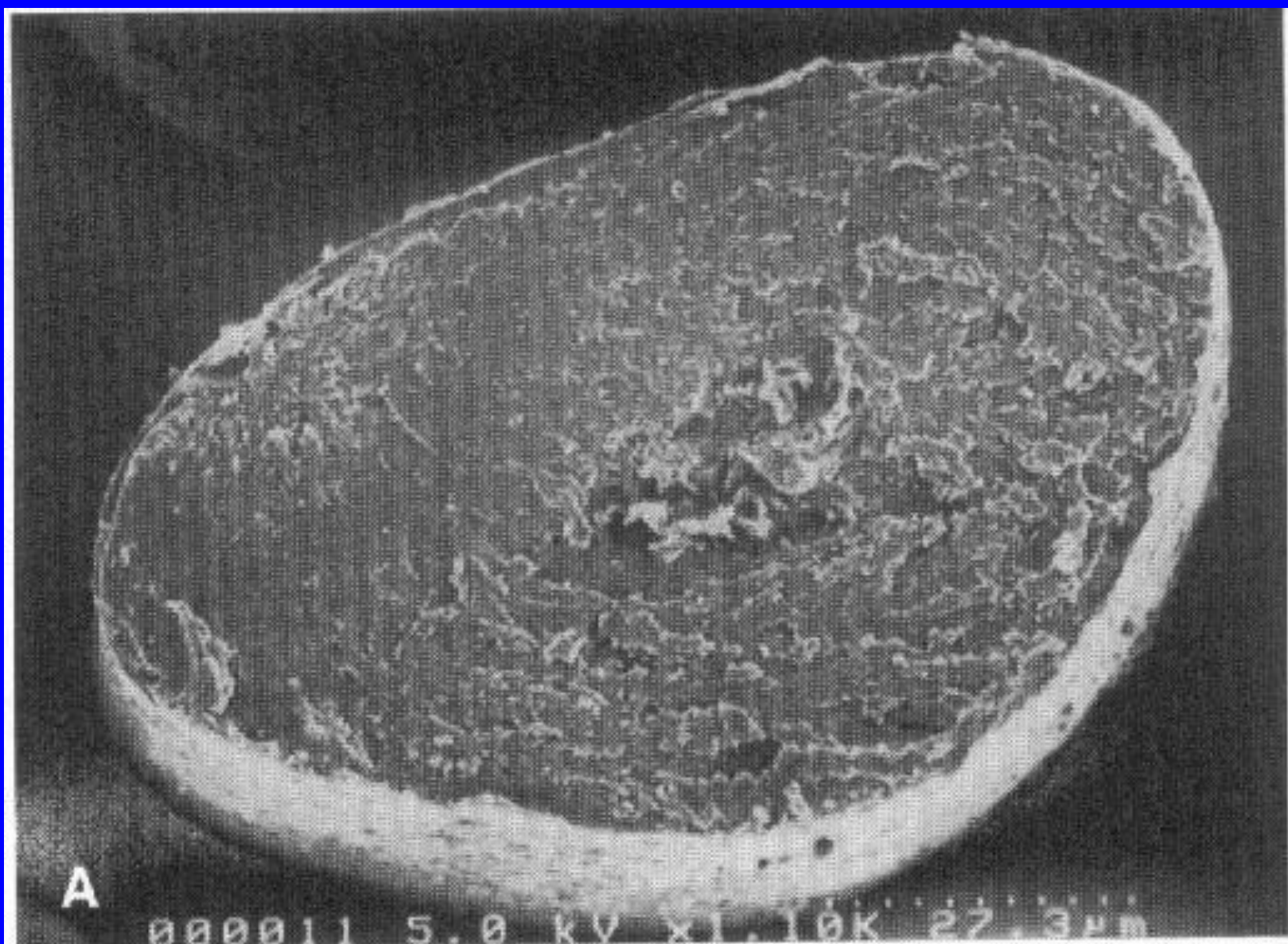
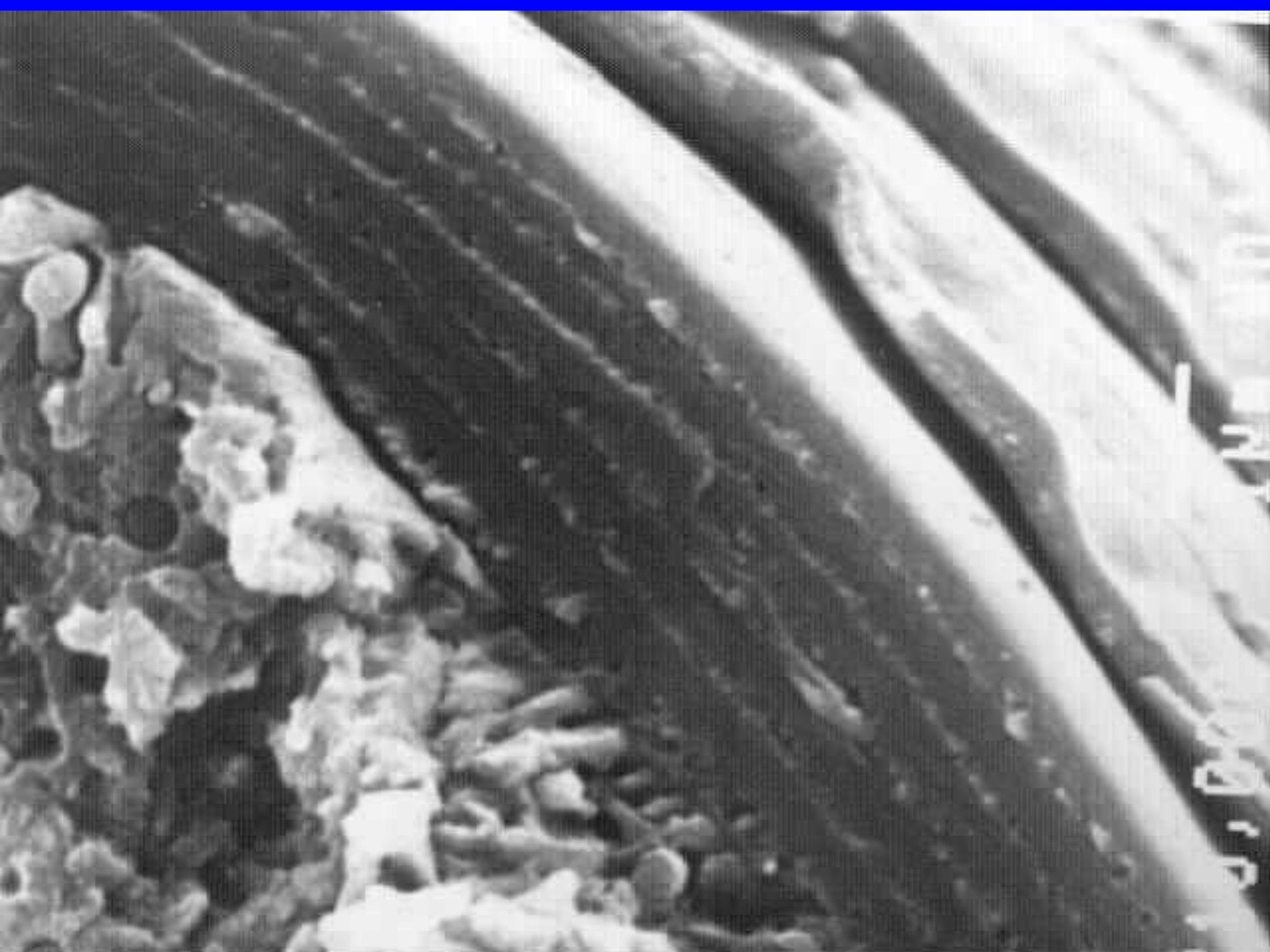


Figure 4. A. Extension to break when wet generally
S. Buetsch TRI Princeton B. Extension to break wh



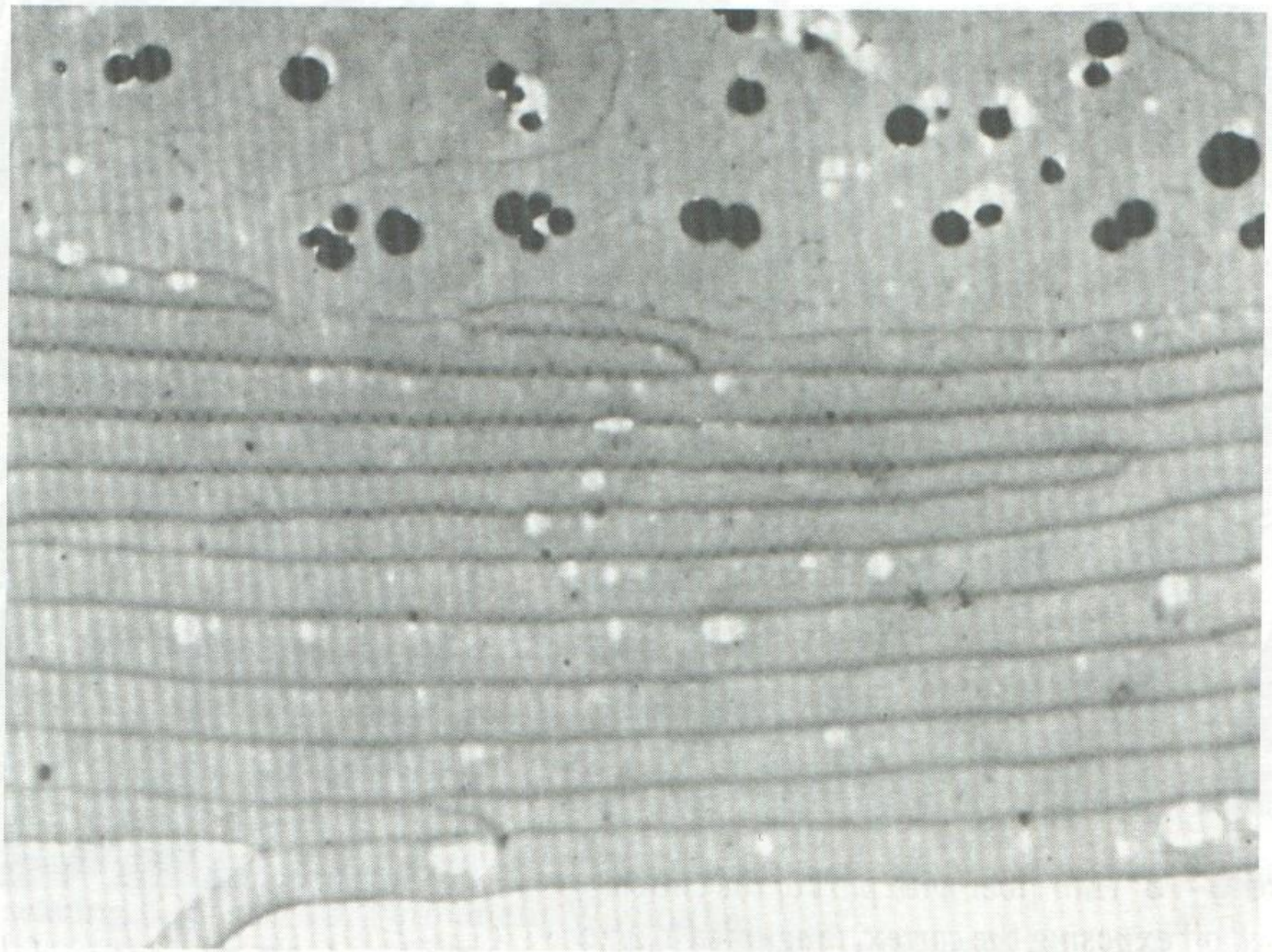


Figure 6-16 A photo of cuticle scales around the cortex, magnified 14,800 times.



Figure 6-15 Cross section of hair showing that, although you can count six distinct layers of overlapping cuticle, each individual scale is attached to the cortex in one cuticle layer.

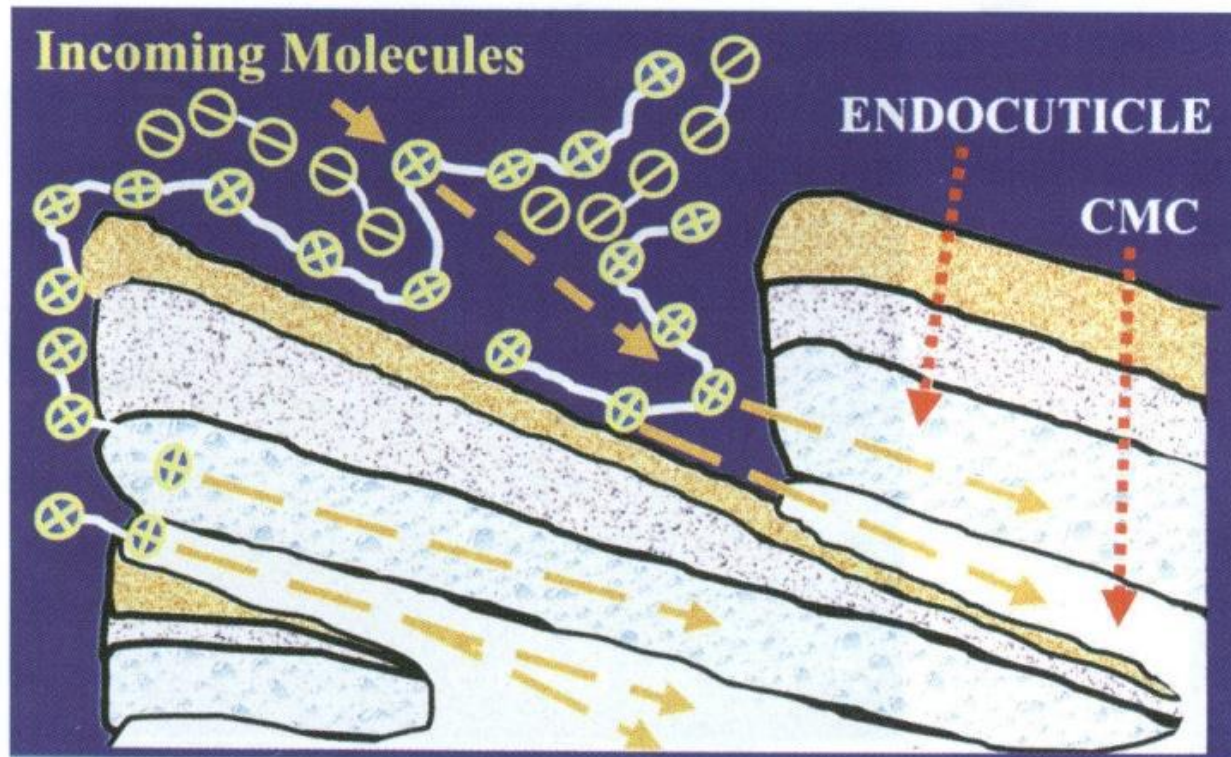


Figure 1: Components of the cell membrane complex and endocuticle are the assumed main diffusion paths of molecules into the hair shaft.

Penetration Occurs Between The Cuticle Scales



Subtractive Color

Reflects Available Light

What color is your hair
If you turn out all the lights?

- Fluorescent Lights - Green
- Tungsten Lights - Orange
- Bright Daylight - White

NATURAL LIGHT CONDITIONS	KELVIN COLOR TEMPERATURE	ARTIFICIAL LIGHT SOURCE	COLOR TINT MIXTURE
<ul style="list-style-type: none"> • Fair weather, blue sky 	10,000	<ul style="list-style-type: none"> • Color television 	Bluish
<ul style="list-style-type: none"> • Slightly cloudy sky • Cloudy or rainy sky 	8,000 7,000 6,500	<ul style="list-style-type: none"> • Fluorescent lamp (Daylight) • Camera flash bulb 	
<ul style="list-style-type: none"> • Sunlight in clear weather at midday 	6,000 5,500	<ul style="list-style-type: none"> • Blue lamp for photography 	
<ul style="list-style-type: none"> • Average sunlight in clear weather 	5,000		
<ul style="list-style-type: none"> • Sunlight 2 hours after sunrise and before sunset 	4,500 4,000 3,500	<ul style="list-style-type: none"> • Fluorescent lamp (White) • Normal flash bulb • Fluorescent lamp (Off-white) • Tungsten lamp for photography 	Whitish
<ul style="list-style-type: none"> • Sunlight 40 min. after sunrise and before sunset 	3,200	<ul style="list-style-type: none"> • Halogen lamp • Iodine lamp 	
<ul style="list-style-type: none"> • Sunlight 30 min. after sunrise and before sunset 	2,800	<ul style="list-style-type: none"> • Tungsten lamp 	Yellowish
<ul style="list-style-type: none"> • Sunlight 20 min. after sunrise and before sunset 		<ul style="list-style-type: none"> • Acetylene lamp • Kerosene lamp 	
	2,000	<ul style="list-style-type: none"> • Candlelight 	Reddish

Color Theory

1) Shade or Hue of Color

Balance of Color, Tone or Hue

Which Color?

What color is equal parts Yellow, Red and Blue?

2) Level of Color

Concentration, Density, or Saturation

How Much Color?

White, Black, & Gray are the Same Color

Different Levels

Pink is a Lighter Tint of Red

	COOLER/MAS FRIO			NEUTRAL/NEUTRO		WARMER/MAS CALIDO			
	ASH/CENIZO			NATURAL/NATURALES		GOLD/DORADOS		RED/ROJOS	
10	1001 Super Shimmery Ash Blonde Rubio Cenizo Muy Platinado	1030 Platinum Ash Blonde Rubio Cenizo Muy Platinado		1060 Super Ash Blonde Rubio Cenizo Super		1036 Heavy Blonde Rubio Muy	1070 Heavy Shimmery Blonde Rubio Sencillo Muy		
9		940 Pale Ash Blonde Rubio Platinado Claro		911 Very Light Blonde Rubio Muy Claro					
8	882 Light Shimmery Ash Blonde Rubio Sencillo Claro			740 LT Light Ash Blonde Rubio Claro	811 Light Blonde Rubio Claro	831 Beige Blonde Rubio Sencillo	841 Light Golden Blonde Rubio Ligero Sencillo	729 Tilman Red Blonde Rubio Rubro	892 Light Bright Red Rubio Brillante Claro
7	672 Medium Shimmery Ash Blonde Rubio Sencillo Medio			711 Medium Blonde Rubio Medio			725 Sunlight Blonde Brown Rubio Castaño Brillante	643 Tan Blonde Rubio Sencillo	
6	462 Dark Shimmery Ash Blonde Rubio Sencillo Oscuro	632 Medium Ash Blonde Rubio Cenizo Medio	542 Ash Blonde Rubio Claro	611 Dark Blonde Rubio Oscuro		555 Neutral Blonde Rubio Neutro	544 Light Copper Cobre Claro	633 Red Blonde Rubio Rojo	607 Carmine Carmin
5		336 Light Shimmery Brown Pardo Castaño Claro		511 Light Brown Castaño Claro				445 Light Auburn Castaño Rojo Claro	507 Burgundy Rubio Vino
4		237 Medium Ash Brown Castaño Cenizo Medio	246 Light Ash Brown Castaño Claro	411 Medium Brown Castaño Medio		435 Light Golden Brown Castaño Dorado Claro	356 Cinnamon Brown Castaño Canela	347 Dark Auburn Castaño Rojo Oscuro	
3				311 Dark Brown Castaño Oscuro		257 Dark Golden Brown Castaño Dorado Oscuro			367 Black Cherry Castaño Negro
2	148 Dark Ash Brown Castaño Oscuro			211 Dark Brown Castaño Oscuro					
1	052 Blue Black Negro Azulado		051 Black Negro						
						MODIFIERS/MODIFICADORES			
						INTENSIFIERS/INTENSIFICADORES			
	050 Light Drabber Pardo Claro	049 Dark Drabber Pardo Oscuro	042 Gold Dorado	010 Red Ash Rubio Rojo					

10 Stages of Decolorization

- Lightening Natural Color Makes it Warmer
- Natural Hair Color
 - 3 Parts Yellow
 - 2 Parts Red
 - 1 Part Blue

Oxidative & Non-oxidative Color

1) Non-oxidative

- Temporary
- Semi-Permanent

2) Oxidative

- Demi-Permanent (Deposit Only)
- Permanent (Lift & Deposit)
- All Lighteners

“Coal Tar” Dyes

- Primary Intermediates – Provide Base Color
 - Para-Phenylenediamines (PPD)
 - Para-Aminophenols (PAP)
- Couplers/Secondary Intermediates– Modify Color
 - Meta-Phenylenediamines
 - Meta-Aminophenols
 - Resorcinols
- Cosmetic Toiletries & Fragrance Act of 1938
 - Patch Test 48 hours prior to EACH application
 - Not for use on eyelashes or eyebrows

Alkaline Haircolor

- 1) Swells the hair to allow penetration.
- 2) Triggers the decomposition of peroxide.
- 3) Aids in developing the dye.

Inorganic Alkalizing Agents

- Ammonia, NH_3 (17 aw)
- Water, H_2O (18 aw)
- Ammonium Hydroxide, NH_4OH (35 aw)
- Sodium Hydroxide, NaOH (40 aw)

Organic Alkalizing Agents

Alkanolamines, R-NH_2

- Aminomethylpropanol (AMP) (89 aw)
Deposit Only - Over 5 times larger than Ammonia
- Monoethanolamine (MEA) (61 aw)
Lightening – 3.5 times larger than Ammonia

Oxidizers

- Oxidation is necessary to:
 - 1) Develop the dye – Low Concentration
 - 2) Lighten natural hair color – High Concentration

- Examples of oxidizers

Sodium Bromate NaBrO_3 Sodium Perborate NaBO_3

Hydrogen Peroxide H_2O_2 Atmospheric Oxygen O_2

Urea Peroxide $\text{CH}_2\text{N}_2\text{O}\cdot\text{H}_2\text{O}_2$

Hydrogen Peroxide

- Peroxide is H_2O_2
- Water is H_2O
- Peroxide is Water with an extra Oxygen
- Peroxide decomposes into Oxygen Gas and Water
 - 1 ounce of 20 Volume produces
 - 1 ounce of water and
 - 20 ounces of Oxygen Gas

Hydrogen Peroxide H_2O_2

- Solution of Hydrogen Peroxide and Water
 - 20 Volume
 - 6% Hydrogen Peroxide
 - 94% Water
 - 40 Volume
 - 12% Hydrogen Peroxide
 - 88% Water

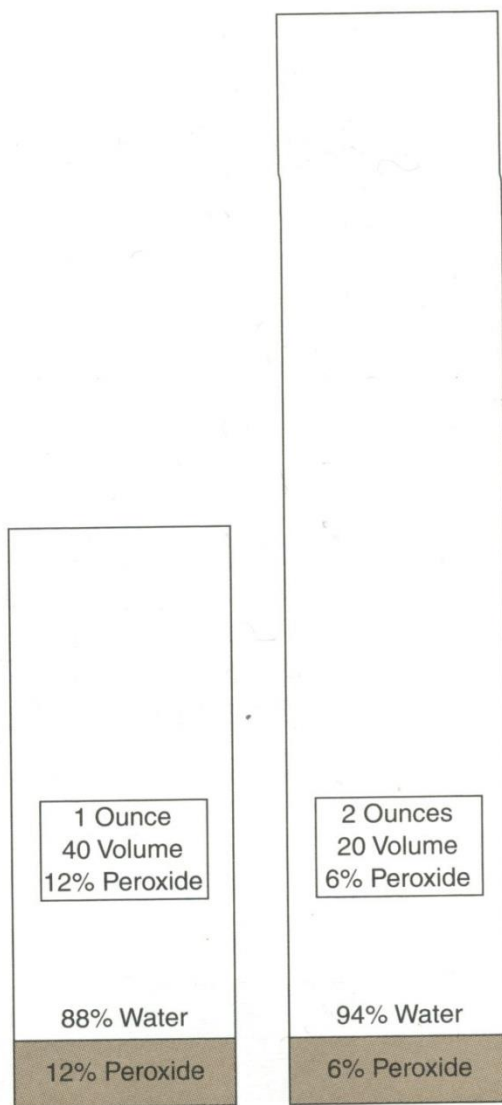


Figure 11-24 This illustration shows that one ounce of 40 volume peroxide contains the same amount of peroxide as two ounces of 20 volume peroxide. The 40 volume simply contains less water.

When You Mix Equal Parts Color & 20 Volume You Apply 10 Volume to the Hair

The Effective Volume is the relationship of:

- 1) The total amount of the color mixture
- 2) To the amount of peroxide
- 3) To the volume of peroxide

- 2 ounces Color
- 2 ounces 20 Volume

- 1) $2 + 2 = 4$ ounces total
- 2) $4 / 2 = 2$, $\frac{1}{2}$ is peroxide
- 3) $20 / 2 = 10$ effective volume

- 3 ounces Color
- 1 ounce 40 Volume

- 1) $3 + 1 = 4$ ounces total
- 2) $4 / 1 = 4$, $\frac{1}{4}$ is peroxide
- 3) $40 / 4 = 10$ effective volume

“Resistant” Gray Hair

Not Resistant - Just White

- The structure of non-pigmented hair is identical to that of pigmented hair except for the absence of melanin.
- Non-pigmented hair is no more resistant than the pigmented hair on the same head. It's just white.
- “Gray” hair is more difficult to color only because it is white and needs more color.

Grey Hair Deposit Only

Formula

3 Ounces - Haircolor

1 Ounce - 30 Volume Peroxide

4 Ounces - 7.5 Effective Volume

- 3 Parts Yellow, 2 Parts Red, 1 Part Blue
- Level 6 or Darker
- Apply to Clean Damp Hair
- Process 30 minutes at room temperature

High Lift

Formula

1 Ounce - Haircolor

2 Ounces - 40 Volume Peroxide

3 Ounces - 27 Effective Volume

- Level 8 to 10 with a Blue or Violet Base
- Add ½ ounce of Powder Lightener
- Apply to Clean Damp Hair
- Process 30 minutes, at room temperature

Off-The-Scalp Lighteners

- Persulfate Salts
Ammonium Persulfate, Potassium Persulfate,
Sodium Persulfate
- Powdered Form Only - Anhydrous
Powder Lighteners, Cream Bleach Activators
- CAUTION – SCALP IRRITATION
Mix the Powder Thoroughly Before Each Use.
Off Scalp Only
Do Not Use Heat

Clarifying Treatment

Formula

- 1 Ounce - Fruit Fresh (Ascorbic Acid/Vitamin C))
- 1 Ounce - Warm Water
- 1 Ounce - Clarifying Shampoo with EDTA

- Shampoo with Clarifying Shampoo
- Mix Fruit Fresh and Warm Water
- Add Clarifying Shampoo and Mix Well
- Apply to Damp, Towel Dry Hair
- Cover with Plastic Cap with Holes
- Place Under Hot Dryer for 10 Minutes
- Shampoo with Clarifying Shampoo
- If removing color. Strand test with 10 volume developer.
- If color returns, shampoo again.

Rate of Reaction Diminishes over time

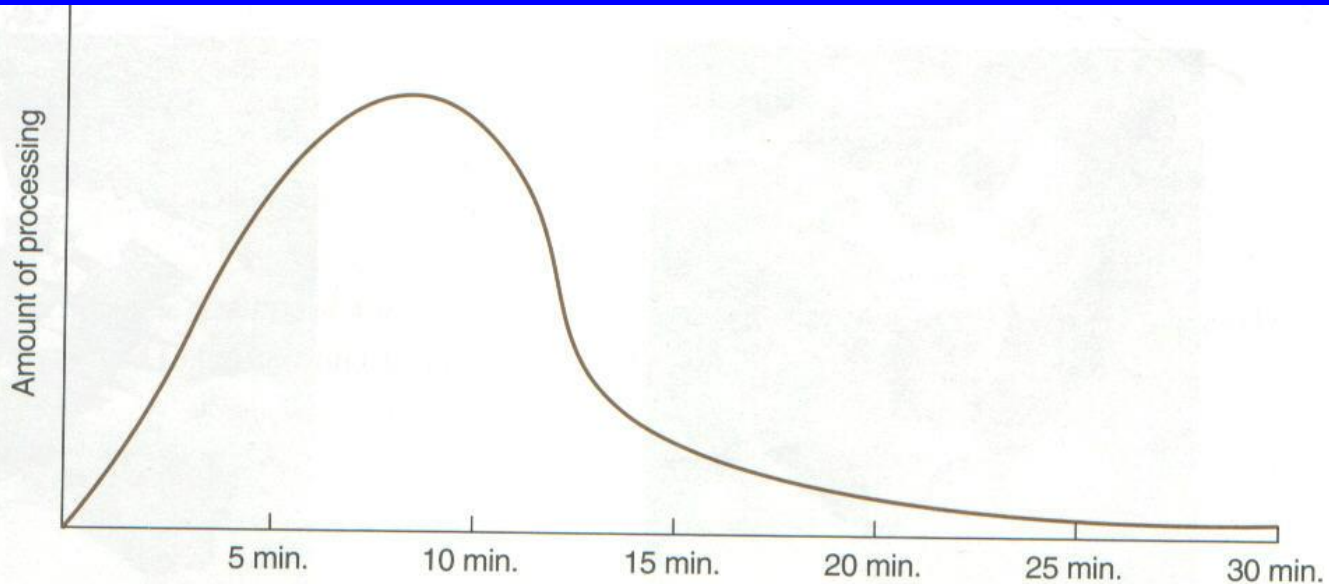


Figure 13-22 The graph shows that the rate of most chemical reactions is not uniform over time. The rate of reaction begins slowly until the chemicals penetrate the hair, then drops sharply as the reactants are “used up” and converted to products. Most chemical reactions have very little chemical activity after 20 minutes.

pH is due to the
ionization of Water
 $\text{H}_2\text{O} \rightarrow \text{H}^+ + \text{OH}^-$

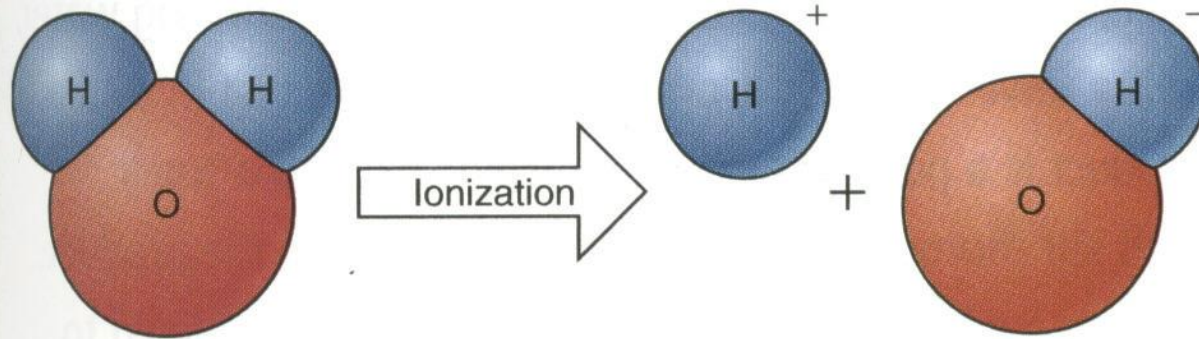


Figure 7-10 The ionization of water.

The pH Scale is a Logarithm

- The pH is the negative exponent.
- The pH is the number of decimal places.
- A pH of 7.0 is 50% alkaline & 50% acidic
- pH of 7.0 may be neutral for water, but it's alkaline for hair.
- Place a dollar sign in front of the decimal.
 - Each whole step is a tenfold change.
 - Two whole steps is a one-hundred fold change.

The pH Scale

H^+

pH	H^+ Hydrogen Ion		OH^- Hydroxide Ion	
	Exponential Notation	With Decimal	Exponential Notation	With Decimal
0	1×10^{-0}	1.	1×10^{-14}	.000000000000001
1	1×10^{-1}	.1	1×10^{-13}	.00000000000001
2	1×10^{-2}	.01	1×10^{-12}	.0000000000001
3	1×10^{-3}	.001	1×10^{-11}	.000000000001
4	1×10^{-4}	.0001	1×10^{-10}	.0000000001
5	1×10^{-5}	.00001	1×10^{-9}	.000000001
6	1×10^{-6}	.000001	1×10^{-8}	.00000001
7	1×10^{-7}	.0000001	1×10^{-7}	.0000001
8	1×10^{-8}	.00000001	1×10^{-6}	.000001
9	1×10^{-9}	.000000001	1×10^{-5}	.00001
10	1×10^{-10}	.0000000001	1×10^{-4}	.0001
11	1×10^{-11}	.00000000001	1×10^{-3}	.001
12	1×10^{-12}	.000000000001	1×10^{-2}	.01
13	1×10^{-13}	.0000000000001	1×10^{-1}	.1
14	1×10^{-14}	.00000000000001	1×10^{-0}	1.

Figure 9-3 The quantities of the pH scale expressed as pH, exponential notation, and with a decimal point.

Acid – Alkali Neutralization

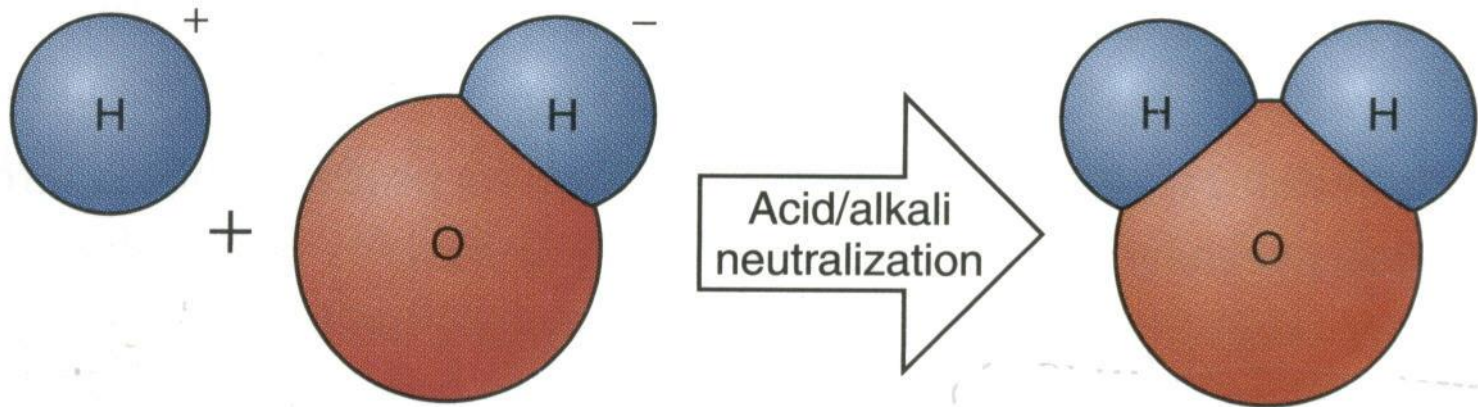
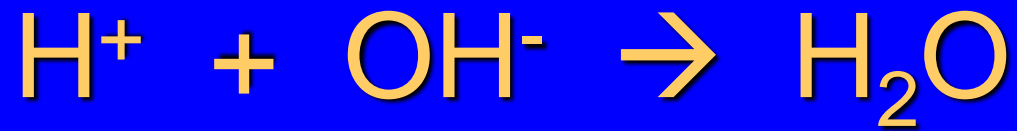


Figure 7-12 Acid/alkali neutralization reaction.

- Allured Publishing
 - (630) 653-2155 or www.allured.com
 - The Chemistry and Manufacture of Cosmetics
 - Beginning Cosmetic Chemistry
 - Cosmetics and Toiletries Magazine
- Harry's Cosmeticology, Chemical Publishing Co.
- Global Cosmetic Industry Magazine
 - (800) 598-6008 or www.globalcosmetic.com
- Society of Cosmetic Chemists
 - (212) 668-1500 or www.scconline.org

The Copernican Revolution

- The earth is the center of the universe.
The sun revolves around the earth.
- Nicolaus Copernicus, 1473 to 1543
- Galileo Galilei, 1564 to 1642
- Sir Isaac Newton, 1642 to 1727
- (1) The Copernican Revolution - YouTube