


# Chapter 12

# Basics of Chemistry

MILADY  
STANDARD COSMETOLOGY INSTRUCTOR SUPPORT SLIDES



“We only become what we are by the radical  
and deep-seated refusal of that which others  
have made of us.”

– Jean-Paul Sartre

# Objectives

- Explain the difference between organic and inorganic chemistry.
- Describe oxidation and reduction (redox) reactions.
- Discuss the different forms of matter: elements, compounds, and mixtures.
- Explain the difference between solutions, suspensions, and emulsions.
- Explain pH and the pH scale.

# Chemistry

- The science that deals with the composition, structures, and properties of matter and how matter changes under different conditions.

# Organic Chemistry

- The study of substances that contain carbon, which allows them to burn
- All living or formerly alive things contain carbon.
- *Organic* does not always mean natural or safe.

# Inorganic Chemistry

- The study of substances that do not contain the element carbon but may contain the element hydrogen.

# Matter

- Anything that occupies space; has physical and chemical properties; and exists as either a solid, liquid, or gas

# Elements

- Simplest form of matter
- Cannot be reduced without loss of identity
- At least 90 naturally occurring
- Identified by a letter symbol

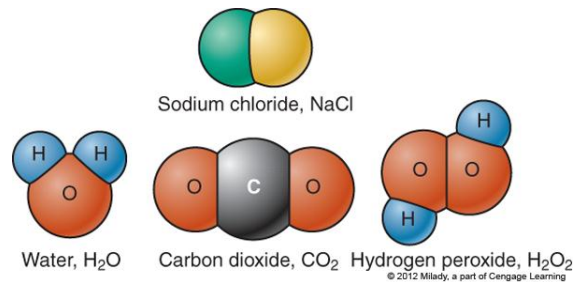
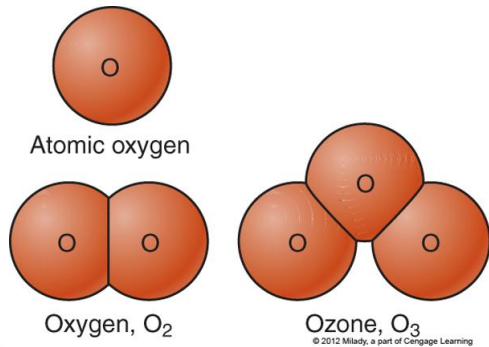


# COHNS

- C: Carbon
- O: Oxygen
- H: Hydrogen
- N: Nitrogen
- S: Sulfur

# Atoms and Molecules

- Atom: particles from which all matter is composed
- Molecules: result of joined atoms
  - Elemental molecule
  - Compound molecule



# States of Matter

- Solid: has shape, volume, weight (ice)
- Liquid: has volume and weight, no shape (water)
- Gas: has no volume or shape (steam)

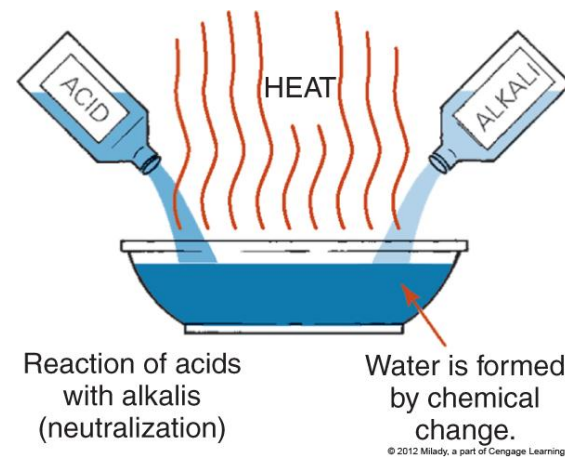
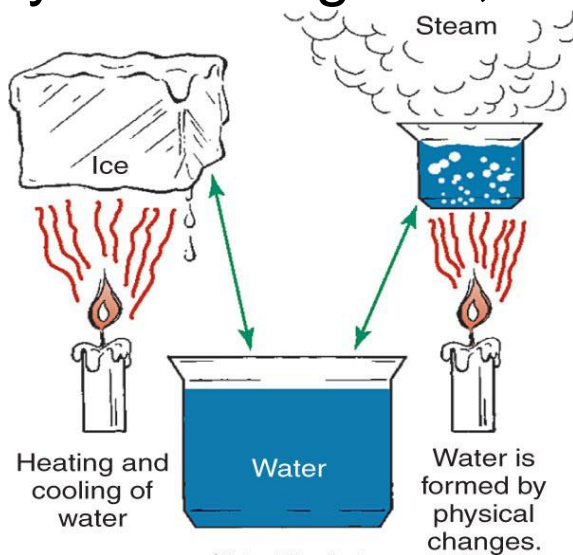
# States of Matter (*continued*)

<b>STATES OF MATTER</b>		
<b>STATE</b>	<b>DESCRIPTION</b>	<b>EXAMPLES</b>
<b>Solid</b>	Rigid; has a fixed shape and volume.	brush, roller, wooden nail pusher, ice
<b>Liquid</b>	Definite volume but takes the shape of its container.	bleach, shampoo, haircolor, water
<b>Gas</b>	No fixed volume or shape; takes the shape and volume of its container. Can never be liquid at normal temperatures or pressures.	propellant in hairspray, mousse, propane

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# Physical and Chemical Properties

- Physical: determined without a chemical reaction (color, odor, weight, density)
- Chemical: determined with a chemical reaction (change identity — rusting iron, burning wood)



# Physical Change

- The form is changed without becoming a new substance.
- Example: Solid ice melts and becomes water.

# Chemical Change

- A change in the chemical composition or makeup of a substance.
- Example: Burning wood turns into ashes.

# Oxidation

- A chemical reaction that combines a substance with oxygen to produce an oxide.
- Example: Wood turns into charcoal after it has burned.



# Oxidation-Reduction

- Also known as redox. A chemical reaction in which the oxidizing agent is reduced (by losing oxygen) and the reducing agent is oxidized (by gaining oxygen).

# Oxidizing Agent

- A substance that releases oxygen
- Hydrogen peroxide (an oxidizing agent) can be thought of as water with an extra atom of oxygen.

# Reducing Agent

- A substance that adds hydrogen to a chemical compound or subtracts oxygen from the compound

# Reduction

- The process by which oxygen is subtracted from or hydrogen is added to a substance through a chemical reaction

## OXIDATION

+ Oxygen

– Hydrogen

## REDUCTION

– Oxygen

+ Hydrogen

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# Exothermic Reaction

- A chemical reaction when heat is released

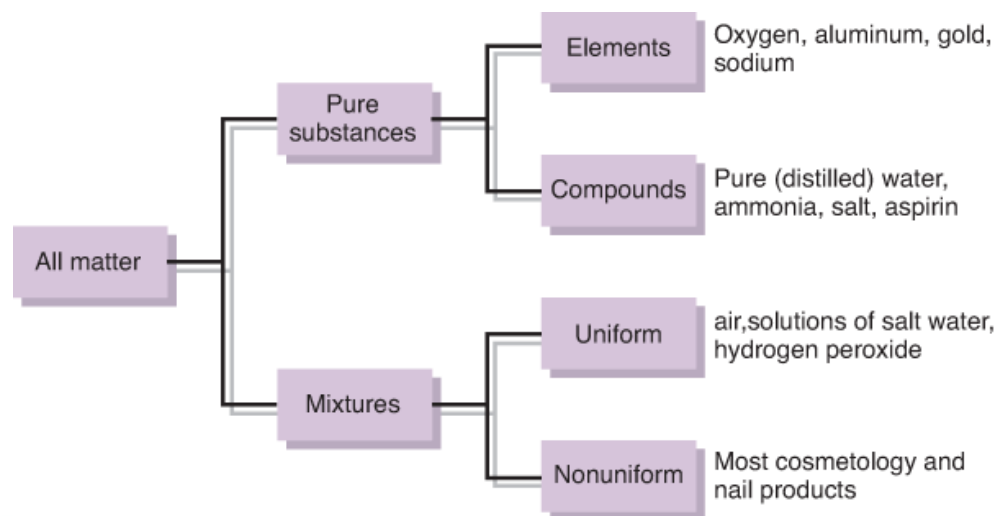
# Combustion



- Rapid oxidation of a substance accompanied by the production of heat and light

# Pure Substances and Physical Mixtures

- Pure substances (distinct properties)
- Physical mixtures (elements combined physically)



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# Pure Substances

- A chemical combination of matter in definite (fixed) proportions
- Examples: atoms, elements, elemental molecules, and compound molecules
- Distilled water results from the combination of two atoms of hydrogen and one atom of oxygen in fixed proportions



# Physical Mixtures

- A physical combination of matter in any proportions
- Examples: Concrete is a mixture of sand, gravel, and cement. Air is a mixture of gases (nitrogen and oxygen).

# Solutions, Suspensions, and Emulsions

- **Solution:** a blend of two or more liquids or a solid dissolved in a liquid
- **Solute:** the dissolved substance in a solution
- **Solvent:** the substance that dissolves another substance to form a solution with no change in chemical composition

# Solutions, Suspensions, and Emulsions (continued)

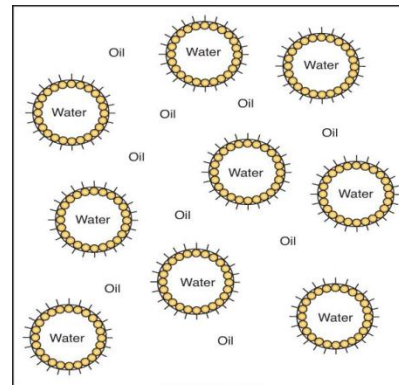
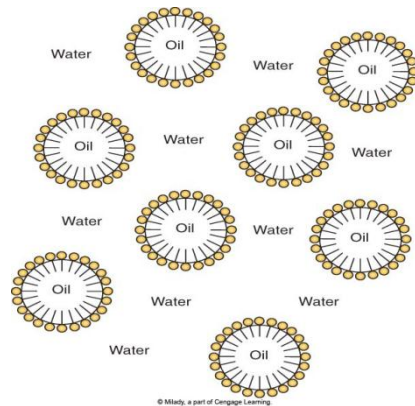
- Miscible liquids: mutually soluble
- Immiscible liquids: not capable of being mixed
- Suspension: solid particles distributed in a liquid medium, tending to separate over time

# Solutions, Suspensions, and Emulsions (continued)

- **Emulsion:** mixture of two or more immiscible substances united with a binder
- **Emulsifier:** ingredient that brings two normally incompatible materials together and binds them into a uniform and fairly stable blend

# Surfactants

- Head: water loving
- Tail: oil loving
- Surfactant molecule: joins water and oil
- Oil in water emulsion (O/W)
- Water in oil emulsion (W/O)



# Differences Among Solutions, Suspensions, and Emulsions

## DIFFERENCES AMONG SOLUTIONS, SUSPENSIONS, AND EMULSIONS

SOLUTIONS	SUSPENSIONS	EMULSIONS
miscible	slightly miscible	immiscible
no surfactant	no surfactant	surfactant
small particles	larger particles	largest particles
stable mixture	unstable, temporary mixture	limited stability through an emulsifier
usually clear	usually cloudy	usually a solid color
solution of nail primer	nail polish, glitter in nail polish	shampoos, conditioners, hand lotions

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# Other Physical Mixtures

- Ointments: semisolids made with any combination of petrolatum, oil, and wax
- Powders: physical mixture of two solids

# Common Product Ingredients

- Volatile alcohols
- Fatty alcohols
- *Alkanolamines*
- Ammonia
- Glycerine
- Silicones
- Volatile organic compounds



# Potential Hydrogen (pH)

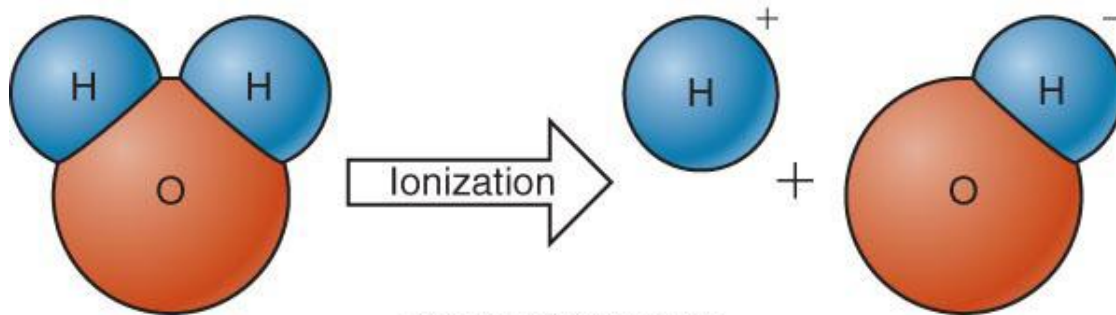
- The small ***p*** represents a quantity.
- The capital ***H*** represents the hydrogen ion.

# Potential Hydrogen and Ions

- Ion: atom or molecule that carries an electrical charge
- Ionization: temporary separation of a substance into ions
- Anion: ion with a negative electrical charge
- Cation: ion with a positive electrical charge

# Water and pH

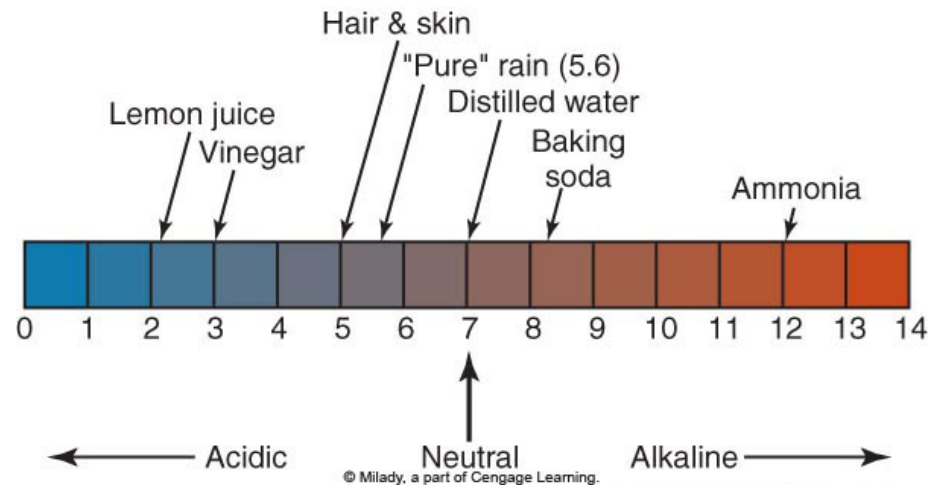
- Hydrogen ion ( $H^+$ ) is acidic.
- Hydroxide ion ( $OH^-$ ) is alkaline.



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# The pH Scale

- Logarithm: multiples of ten
- pH: Potential Hydrogen
  - Scale: 0 – 14
  - pH of 7 is neutral



# Alpha Hydroxy Acids

- pH below 7
- Turn litmus paper from blue to red
- Derived from plants (mostly fruit)
- Used to exfoliate skin and help adjust the pH of a lotion or cream
- Contract and harden hair (thioglycolic acid used in permanent waving solutions)

# Acids

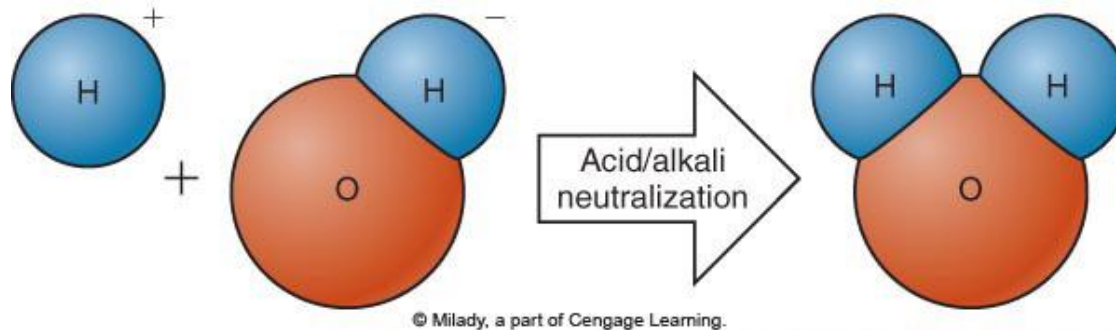
- pH below 7
- Turn litmus paper from blue to red

# Alkalis

- pH above 7
- Known as *base*
- Turn litmus paper from red to blue
- Feel slippery and soapy on skin
- Soften and swell hair

# Acid-Alkali Neutralization Reactions

- Ionized water
- Neutralizing shampoos and normalizing lotions





# Summary and Review

- What is chemistry?
- Why is a basic understanding of chemistry important to a cosmetologist?
- What is the difference between organic and inorganic chemistry?

# Summary and Review (*continued*)

- What is matter?
- What is an element?
- What are atoms?
- Explain the difference between elemental molecules and compound molecules. Give examples.

# Summary and Review (*continued*)

- Name and describe the three states of matter.
- What are the physical and chemical properties of matter? Give examples.
- What is the difference between physical and chemical change? Give examples.

# Summary and Review (*continued*)

- Explain oxidation-reduction (redox).
- Explain pure substances and physical mixtures. Give examples.
- What is the difference between solutions, suspensions, and emulsions? Give examples.
- Define pH and the pH scale.

# Congratulations!

You have completed one unit of study  
toward course completion.

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