Lesson 1: Chemical Solutions

Introduction

Fruit juice can be made up by adding water to a packet of fruit juice powder. Each packet includes instructions on how much water to add. Will it taste good if you want to make more and so add twice the amount of water? Or if you add only a quarter of the amount of water will it all dissolve? Will it taste okay?

Are there limits as to how much of a substance can dissolve in a given volume of liquid?

Why do some things dissolve in one liquid but not in another?

Maybe you have noticed that you can add sugar to hot tea or coffee and it all dissolves completely, but later you find a layer of undissolved sugar at the bottom of the cup. Why is this?

This lesson introduces the topic of solutions.

Objectives

After completing this lesson you will be able to:

- Define a solution.
- Define important terms such as solvent and solute.
- Describe the dissolving process.
- Explain how polarity affects solutions.
- Discuss solutions of different states of matter.
- Define solubility and use solubility tables.
- Define precipitation, saturation and concentration.
- Calculate the concentration of a solution.

List of Sections

This lesson includes the following sections:

Lesson 2: The Dissolving Process

Introduction

Have you ever tried adding sugar to iced tea or coffee? Did you notice that the sugar hardly dissolves, why does that happen?

When you add sugar to hot tea or coffee and you make sure that it completely dissolves, why is it then that after you finish drinking it all, you can often find a layer of undissolved sugar at the bottom of the glass or cup? If you made sure it was all dissolved then where did it come from?

Some makers of soda drinks suggest that you cool it in the refrigerator before drinking. Well that makes sense in hot weather. Have you also noticed something else about cold soda: it is a lot fizzier when it is cold, and when it is warm it is flat, why?

Objectives

After completing this lesson you will be able to:

- Differentiate between saturated, unsaturated and supersaturated solutions.
- Read a solubility curve.
- Discuss how temperature affects solubility.
- Differentiate between endothermic and exothermic reactions.
- Define enthalpy of solution and understand enthalpy graphs.
- Discuss the solution of gases in liquid.
- Describe how the rate of the dissolving process can be increased.
- Discuss the effect of pressure on the dissolving process.

List of Sections

This lesson includes the following sections:

Lesson 3: Suspensions and Colloids

Introduction

Why is it that in a movie theater you can see the beam of light through the air from the projector to the screen? Why can you see sunbeams around the edges of dark clouds? Why does the sky look blue during the day, and turn red at sunset?

After this lesson you will better understand the phenomena discussed above.

Objectives

After completing this lesson you will be able to:

- Differentiate between homogenous and heterogeneous mixtures.
- Differentiate between solutions, suspensions and colloids.
- Perform experiments to determine whether a mixture is a solution, a suspension or a colloid.
- Discuss the influence of particle size on the nature of the mixture they form in liquid.
- Describe the various properties of colloids, including:
    - The Tyndall Effect
    - Brownian Motion
    - Diffusion
- List and describe practical uses of colloids.

List of Sections

This lesson includes the following sections:

- Homogenous and Heterogeneous Mixtures
- Defining Solutions
- Colloids
- Particle Size
- Suspensions
- The Properties of Colloids
- Sky Color
- Use of Colloids

Lesson 4: Molar Concentrations, Titration, and Solubility Constants

Introduction

Everybody is familiar with vinegar as it is such a common product for use in food preparation, and there are many commercial brands available in stores and supermarkets everywhere.

Did you know that vinegar is made by fermentation in a similar way that alcohol (ethanol) is made from fruits and vegetables? The only difference being that in making vinegar the materials are left open to the air to cause oxidation, while in alcohol making, air is kept out by using a valve.

Now, the vinegar you buy in a bottle is not pure vinegar. Rather, it is a little bit of vinegar mixed with a lot of water. How can you tell how much vinegar you are actually getting? One bottle might be more expensive than another, but might contain more vinegar.

In this lesson you will learn all about the topic of concentration of solutions.

Objectives

After completing this lesson you will be able to:

- Perform calculations to calculate the number of moles of an atom or molecule in a given mass of the substance.
- Define molar concentration and be able to determine the molar concentration of a solution.
- Explain what an indicator is, and how to use one.
- Outline the process of performing a titration, and explain why titrations are performed.
- Define a reversible reaction.
- Define dynamic equilibrium.
- Calculate the equilibrium constant of a solution.
- Define and use solubility product constants.

List of Sections

This lesson includes the following sections:

- Moles
- Molar Concentration
- Indicators
- Titration
- Reversible Reactions
- Equilibrium Constants
- Solubility Product Constants
- Kitchen Laboratories (Various)

Lesson 5: Acids and Bases

Introduction

In the previous lesson you learned about concentrations, and saw that you can have concentrated or dilute acids and bases. What is a strong acid or base? What is a weak acid or base? Is there a difference between strong and being concentrated, or are they just the same thing.

What do the numbers on a pH chart show? What is pOH? In this lesson you will explore the concepts of acids and bases more fully.

Why do many foods have distinctive tastes? Some are bitter, others are sour or salty. It is known that a lemon or a grapefruit has a sour taste because it contains a compound called citric acid. Soaps that contain lye (NaOH), a base, taste bitter. Salty foods taste salty because they contain a salt, sodium chloride (NaCl). The presence of these compounds, called acids, bases, and salts, gives many of our foods their distinctive flavors.

It was discovered long ago that these substances, when dissolved in water, conduct an electric current. Because they conduct a current, they are called electrolytes. Why do electrolytes conduct an electric current?

This lesson is all about acids and bases.

Objectives

After completing this lesson you will be able to:

- Define acids and bases according to three different theories.
    - Arrhenius Theory
    - Bronsted-Lowry Theory
    - Lewis Theory
- Identify common acids and bases.
- List important properties of acids and bases.
- Understand the pH scale.
- Calculate the pH value of a solution.
- Understand the pOH scale.
- Calculate the pOH value of a solution.
- Explain the relationship between pH and pOH scales.

List of Sections

This lesson includes the following sections:

- Lewis Theory
- Common Acids and Bases
- Properties of Acids and Bases
- Kitchen Lab – pH and Food
- The pH Scale
- The pOH Scale