Chapter 6: Mixtures

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Time Required:

Text reading - 1 hour
Experimental - 30 minutes

Experimental Pre-setup:

NONE

Additional Materials:

Vinegar
Vegetable oil
Rubbing alcohol
Ammonia
Melted butter

Overall Objectives:

In this chapter the students will learn about different types of mixtures and what makes something mix or not mix.

6.1 Introduction

Most of the things we encounter in daily life are mixtures, rather than pure substances. The example given is cake. From the outside cake looks like it is one substance, but it is actually a mixture of many different things.

Discuss with the students other things that are mixtures such as other foods, shampoo, most commercial cleaning fluids, concrete, etc.

JUST FOR FUN

Have the students bake a cake and let them mix the ingredients:

All natural substances like eggs, flour, milk and chocolate are also mixtures of many different kinds of molecules.

Easy Chocolate Cake

2 cups sugar
3/4 cup shortening
2 eggs
3 cups flour
2 teaspoons baking soda
1 tsp. salt
1/2 cup cocoa
1 cup buttermilk
1 cup boiling water

Add dry ingredients with 1 cup buttermilk. Beat until smooth. Mix in 1 cup boiling water mixed with two teaspoons of baking soda. Bake at 350 degrees for 25 to 30minutes. Makes three layers.

6.2 Types of mixtures

Two types of mixtures are discussed. These are called homogeneous mixtures and heterogeneous mixtures. Homogeneous mixtures are mixtures where the molecules are evenly distributed throughout the mixture. Salt water is an example of a homogeneous mixture. Other examples include:

alchohol-water mixtures
sugar-water mixtures
vinegar
household ammonia

A heterogeneous mixtures are those mixtures where the molecules are not evenly distributed throughout the mixture. Ice water is an example of a heterogeneous mixture. Other examples include:

sand
concrete
ice cream floats
salad dressing

Another mixture that looks homogeneous but is actually heterogeneous is milk. Milk is a colloid. A colloid has very small molecules suspended in it that are not evenly distributed in solution and are too small to see with our eyes. All colloids are heterogeneous and are cloudy. True homogeneous solutions are clear or colored but not cloudy.

6.3 Like dissolves like

“Like” in this context means both are either polar or charged (see next page for definition of polar).

“Unlike” means that one substance is made of polar, or charged, molecules and the other is made of nonpolar, or uncharged, molecules.

The rule states that substances that are alike will dissolve in one another and substances that are not alike will not dissolve in one another.

A molecule with a "+" end and a "-" end is a polar molecule.

Polar simply means having two opposite directions or natures. In the case of molecules, polar means that there are two oppositely charged ends.

Water is very polar. All -OH ends are also very polar wherever they occur on any molecule. Molecules with these -OH ends will easily mix with water. Methanol (wood alcohol) has the structure CH_3 -OH and mixes easily with water because of the -OH at the end.

Other molecules that are also polar in water are acetic acid and sugar. Both of these molecules also contain -OH groups, that are polar, and both easily dissolve in water.

Most of the vegetable oil molecule is not charged. Point out the long chains (blue) and discuss that these chains are not polar (charged). The C-O bonds (red) in the vegetable oil are slightly polar, but not enough to allow the oil to dissolve in water.

Mineral oil has only carbons and hydrogens. This molecule has no polar groups at all and will not dissolve in water.

Many cleaning fluids are based on the principle that like dissolves like. Cleaning fluids that are used to clean things other than water-based products are generally non-polar. Mineral oil cleans oil-based paints because mineral oil is non-polar.

6.4 Soap

The most common soap, or detergent, is SDS (sodium dodecyl sulfate or sodium lauryl sufate). Many of the soaps, shampoos and detergents contain SDS and will be listed as a primary ingredient.

The main points to emphaisize in this section is that soap allows oils to dissolve in water. It does this by forming tiny oil droplets that are suspended in the surrounding water. These little oil droplets can then be washed away by the excess water.

6.5 Summary

Discuss with the students the main points for this chapter:

- There are main types of mixtures called homogeneous and heterogeneous. Homogeneous mixtures are the same throughout and heterogeneous mixtures are not.
- If two things are "like" each other, they will mix more readily than things that are not alike.
- Things that are alike will dissolve in each other. Dissolve means to loosen and separate the molecules of one thing so that it can mix into another thing.
- Soap can mix with both oil and water. This allows soap to "dissolve" oil in water.

Experiment 6: Mix it up! Date: _____

Objective: *We will observe which solutions mix and which do not.*

Hypothesis: *Oil will not dissolve in water without soap.*
Vegetable oil and butter will mix, but oil and water will not mix.

Materials:

vinegar
rubbing alcohol
ammonia
vegetable oil
melted butter
several small jars
food coloring
dish soap

Experiment:

Part I: See what mixes.

1. The grid in the Results section is labeled with the following items: water, vinegar, rubbing alcohol, ammonia, vegetable oil, melted butter, along the top and sides of the grid.

2. Take out 6 small jars and add 1/4 cup of each item to each jar. Label the jars.

3. Add a drop of food coloring to each jar.

4. Mix one tablespoon of the uncolored items with 1 tablespoon of each colored item. Record in the boxes if the two items mix.

In this experiment the students will observe different mixtures.

The Objective is left blank. To help the students write a suitable objective for this experiment, have them first read the experiment carefully. A suggested Objective is listed.

The Hypothesis is also left blank. Help the students write a suitable hypothesis. To help them, discuss the main points of this chapter:

- most things are mixtures
- like dissolves like
- soap helps oil dissolve in water

Two suggestions are given.

Materials:

Any of these items can be substituted for other solutions if needed. Try to pick at least two "oily" items and two water-based items.

Results:

	Water	Ammonia	Vegetable Oil	Rubbing Alcohol	Melted Butter	Vinegar
Water		*mixes*	*does not mix*	*mixes*	*does not mix*	*mixes*
Ammonia			*does not mix*	*does not mix*	*does not mix*	*REACTS*
Vegetable Oil				*does not mix*	*mixes*	*does not mix*
Rubbing Alcohol					*does not mix*	*mixes*
Melted Butter						*does not mix*
Vinegar						

Have the students fill in the grid and note which solutions mix and which do not.

The groups that will mix are:

- water, ammonia, rubbing alcohol, and vinegar
- vegetable oil and melted butter.

NOTE:
Ammonia and vingear will react. This is an acid base reaction. They also mix.

Part II: Soap, oil and water.

1. Put 1/4 cup of water into one of the small glass jars. Add one drop of food coloring.
2. Add 1 tablespoon of vegetable oil to the water.
3. Mix the water and oil. Record your results.
4. Add 1 tablespoon of liquid dishsoap to the oil/water mixture.
5. Mix thoroughly. Record your results.
6. Add another tablespoon of liquid dishsoap to the mixture, and mix thoroughly.
7. Record your results.

Results:

Oil + water: *The oil and water do not mix.*

Oil + water + 1T soap: *The solution is cloudy. Some oil has disappeard, but most of the oil is still visible.*

Oil + water + 2T soap: *The solution is even more cloudy, and more oil has disappeared.*

In this section the students will experiment with soap to dissolve an oil-water mixture.

As mentioned earlier, soap will make a colloidal mixture of oil and water. This will be visible as the soap turns the oil-water mixture cloudy. There will also be some bubbles, but overall the mixture should begin to turn cloudy.

As more soap is added, less free oil is visible.

Conclusions:

Oil does not mix with water.

Oil forms a heterogeneous mixture with water.

Alcohol mixes with water. Alcohol is "like" water.

Vegetable oil dissolves in butter. Vegetable oil and butter are like each other.

Vegetable oil and butter are both not like water.

Help the students make valid conclusions based on the data they have collected.

Some suggestions are given.

Help the students make conclusions using the ideas presented in this chapter. Have the students decide which solutions are "like" each other and which are not. Have them record these as their observations.

Review

Define the following terms:

mixture *Two or more pure substances mixed together.*

homogeneous *A mixture of the "same kind," like salt water.*

heterogeneous *A mixture of a the "other kind," like ice water.*

dissolve *When two or more substances like to mix.*

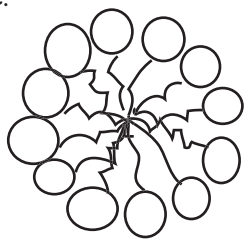
What does the term "like dissolves like" mean? *Two solutions that are "like" each other will dissolve in each other. Two that are not alike, will not dissolve.*

Name two molecules with charged ends. *water and salt*

Name two molecules without charged ends. *vegetable oil and mineral oil*

How does soap work? *Soap is a molecule with a charged end and an uncharged end. Uncharged molecules will dissolve in the uncharged end of a soap molecule, and charged molecules will dissolve in the charged end. A micelle will form, with the oil on the inside, surrounded by water. The oil can then be washed away.*

Draw a micelle.



NOTES: