1. Purpose of Studying Mixtures

The purpose of Chapter 7 is to help the children to learn the definition of mixture, to learn the different kinds of mixtures, to make the different mixtures, and to learn the properties of different mixtures. The children will develop an understanding of what a mixture is and be able to distinguish the difference between heterogeneous and homogeneous mixtures. The children will do experiments with solutions, suspensions, and colloids. Most of the work on solubility is more appropriate for Levels IV to VI.

2. Mixtures

Most samples of matter are mixtures rather than pure substances. A **mixture** is a physical blend of two or more substances each of which retains its own composition and properties. Mixtures differ from pure substances because they have a variable composition. For example, air is a mixture of oxygen, nitrogen, carbon dioxide, argon, other gases, and water. Brine is a mixture of salt and water. Brass is a solid mixture of copper and zinc. Gasoline may contain a few or up to 20 different substances. Grapefruit is a mixture of about 2000 different substances. Other examples are granite, vegetable soup, milk, soft drinks, and syrup.

Mixtures are not chemically combined. The components keep their separate identity and most of their own properties. The properties are a combination of the properties of the different kinds of matter in the mixture. Some of the properties that may change are color, melting point, and boiling point. In a mixture, the substances may be present in any amount, so that the amount is not fixed. The components of a mixture can be separated out by physical means.

2A. Demonstrations and Activities

1. Show the children some examples of mixtures such as those listed above. Have a group discussion about the properties and characteristics of each.
2. The children make mixtures of sand and sugar, salt and sand, sugar and water, and salt and water.

2B. Experiments with Mixtures

Levels I to III

Solid Mixture

Question: What happens when iron filings and sugar are mixed?

Hypothesis: The substances will mix together, but the two substances will still be visible. The two substances may be separated with a magnet.

Materials:

- iron filings
- teaspoon
- magnet
- sugar
- beaker
- cloth

Procedure:

1. Place 1 teaspoon of iron filings in the beaker.
2. Add 1 teaspoon sugar.
3. Mix the two substances together.
4. Observe.
5. Remove the iron filings with the magnet enclosed in a cloth.

Observations: The mixture turned gray but the sugar and iron filings were still visible. The magnet removed the iron filings.

Conclusions: The sugar and iron filings formed a mixture but retained their original properties.

Discussion: The magnet showed that the iron filings retained the property of magnetism. By tasting the sugar, we show that the sugar retained its property of sweetness (be careful not to eat iron filings). Because we were able to separate the two substances after mixing, they were not chemically combined. The mixture appeared to change color because white and black make gray, but the color of each substance was retained when we removed the iron filings with the magnet.

Levels IV to VI

Solid and Liquid Mixture

Question: What happens when water and sugar are mixed?

Hypothesis: The sugar will dissolve in the water.

Materials:

- sugar
- 250 ml water
- 500 ml beaker
- teaspoon

Procedure:

1. Add 250 ml of water to the beaker.
2. Stir in 1 teaspoon of sugar until it disappears.
3. Observe.
4. Place the beaker in the sun for several days until the water evaporates.
5. Observe

Observations: The sugar disappeared into the water. After the water evaporated, the sugar was left in the beaker.

Conclusions: The sugar dissolved into the water. The sugar could be recovered by evaporating the water.

Discussion: The sugar went into solution in the water. It was not visible at all. When the water evaporated, the sugar was recovered, proving that it still existed as a substance and was not chemically combined with the water. When the sugar water is tasted, it is sweet, showing that the sugar retained its property of sweetness. The solution was colorless after the sugar dissolved, but the sugar continued to be white upon recovery. The two substances were separated by physical means (evaporation), although the water was lost.

Further Experimentation: The same experiment may be done with salt and water.

3. Kinds of Mixtures

Mixtures may be either heterogeneous or homogeneous. In a **heterogeneous mixture**, the composition and properties are not uniform and differ from point to point in the mixture. Examples are vegetable soup, granite, and milk. Granite is a mixture of quartz, feldspar, and mica minerals that are not uniformly distributed throughout the rock specimen. Milk appears uniform, but under a microscope, there are globules of fat and protein within the liquid. **Suspensions** and **colloids** are heterogeneous mixtures.

In a **homogeneous mixture**, the composition and properties are uniform throughout the mixture and are the same from point to point. Sugar water is an example. As sugar is stirred in a glass of water, the sugar dissolves, spreading throughout the water and seeming to disappear. Even under a microscope, the two substances cannot be separated. Yet each teaspoonful of the mixture contains the same amount of dissolved sugar and water. **Solutions** are homogeneous mixtures.

The component substances in a mixture are called the **phases**. A phase is matter that has both the same chemical properties and the same physical properties. The phases in granite are quartz, feldspar, and mica. The phases in sugar water are sugar and water.

4. Solutions

A **solution** is a homogeneous mixture of two or more substances in a single phase. The atoms, molecules, or ions are thoroughly mixed, resulting in a mixture with the same composition and properties throughout. The particles in a solution are the smallest in any mixture. An example is sugar water. Sugar is **soluble** in water, meaning that it is capable of being dissolved in water. As the sugar dissolves, all its molecules become uniformly distributed among the water molecules, such that, even under a microscope, no particles of sugar would be visible. Each teaspoon of sugar water would contain the same amount of sugar and water and would taste equally sweet.

In a solution, the molecules of one substance are distributed around the molecules of another substance. The dissolving medium in a solution is called the **solvent**, and the substance being dissolved is called the **solute**. Thus in the sugar water solution, water is the solvent and sugar is the solute.

Substances that dissolve in water are divided into two types, depending on whether they yield molecules or ions in solution. When an **ionic compound** such as salt dissolves in water, the positive (sodium) and negative (chlorine) ions separate from each other and become surrounded by water molecules. The ions move freely, making it possible for an electric current to pass through the solution. A substance that dissolves in water, giving a solution that conducts an electric current, is called an **electrolyte**. Thus salt or sodium chloride is an electrolyte.

A solution that contains neutral solute molecules does not conduct an electric current because there are no mobile charged particles available. A substance that dissolves in water, giving a solution that does not conduct an electric current, is called a **nonelectrolyte**. Sugar is a nonelectrolyte.