7.6: Colloids and Suspensions

Learning Outcomes

- Describe the properties of a suspension.
- Describe the properties of a colloid.
- Distinguish among suspensions. colloids, and solutions.

Suspensions

Take a glass of water and throw in a handful of sand or dirt. Stir it and stir it and stir it. Have you made a solution? Sand and dirt do not dissolve in water, and, though it may look homogenous for a few moments, the sand or dirt gradually sinks to the bottom of the glass (see figure below). Some medications are delivered as suspensions and must be mixed well before the doses measured to make sure the patient is receiving the correct amount of medication.

Figure 7.6.1: A mixture of sand and water forms a suspension.

A **suspension** *is a heterogeneous mixture in which some of the particles settle out of the mixture upon standing*. The particles in a suspension are far larger than those of a solution, so gravity is able to pull them down out of the dispersion medium (water). The diameter for the dispersed particles in a suspension, such as the sand in the suspension described above, is typically at least 1000 times greater than those in a solution. Unlike a solution, the dispersed particles can be separated from the dispersion medium by filtering. Suspensions are considered heterogeneous because the different substances in the mixture will not remain uniformly distributed if they are not actively being mixed.

Colloids

A colloid is a heterogeneous mixture in which the dispersed particles are intermediate in size between those of a solution and a suspension. The particles are spread evenly throughout the dispersion medium, which can be a solid, liquid, or gas. Because the dispersed particles of a colloid are not as large as those of a suspension, they do not settle out upon standing. The table below summarizes the properties and distinctions between solutions, colloids, and suspensions.

Table 7.6.1: Properties of Solutions, Colloids, and Suspensions

Solution	Colloids	Suspensions
Homogeneous	Heterogeneous	Heterogeneous
Particle size: 0.01-1 nm; atoms, ions or molecules	Particle size: 1-1000 nm, dispersed; large molecules or aggregates	Particle size: over 1000 nm, suspended: large particles or aggregates
Do not separate on standing	Do not separate on standing	Particles settle out
Cannot be separated by filtration	Cannot be separated by filtration	Can be separated by filtration
Do not scatter light	Scatter light (Tyndall effect)	May either scatter light or be opaque

Colloids are unlike solutions because their dispersed particles are much larger than those of a solution. The dispersed particles of a colloid cannot be separated by filtration, but they scatter light, a phenomenon called the Tyndall effect.

Tyndall Effect

Colloids are often confused with true homogenous solutions because the individual dispersed particles of a colloid cannot be seen. When light is passed through a true solution, the dissolved particles are too small to deflect the light. However, the dispersed particles of a colloid, being larger, do deflect light (see figure below). The **Tyndall effect** *is the scattering of visible light by colloidal particles*. You have undoubtedly "seen" a light beam as it passes through fog, smoke, or a scattering of dust particles suspended in air. All three are examples of colloids. Suspensions may scatter light, but if the number of suspended particles is sufficiently large, the suspension may simply be opaque, and the light scattering will not occur.

Figure 7.6.2: Light passes through a colorless solution and is not scattered. When it passes through a diluted milk solution, the light is scattered by colloidal particles, an observation of the Tyndall effect. The Tyndall effect allows sunlight to be seen as it passes through a fine mist.

Examples of Colloids

Listed in the table below are examples of colloidal systems, most of which are very familiar. Some of these are shown below (see figure below). The dispersed phase describes the particles, while the dispersion medium is the material in which the particles are distributed.

Table 7.6.2: Classes of Colloids

Class of Colloid	Dispersed Phase	Dispersion Medium	Examples
Sol and gel	solid	liquid	paint, jellies, blood, gelatin, mud
Solid aerosol	solid	gas	smoke, dust in air
Solid emulsion	liquid	solid	cheese, butter
Liquid emulsion	liquid	liquid	milk, mayonnaise
Liquid aerosol	liquid	gas	fog, mist, clouds, aerosol spray
Foam	gas	solid	marshmallow
Foam	gas	liquid	whipped cream, shaving cream

Figure 7.6.3: Some common colloids (A) gelatin dessert, (B) smoke (solid aerosol), (C) butter (solid emulsion), (D) mayonnaise (liquid emulsion), (E) fog (liquid aerosol), (F) marshmallows (foam), (G) whipped cream (foam)

Emulsions

Butter and mayonnaise are examples of a class of colloids called emulsions. An **emulsion** *is a colloidal dispersion of a liquid in either a liquid or a solid.* A stable emulsion requires an emulsifying agent to be present. Mayonnaise is made in part of oil and vinegar. Since oil is nonpolar, and vinegar is a polar aqueous solution, the two do not mix and would quickly separate into layers. However, the addition of egg yolk causes the mixture to become stable and not separate. Egg yolk is capable of interacting with both the polar vinegar and the nonpolar oil. The egg yolk is called the emulsifying agent. Soap acts as an emulsifying agent because one end of a soap molecule is polar, and the other end is nonpolar. This allows the grease to be removed from your hands or your clothing by washing with soapy water.

Supplemental Resources

- Types of Mixtures - Solutions, Suspensions, Colloids: www.edinformatics.com/math_sc.../mixtures.html

Contributors and Attributions

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- Allison Soult, Ph.D. (Department of Chemistry, University of Kentucky)
