Name: _____

Date: _____

Class/Period: _____

Introduction to Mixtures and Solutions For Biology — Student Guide

Activity 1 – Solutions, Suspensions, and Colloids

BACKGROUND

Mixtures consist of two or more substances mingled together without undergoing a chemical reaction. They can be separated by physical means such as filtration, distillation, chromatography, evaporation, etc. Mixtures are classified into two broad categories: homogeneous mixtures and heterogeneous mixtures. Homogeneous mixtures have the same composition and appearance throughout the mixture. Heterogeneous mixtures have visible differences throughout the mixture. Some of these differences can be seen immediately with the naked eye (for example, the dirt particles that can be seen in a mixture of dirt and water); others can only be seen under a microscope, and/or after a period of time after the contents separate or settle out.

Solutions

- Solutions are **homogeneous** mixtures that are usually made up of a liquid solvent and a dissolved substance called a solute. However, solvents and solutes can be either gas, liquid, or solid.
- Solutions in living systems usually have water as the solvent.
- Substances in a solution do not separate or settle out; the mixture does not separate after standing.
- In a solution, the solute exists at the molecule or ion level. The molecules or ions range in size from 0.1 to 2 nanometers. These particles are so small they cannot be separated by simple filtration.
- Aqueous solutions are transparent (they may have color). An aqueous solution is one that has water as the solvent.
- Saltwater is an example of a solution.

Suspensions

- Suspensions are **heterogeneous** mixtures in which neither substance dissolves in the other.
- The particles in a suspension settle out when the mixture is left standing.
- The particles in a suspension may be filtered out through filter paper.
- Generally, the particles in a suspension are relatively large, with diameters greater than 1000 nm. They are visible through a microscope and sometimes to the naked eye.
- The particles in a suspension cause the mixture to appear murky, cloudy, or opaque, making it difficult to see through the suspension.
- Dirt stirred into water is an example of a suspension.

Colloids

- Colloids are also made of two or more substances that do not dissolve in each other, but the particles in colloids are too small to be filtered out and they do not readily settle out.
- Although colloids may appear homogeneous, they are **heterogeneous** mixtures, with particles that consist of one or more molecules.
- The particles in colloids have dimensions between 1 to 1000 nanometers and are not visible through a light microscope. However, the particles are large enough to scatter light, resulting in the Tyndall effect (described on the following page).
- Colloids may appear translucent (let light through, but the image is not sharp) or opaque (do not let light pass through).
- Fog and milk are examples of colloids.

The Tyndall Effect

- The Tyndall effect is a characteristic that can be used to differentiate colloids from solutions. When a bright light is passed through a colloid, the beam is visible in the mixture, due to the reflection of the light off the tiny dispersed particles. When the same light is passed through a solution, the ray of light is not visible. You have observed the Tyndall effect in the way fog interacts with the light from car headlights.

Mixtures can be any combination of substances in various phases (solid, liquid, or gas). The list below contains examples of mixtures in varying phase combinations.

Phase Combination	Mixture
Gas in gas	Air (N_2, O_2, Ar, CO_2, other gases)
Gas in liquid	Soda pop (CO_2 in water)
Liquid in liquid	Gasoline (a mixture of hydrocarbon compounds)
Solid in liquid	Sea water (NaCl and other salts in water)
Gas in solid	H_2 in platinum or palladium
Liquid in solid	Dental amalgams (mercury in silver)
Solid in solid	Alloys (brass (Cu/Zn), solder (Sn/Pb)

Table 1 lists characteristics for the three types of mixtures.

Table 1: Characteristics of Different Types of Mixtures

	Solutions	Suspensions	Colloids
particle size	< 2 nm – atoms, ions, or molecules	> 1000 nm	1 - 1000 nm
particles visible	no	yes	no
appearance	transparent	opaque	translucent or opaque
heterogeneous or homogeneous	homogeneous	heterogeneous	heterogeneous
Tyndall effect	no	no	yes
separation or settling	no	yes	not readily *
particles filter out	no	yes	no

* Depending on the colloid, settling may take a very long time (even years) to occur.

OBJECTIVE

In this activity, you will make mixtures and determine if they are solutions, suspensions, or colloids.

MATERIALS

2 beakers, 150-mL
Sugar (2.5 g)
Water
2 stirring rods
Flashlight
Tape (for labeling)
Funnel
Filter paper
Magnifying lens or microscope (optional)
Flour (2.5 g)
Gelatin mixture in 150-mL beaker
Balance
Distilled water
Stopwatch or clock with second hand
Weighing paper

PROCEDURE

1. Obtain the materials listed above.
2. Label the beakers A, B, and C. Prepare and/or obtain the following mixtures:

   Beaker A: Mix 2.5 g of sugar and 100 mL of distilled water. Stir 2 minutes.
   Beaker B: Mix 2.5 g of flour and 100 mL of distilled water. Stir 2 minutes.
   Beaker C: Your teacher should have already prepared and poured 100 mL of a gelatin/water mixture into this beaker.

3. For each mixture, carry out each of the procedures below and record your results in the proper spaces of Data Table 1 on the following page. NOTE: Carry out all of the procedures for one mixture before starting the procedures for the next mixture.

   A. Look at the mixture. Can you see the particles? Look at the mixture through a microscope or with a magnifying lens, if they are available. Can you see the particles now?

   B. Look through the mixture at an object. Is the mixture transparent, translucent, or opaque?

   C. Is the mixture homogeneous or heterogeneous?

   D. Shine a bright flashlight through the mixture. Does the mixture exhibit the Tyndall effect?

   E. Allow the mixture to sit for 1 minute. Does settling or separation occur?

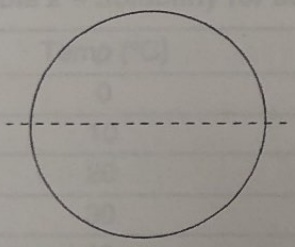
   F. Fold a piece of filter paper in half twice, as shown below. Place the filter paper cone into a funnel; place the funnel into a clean beaker. Using a clean stirrer, stir the mixture, and then pour approximately 50 mL of the mixture into the funnel. Wait for all of the liquid to filter through. Remove the filter paper from the funnel and look at it closely. Were any particles filtered out of the mixture?

   G. Compare your results with the information in Table 1. Use this information to identify each mixture as a solution, suspension, or colloid. Record your answers in the proper space of the data table.

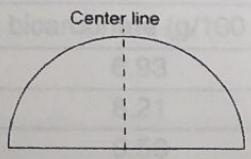
4. Clean up your lab area and put your lab materials away.

Filter Paper Folding Instructions

Step 1: Fold the filter paper in half.

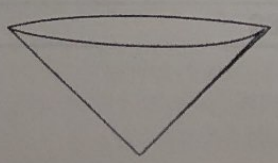


Step 2: Fold the filter paper in half again along the center line.

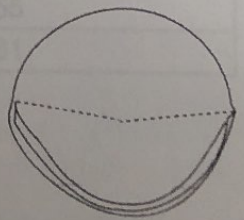


Step 3: The filter paper should now look like this.

Step 4: Rotate filter paper so that the open end is up. Insert fingers into the open end and the unfolded portion will open into a cone with three layers of paper on one side, and one layer of paper on the other side.



side view



top view

DATA

Data Table 1

	A. Sugar Mixture	B. Flour Mixture	C. Gelatin Mixture
Are particles visible?			
Transparent, translucent, or opaque?			
Heterogeneous or homogeneous?			
Is there Tyndall effect?			
Did any settling or separation occur?			
Was the solute filtered out?			
Solution, suspension, or colloid?			