Mixture/Concentration Investigation

Adapted from: Foss Chemical Interactions Course Kit

Grade: 7

Time Allotted: 2 class periods

Teachers: Stewart Hengeveld and Diana Sanchez

Goal: The students will investigate and learn about the properties and behaviors of solutions. Additionally, students will describe the properties and behaviors of solutions at the macroscopic and microscopic stages.

Objectives:

- When two or more substances are combined, a mixture has been created.
- In a mixture, a solution occurs when one substance has dissolved and "disappeared" in the second substance.
- The uniform distribution of the reduce particles from one substance (solute) throughout the particles of a second substance (solvent) is the occurrence of dissolving.
- Describe, at the particle level, the characteristics of a solution, saturated solution, and diluted solutions of any type.
- In a solution, its concentration is the ratio of solute to solvent particles.
- Various solutions at various concentrations can be created with the same substances; thus, various densities will be produced.

NJCCCS (2009): 5.1.8.A, 5.1.8.B, 5.1.8.C, 5.1.8.D.1-3, 5.2.6.A.3, 5.2.8.A.3

NJCCCS (2008): 4.1.7.A.1-2, 4.1.7.B.1, 4.1.7.B.3, 4.2.7.D, 4.2.8.D.1, 4.3.7.A, 4.3.7.D.3-4, 5.3.8.B, 5.3.8.C, 5.6.8.A.7

Key Vocabulary:

mixture, solution, dissolving, particles, solutes, solvents, solubility, filtration, filtrate, evaporation, saturation, precipitate, dilution, density, concentration, solubility

Student Materials:

Protective Eyewear (at ALL TIMES)

For Each Group	For the Class
• 2 Plastic cups, 250-mL • 1 Stirring stick (craft stick) • 1 Syringe, 35-mL • Water • Magnesium sulfate • Mixture/Concentration Investigation worksheet	• Sodium chloride/ water solution • Calcium carbonate/water mixture • Mixture/Concentration Investigation worksheet • Sugar/water solution • Sugar/water saturated solution • Sugar/water super saturated solution • Syringe, 35-mL • Balance (for weighing) • 2 Jars of Magnesium sulfate • 2 Spoons, 5-mL • Water • Pipettes • Plastic cups, 250-mL • 2 Container with lids, ½-L • 8 Trays, tote • Sticky Notes, labels • Magnesium sulfate Solution 1 • Magnesium sulfate Solution 2 • Magnesium sulfate Solutions Chart

Teacher Preparation:

- Know the background information of the following topics: mixture, solution, dissolving, particles, solutes, solvents, solubility, filtration, filtrate, evaporation, saturation, precipitate, dilution, density, concentration, and solubility.
  The M & M Game (Match that Mixture). The student will match a mixture example to a type of mixture. First have the students copy down two lists…one listing the type of mixtures and the other listing examples of mixtures. The students should write each list set twice. First round: predictions. To help the students predict the answers, setup mixture demonstrations for the class. Show the students the following mixtures: the air we breathe (~78% N, ~21% O, and 1% of such gases as CO_2 and Ar), salt + sugar, water and food coloring dye, hair spray, whipped cream, styrofoam cup, salt and water. (optional: the students can receive the prize of M & Ms). Round two: review the answers (here is when recording the lists twice applies: just in case the students made mistakes the first time around).
- Using the solid/liquid demonstrations, show the difference between creating a mixture and a solution.

- Setup a saturated solution and super saturated solution demonstrations for the class. Add sugar to 200-mL water until the sugar begins to precipitate. In another beaker with 200-mL water, add double the amount of sugar that was added to the saturated solution demo. The saturated solution demonstration will also be used to demonstrate dilution. Therefore, add 50-mL of water each time to the initial 200-mL saturated solution until 400-mL is reached. In between each 50-mL addition, have the students calculate the percent of solute in the solution.
- Setup stations with the materials necessary to carry out the respective "recipe."
- Setup weighing stations with a triple-beam balance. Keep dry, plastic 35-mL syringe next to each balance. Remind students that to zero/ tare the triple-beam balance they need to use the empty, dry plastic syringe. Reminding students to record the mass of the empty, dry plastic syringe to calculate the mass of the Magnesium sulfate and water.

Student In Class Prep & Procedure

- Hand out the Mixture/Concentration Investigation worksheets.
- Introduce the term mixture. Have the students define mixture. Then, define what a mixture as in chemistry. Ask the students: What kinds of mixtures can be created? or What can you mix together? The students should come up with the following: solid/solid, liquid/liquid, solid/liquid, gas/solid, etc. Introduce the M & M Game. The following will be prepare to demonstrate: solid/solid (salt + sugar), liquid/ liquid (water and food coloring dye), gas/ liquid (hair spray; whipped cream), gas/solid (Styrofoam cup), solid/liquid (salt and water).

Mixtures	Examples
Gas/Gas	Salt + Water
Solid/Solid	The air we breathe (~78% N, ~21% O, and 1% of such gases as CO_2 and Ar)
Liquid/Liquid	Styrofoam Cup
Gas/Solid	Hair Spray
Gas/Liquid	Whipped Cream
Solid/Liquid	Food Coloring Dye + Water
	Sugar + Salt

- Introduce the terms solution, solute, and solvent. Have the students define these terms. Then, define these terms as in chemistry. Using the solid/liquid demonstrations, show the difference between creating a mixture and a solution.

- Introduce the term saturation. Have the students define the term saturated solution. Then, define saturation as in chemistry. As so the term precipitate would also be introduced and defined as in chemistry.
    - Have a demonstration of a saturated sugar/water mixture.
    - Have a demonstration of a super saturated sugar/water mixture.
    - Have the students stand around the demonstration.
- Introduce the term concentration. Ask the students: What does it mean for a substance to have a concentration or a mixture or solution to be concentrated? Define what concentration is in chemistry.
- Review the materials and procedure for the investigation. Introduce the Magnesium sulfate solutions and assign a recipe to each group (Mixture/Concentration Investigation worksheet). Note, emphasize to each group to circle their assigned recipe. Review the column headings in the data table.

Recipe	**Magnesium sulfate (g)**	**Water (g)**	**Mass of __15___mL Sample (g)**	
1	5	25		
2	8	20		
3	12	20		
4	8	40		
5	10	25		
6	15	25		
7	10	50		
8	16	40		

- Notify the students about the various stations setup around the classroom for the investigation.
- Remind the students to "zero" the balance to accurately measure the mass of Magnesium sulfate.

Procedure

1. Put on protective eyewear.
2. Measure out the amount of water and Magnesium sulfate that corresponds to your "recipe".
3. Add the water to the Magnesium sulfate and stir. Avoid spilling.
4. Use the 35-mL syringe to measure 15 mL of your prepared solution (your recipe).
5. Record the mass of your 15 mL sample.

Recipe	Magnesium sulfate (g)	Water (g)	Mass of __15__mL Sample (g)	
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8	16	40		

- After the students have weighed their 15mL sample, they can clean up.
- Have the students write the title Concentration in the first row of the last column.
- Show the students how to calculate the concentration of a sample.
    - Discuss with the students that another way to easily compare the concentration of solutions, is to express the concentrations as mass per unit volume = grams per 1-mL. Ask the students to identify which mass and unit volume will be part of their concentration calculation. Once the students have identified the mass (grams of _15_ mL Sample) and the volume (15 mL), ask the students to calculate the concentration of each solution. Note, students should notice that they are actually calculating the density of the solution (concentration ←→ density).
        - Let students know and write on the board that when identifying the concentration of a substance the following the units can be used:
            - g/mL (as in our investigation)
            - moles/g (explain what is a mole)
                - moles: how many building blocks/ ingredients are necessary to create one atom, small molecule or large molecule. Comparison: How many eggs and pieces of cheese did you use to create your omelet (your atom)
            - moles/L (M)
- Introduce the term dilution and define what dilution is in chemistry.
    - Demonstrate dilution using the saturated sugar/water solution demo. Have the students stand around the demonstration. Add 50-mL water each time to the initial 200-mL saturated solution until 400-mL is reached.
        - Calculate the percent of solute in the solution each time after adding 50-mL, assuming there are 50g of solute and 1-mL of solvent = 1g of solvent. Discuss how to calculate the percent of solute in a solution.

- Honors Math:
  - Introduce the dilution equation: $C_1V_1 = C_2V_2$. Have the students identify the variables.
    - C_1 = Initial Concentration
    - V_1 = Initial Volume
    - C_2 = Final Concentration
    - V_2 = Final Volume
    - Using this equation have the students calculate the final concentration of
    - Examples:
      - John initially prepared a 100-mL solution of 5.0M NaCl. If he were to add another 50-mL of water, what would be the final concentration of the NaCl?
      - Andrea prepared a 1-L mixture of 2.5g/mL $CaCO_3$. If the initial volume of the mixture was 550-mL, what was the initial concentration of the $CaCO_3$?

Accommodations:

- ESL students can be paired with or grouped where a bilingual student excels in the English language, thus helping to explain and carry out the investigations. If no other student can speak the ESL student's native language, then pair or group the student with another student who excels in the English language. Also, assess these pairs or groups to some extent be assessed more frequently, without avoiding the needs of the other pairs or groups.
- The pairs or groups that include students who have learning disabilities (helping to explain and carry out the investigations) can to some extent be assessed more frequently, without avoiding the needs of the other pairs or groups. Also, if it is necessary, during the session or the following session review the investigation using techniques, such as multimedia, that would additional help the students with learning disabilities better understand the investigation.

Mixture/Concentration Investigation: Vocabulary

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Mixture – when two or more substances are combined

- What types of mixtures can exist:

Solution – is a type of mixture created when one substance dissolves in another substance

Solute – the substance that dissolves when creating a solution

Solvent – the substance that is capable of dissolving another substance when creating a solution (a solvent is usually a liquid)

- Solution Example: Salt in Water
  - Solute: SALT
  - Solvent: WATER

Saturated Solution – when a solution has reached the maximum amount of dissolved solute

- Example: When the particles of salt become visible and accumulate, because too much salt has been added to a certain amount of water.

Precipitate – are the particles of a substance that do not dissolve and accumulate (build up) in a solvent, because the solution is saturated

Concentration – the amount of solute dissolved in a certain volume of solvent

Name: _____

Science: _____ Math: _____ Date: _____

Mixture/Concentration Investigation

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Materials

2 Plastic cups, 250-mL	Water	1 Scoop, Plastic, 2mL
1 Stirring stick (craft stick)	Magnesium sulfate	
1 Syringe, 35-mL	Triple-beam balance	

Procedure

1. Put on protective eyewear.
2. Measure out the amount of water and Magnesium sulfate that corresponds to your “recipe”.
3. Add the water to the Magnesium sulfate and stir. Avoid spilling.
4. Use the 35-mL syringe to measure 15 mL of your prepared solution (your recipe).
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Mixture/Concentration Investigation

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5	10	25		
6	15	25		
7	10	50		
8	16	40		

How to Calculate a Concentration:

Name: _____

Science: _____ Math: _____ Date: _____

Dilution Questions

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$C_1V_1 = C_2V_2$

- C_1 = initial concentration
- V_1 = initial volume
- C_2 = final concentration
- V_2 = final volume

John initially prepared a 100-mL solution of 5.0M NaCl. If he were to add another 50-mL of water, what would be the final concentration of the NaCl?

Andrea prepared a 1-L mixture of 2.5g/mL $CaCO_3$. If the initial volume of the mixture was 550-mL, what was the initial concentration of the $CaCO_3$?