**EDUC 5863 – Methods in Middle/Secondary Science**

**Lesson Plan Assignment**

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**Tuesday, October 23rd, 2012**

This set of lesson plans corresponds to Unit 4 of the Grade 7 Science Curriculum, Mixtures and Solutions. The lessons introduced herein will begin the unit, with a focus on defining mixtures and solutions, identifying their components, and discussing how they can be separated. The first lesson will introduce students to both mixtures and solutions on a very basic level. The second lesson will build on this knowledge with a more in depth look at solutions, solubility, and solute and solvent properties. The third lesson will combine the information presented in the first and second lessons, with a focus on separating mixtures. In this lesson, students will be given the chance to put their knowledge of mixtures and solutions into practice by participating in a hands-on exploration activity.

Each lesson begins with a brief overview, followed by a detailed breakdown of activities. Materials such as hand outs, exit slips, and lecture notes can be found in Appendix A.

Lesson 1: Introduction to Mixtures and Solutions

**Description:** This is an introductory lesson on mixtures and solutions. It is the first lesson of the unit and will provide a foundation for an in depth look at solutions and separation of mixtures which will be discussed in the following lessons.

**Learning Objectives:** After participating in this lesson, students will be able to:

1. Describe mixtures involving solids and liquids (solid-solid, solid-liquid, and liquid-liquid) and provide an example of each.
2. Differentiate between homogeneous and heterogeneous mixtures using authentic examples.
3. Classify common materials as either mixtures or pure substances.

**Curriculum Outcomes:** 307-1: Distinguish between pure substances and mixtures using the particle theory of matter (pure substances vs. mixtures, heterogeneous mixtures, homogeneous mixtures/solutions)

**Materials needed:** mini-lesson powerpoint, scavenger hunt handout (1 per group), exit slip (1 per student)

**Activities:**

1. **Jot-Pair-Share: Mixtures (10 minutes)**

Students will be given two minutes to write down everything that they know about mixtures. After the allotted time, they will share their responses with a partner, then with the whole class. This brainstorming activity will help the teacher to assess students’ prior knowledge and will lead into a mini-lesson on mixtures and solutions.

1. **Interactive Mini Lesson (Mixtures, Solutions, and Pure Substances) (15 minutes)**

Using the powerpoint provided (see attached) the teacher will lead an interactive mini-lesson on mixtures and solutions. An introduction to a variety of solid-solid, liquid-liquid, and solid-liquid mixtures will be provided and a distinction between heterogeneous and homogeneous mixtures (solutions) will be made. The classification of matter into mixtures and substances will then lead to a discussion on pure substances, and several real examples of mixtures, solutions, and pure substances will be introduced. Students will be expected to participate and take notes during the mini-lesson.

1. **Science Scavenger Hunt – Mixtures vs. Substances (15 minutes)**

Using the handout provided (see Appendix A), students will identify as many mixtures and substances as possible that can be found in the classroom (in groups of 3). The list of mixtures may include things like people (boys vs. girls), crayons, food (lunch), class fish tank, teacher’s coffee etc. They will classify the observed mixtures as either homogeneous or heterogeneous, and will state whether or not a substance is pure.

1. **Scavenger Hunt Discussion (10 minutes)**

Following the scavenger hunt activity, each group will share their list of items with the class and explain why certain items were classified as homogeneous, heterogeneous, or pure substances. This gives the teacher an opportunity to check for understanding of the material.

1. **Exit Slips (5 minutes)**

See assessment.

**Assessment:** With the time remaining, students will complete an exit slip to assess what they have learned. For a sample exit slip and response see Appendix A.

**Wrap Up/Reflection:** The discussion following the scavenger hunt activity will be used to re-emphasize the important points of the lesson (ie. mixture vs. substance, heterogeneous vs. homogeneous) and to answer any questions that arise.

Lesson 2: An In Depth Look at Solutions

**Description:** This lesson will provide a more in depth look at solutions, with a focus on solubility, solvent-solute interactions, and factors that may affect them. Halfway through the lesson, we will switch gears a little, and will engage in a concept mapping activity on separating mixtures in preparation for the exploration in the next class.

**Learning Objectives:** After participating in this lesson, students will be able to:

1. Identify solutes and solvents in several common solutions.
2. Describe how temperature can affect solubility using a specific example.

**Curriculum Outcomes:** 307-2: Describe the characteristics of solutions, using the particle model of matter and the terms solute, solvent, dissolving, and soluble; 307-5: Describe qualitatively the factors that affect solubility (ie. temperature, pressure).

**Materials Needed:** chart paper, water, sugar, plastic cups, vegetable oil, Kraft dinner, hot plate, milk, Mix-O cards

**Activities:**

1. **Chalk Talk: Solutions, Solvent-Solute Interactions, and Solubility (10 minutes)**

This class should begin with a recap of what a homogeneous mixture or solution is. Students will likely remember that a homogeneous mixture is one in which the components are of the same phase. They should be able to give an example (such as salt water, sugar water, juice). Students should then be asked how a solution can be made. If they simply answer, by mixing two things together, try mixing oil and water together in front of the class and show them that it does not form a solution. They may describe one substance as “dissolving” another, this is a key term to the study of solubility. The following terms should then be explained: The ability of a substance to dissolve in another is referred to as solubility. The substance being dissolved is referred to as the solute, and the substance doing the dissolving is called the solvent. The mixture of a solute and a solvent forms a solution. Students should then be asked what affects solubility. To illustrate this question, try adding a large amount of sugar to a glass of water. Show the students that the sugar becomes increasingly difficult to dissolve as you add more of it to the water. Ask them how you could make the sugar dissolve more easily. Their first suggestion will likely be to add more water, which is not incorrect, but you are looking for a way to increase solubility without adding more water or removing some sugar. Students may also suggest stirring the mixture which promotes molecular motion and adds energy to the system. If we stir the solution fast enough the effect is similar to heating it. Heating it would be much faster though. The temperature dependence of solubility could also be illustrated by making a pot of Kraft Dinner. If the cheese powder is added to cold noodles and milk it will take a really long time to dissolve, but if some heat is added to the system, it dissolves much faster. (The key points of this discussion, including the underlined terms, will be written on the board as the discussion progresses and students will be expected to take notes.)

1. **MIX-O Summarizing Activity (15 minutes)**

A lot of material has been covered over the past two lessons, and this activity will allow students to summarize what they have learned so far. Each student will be given a blank MIX-O grid (like a Bingo card). In each square tile, they will put one vocabulary word related to the mixtures and solutions unit (ex. solubility, solute, solvent, dissolve, mixture, solution, homogeneous, heterogeneous, pure substance, solid-solid mixture, solid-liquid mixture, liquid-liquid mixture, etc.). After everyone has filled out their cards, students will circulate the class and exchange their mix-o cards with their classmates. In order to win the game, a student must produce a line of signatures by having other students sign off on a vocabulary word and explain it to them. There is a catch though, the same person can’t sign your card twice, and the first person with a line only wins if they too can explain each of the signed vocabulary words.

1. **Concept Mapping and Introduction to the Separation Exploration (25 minutes)**

 To prepare for the upcoming exploration, the class will engage in a group concept mapping activity on separation of mixtures. Students will work together in groups of 3-4 to develop a concept map (on chart paper) based on the template shown in Appendix A and will be asked to think about what separation is, why it is used, and how it can be accomplished with respect to mixtures and solutions. This will help ease them into the inquiry mindset, and will set a strong foundation for the upcoming exploration. Each group will be given 10 minutes to create their concept map. After 10 minutes, the maps will be posted around the room and students will participate in a “gallery walk” where they circulate the room and look at one other’s work. Following the gallery walk activity, students will compare and contrast the ideas presented on each map which will lead to a general discussion on separation of mixtures and solutions.

**Assessment:** The MIX-O activity will provide an excellent opportunity for the teacher to assess students’ overall understanding of the mixtures and solutions unit. As the activity is going on, the teacher can circulate and listen to students’ oral explanation of key vocabulary terms, and can address any common mistakes/misunderstandings with the whole class at the end of the activity.

**Wrap Up/Reflection:** The Mix-O activity will provide a midway wrap-up for the mixtures and solutions unit. Students will be given an opportunity to reflect on what they have learned, and to share their knowledge with others. The concept mapping activity is actually a lead in to the next activity, not a wrap-up/reflection in this case.

Lesson 3: Separating Mixtures and Solutions

**Description:** This lesson will be used to introduce a variety of techniques for separating mixtures. The class will begin with a brief review of the concept mapping activity completed in the previous lesson (what do we separate, why do we separate, how do we separate?). The students will then be given a variety of mixtures to explore, and will design an experiment to separate each mixture. Following this activity, students will share their ideas with the class, and each of the techniques will be categorized as mechanical sorting, filtration, evaporation, filtration, or distillation.

**Learning Objectives:** After participating in this lesson, students will be able to:

1. Identify and separate the components of various mixtures by making use of their physical and chemical properties.
2. Name and explain three common separation techniques, giving real world examples of how they could be used.

**Curriculum Outcomes:** 209-6, 307-2: Safely, using tools and apparatus, identify and separate the components of a variety of mixtures using mechanical sorting, filtration, evaporation, distillation, and paper chromatography.

**Materials Needed:** Experiment handout (see Appendix A), salt, water, sand, iron shavings, small and large rocks, rubbing alcohol, coin sorter.

**Activities:** The class will begin with a recap of the previous 2 classes. Students will remind themselves of how mixtures and solutions are defined and how they can be classified as either heterogeneous or homogeneous. The topic of separation will then be introduced, and students will be given an opportunity to brainstorm their ideas before conducting an inquiry based experiment.

1. **Separation Demo – Coin Sorter (3 minutes)**

To get students in the mindset of separation, a simple demonstration involving a coin sorter will be done. A handful of change (quarters, dimes, nickels, pennies) will be presented, and students will identify it as a heterogeneous, solid-solid mixture. The teacher will then add change, one at a time to the coin sorter, and students will be asked to observe what is happening. Although it is obvious that the coins are being separated, it is important for students to recognize that this separation is based on the shape/size and weight of the coin These physical properties are the basis of the separation, which is the underlying theme of today’s exploration.

1. **Separating Mixtures Exploration (35 minutes)**

Before the common techniques for separating mixtures are introduced, students will be given an opportunity to explore a variety of mixtures and make educated guesses on how they could be separated based on the differing physical and chemical properties of their individual components. To conduct the exploration, the class will be divided into 5 stations, and the students will be divided into five groups. At each station, a mixture will be provided, and students will be asked to first identify the mixture, then state whether it is a solid-solid, solid-liquid, or liquid-liquid mixture and whether is heterogeneous or homogeneous. This is simply to review the basic concepts presented in the first two classes. Next they will identify the components of the mixture, and will generate a list of their chemical and physical properties in order to predict a separation technique. A brief experimental design will then be recorded and a list of required materials to perform the experiment will be provided. Each student will record their work at each station on the exploration handout provided in Appendix A which will be submitted for marking at the end of the period. Students will be given 6 minutes at every station, for a total of 35 minutes (extra 5 minutes for transitioning) to conduct the entire exploration. The five mixtures will be salt water (evaporation), small rocks and big rocks (mechanical separation/filtration), muddy water (filtration), sand and iron filings (mechanical separation), and water and rubbing alcohol (distillation).

1. **Class Discussion: Separating Mixtures and Solutions (10 minutes)**

Immediately following the experiment, students will participate in a whole class discussion on the separation techniques they came up with (see wrap up/reflection)

**Assessment:** During the experiment, students will record their observations on the experiment handout provided in Appendix A. They will be expected to describe a mixture as either heterogeneous or homogeneous, and will identify physical and chemical components of the mixture that will help lead them to possible separation techniques. They will then describe an experimental procedure that could be used to separate the mixture into its individual components and will list the materials necessary to conduct this experiment.

**Wrap Up/Reflection:** Immediately following this exploration there will be a class discussion where students will be encouraged to share what they have discovered about separating mixtures. In a sense, they will present their experimental designs for separating the provided mixtures, and their ideas will be linked to standard separation techniques including filtration, evaporation, distillation, and mechanical sorting. A variety of methods to separate each mixture will be discussed, and the class will decide which separation technique is best and why (ie. what makes one separation technique better than another? – speed, efficiency, etc.). If a student suggests that mixture of small rocks and large rocks be separated by hand, the method of manual separation could be introduced, for example. Mechanical separation could then be linked to real life examples such as sorting laundry into darks and lights, separating garbage into wet and dry components, etc. If students suggest that the muddy water mixture be passed through a small filter, the teacher would introduce filtration and provide real life examples of when this technique is used (water filtration, straining vegetables or pasta, etc.) If students suggest that salt water be boiled until only salt remains, the method of evaporation will be introduced, and other examples of where this technique could be applied will be provided and discussed. By the end of the discussion, each of the above mentioned separation techniques will be introduced, and the applicability of each separation technique to a given type of mixture will be established.

**Appendix A: Teaching Resources and Materials**

**Mixtures and Solutions Scavenger Hunt**

Group Members: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| What is it? | Mixture/Substance | Heterogeneous/Homogeneous/Pure Substance |
| **Ex. Ms. Marks’ Coffee** | **Mixture** | **Homogeneous** |
|  |

**Exit Slip: Introduction to Mixtures and Solutions**

Name: *Ms. Marks*

1. What is the difference between a heterogeneous and a homogeneous mixture?

*A heterogeneous mixture consists of two or more visible phases while a homogeneous mixture consists only of one single phase.*

1. Provide an example of each of the following mixtures: solid-solid, solid-liquid, liquid-liquid.

*An example of a solid-solid mixture is sugar and sand. An example of a solid-liquid mixture is salt and water, and an example of a liquid-liquid mixture is water and oil.*

1. What is a pure substance? Give an example.

*A pure substance is a material of constant composition (homogeneous) like sugar or salt. It cannot be broken down any further.*

**Exit Slip: Introduction to Mixtures and Solutions**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What is the difference between a heterogeneous and a homogeneous mixture?
2. Provide an example of each of the following mixtures: solid-solid, solid-liquid, liquid-liquid.
3. What is a pure substance? Give an example.

**MIX-O Sample Cards:**

|  |  |  |  |
| --- | --- | --- | --- |
| **M** | I | X- | O |
| *Solid-liquid Mixture* | *Solute* | *Solvent* | *Pure Substance* |
| *Homogeneous* | *Dissolve* | *Liquid-liquid mixture* | *Solution* |
| *Solubility* | *Mixture* | *Heterogeneous* | *Solid-solid Mixture* |

Sample Concept Map (Bolded is template)

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Grade 7 Marks

Group Members: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Tuesday, October 23rd, 2012

Separation of Mixtures Experiment

The purpose of this experiment is to explore the many possible techniques for separating mixtures into their individual components. In this lesson, you will use your knowledge of physical and chemical properties, as well as mixtures and solutions to predict separation strategies for a variety of mixtures.

For each of the mixtures presented, identify whether it is heterogeneous or homogeneous, list the components of the mixture and any of their physical (size, color, mass) and chemical properties (boiling point, solubility, state) that may assist you in the separation. Finally, suggest a method that could be used to separate the mixture based on the physical and chemical properties you have identified. Be sure to record all the materials needed to conduct your experiment and provide an explanation on how the experiment could be conducted. Record all of your ideas in the tables provided. See the example below for more details.

|  |  |
| --- | --- |
| **Name of Mixture** | Candy Jar |
| **Type of Mixture (solid-solid, solid-liquid, liquid-liquid)** | Solid-solid |
| **Heterogeneous or Homogeneous?** | Heterogeneous |
| **Components** | Gummy bears and jelly beans |
| **Physical/Chemical Properties of Components** | Shape, size, mass, color |
| **Possible Separation Techniques** | Manual separation (put all the gummy bears in one pile, all the jelly beans in another) |
| **Materials Needed for Separation** | Hands, two containers |
| **Experimental Design** | To separate the mixture of gummy bears and jelly beans in the candy jar, we would manually remove all gummy bears and put them into one container, and put all the jelly beans in another. |



Separation Experiment Handout (5 per group)

|  |  |
| --- | --- |
| **Name of Mixture** |  |
| **Type of Mixture (solid-solid, solid-liquid, liquid-liquid)** |  |
| **Heterogeneous or Homogeneous?** |  |
| **Components** |  |
| **Physical/Chemical Properties of Components** |  |
| **Possible Separation Techniques** |  |
| **Materials Needed for Separation** |  |
| **Experimental Design** |  |

Double Click on the slide below to access the powerpoint presentation!

