



IN THE MIX!

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Annotation

In this inquiry exercise, students will devise a procedure to separate and quantify the components of a mixture containing sand, salt, and iron filings.

Primary Learning Outcome:

Students will be able to design and follow a laboratory procedure.

Students will be able to identify matter as an element, compound, or mixture.

Students will be able to classify a mixture as homogeneous, heterogeneous, or a solution.

Students will be able to recognize physical properties of mixture components that allow for the separation of the components from the mixture.

Students will be able to separate and quantify the mass of the components of an unknown mixture.

Students will be able to communicate scientifically the procedures and results of the exercise.

Assessed QCC:

Grade: 9-12

Science

Physical Science/Chemistry

1 Topic: Inquiry, Process and Problem Solving

Standard: Uses science process skills in laboratory or field investigations, including observation, classification, communication, metric measurement, prediction, inference, collecting and analyzing data.

1.1 Designs and conducts a scientific experiment that identifies the problem, distinguishes manipulated, responding and controlled variables, collects, analyzes and communicates data, and makes valid inferences and conclusions.

1.2 Evaluates procedures, data and conclusions to determine the scientific validity of research.

Physical Science

4 Topic: Matter: Structure and Properties

Standard: Compare and contrast matter and its characteristics related to its state (solids, liquids, and gases).

4.3 Identifies matter in its various forms including pure substances, heterogeneous and homogeneous mixtures, and solution.

4.4 Describes solutions in terms of solvent, solute, and relative solubility.

4.5 Identifies characteristics of water that make it the universal solvent.

5 Topic: Matter: Structure and Properties

Standard: Quantifies mass, weight, volume, density, conductivity, and temperature as physical properties of objects in the learner's environment.

5.1 Measures and records in appropriate units, the quantifiable physical properties identified.

5.2 Distinguishes physical from chemical properties.

6 Topic: Matter: Structure and Properties

Standard: Identifies chemical or physical changes conceptually in a laboratory setting.

6.1 Differentiates chemical from physical changes in the following laboratory investigations: combustion, fermentation, melting, dissolving, metabolism, boiling, and electrolysis.

Chemistry

16 Topic: Solutions

Standard: Given a mixture of liquids and/or solids, classifies the mixture as: homogeneous, heterogeneous, miscible, immiscible, or a colloid.

Non-Assessed QCC:

Grade: 9-12

Science

Physical Science/Chemistry

3 Topic: Inquiry, Process and Problem Solving

Standard: Learns and uses on a regular basis standard safety practices for laboratory or field investigations.

3.1 Learns and uses safety procedures specific to an investigation or research activity.

Duration:

Preparation: 30 minutes

Introduction: 5 minutes

Lab Exercise: 70 minutes

Discussion: 15 minutes

Total Class Time: 90 minutes

Materials and Equipment:

For Teacher Preparation:

1. Sand
2. Salt
3. Iron filings
4. Large mixing bowl
5. 1 L Beaker

Suggested Materials To Have Available for Students:

1. Electronic balance(s)

2. Hotplates or Bunsen burners
3. Ring stands
4. Clamps
5. Funnels
6. Filter paper
7. Beakers
8. Tongs
9. Magnets
10. Sieves
11. Graduated cylinders
12. Heat-resistant gloves

Safety:

The primary safety concern in this laboratory exercise is the heat produced when using hotplates or Bunsen burners. Ensure students use caution when handling hot objects.

Technology Connection:

Not applicable.

Procedures:Teacher Preparation:

Prepare a mixture with known mass ratios of sand, salt, and iron filings.
Place the mixture in a 1 L beaker to be used by students.

Estimated Time:

30 minutes

Introduction:

Show students the 1 L beaker containing the sand, salt, and iron filings. Explain to students that their assignment will be to determine the mass of each of the mixture components contained in the 1 L beaker. Tell them that they will obtain a 100 mL sample of the mixture, as well as 50 mL samples of each of the components, and will be allowed to use any of the available laboratory equipment to complete the assignment. Explain to the students that each group will independently develop and carry out a procedure that allows them to separate the mixture components and quantify the mass of each component. Lastly, explain to students the grading procedures found below.

Estimated Time:

5 minutes

Lab Exercise:

Students should obtain a 100 mL sample of the mixture contained in the 1 L beaker, as well as 50 mL samples of each of the three components. Students should use any available equipment to develop and perform a procedure to separate the mixture into its components. **ALL** procedures, including failed attempts, should be documented. Once the mixture has been separated into its components, students should quantify the mass of each component. This data should then be used to calculate the mass of each component of the mixture contained within the 1 L beaker.

Estimated Time:

70 minutes.

Discussion:

Have each group present to the class, in two minutes or less, their separation procedure. Following the presentations, as a class, discuss the methods chosen, the reasoning each was selected, and the physical characteristics that made the separation possible.

Post-lab Questions:

Students should answer the following questions based on the data they collect during the exercise:

1. Classify the mixture used in this exercise as homogeneous or heterogeneous and each of its components as a compound or element.
2. If a solution was formed during the procedure, identify the solute and solvent. Briefly describe the properties of each that are important in the formation of a solution.
3. What mass of each of the components was added to the 1 L beaker to form the mixture used in this exercise?
4. Suppose a fourth component, poppy seeds, was added to the mixture. How might you go about separating the poppy seeds from the mixture?
5. Identify sources of error in your procedure and quantification of the components. What might you do differently if you were to perform this activity again?

Estimated Time:

15 minutes

Assessment:

Assessment should be based on process skills demonstrated during the laboratory exercise, reproducibility of procedures (i.e. could you recreate their procedures based only on their lab notes), accuracy of their results, and quality of post-lab write-up and interpretations. The following rubric may be used as a guideline.

Total Points = 100

1. Accuracy of Results and Calculations (30 points)
 - Relative Percent Difference $\leq 10\%$ - 30 pts
 - 10-20% - 25 pts



- 20-30% - 20 pts
 - 30-40% - 15 pts
 - 40-50% - 10 pts
 - >50% - 5 pts
2. Procedure (20 points)
 3. Laboratory Write-Up (20 points)
 4. Post-Lab Questions (30 points)