

# Analyzing a Mixture Using Stoichiometry

## Background

Analytical chemists are employed in industrial research, academic research, and forensic science. Their job usually involves two different types of work: *qualitative analysis* and *quantitative analysis*. A qualitative analysis determines which substances are present. A quantitative analysis determines how much of a specific substance is present.

Many other chemists also need to use the principles of analytical chemistry. An environmental chemist, for example, tests water or soil for the presence and amounts of impurities. In this investigation, you will design a procedure to analyze a sample of contaminated sand.



This analyst is collecting run-off water for testing.

## Pre-Lab Focus

A shipment of sand has become contaminated with barium chloride,  $\text{BaCl}_2$ , and sodium chloride,  $\text{NaCl}$ . As an analytical chemist, your job is to design a procedure to determine the percent by mass of each substance in the sand.

You will need to use the following double displacement reaction. This reaction produces a precipitate of barium sulfate.

To design your procedure, carefully consider the physical and chemical properties of the two substances in the mixture.

## Question

How can you determine the percent by mass of barium chloride and the percent by mass of sodium chloride in the sand?

## Hypothesis

Formulate a hypothesis in response to the question above.

## Materials

electronic balance  
retort stand  
ring clamp  
filter funnel  
filter paper (to fit filter funnel)  
glass rod  
3 beakers (250 mL)  
drying oven (optional)  
wash bottle with distilled water  
sample of sand containing  $\text{BaCl}_2$  and  $\text{NaCl}$   
solid sodium sulfate,

## Safety Precautions



- Be careful not to inhale grains of the sodium sulfate,  $\text{Na}_2\text{SO}_4$ .
- Wear gloves at all times. Wash your hands thoroughly after you have finished the investigation.

## Procedure

1. Design a rubric, an assessment checklist, or some other means of assessing your experimental design and procedure.
2. Using the materials, design a procedure that will help you solve the problem. Remember that you will need to perform several trials.
3. Before beginning your procedure, show it to your teacher for approval.
4. Obtain a sample of the mixture from your teacher. Record the number of the sample. Carry out your procedure.
5. When you have finished, dispose of the materials as directed by your teacher.
6. Use the following questions to write a complete laboratory report. Include all the equations and calculations that you used.

## Analysis

Here are some questions that you will need to answer in your laboratory report.

1. What mass of sand was in the sample? What property of sand did you use to determine this mass?
2. Explain why you used sodium sulfate,  $\text{Na}_2\text{SO}_4$ , in your procedure.
3. What physical and chemical properties of the reactants and products did you use in your procedure?
4. What assumption did you make about the reactivity of sodium chloride with sodium sulfate?
5. What possible sources of error did your procedure introduce? How might they have affected your results?
6. Would your procedure have worked if you had used contaminated sugar instead of contaminated sand? Explain. How could you have changed your procedure?

After you complete this investigation:

- Assess your procedure by having a classmate try to duplicate your results.
- Use the rubric you developed to assess the success of your experimental design.
- List ways you would improve your procedure if you were to perform this investigation again.
- Assess your presentation based on the clarity of chemical concepts to be conveyed.

## Conclusion

7. Write a statement that gives the percent by mass of barium chloride,  $\text{BaCl}_2$ , and the percent by mass of sodium chloride,  $\text{NaCl}$ , in the sample of contaminated sand.