

# Eight Bottles

## An Introduction to Scientific Investigations

### INTRODUCTION

Problem solving is not restricted to scientific investigations. Indeed, it is a life long process that involves every aspect of human endeavor. The way one solves a problem is related to one's individual learning style. There are, however, some common factors which seem to be part of most scientific investigations. Although, every investigator, being human, approaches each problem with some preconceived ideas, facts are gathered by accurate observation of behavior of the system of interest. Conclusions are based solely on the observed data.

Only by using experimental observations to study the behavior of matter, arranging the results of such studies in an orderly fashion, correlating the observed data and testing these correlations (theories or hypothesis) by further systematic observations can one hope to increase our ability to deal with the physical world around us. This approach is usually referred to as the Scientific Method. There is nothing unique about the order of activity to this method other than it provides a logical way to deduce order and causality for natural phenomena. An inherent part of the scientific method is the element of creativity. This is what makes possible the development of completely new concepts. This experiment is designed to allow you to use some of the elements of scientific investigation mentioned here.

Eight bottles, labeled A through H, containing eight different solutions have been prepared for your examination. When mixed together, in pairs, several of these solutions will undergo a chemical reaction. A reaction can be observed by one of the following changes:

1. A color change will occur.
2. A gas will be evolved.
3. A precipitate (a cloudy mixture) will form.
4. The evolution of heat.

Be carefully observing any changes that occur it should be possible for you obtain enough data to characterize each of these solutions. In this experiment we will use only a color change or a precipitate to detect a chemical reaction. From the results of your study, you should then be able to prepare a concise description of how to identify the contents of an unlabeled bottle assuming the others are available for mixing.

### PROCEDURE

Obtain a tray with dropper bottles containing solutions labeled A-H. In each dimple of a spot plate, combine 3 drops each of various combinations of two solutions. Mix with a clean stirring rod, and record your observations (**color change or precipitate formation along with the color of the precipitate**) in the data table provided. When the spot plate is full, simply rinse it off with distilled water into the waste container and continue experimenting.

Obtain two unknown solutions from your instructor and record their ID #s on your data sheet. Experiment with these unknown by mixing with the contents of each of the bottles labeled A-H. Remember to mix only two solutions at a time. Record your observations on the data sheet.

From the data recorded in your data table, determine the identity of your unknowns (one of the solutions A-H)



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DATA

NAME:

Lab Partner(s):

*Include **all** first and last names for full credit!*

Solutions	A	B	C	D	E	F	G	H
A								
B								
C								
D								
E								
F								
G								
H								
Unknown Number								
Unknown Number								

CONCLUSIONS:

Based upon your observations, describe how you would identify an unknown solution containing one of these eight solutions (A-H). Be careful with your wording. Your answer should make sense to someone who has not performed the experiment.

1. Why do you obtain the maximum useful information about the solutions by mixing only two solutions at a time?

2. How would you detect the evolution of a gas upon mixing the solutions?

3. Which of the A-H "solution(s)" could be distilled water? How do you know?

Unknown number \_\_\_\_\_ Identity (letter) \_\_\_\_\_

Unknown number \_\_\_\_\_ Identity (letter) \_\_\_\_\_