

# Observation and Experiment

## Introduction to the Scientific Method

### Introduction

*"The world is full of obvious things, which nobody by any chance ever observes."*

This quote is from Sherlock Holmes, talking about the importance of careful observation in detection. Careful observation is also the foundation of chemistry as an experimental science, leading us to question what we have observed. How, what, why? The answers to these questions are sought in experiments, which may be described as observations made under controlled conditions. Observation and experiment – twin pillars of the scientific method.

### Concepts

- Scientific method
- Observation
- Chemistry
- Experiment

### Background

The scientific way of knowing, often called the scientific method, is sometimes presented as a rigid sequence of events. The scientific method, however, is not a rigid path, it is a process – a process of discovery! Discovery begins when we make observations and then try to understand what we have observed by asking key questions and proposing possible answers. The process of discovery continues as we design and conduct experiments to test whether our answers to these questions are valid.

Chemistry is defined as the study of matter – what a substance is made of, its structure and properties, and the changes that it undergoes. Observations of the properties of matter are often complex, arising from the interaction of many different factors or variables. Experiments should be designed so that the effects of different variables on the behavior of a substance can be studied independently. This is done by making observations under controlled experiments make it possible to separate or isolate the factors that are responsible for a given observation in a complex series of events.

When three substances – solid calcium chloride, solid sodium bicarbonate, and a solution of phenol red in water – are mixed in a closed container, a complex series of changes is observed. Observations include temperature changes, color changes, and changes in state. How can we learn more about the individual interactions responsible for each observation? Imagine that each substance in the mixture represents a variable. By changing only one variable at a time, it should be possible to determine the contribution of each substance to the changes observed for the overall reaction.

The three substances that are used in this experiment are all common chemicals. Sodium bicarbonate, or baking soda, is used as a food additive in baking. It is also used as a natural deodorant to absorb and remove odor-causing chemicals in refrigerators and carpets. Calcium chloride ("road salt") is a salt-like compound that is used as a de-icer for sidewalks and roads. Phenol red is a naturally occurring dye that is used as an indicator – it changes color under different conditions.

*Note:* Because phenol red is a solution of the dye dissolved in water, it is actually composed of two substances. Thus, water must be considered as a fourth substance (variable) in the overall reaction, and its effect should also be examined.

# Biology Laboratory Manual Observational And Experimental Activities

**National Science Foundation (U.S.).**



## **Biology Laboratory Manual Observational And Experimental Activities:**

**Biology Laboratory Manual** Warren D. Dolphin, K. E. Oulman, 1987      Biology Laboratory Manual Darrell S. Vodopich, Randy Moore, 1998-12 This laboratory manual is designed for an introductory majors biology course with a broad survey of basic laboratory techniques The experiments and procedures are simple safe easy to perform and especially appropriate for large classes Few experiments require a second class meeting to complete the procedure Each exercise includes many photographs traditional topics and experiments that help students learn about life Procedures within each exercise are numerous and discrete so that an exercise can be tailored to the needs of the students the style of the instructor and the facilities available      **Analysing Scientific Discourse from A Systemic Functional Linguistic Perspective** Jing Hao, 2020-01-21 This book describes the discourse of biology from a systemic functional linguistic perspective It offers a detailed description of resources based on text analysis The description reveals co textual patterns of language features their expressions through grammatical resources as well as their functions in the disciplinary context The book also applies the description to analyse student texts in undergraduate biology revealing characteristics of language and knowledge development Although the discussion in this book focuses on the discourse of biology both the language description and the descriptive principle can be used to inform the examination of knowledge in academic discourse in general making this key reading for students and researchers in systemic functional linguistics discourse analysis English for academic purposes applied linguistics and science education      **Guide to Programs** National Science Foundation (U.S.), 1992      *America's Lab Report* National Research Council, Division of Behavioral and Social Sciences and Education, Center for Education, Board on Science Education, Committee on High School Laboratories: Role and Vision, 2006-01-20 Laboratory experiences as a part of most U S high school science curricula have been taken for granted for decades but they have rarely been carefully examined What do they contribute to science learning What can they contribute to science learning What is the current status of labs in our nation s high schools as a context for learning science This book looks at a range of questions about how laboratory experiences fit into U S high schools What is effective laboratory teaching What does research tell us about learning in high school science labs How should student learning in laboratory experiences be assessed Do all student have access to laboratory experiences What changes need to be made to improve laboratory experiences for high school students How can school organization contribute to effective laboratory teaching With increased attention to the U S education system and student outcomes no part of the high school curriculum should escape scrutiny This timely book investigates factors that influence a high school laboratory experience looking closely at what currently takes place and what the goals of those experiences are and should be Science educators school administrators policy makers and parents will all benefit from a better understanding of the need for laboratory experiences to be an integral part of the science curriculum and how that can be accomplished      *Concepts Biology Lab Manual* Roger Davis, 1995-07      *Laboratory Investigations for Biology* Jean

Dickey,1995 An investigative approach actively involves students in the process of scientific discovery by allowing them to make observations devise techniques and draw conclusions Twenty carefully chosen laboratory topics encourage students to use their critical thinking skills to solve problems using the scientific method      **Biological Investigations Lab Manual**  
Warren Dolphin,David Vleck,Linda Westgate,James Colbert,2010-01-27 The lead author of eight successful previous editions has brought together a team that combined has well over 60 years experience in offering beginning biology labs to several thousand students each year at Iowa State University Their experience and diverse backgrounds ensure that this extensively revised edition will meet the needs of a new generation of students Designed to be used with all majors level general biology textbooks the included labs are investigative using both discovery and hypothesis based science methods Students experimentally investigate topics observe structure use critical thinking skills to predict and test ideas and engage in hands on learning Students are often asked what evidence do you have that in order to encourage them to think for themselves By emphasizing investigative quantitative and comparative approaches to the topics the authors continually emphasize how the biological sciences are integrative yet unique An instructor s manual available through McGraw Hill Lab Central provides detailed advice based on the authors experience on how to prepare materials for each lab teachings tips and lesson plans and questions that can be used in quizzes and practical exams This manual is an excellent choice for colleges and universities that want their students to experience the breadth of modern biology      **Resources in Education** ,1998      United States Government Organization Manual ,1966

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