

**STUDENT
LABORATORY
GUIDE**

BIOLOGICAL SCIENCE

AN INQUIRY INTO LIFE
BIOLOGICAL SCIENCES CURRICULUM STUD



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Contents

The *Student Laboratory Guide* contains 89 inquiries. Each presents different content and illustrates different aspects of an investigation or a concept. Many involve different equipment and techniques. Some are graded in terms of open-endedness, with earlier inquiries more highly structured than later ones. This variety in the inquiries increases the flexibility within the classroom and laboratory environments and necessarily involves the teacher in decisions between different inquiries as basic or supplementary.

A decision to use all the inquiries involves assigning different teams of students different inquiries at least some of the time. Whether this is feasible depends not only upon the necessary laboratory facilities and supplies but upon the degree of independence students are to have in their laboratory work. If all students are to undertake the same inquiries, some—perhaps many—of the inquiries will not be assigned, but students of high initiative will want to undertake certain optional inquiries on their own.

One suggested organization of the 89 inquiries into basic and optional categories is given in this table of contents, with optional inquiries indented. The decision of which inquiries to use, however, remains the teacher's.

INQUIRY 1-1	Life In Unexpected Places?	1
	An investigation basic to Chapter 1, to development of the need for microscopes, and to preparations for Inquiry 2-1. It may be omitted if Inquiry 2-1 will not be assigned.	
INQUIRY 1-2	The Compound Microscope—A Scientific Tool	3
	Basic techniques of microscopic observation.	
INQUIRY 1-3	Measuring the Invisible	8
	An optional inquiry into quantitative techniques with the compound microscope.	
INQUIRY 1-4	Types of Microscopes	10
	An optional inquiry into specialized types of compound microscopes and comparisons of their capabilities with those of the electron microscope.	
INQUIRY 2-1	Life from Nonlife?	22
	A basic inquiry continuing the investigations begun in Inquiry 1-1 and establishing their relationship to the biogenesis-abiogenesis controversy of Chapter 2.	
INQUIRY 3-1	Cork—An Investigation Into Form and Function	
	A classical investigation of the plant part in which cells first were discovered.	

INQUIRY 3-2

Cells of Living Plants

Cells of living plants are introduced in Inquiry 3-1. An optional inquiry is to be used for an introduction to plant cells. Living plant tissues can be made basic, and Inquiry 3-1 can become more basic.

Cells from You and Frogs

A basic inquiry into several types of 3-1 or 3-2.

Cells from You and Frogs

A basic inquiry into several types of 3-1 or 3-2.

INQUIRY 3-3

Cells from You and Frogs
A basic inquiry into several types of 3-1 or 3-2.

INQUIRY 4-1

Cells from You and Frogs
A basic inquiry into several types of 3-1 or 3-2.

Cells from You and Frogs
A basic inquiry into several types of 3-1 or 3-2.

INQUIRY 5-1

Cells from You and Frogs
A basic inquiry into several types of 3-1 or 3-2.

INQUIRY 6-3 The Environment of an Enzyme

45

An inquiry establishing the importance of homeostasis. Different conditions of pH, temperature, and enzyme concentration are investigated in relation to the efficient action of the enzyme.

INQUIRY 6-4 The Closed Box Mystery

43

How do materials move in and out of cells? Enlarged models with closed membranes are used to investigate the problem.

INQUIRY 6-5 Reactions of Cells in Changing Environments

51

Living cells are investigated directly in an extension of Inquiry 6-4.

INQUIRY 7-1 Mitosis and Genetic Continuity

52

A basic inquiry into cellular reproduction and the mechanisms important in genetic continuity.

INQUIRY 8-1 An Analysis of DNA

55

An inquiry classed as optional because of its requirement for use of a shorter-wave ultraviolet source. With proper precautions, the inquiry provides a rewarding direct experience with DNA and its components. Paper chromatography, with ultraviolet illumination of the chromatogram, is used in making the identifications.

INQUIRY 8-2 Trailing a Virus

58

An inquiry into procedures for detecting ultramicroscopic organisms through the effects they produce.

INQUIRY 8-3 Investigating Differences in Peas

59

An investigation of morphologically different peas and the action of some of their enzymes, to determine whether a genetic basis exists for their differences in appearance.

INQUIRY 8-4 Levels of Biological Organization

62

A broadening of perspective from the cellular level to other organizational levels — tissues, organs, and micro- and macroorganisms.

INQUIRY 9-1 Microbiological Techniques

63

The essential techniques of laboratory work with microorganisms — basic to use of the immediately following inquiries.

INQUIRY 9-2 A Disease of Bacteria

69

An investigation related to Inquiry 8-2 and similarly concerned with the effects of viruses upon their hosts — in this case, bacteria.

INQUIRY 10-1 Distribution of Microorganisms 76
Where around us are microorganisms found? A basic inquiry into a surprisingly extensive domain.

INQUIRY 10-2 Staining and Observing Bacterial Cells 72
The Gram stain technique and its use in microscopic studies of bacteria.

INQUIRY 11-1 Descendants of a Single Cell 74
An investigation showing how to keep track of reproducing microorganisms and how to obtain pure cultures.

INQUIRY 11-2 War on Bacteria 77
An opportunity to test the relative effectiveness of known drugs on bacteria.

INQUIRY 11-3 The Environment of a Microorganism 70
An optional inquiry related to Inquiry 6-3, replacing tissue cells with microorganisms in a study of interaction with the environment. The use of an ultraviolet light source requires special precautions.

INQUIRY 11-4 Discriminating Microorganisms 60
An investigation of differences in the metabolism of several types of microorganisms — specifically in their utilization of sugars.

12-1 A Plant-Animal? 62
A basic inquiry into the value of a questioning attitude instead of rigid concepts of organisms as "plants" or "animals."

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The basis for plant classification, and an introduction to plant phylogeny.

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A search for reasons why green algae are central to consideration of the evolution of plants.

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INQUIRY 17-8 A Simple Way to Stimulating Plants
An optional introduction to the use of a key to finding plants in this case representation of various kinds of plants.

INQUIRY 17-9 From Seed to Seedling

An extension of Inquiry 14-1, proceeding from seed to the growing and development of new plants; what are the conditions which are necessary for the growth of energy for the process.

INQUIRY 17-4 Plant Reactions to Environment
Do plants show "behavior"? A basic inquiry that investigates responses of plants to various stimuli.

INQUIRY 17-6 Regulation of Growth in Plants
An analysis of a classical investigation in plant growth, leading to a pattern of evidence about one mechanism involved.

INQUIRY 18-1 Plants or Animals?
A basic inquiry that explores in greater detail the question raised by study of a single organism in Inquiry 12-1.

INQUIRY 18-2 Structure and Function in *Paramecium*
The introduction to a series of investigations of basic animal processes in a single-celled animal. Hypotheses affecting succeeding investigations are required from the initial observations.

INQUIRY 18-3 Locomotion of *Paramecium*
The hypotheses of locomotion from Inquiry 18-2 are investigated and are confirmed or rejected.

INQUIRY 18-4 Ingestion and Digestion in *Paramecium*
Several related hypotheses from Inquiry 18-2 are investigated as a *Paramecium* is fed and observed.

INQUIRY 18-5 Contractile Vacuoles in *Paramecium*
An investigation of a homeostatic mechanism associated with one or more hypotheses from Inquiry 18-2.

INQUIRY 18-6 Reproduction in *Paramecium*

The last inquiry of the initial series of investigations into basic processes (see also Inquiry 12-1).

INQUIRY 19-1 Animal Classification

138

An inquiry into animal variety and classification, corresponding to Inquiries 13-1 and 17-2 for plants. If the earlier two inquiries are assigned, this one may be made optional.

INQUIRY 19-2 Two Ways of Life

140

How are animals adapted to their particular ways of life? Structural and functional differences in free-living and parasitic worms are explored as examples.

INQUIRY 19-3 Animals with Jointed Appendages

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An extension of Inquiry 19-2, involving animals of greater complexity—the insects and other arthropods.

INQUIRY 19-4 Form and Function in the Frog

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The internal structure of a vertebrate is investigated through dissection of a frog.

INQUIRY 20-1 Protein Digestion

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A basic inquiry into some of the factors involved in the digestion of proteins—a process essential to the animal way of life and related to the digestion of carbohydrates and, to an extent, fats also.

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A study of a living animal to investigate the environmental factors that influence heart-beat, and to determine the effects of drugs on heartbeat.

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Observation of blood flow in a closed circulatory system, and investigation of the principles involved.

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A basic inquiry into suspected factors in the rate of breathing of humans.

INQUIRY 23-1 Water Balance

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An investigation of the interaction between one homeostatic mechanism and varying conditions of the environment.

INQUIRY 24-1 Sense Reception and the Nervous System

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Aspects of sensory reception in humans.

INQUIRY 25-1 Control of Muscle Contraction

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An inquiry into the nerve-muscle relationship.

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1.3 THE COURSE OBJECTIVES
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