

**LABORATORY
GUIDE**

**BIOLOGY
SCIENCE**

**AN INQUIRY INTO
BIOLOGICAL SCIENCES CURRICULUM**



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What is Microbiology?

Microbiology is the study of organisms that are too small to be seen with the naked eye.

The Microbiology Laboratory is a laboratory that is used for the study of microorganisms.

Activity 1 - 1 **Microbiology the invisible**
An initial inquiry into microbiology laboratory

Activity 1 - 2 **Types of Microorganisms**
An initial inquiry into specialized types and characteristics of their populations and micrographs

Life from Nonlife?

A basic inquiry concerning the investigations begun in tracing relationship to the emergence abiotic/abiogenesis controversy of life

Investigation into Form and Function

INQUIRY 4-2

Cells of Living Plants

An optional inquiry if plant cells are introduced in Inquiry 3-1. Average plant tissues are to be used for an introduction. (This inquiry can be made basic, and Inquiry 3-1 can be made more advanced.)

INQUIRY 4-3

Cells from Yew and Frog

A basic inquiry into several types of animal cells and their contrasts with those with the cells of Inquiry 3-1 or 3-2.

INQUIRY 4-1

A Chemical Reaction of Living Systems

A classical investigation of the first-discovered enzyme — linking events in chemistry with events in living cells.

INQUIRY 5-1

An Enzyme in Plant and Animal Tissues

An inquiry again involving an enzyme, but investigating its action and action in tissue samples rather than in its extracted form. A simple calorimeter is used to help gather data on whether enzyme-controlled reactions are taking place.

INQUIRY 5-2

Food Energy

A slightly more refined calorimeter is designed and constructed to measure energy equivalents of common foodstuffs.

INQUIRY 5-3

Compounds of Living Organisms

An inquiry introducing the need for, and use of, simple tests to help distinguish one compound from another in plant and animal tissues.

INQUIRY 5-4

Oxidation-Reduction in Living Cells

A basic inquiry into a significant pattern of chemical reactions in living systems, first in a model and then in living microorganisms.

INQUIRY 6-1

Acids, Bases, and Cells

An investigation into one of the ways cells maintain their narrow range of pH and osmotic pressure despite a wide range of chemical changes in tissue extracts.

INQUIRY 6-2

Amino Acid Composition

An inquiry into the composition of amino acids in living tissues.

INQUIRY 6-3 The Environment of an Enzyme 45

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

6-4 The Closed Box Mystery 48

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.

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.

4 Levels of Biological Organization 62

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

Microbiological Techniques 6

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

INQUIRY 9-2 A Disease of Bacteria

An investigation related to Inquiry 8-2 and similarly concerned

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

INQUIRY 10-2 Staining and Observing Bacterial Cells
The Gram stain technique and its use in identifying bacteria.

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

INQUIRY 11-2 War on Bacteria
An opportunity to test the relative effectiveness of antibiotics against bacteria.

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

INQUIRY 11-4 Discriminating Microorganisms
An investigation of differences in the metabolism of microorganisms—specifically in their utilization of various carbon sources.

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

INQUIRY 12-2 Fungus Among Us
An optional investigation of types of fungi.

INQUIRY 13-1 Comparison of Plants—Simple or Complex?
The basis for plant classification, and an introduction to plant phylogeny.

INQUIRY 13-2 Green Algae—Simple and Complex
A search for reasons why green algae are central to the study of the evolution of green land plants.

INQUIRY 14-1 Alternation of Generations
An investigation of a prominent pattern in the life cycles of both green and brown land plants. Mosses are the laboratory example.

INQUIRY 14-3	A Pollinated Flowering Plant The structure of a flower and its adaptation for its function.	94
INQUIRY 14-3	The Importance of Roots An inquiry into reproductive specialization in root plants.	94
INQUIRY 14-1	The Significance of Leaf Color Is chlorophyll necessary in photosynthesis?	96
INQUIRY 14-2	Leaf Structure and Function An opportunity to investigate complementarity of structure and function.	97
14-3	The Pigments in a Leaf Chlorophyll is extracted from leaves and investigated to determine if it is one or more than one green pigment.	98
14-4	Light and Leaves An inquiry into the essential nature of the light that leaves absorb, and whether this light can be demonstrated to lead to photosynthesis.	100
INQUIRY 14-3	Plants and Air An optional investigation providing experimental evidence for the role of carbon dioxide in photosynthesis.	101
14-5	The Gateway into a Leaf The homeostatic mechanisms of guard cell metabolism, affecting the stomata.	102
INQUIRY 14-1	Stems An optional inquiry into the structure and functions of stems, following the pattern of Inquiry 14-2.	103
INQUIRY 14-2	Roots An inquiry into the structure and functions of roots.	103
3	Transpiration in Plants Experimental evidence for an essential plant process, and an investigation of	

INQUIRY 17-2 A Simple Key to Flowering Plants

An optional introduction to the use of a key in classifying plants. —In this case, representatives of common families of plants.

INQUIRY 17-3 From Seed to Seedling

An extension of Inquiry 14-3, proceeding from seeds to the growth and development of new plants; also an investigation into the source 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 17-5 Regulation of Growth in Plants

An analysis of a classical investigation in plant growth, looking for 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 the 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 such 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. *Paramecium* is fed and observed.

INQUIRY 18-5 Contractile Vacuoles in *Paramecium*

An investigation of a homeostatic mechanism associated with contractile vacuoles. More hypotheses from Inquiry 18-2.

INQUIRY 18-6 Reproduction in *Paramecium*

The last inquiry of the initial series of investigations into the life processes (see also inquiry 15-2).

- 13-1 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** 143
An extension of Inquiry 19-2, involving animals of greater complexity—the insects and other arthropods.
- 19-4 Form and Function in the Frog** 148
The internal structure of a vertebrate is investigated through dissection of a frog.
- 20-1 Protein Digestion** 150
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.
- 21-1 A Living Invertebrate Heart** 151
A study of a living animal to investigate the environmental factors that influence heart beat, and to determine the effects of drugs on heartbeat.
- INQUIRY 21-2 Capillary Circulation**
Observation of blood flow in a closed circulatory system, and investigation of the principles involved.
- 22-1 Regulation of Your Breathing Rate**
A basic inquiry into suspected factors in the rate of breathing of humans.
- 23-1 Water Balance**
An investigation of the interaction between one homeostatic mechanism and conditions of the environment.
- 24-1 Sense Reception and the Nervous System**
Aspects of sensory reception in humans.
- 25-1 Control of Muscle Contraction**
An inquiry into the nerve-muscle relationship.

INQUIRY 25-2 Looking Inside a Contracting Muscle

A microscopic examination of the physical differences in muscle fibers when contracted and relaxed, and to determine certain chemical events associated with contraction.

INQUIRY 26-1 Effects of Reproductive Hormones

A basic inquiry providing evidence of the influence of reproductive hormones on characteristics.

INQUIRY 27-1 Reproduction and Development in the Frog

An introduction to the processes involved in reproduction and observation of growth and development of frogs from egg to adult. An optional inquiry may be substituted for Inquiry 27-1 if appropriate for the particular classroom situation, or it may be used to study development in different animals.

INQUIRY 27-2 How Does an Egg Form a Chicken?

A basic investigation of animal embryology and development.

INQUIRY 28-1 Growing a New Body

Regeneration in an invertebrate and in a vertebrate—a basic inquiry involving growth and development.

INQUIRY 29-1 *Drosophila* Technique

The techniques of laboratory work with *Drosophila*, essential if *Drosophila* is used in the following investigations of genetic principles.

INQUIRY 29-2 Randomness, Chance, and Probability

An investigation of the laws of chance and their relation to principles of Mendel. This inquiry is basic to the analysis of ratios of offspring from selection of *Drosophila* (or from observed crosses in corn).

INQUIRY 29-3 Inheritance of One-factor Differences

The study of a single trait and its inheritance in *Drosophila* or in corn.

INQUIRY 29-4 Independent Inheritance

The study of two traits and their inheritance in *Drosophila*.

INQUIRY 30-1 Sex-linked Inheritance

The investigation of a trait associated with genes on sex chromosomes, inheritance of which is not accounted for by Mendel.