

# Biology: A Search for Order in Complexity

*Second Edition*



**TEACHER'S MANUAL**

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# Preface

## TWO DIFFERENT APPROACHES

Two different approaches can be used in preparing a science textbook. By *one approach*, the data of science would simply be presented as it is, with accurate descriptions of the pertinent systems and processes and their interrelationships in the present world. This approach is true **science**, which is “knowledge”—*the organized body of observation of, and experiment with, present processes*. In biology, this method would entail careful descriptions of the plant, animal, and human worlds and the complex processes that constitute the phenomenon of life.

But most of us are not content with merely knowing about things as they now exist. We are also intensely interested in how they came to be as they are. Thus, authors of most textbooks of science follow the second approach, seeking not only to describe the phenomena of a particular science as they now function but also, if possible, to explain how they got that way.

In biology, the *second approach* necessarily entails a philosophic viewpoint regarding **origins**. We want to know not only the characteristics of the various living organisms but also when these organisms came into existence. Consequently, practically all biology textbooks include a discussion of the supposed origin of life of the various forms of plants and animals.

But a word of caution is necessary here. The discussion of origins, strictly speaking, is *not* science. This is because origins are not subject to experimental verification. No scientific observers were present when life began or when different kinds of organisms first came into existence, and these events are not taking place in the present world; therefore, the solution to the question of origins is simply impossible by scientific means. *The student should always be careful (though some textbook writers are not) to distinguish between the actual facts of biology and some viewpoint about origins with which particular biologists may try to explain those facts.*

There are essentially only two philosophic viewpoints of origins among modern biologists—the doctrine of **evolution** and the doctrine of **special creation**. Proponents of the former postulate the gradual appearance of the various forms of life and of life itself by natural processes over vast ages of time. Exponents of the latter assume the essentially instantaneous origin of life and of the major kinds of living organisms by special creative acts utilized directly by the Creator Himself.

Both evolutionists and creationists agree to the actual facts of biology, but the *interpretation* of those facts in relation to the question of origins and intrinsic meanings will depend upon the philosophic preference of the individual biologist.

Scientists work in terms of “models,” and each proposed model is evaluated in terms of the effectiveness with which available data may be correlated into the model as a frame of reference. Following this example, the two basic viewpoints of origins may be called the “evolution model” and the “creation model.” A choice between these two models may be made in terms of the effectiveness with which each may be used to correlate available data.

At this point it may be well to recognize that some persons have attempted to formulate a **middle position** of some kind between the two models, by which they hope to accept *both* evolution and creation. That is, they hold that perhaps evolution was the *method* of creation. The tenability of this type of compromise can best be considered after the two basic models are first evaluated. In any case, it is certainly true that many evolutionist scientists and many creationist scientists alike reject this idea.

The consistent evolutionist insists that if indeed innate evolutionary processes suffice to explain all the data, as he *believes* they do, then there is no need to invoke extraneous creative processes. The creationist says that, since there is a need to postulate extraneous creative acts and processes to explain the data, as he believes, the evolution model is by that

very fact rendered impotent. These two models cannot really be harmonized, except at a very superficial level, since they represent diametrically opposite viewpoints of origins.

## THE EVOLUTION MODEL

The present processes of nature are, in the *evolution model*, adequate to explain the origin of the universe and all changes preliminary to the present immense degree of variety and complexity. Despite occasional failures and even retrogressions, the overall effect of these innate principles and processes has been that of the rise of diversity and complexity from primeval simplicity. The processes of the cosmos, therefore, are supposedly processes of origination and integration.

Since, according to this model, all things are interrelated by common descent through slowly operating innate processes, certain **basic predictions** can be made from the model as a test of validity of the model. Consider the following:

1. Countless structural and functional similarities should be observed among the entities of the present world—with, in fact, a more or less continuous array of *inorganic species*, *semi-organic transitional species*, and *organic species*; and with no “gaps” of any consequence between adjacent kinds.
2. The basic processes which have presumably given rise to all things should, when observed in the present world, turn out to be processes which tend to produce new entities in an ever higher state of order and integration.
3. If it is possible to decipher the actual history of the earth, it should be found that the variety and complexity of the world and all its inhabitants tend to increase as time increases.

### ***Support for Predictions Only Apparent***

These three predictions may be supported to some degree by the observed data. Many types of similarities are observed between different organisms; for example, similarities in anatomy, in embryonic development, in genetic biochemistry, and in blood serology.

However, the inference of a continuous array of such similarities, with no gaps of any consequence between adjacent kinds, is *not* supported by the data. Although certain conjectures might be offered to explain the existence of the great gaps between all the basic kinds, these ideas are not accessible to experimental test and thus do not afford any genuine scientific explanation for this obvious deficiency in the evolution model.

Secondly, study of various processes does bear out the evolutionary inference that many changes continually take place in the world. In the organic world, for example, new varieties and even new species are easily produced through the mechanisms of hybridization, induced mutation, and selection; and these phenomena may occur either naturally or artificially. No two individuals are alike, even from the same parents, and there is obviously a great deal of variation and change taking place in the world.

Once again, however, this evidence alone is not very compelling, since these processes of change are not innately processes tending toward increase of order as predicted. On the contrary, they seem always to fall into one of two categories:

- a) *variation within relatively small limits*, leading merely to new varieties within a basic kind; and
- b) *mutations that represent random changes in the DNA of the germ cells*, resulting almost always in decreased order at immature or adult stages and never resulting in the appearance of new physical traits.

Actually, these two phenomena may be used better to support the principles of conservation and decay, rather than origination and integration, as proponents of the evolution model would suggest. These observational fallacies to date have not been overcome by any measurable facts, although evolutionists feel justified in *extrapolating* these small variations into broader evolutionary changes between basic kinds.

### *Prediction Denied by Basic Facts*

The inference that the complexity of life should have increased with the passage of geologic time does *seem* at first to be substantiated by the fossil record; and, indeed, this evidence from paleontology is undoubtedly the strongest of the evidences offered in support of evolution. However, it is seriously weakened by the necessity of *circular reasoning* in its development. That is, the scale of geologic time must necessarily be based on the assumption of evolution in the first place.

The relative dating of the geologic formations is always determined mainly by the “index fossils” that they contain, and their supposed “absolute dating” by radioactive minerals is always subject to correction by these *paleontologic* (pā'lē•ān•tā•lō'jīk) *criteria*. Furthermore, there are many, many locations where fossils from different “ages” are found in the same beds, and even where entire formations containing “old” fossils are superimposed vertically above formations containing “young” fossils.

This argument is still further weakened by the obvious fact that most of the fossiliferous (fā'sā•lī'fā•rās) rocks—especially those containing fossils of large plants or animals—must have been deposited and petrified *rapidly*, even *catastrophically*; otherwise, the fossils would not have been preserved at all. Thus, the fossil record does not necessarily reflect slow, uniformitarian evolutionary change over vast ages, but rather it contains a graphic record of violence and death on a worldwide scale.

Though some of the data may possibly be interpreted in an evolutionary framework, this interpretation is not at all compelling or conclusive. The evolution model contains numerous deficiencies and discrepancies. One may adhere to it as an act of *faith*, but it is fallacious and misleading to label it “science.”

## THE CREATION MODEL

That there was a period of **special creation** in the past, during which the world was brought into existence out of nothing by the power of the Creator, is a basic postulate of the *creation model*. All of the basic physical entities were perfected and all the basic biologic kinds established, each with specific form and function, through intelligent design.

These basic units are now being “conserved” rather than “created.” The present processes of nature are therefore not *creative* (nor evolutionary) processes at all, but rather *conservative* processes, which maintain the essential integrity and stability of the universe as created.

This does not mean, of course, that no change or variety is possible. To the contrary, an important postulate of the creation model is that a tremendous complex of *inorganic* and *organic variants* have come into existence from the basic created entities. However, such variation will always be found to be within the limits imposed by the initially created structure of each entity. In the biologic realm, for example, many new varieties (or even species or genera, depending on terminology) may quickly appear in response to environmental constraints, but *never* a new basic “kind.”

In addition, according to the biblical version of the creation model, *a universal principle of decay and death* (though not annihilation) throughout the world was established at some time after the creation period. Finally, a great **worldwide cataclysmic flood** at a still later date, which radically changed the face of the earth, as well as the nature and rate of action of most processes on the earth, is incorporated into the creation model.

## *Specific Predictions Are Confirmed*

The above features of the creation model are confirmed by most or all of the *actual observed phenomena* of nature, thus demonstrating the validity of the creation model as being scientifically sound, even though no model of origins can be fully verified by scientific methods.

The two most basic and firmly established scientific principles are the *first* and *second laws of thermodynamics*. These apply without exception to all scientific disciplines and may properly be regarded as confirmed predictions of the creation model. That is, the **first law** (conservation of mass-energy) supports the prediction that nothing is being created or annihilated in the present order of things, since the creation was completed and perfected at some time in the past and is now merely being maintained and conserved. Similarly, the **second law** (increasing entropy) is essentially a confirmation of the universal law of decay and death postulated in accordance with the biblical version of the creation model.

The *permanence of basic "kinds"* is supported without exception by all observed biologic data. Thus, a population of moths may change color because of a change in the smoke content of the atmosphere, but they remain moths. A thousand successive generations of fruit flies may be exposed to radiations and other mutagenic influences, with the production of a wide variety of mutants, but they still are fruit flies.

Great **gaps** between basic kinds are likewise to be expected, since each kind has a created purpose and, therefore, a structure uniquely designed with that purpose in view. On the other hand, many **similarities** would likewise be expected since it is reasonable that, when similar functions are to be performed in similar environments, even different "kinds" would be designed with somewhat similar structures by a common Creator.

As far as the fossil record is concerned, it is well known that essentially the same gaps between basic "kinds" exist in both the fossil record and the present biologic world. There are, of course, many extinct kinds, as well as extinct varieties of present kinds, found in the fossils, but none of these can be considered as actual transitional or *genetic* links between any of the established kinds.

## *Sedimentary Layers Relate to Cataclysmic Flood*

Furthermore, according to the creation model, such fossil deposits should be found in sedimentary beds all over the world. In fact, there seems to be no way of accounting for most of the great fossil beds of the world, especially of vertebrate fossils, except in terms of very rapid burial and *lithification* (lith·o·fā·kā'shən, process by which sediments are consolidated into sedimentary rock), such as might be posited in accordance with the **biblical deluge**, and accompanying volcanic and tectonic activity and inferred subsequent glaciological (glā'shē·lā'jī·kəl) phenomena.

The apparent order of "succession" of fossils may be predicted from the creation model to be from the least complex at the bottom to the most complex near the top, though with numerous statistical exceptions to this rule. That is, the *hydrodynamic action* of moving water is a highly efficient sorting agent, and sedimentary contents would be expected to be segregated into aggregations of similar sizes and shapes, normally being deposited in nicely stratified layers.

Hydrodynamically, the simplest (i.e., most nearly spherical) and densest would tend to settle out first and thus be buried deepest. Further, the least complex organisms tend to inhabit the lowest elevations and would, therefore, tend to be deposited at the lowest levels. Finally, the more advanced organisms are the more mobile and would, therefore, be expected to survive floodwaters longer and consequently be trapped and buried at the higher levels if at all.

These should be considered statistical criteria only, of course, and many exceptions would be anticipated in the context of a *universal aqueous cataclysm* lasting an entire year (and, in



lesser intensity, for centuries). Both the expected normal sequences and the occasional exceptions are found as predicted in the geologic "column" all over the world.

## SUMMARY

Thus, in summary, there are two possible models of origins, the *creation model* and the *evolution model*, though several variants of each have been developed. Both deal with ultimate meanings, and both are incapable of scientific proof. On the other hand, both may be used as frames of reference for development of predictions for comparative evaluation of the present phenomena of nature.

On this basis, the creation model is a framework of interpretation and correlation that is, at least, as satisfactory as the evolution model. However, the two laws of thermodynamics, the apparent stability of the basic "kinds," the existence of great gaps between the kinds, the deteriorative nature of mutations, and the catastrophic nature of the worldwide fossil-bearing formations all may be correlated far more easily with the creation model than with the evolution model. In other words, *it requires more faith to believe in evolution rather than special creation.*

Furthermore, the data and principles of physics, chemistry, and the other physical sciences are much more easily understood within the framework of the creation model than in that of the evolution model.

Yet, the majority of modern biologists prefer the evolutionary viewpoint of origins as *the* explanation of the factual data of biology. In fact, many have been so confident in this position that *some have insisted that evolution is a fact of science.* But this assertion has never been proved and, of course, cannot even be tested.

There also exists today a significant number of biologists and other scientists who are convinced that special creation doctrine or the creation model is a more reasonable and satisfying viewpoint of origins than evolution. Many of these men and women are members of the *Creation Research Society*, an organization of hundreds of scientists (with at least a masters degree in science, and representing most of the disciplines in the physical and biological sciences) dedicated to research and publication in support of creation versus evolution as the most likely explanation of origins.

The preponderance of evolutionists in the present-day scientific and educational establishments, however, has led to an effective monopoly of evolutionary *opinion* in modern textbooks. Thus, a great need exists for an introductory biology textbook that can be used effectively both in teaching the actual facts of biologic science and also in presenting the creation concept as the most acceptable underlying explanation of those facts.

*John N. Moore, Co-editor of first edition*

# Foreword

This teacher's manual is designed to assist the teacher in using *BIOLOGY: A Search for Order in Complexity*. Suggestions regarding a correlated laboratory program can be found in the teachers' laboratory manual.

Effectiveness of teaching in biology is influenced by many factors such as academic background, teaching experience, equipment available, and background of students. Since effective teaching depends upon more than subject matter organization, various features of this teacher's manual have been formulated to enhance the interest and enthusiasm with which biological subject matter is presented.

The general design or outline of this teacher's manual parallels the organization of the book as follows:

- a. Chapter by chapter suggestions for student motivation and enrichment in regard to the subject matter are presented in interesting and imaginative practical projects.
- b. Lists of instructional films and supplemental readings are given for each chapter. The creation viewpoint is presented in some of the films, books, and scientific journals. Although most of them have been produced with a general evolutionary outlook, such resources are included in the list because the subject matter is valuable. In addition, the teacher should be able to utilize their content as examples of the *overgeneralization* and typically *speculative thinking* that is characteristic of evolutionists. Thus, special lessons in understanding how to meet everyday expressions heard in the media can be gained.
- c. Answers to most questions found at the end of chapter sections and ends of chapters of the textbook have been provided.
- d. "Think-Session Guides" conclude the material for each unit. Thought-provoking questions or suggestions are interspersed in paragraphs designed to stimulate individual teacher thinking; they may be used directly (or rephrased for a particular class level) to promote class discussion prior to the commencement of each unit of study or to be used as review. Their appearance at the end of each unit in this manual is not intended to indicate that they should be used only after the student has completed the unit in the text.

Acknowledgment is hereby made of the excellent cooperative efforts of contributing authors Mrs. Olive Fischbacher, Dr. William J. Tinkle, and Dr. Ralph Paisley. Mrs. Fischbacher has participated in various science-writing projects with other publishers; Dr. William Tinkle is Emeritus Professor of Biology, Anderson College, Indiana; and Dr. Paisley has drawn upon his excellent teaching experience at The King's College, Briarcliff Manor, New York. A word of grateful appreciation is extended to these authors.

*John N. Moore, Co-editor of first edition*

# *Introduction to Teacher's Manual*

## *A. Guidelines*

### 1. Motivation or Enrichment

### 2. Multimedia Resources

### 3. Supplementary Reading

Two guidelines have been followed in the preparation of this teacher's manual. First, and most important, has been the safeguarding of the textbook's distinctiveness, notably the inclusion of creation in every consideration of origins. With this in view, it has seemed advisable to alert teachers regarding the suggested films and Supplementary Readings. No restrictions have been placed on such suggested materials, but asterisks and footnotes serve as reminders of possible problems in content.

The second guideline has been to afford the fullest possible assistance to home-school and classroom teachers in practical ways. These include the categories of suggestions described below.

The **Suggestions for Motivation or Enrichment** in this manual were planned to capture student interest and focus attention on the specific content of each textbook chapter. It is hoped that the suggested form of presentation—even direct use of the given wording—will facilitate utilization of these motivational concepts. Motivation is never just an end in itself, and teachers should be able to sense by student reaction just when to proceed to the succeeding item in the text sequence. Many of the suggestions also lend themselves to development as enrichment experiences and may even supplement the laboratory manual in scope.

The **Suggestions for Multimedia Resources** are representative of videos, DVDs, CD-ROMs, and Internet sources currently available. There has been no restriction placed upon the inclusion of media having an evolutionary bias, but an effort has been made to include creation-oriented resources whenever feasible. It is strongly recommended that teachers preview all material before class time and be prepared to refute any questionable statements. Many teachers will find that this has the added advantages of providing opportunity for improvised clarification of concepts and of stimulating useful dialogue.

Sources for films and laboratory supplies are listed after this introduction. Additional appropriate films may be found through local government offices, health agencies, or libraries.

The **Suggestions for Supplementary Reading** are taken largely from recent issues of periodicals available on the Internet or in public libraries. An effort has been made to prefer currently published material, but many serious students will want to check indices for additional titles.

Certain contemporary or uniquely appropriate books are also listed, with brief annotations. Such books could make valuable additions as budgets permit. Some basic references are also available at the end of some chapters in the textbook.

## *B. Answers to Questions*

The answers to the questions are suggested solutions; some are exact answers, and some are illustrations. All of them can be elucidated or expanded by the teacher. They are intended to be guides to the teacher in his imaginative presentation of an exciting course in biological science.

### ***C. Think-Session Guides***

The teacher must read over the material and understand the biology problems involved. He should then prepare any visual materials he thinks necessary for his student or class.

After presenting the background information (if deemed necessary), he presents the problems and invites student response. Now the teacher's greatest skills come into play. He must direct the discussion by asking *diagnostic* and *analytical questions*. This procedure will help students see for themselves why certain answers are poor and others good.

Remember that getting the "right" answer is not the prime objective. Instead, the student must use his information and intelligence to search out the answer. Each answer is discussed to determine not if it is right or wrong but whether the reasoning was correct in obtaining that answer.

# Resource Contact Information

## *Answers in Genesis*

Answers in Genesis (AiG) is a Christian apologetics ministry that equips the church to uphold the authority of the Bible from the very first verse. AiG also provides biblical answers to tough questions about creation, evolution, and the Bible. Their Web site features thousands of articles covering dozens of scientific and biblical topics, plus media programs, daily devotionals, resources, and much more.

AiG's Web site also provides featured articles with a biblical perspective on current events, scientific topics, and other issues relevant to the Christian faith. Their "Question and Answer" section provides thousands of articles on creation, dinosaurs, geology, genetics, Noah's Flood, and dozens of other scientific and biblical topics. In their "Answers Media" section, you can listen online to hundreds of free audio and video programs. In addition, their "Online Bookstore" offers books, DVDs, witnessing tools, inspiring music, and much more. For curricula information visit their "Creation Education Center" Web page ([www.answersingenesis.org/home/area/curriculum\\_info](http://www.answersingenesis.org/home/area/curriculum_info)). Below is contact information for *AiG-United States*:

**Mail Address:** P.O. Box 510, Hebron, KY 41048  
[2800 Bullittsburg Church Rd., Petersburg, KY 41080]

**Phone:** (859) 727-2222

**Customer service:** (800) 778-3390

**Ministry information:** (800) 350-3232

**Web site:** [www.answersingenesis.org](http://www.answersingenesis.org)

**E-mail:** Use their [www.answersingenesis.org/feedback](http://www.answersingenesis.org/feedback) page for specific questions.

## *Creation Research Society, The*

The Creation Research Society (CRS) is a professional organization of trained scientists and interested laypersons who are firmly committed to scientific *special creation*. The Society was organized in 1963 by a committee of ten like-minded scientists and has grown into an organization with worldwide membership. The primary functions of the Society are (1) the publication of a quarterly peer-reviewed journal (*CRS Quarterly*), (2) the conducting of research to develop and test creation models, and (3) the provision of research grants and facilities to creation scientists for approved research projects. The *Creation Research Society Quarterly* presents scientific evidence supporting intelligent design, a recent creation (young earth creationism), and a catastrophic worldwide flood. The CRS produced the first edition of this textbook in the early 1970s. Their online bookstore carries a large selection of creation books, videos, and DVDs.

**Address:** P.O. Box 8263, St. Joseph, MO 64508-8263

**Web site:** [www.creationresearch.org](http://www.creationresearch.org)

**E-mail:** [contact@creationresearch.org](mailto:contact@creationresearch.org)

The CRS has also established the Van Andel Creation Research Center in north-central Arizona for the purpose of aiding the Society and other visiting scientists in their research efforts. The Society encourages a broad spectrum of research to develop and test a *creation model* and administers a research grant program whereby modest funds are distributed to qualified researchers for the conduct of creation-related research.

For additional information not provided on their Web site about the CRS Van Andel Research Center, contact Dr. Kevin Anderson:

**Address:** 6801 N Highway 89, Chino Valley, AZ 86323-9186

**Phone:** (928) 636-1153

**E-mail:** vacrc@creationresearch.org

### ***Fogware Publishing***

Fogware Publishing provides educational media for grades K–12.

**Address:** 9625 West 76th Street, Suite 150, Eden Prairie, MN 55344

**Phone:** (408) 977-0250

**Web site:** www.fogwarepublishing.com

**E-mail:** support@jcresearch.com

### ***Illustra Media***

“Now a superb new documentary from Illustra Media, entitled *Unlocking the Mystery of Life*, explains how biological evidence both challenges Darwinian evolution and strongly supports the alternative theory of intelligent design.”

Charles Colson, *Breakpoint*, May 21, 2002

**Address:** 18005 Sky Park Circle, Suite K, Irvine, CA 92614

**Phone:** (800) 266-7741 or (949) 794-9109

**Web site:** www.illustramedia.com

**E-mail:** felicia@go2rpi.com

### ***Institute for Creation Research***

The Institute for Creation Research (ICR) offers seminars, conferences, debates, various other speaking engagements, creation science workshops, radio and television outreach, creation research, guided tours to areas of geological interest, books, videos, publications, and free periodicals. The ICR also houses the Museum of Creation and Earth History, ICR Graduate School, library, science labs (one with an electron microscope), computer center, art center, radio broadcast facility, as well as various other facilities.

**Address:** 10946 Woodside Ave., North, Santee, CA 92071

**Phone:** (619) 448-0900

**Fax:** (619) 448-3469

**Web site:** www.icr.org

### ***Moody Publishers***

Moody Video, a division of Moody Publishers, has exciting videos/DVDs that bridge the gap between science and faith. They have a wide selection of items for family entertainment, faith and reflection, Christian education, and homeschooling. Both educational and fun to watch, Moody Videos/DVDs show us that faith can be combined with science, helping us to understand the majesty of God through the wonders of His creation.

**Address:** 820 N. La Salle Blvd., Chicago, IL 60610

**Phone:** (800) 678-6928 or (800) 842-1223 or (312) 329-2101

**Web site:** [www.moodyvideo.org](http://www.moodyvideo.org) or [www.moodypublishers.com](http://www.moodypublishers.com)

**E-mail:** [mpcustomerservice@moody.edu](mailto:mpcustomerservice@moody.edu) or [pressinfo@moody.edu](mailto:pressinfo@moody.edu)

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### ***Moody Science Classics, 20 DVD Set<sup>1</sup>***

Marvel at amazing animals. Journey through the human circulatory system. Discover why the Incan culture mysteriously declined.... And through it all, rejoice in the majesty of God! This set of award-winning DVDs offers your whole family a balanced approach to science, while giving credit to the Creator. Addresses physics, biology, astronomy, and more! 28 minutes each.

*City of the Bees, Dust or Destiny, Empty Cities, Facts of Faith, God of Creation, Hidden Treasures, Prior Claim, Red River of Life, Signposts Aloft, Where the Waters Run, Windows of the Soul, God of the Atom, Of Books and Sloths, Professor and the Prophets, Ultimate Adventure, Experience with an Eel, Mystery of the Three Clocks, Time and Eternity, Voice of the Deep, Journey of Life*

### ***NASA Central Operation of Resources for Educators<sup>2</sup>***

The NASA Central Operation of Resources for Educators (CORE), established in cooperation with Lorain County Joint Vocational School, serves as the worldwide distribution center for NASA-produced multimedia materials. For a minimal charge, CORE will provide a valuable service to educators unable to visit one of the NASA Educator Resource Centers by making NASA educational materials available through its mail order service.

Through CORE's distribution network, the public has access to more than 200 video, DVD, slide, and CD-ROM programs, chronicling NASA's state-of-the-art research and technology. Through the use of these curriculum supplement materials, teachers can provide their students with the latest in aerospace information. NASA's educational materials on aeronautics and space provide a springboard for classroom discussion of life science, physical science, space science, energy, earth science, mathematics, technology, and career education.

**Mail Address:** Central Operation of Resources for Educators (CORE)  
Lorain County Joint Vocational School  
15181 Route 58 South, Oberlin, OH 44074

**Phone:** (866) 776-CORE (or 2673) or (440) 775-1400

**Fax:** (866) 775-1460 or (440) 775-1460

**Web site:** [core.nasa.gov](http://core.nasa.gov) or [education.nasa.gov/edprograms/core/home/index.html](http://education.nasa.gov/edprograms/core/home/index.html)

**E-mail:** [nasa\\_order@leeca.org](mailto:nasa_order@leeca.org)

### ***National Agricultural Library, The***

The National Agricultural Library (NAL) supplies agricultural materials to other libraries and information centers. You should submit your requests through your local library. In the United States, possible sources are public libraries, state libraries, land-grant university libraries, or other large research libraries in your state. If the publications are not available, have the library submit an *interlibrary loan request* to the NAL. Look for the "NAL CALL Number" or search online at [agricola.nal.usda.gov](http://agricola.nal.usda.gov).

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1. This 20 DVD set is available at a discount from [www.christianbook.com](http://www.christianbook.com); search for item number 679658. For phone orders, call 800-247-4784. Most videos in this series are still available at a discount, but they are going out of print.
  2. **NASA CORE** is a service of the *Education Division of the National Aeronautics and Space Administration and Lorain County Joint Vocational School*.

Outside of North America, individuals should request materials through major university, national, or provincial institutions. Requestors in countries with an AGLINET (Agricultural Libraries Network) library are encouraged to make full use of that library and its networking capabilities. To access the AGLINET Web site, go to <www.fao.org/library> and choose "Partnerships-Networks."

**Address:** National Agricultural Library, Abraham Lincoln Building  
10301 Baltimore Avenue, Beltsville, MD 20705-2351

**Phone:** (301) 504-5755

**Web site:** [agricola.nal.usda.gov](http://agricola.nal.usda.gov)

***Phoenix Learning Group, Inc., The Divisions: Phoenix Films & Video, BFA Educational Media, Phoenix Learning Resources, and Coronet/MTI***

In 1973, Heinz Gelles and Barbara Bryant formed a company called *Phoenix Films & Video*, committed to producing quality educational films. After Phoenix Films became established, *BFA Educational Media* was purchased from CBS. This division is geared mainly toward the educational marketplace.

In 1993, Phoenix moved its corporate headquarters from New York City to St. Louis, Missouri. In conjunction with this relocation to St. Louis, all company divisions were organized as a division of *The Phoenix Learning Group, Inc.*

In 1997, Phoenix acquired a fourth division—*Coronet/MTI Films* and its award-winning collection of educational videos, videodiscs, and multimedia programs—from Simon & Schuster, the publishing operation of Viacom, Inc.

Approximately 6,000 titles are now under the company's ownership or control. Phoenix currently provides quality educational content for almost any technology now developed. These titles are available in a variety of formats: 16 mm, video, laser-disc, CD-ROM, and DVD.

**Address:** 2349 Chaffee Drive, Saint Louis, MO 63146

**Phone:** (314) 569-0211 or (800) 221-1274 to request their Home School catalog

**Fax:** (314) 569-2834

**Web site:** [www.phoenixlearninggroup.com](http://www.phoenixlearninggroup.com) (to request an age-specific catalog online)

**E-mail:** [multimediasales@phoenixlearninggroup.com](mailto:multimediasales@phoenixlearninggroup.com)  
(contact: Erin Bryant, Vice President of Operations and Management)

***Bio Corporation***

Bio Corporation offers quality educational materials at reasonable prices. All the preserved specimens, live specimens, dissection equipment, educational videos, educational CDs, anatomical charts, and 3D models that you are looking for are available.

**Address:** 3911 Nevada Street, Alexandria, MN 56308

**Phone:** (800) 222-9094 to request their Home School catalog

**Fax:** (800) 332-9094

**Web site:** [biologyproducts.com](http://biologyproducts.com) (to request a catalog online)

**E-mail:** online or at <[biocorp@rea-alp.com](mailto:biocorp@rea-alp.com)>



# *Scientific Equipment Resources*

## ***Bob Jones University Press***

Bob Jones University Press has a detailed, step-by-step Biology Dissection Labs video guide on the dissection of a crayfish, perch, earthworm, and frog. This video is available in both DVD and VHS formats. This would be a very helpful product for students who are studying chapters 14 and 15. For further information about this product, simply go to the Bob Jones Web site and search for "biology dissection labs."

**Address:** BJU Press, Customer Services, Greenville, SC 29614-0062

**Phone:** (800) 845-5731 *or* (864) 242-5100, ext.3300

**Fax:** (800) 525-8398 *or* (864) 271-8151 (*orders only*)

**Web site:** [www.bjup.com](http://www.bjup.com)

**E-mail:** [bjupinfo@bjup.com](mailto:bjupinfo@bjup.com)

## ***Carolina Biological Supply Co.***

Carolina Biological Supply Company has a wide selection of scientific equipment, including preserved specimens for use in dissections. The company has established a page on its Web site that is specifically designed for the home education community, featuring resources that the company believes are particularly appropriate for home schoolers.

**Address:** 2700 York Road, Burlington, NC 27215-3398

**Phone:** (800) 334-5551 (US), *or* (800) 933-7833 *or* (519) 737-9212 (Canada)

**Fax:** (800) 222-7112 (US), *or* (519) 737-7901 (Canada)

**Web site:** [www.carolina.com](http://www.carolina.com)

**Home School Web page:** [www.carolina.com/homeschool/](http://www.carolina.com/homeschool/)

**E-mail:** [carolina@carolina.com](mailto:carolina@carolina.com)

## ***Edmund Scientifics***

**Address:** 60 Pearce Avenue, Tonawanda, NY 14150-6711

**Phone:** (800) 728-6999

**Fax:** (800) 828-3299

**Web site:** [www.scientificsonline.com](http://www.scientificsonline.com)

**E-mail:** [scientifics@edsci.com](mailto:scientifics@edsci.com)

## ***Flinn Scientific, Inc.***

Flinn Scientific has a helpful Web site for biology teachers, with suggested activities, useful information, and links to biology-oriented Web sites.

**Address:** P.O. Box 219, Batavia, IL 60510

**Phone:** (800) 452-1261

**Fax:** (866) 452-1436

**Web site:** [www.flinnsci.com](http://www.flinnsci.com)

**E-mail:** [flinn@flinnsci.com](mailto:flinn@flinnsci.com)

## ***Home Training Tools***

Home Training Tools has been in business for ten years, helping families to understand and delight in God's creation through science. This site is owned and operated by Frank and Debbie Schaner. They share a commitment with families who are seeking effective ways to teach science at home. Home Training Tools is truly a family business that also involves their four children, who have always been homeschooled.

**Address:** 665 Carbon Street, Billings, MT 59102

**Phone:** (800) 860-6272 or (406) 256-0990

**Fax:** (888) 860-2344 or (406) 256-0991

**Web site:** [www.hometrainingtools.com](http://www.hometrainingtools.com)

**E-mail:** [service@hometrainingtools.com](mailto:service@hometrainingtools.com)

## ***NASCO***

NASCO has a large number of materials that can be used for dissection activities. These include both biological specimens and dissection alternatives.

**Address:** 901 Janesville Avenue, P.O. Box 901, Ft. Atkinson, WI 53538  
4825 Stoddard Road, P.O. Box 3837, Modesto, CA 95352-3837

**Phone:** (800) 558-9595 or (920) 563-2446

**Fax:** (920) 563-8296; Modesto, CA (209) 545-1669

**Web site:** [www.enasco.com](http://www.enasco.com)

**E-mail:** [custserv@enasco.com](mailto:custserv@enasco.com)

## ***Nebraska Scientific***

**Address:** 3823 Leavenworth Street, Omaha, NE 68105-1180

**Phone:** (800) 228-7117; **Fax:** (402) 346-2216

**Web site:** [www.nebraskascientific.com](http://www.nebraskascientific.com)

**E-mail:** [staff@nebraskascientific.com](mailto:staff@nebraskascientific.com)

## ***Schoolmasters Science***

**Address:** 745 State Circle, Box 1941, Ann Arbor, MI 48106

**Phone:** (800) 521-2832; **Fax:** (800) 654-4321

**Web site:** [www.schoolmasters.com](http://www.schoolmasters.com)

**E-mail:** online or at <[wolverine@school-tech.com](mailto:wolverine@school-tech.com)>

## ***WARD'S Natural Science***

**Address:** 5100 West Henrietta Road, Rochester, NY 14692-9012  
812 Fiero Lane, P.O. Box 5010, San Luis Obispo, CA 93403-5010

**Phone:** (800) 962-2660 or (585) 359-2502; San Luis Obispo, CA (800) 872-7289

**Fax:** (585) 334-6174; San Luis Obispo, CA (805) 781-2704

**Web site:** [wardsci.com](http://wardsci.com)

**E-mail:** [customer\\_service@wardsci.com](mailto:customer_service@wardsci.com)

# UNIT 5

## Small Plants and Little Animals

### CHAPTER 10

#### Kingdom Fungi: Non-green Plants

(Text pages 111-118)

*Classification of Fungi*

*The Molds*

*Other Fungi*

*Benefits from Fungi*

#### ◆ Suggestions for Motivation or Enrichment:

1. Discuss with others the experiences with such common diseases as athlete's foot, ringworm, and valley fever\* (*Coccidioidomycosis*).
2. Separate the word *antibiotic* into its two main parts, and suggest the logic by which it was formed. Make a list of common antibiotics and the ailments which they tend to prevent, inhibit, or destroy.
3. Gently break apart some very moldy bread, examine it with a hand lens, and sketch (with labels) a section of mold with spores and connectors.
4. Research and prepare a report on cheese making. If possible, include samples in your report.

#### ◆ Suggestions for Multimedia Resources:\*\*

1. Microbe World is an official Web site for the *American Society for Microbiology*. To access this Web site, visit <<http://www.microbeworld.org/>>. This interactive site provides basic information for those interested in learning more about microorganisms; it is oriented towards evolution.

#### ◆ Suggestions for Supplementary Reading:\*\*

1. McQueen, Rodney, and David Catchpoole. "The 'Fungus' That 'Walks.'" *Creation*, 22: 349–51. To read this article online, visit the *Answers in Genesis* Web site at <<http://www.answersingenesis.org/creation/v22/i3/fungus.asp>>.

#### ◆ Answers to Questions

*Classification of Fungi (Text page 112)*

##### ➤ Questions: Classification of Fungi

1. It was difficult to classify fungi because they are "plants" without chlorophyll and are unable to manufacture food. For example, during a part of

its life cycle, a **slime mold** resembles a one-celled animal and might be considered an *animal*; but at another stage, it produces spores in structures, characteristic of molds, and is definitely *plantlike*.

Also, a **lichen** is a fungus and an alga growing in a symbiotic relationship, and it is usually classified with algae, under Kingdom Protista. (See "*Lichens: Two Plants in One*" in chapter 12.)

2. A *spore* is a single cell that can grow into a mature fungal plant. It is different from a *seed* in that it contains no embryo plant and very little stored food. Since it lacks these features, a spore cannot grow unless conditions are very favorable. In addition to this asexual method, some fungi reproduce sexually by the union of two gametes to form a zygote.
3. The main difference among the phyla of this kingdom is the type of reproduction used—*conjugation fungi*, *sac fungi*, *club fungi*, and *imperfect fungi*\*\*\*.

**Teacher:** In the first printing of the textbook, at the bottom of page 111, the text states "The members of the fourth phylum in the Fungi kingdom are separated by the type of reproduction used...." It should read "The members of the four phyla in the Fungi kingdom are separated by the type of reproduction used...." (*This was corrected in the 2006 printing.*)

##### ➤ Taking it Further: Classification of Fungi

1. *Answers may vary.* The student is asked to list several positive and negative effects of fungi.

##### *The Molds (Text page 113)*

##### ➤ Questions: The Molds

1. The conjugating (or algal) fungi belong to the Phylum Zygomycota. (See the appendix at the back of this teacher's manual.)
2. Besides making cheese, *Penicillium* was the first antibiotic discovered and was the one most widely used until resistant strains of bacteria became more abundant.
3. *Parasites* obtain food from living hosts, and *saprophytes* obtain food from nonliving organic matter.

##### ➤ Taking It Further: The Molds

1. *Answers may vary.* The student is asked to find an example of a living mold and, by its color and location, try to determine its genus.

\* This fungus is commonly found in the soil of the southwestern United States, Mexico, and parts of Central and South America.

\*\* The listing of these suggestions does not necessarily imply endorsement of content.

\*\*\* Some add a fifth phylum, **Oomycota** (Protistlike Fungi), which includes the water molds that form on fish, on matter in water, etc.

**Other Fungi (Text page 116)****➤ Questions: Other Fungi**

1. The *sac fungi* belong to the Phylum Ascomycota, *club fungi* belong to the Phylum Basidiomycota, and *imperfect fungi* belong to the Phylum Deuteromycota. (See the appendix at the end of this teacher's manual.)
2. A *mycosis* is a fungal infection that attacks man and is extremely difficult to cure and often remains for many years.
3. Rusts require two hosts. For example, wheat rust attacks its **first host** (wheat) during the time it is producing seeds. Late in the summer, the fungus enters a second stage in which it forms black spores on the dry stalks left in the fields. These spores then are blown by the wind and fall on its **second host** (barberry bushes), where they attack the leaves in the spring.

**➤ Taking It Further: Other Fungi**

1. *Answers may vary. The student is asked to give an example of each type of fungi and describe its method of reproduction.*

**Benefits From Fungi (Text page 118)****➤ Questions: Benefits From Fungi**

1. *Answers may vary.* Benefits of fungi are as follows:
  - *For healing*, such as penicillin—an antibiotic used to fight influenza bacteria
  - *For food*, such as edible mushrooms, truffles, and cheeses (produced by the action of molds on milk)
  - *For decomposition*, such as those which break down dead plants and animals—recycling chemical elements in their cytoplasm
  - *For root absorption*, such as mycorrhizae that help pine trees
  - *For insect control*, such as several species of fungi that parasitize insects
2. Decomposers, mostly bacteria and fungi, are *heterotrophs* (organisms that require complex organic compounds of nitrogen and carbon for metabolic synthesis) that obtain food by breaking down substances in dead protoplasm. They are so important because without them the earth would be littered with dead bodies.
3. Fungi have medicinal use as an antibiotic, such as penicillin that fights influenza bacteria. In the production of food, some fungi are edible, such as mushrooms and truffles; baker's yeast is used to make bread rise and to brew beer; and some fungi (i.e., molds) are used in the production of cheeses.

**➤ Taking It Further: Benefits From Fungi**

1. *Answers may vary. The student is asked to find an article on the use of any fungus as an insecticide and summarize the findings.*

**➤ Questions: Chapter Review**

1. Many molds live on organic substance which is not living; therefore, they are called *saprophytes*. Quite a number of molds live on living things, but most of the ones you see are saprophytes.
2. The essential structures of a fungus are fibers called *hyphae*, *spores*, and some structure on which or in which the spores are found. Hyphae may be given different names according to their position.
3. A yeast cell produces a mere protrusion called a bud, which grows and becomes a full-sized cell. *Penicillium* forms a branched stalk. On the ends of these branches grow tiny cells called spores that have the ability to grow into complete mold plants.
4. Since the Japanese barberry is harmless and the common barberry harbors wheat rust, it is important that they be named correctly and that persons learn to recognize them.
5. The alcohol formed by yeast is very volatile and so is dissipated in the oven.
6. Athlete's foot is a parasitic mold. A person should avoid walking barefoot in areas where there may be contamination.
7. Darkness is neither an advantage nor a disadvantage. An even temperature helps mushrooms and an even degree of moisture in the air also helps a great deal. However, a sudden drying of the air would kill them.
8. Mushrooms do not live on mineral soil but on plant or animal material. Garden soil has but little of plant or animal flesh or refuse.
9. If air can circulate between layers of boards, it keeps the boards so dry that molds cannot grow on them. Molds are the chief agents of the decay of wood.
10. Some might say that Sir Alexander Fleming's discovery was "chance"; but, under the direction of God's providence, penicillium spores were allowed to get into the culture dishes of bacteria. Perhaps the wind blew in some spores when someone opened the dishes. But the discovery of what the spores had done was due to the careful training of Alexander Fleming.\*

\* Helpful discoveries always require training and research that a so-called "chance" event may be recognized and developed.