PRACTICING TO TAKE THE

GRE BIOLOGY TEST

2nd Edition

INCLUDES:

- An actual GRE Biology Test administered in 1989-90
- Sample questions, instructions, and answer sheets
- Percent of examinees answering each question correctly

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AN OFFICIAL PUBLICATION OF THE GRE BOARD

Published by Educational Testing Service
for the Graduate Record Examinations Board

The Graduate Record Examinations Program offers a General Test measuring developed verbal, quantitative, and analytical abilities and Subject Tests measuring achievement in the following 16 fields:

Biochemistry, Cell and Molecular Biology	Economics	Literature in English	Political Science
Biology	Education	Mathematics	Psychology
Chemistry	Engineering	Music	Sociology
Computer Science	Geology	Physics	
	History		

The tests are administered by Educational Testing Service under policies determined by the Graduate Record Examinations Board, an independent board affiliated with the Association of Graduate Schools and the Council of Graduate Schools.

The Graduate Record Examinations Board has officially made available for purchase practice books, each containing a full-length test, for 15 of the Subject Tests. A practice book is not available for the Biochemistry, Cell and Molecular Biology Test at this time. Two General Test practice books are also available. These practice books may be purchased by using the order form on page 103.

Individual booklets describing each test and including sample questions are available free of charge for all 16 Subject Tests. These booklets may be requested by writing to:

Graduate Record Examinations
Educational Testing Service
P.O. Box 6014
Princeton, NJ 08541-6014

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TABLE OF CONTENTS

BACKGROUND FOR THE TEST

TAKING THE TEST

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TABLE OF CONTENTS

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PRACTICING TO TAKE THE GRE® BIOLOGY TEST

This practice book has been published on behalf of the Graduate Record Examinations Board to help potential graduate students prepare to take the GRE Biology Test. The book contains the actual GRE Biology Test administered in October 1989, along with a section of sample questions, and includes information about the purpose of the GRE Subject Tests, a detailed description of the content specifications for the GRE Biology Test, and a description of the procedures for developing the test. All test questions that were scored have been included in the practice test.

The sample questions included in this practice book are organized by content category and represent the types of questions included in the test. The purpose of these questions is to provide some indication of the range of topics covered in the test as well as to provide some additional questions for practice purposes. These questions do not represent either the length of the actual test or the proportion of actual test questions within each of the content categories.

Before you take the full-length test, you may want to answer the sample questions. A suggested time limit is provided to give you a rough idea of how much time you would have to complete the sample questions if you were answering them on an actual timed test. After answering the sample questions, evaluate your performance within content categories to determine whether you would benefit by reviewing certain courses.

This practice book contains a complete test book, including the general instructions printed on the back cover and inside back cover. When you take the test at the test center, you will be given time to read these instructions. They show you how to mark your answer sheet properly and give you advice about guessing.

Try to take this practice test under conditions that simulate those in an actual test administration. Use the answer sheets provided on pages 97 to 102 and mark your answers with a No. 2 (soft-lead) pencil as you will do at the test center. Give yourself 2 hours and 50 minutes in a quiet place and work through the test without interruption, focusing your attention on the questions with the same concentration you would use in taking the test to earn a score. Since you will not be permitted to use them at the test center, do not use keyboards, dictionaries or other books, compasses, pamphlets, protractors, highlighter pens, rulers, slide rules, calculators (including watch calculators), stereos or radios with headphones, watch alarms including those with flashing lights or alarm sounds, or paper of any kind.

After you complete the practice test, use the work sheet and conversion tables on pages 48 and 49 to score your test. The work sheet also shows the estimated percent of GRE Biology Test examinees from a recent three-year period who answered each question correctly. This will enable you to compare your performance on the questions with theirs. Evaluating your performance on the actual test questions as well as the sample questions should help you determine whether you would benefit further by reviewing certain courses before taking the test at the test center.

We believe that if you use this practice book as we have suggested, you will be able to approach the testing experience with increased confidence.

ADDITIONAL INFORMATION

If you have any questions about any of the information in this book, please write to:

Graduate Record Examinations
Educational Testing Service
P.O. Box 6000
Princeton, NJ 08541-6000

PURPOSE OF THE GRE SUBJECT TESTS

The GRE Subject Tests are designed to help graduate school admission committees and fellowship sponsors assess the qualifications of applicants in their subject fields. The tests also provide students with an assessment of their own qualifications.

Scores on the tests are intended to indicate students' knowledge of the subject matter emphasized in many undergraduate programs as preparation for graduate study. Since past achievement is usually a good indicator of future performance, the scores are helpful in predicting students' success in graduate study. Because the tests are standardized, the test scores permit comparison of students from different institutions with different undergraduate programs. For some Subject Tests, such as the Biology Test, subscores are provided in addition to the total score; these subscores indicate the strengths and weaknesses of individual students' preparation and may help them plan their future studies.

The Graduate Record Examinations Board recommends that scores on the Subject Tests be considered in conjunction with other relevant information about applicants. Because numerous factors influence success in graduate school, reliance on a single measure to predict success is not advisable. Other indicators of competence typically include undergraduate transcripts showing courses taken and grades earned, letters of recommendation, and GRE General Test scores.

DEVELOPMENT OF THE GRE BIOLOGY TEST

Each new edition of the Biology Test is developed by a committee of examiners composed of professors in the subject who are on undergraduate and graduate faculties in different types of institutions and in different regions of the United States. In selecting members for the committee of examiners, the GRE Program seeks the advice of the American Institute of Biological Sciences, the Botanical Society of America, and the American Society of Zoologists.

The content and scope of each test are specified and reviewed periodically by the committee of examiners who, along with other faculty members who are also subject-matter specialists, write the test questions. All questions proposed for the test are reviewed by the committee and revised as necessary. The accepted questions are assembled into a test in accordance with the content specifications developed by the committee of examiners to ensure adequate coverage of the various aspects of the field and at the same time to prevent overemphasis on any single topic. The entire test is then reviewed and approved by the committee.

Subject-matter and measurement specialists on the ETS staff assist the committee of examiners, providing information and advice about methods of test construction and helping to prepare the questions and assemble the test. In addition, they review every test question to identify and eliminate language, symbols, or content considered to be potentially offensive, inappropriate, or

serving to perpetuate any negative attitudes. The test as a whole is also reviewed to make sure that the test questions, where applicable, include an appropriate balance of people in different groups and different roles.

Because of the diversity of undergraduate curricula in biology, it is not possible for a single test to cover all the material an examinee may have studied. The examiners, therefore, select questions that test the basic knowledge and understanding most important for successful graduate study in the field. The committee keeps the test up-to-date by regularly developing new editions and revising existing editions. In this way, the test content changes steadily but gradually, much like most curricula.

When a new edition is introduced into the program, it is equated; that is, the scores are related by statistical methods to scores on previous editions so that scores from all editions in use are directly comparable. Although they do not contain the same questions, all editions of the Biology Test are constructed according to equivalent specifications for content and level of difficulty, and all measure equivalent knowledge and skills.

After a new edition of the Biology Test is first administered, examinees' responses to each test question are analyzed to determine whether the question functioned as expected. This analysis may reveal that a question is ambiguous, requires knowledge beyond the scope of the test, or is inappropriate for the group or a particular subgroup of examinees taking the test. Such questions are not counted in computing examinees' scores.

CONTENT OF THE GRE BIOLOGY TEST

The test contains about 210 five-choice questions, a number of which are grouped in sets toward the end of the test and based on descriptions of laboratory and field situations, diagrams, or experimental results.

To cover the broad field of the biological sciences, the committee has decided to organize the subject matter on which the students are tested into three major areas: cellular and molecular biology; organismal biology; and ecology, evolution, and population biology. Approximately equal weight is given to these three areas.

Cellular and Molecular Biology

Cellular biology, together with molecular genetics and molecular biology, are fundamental for the whole of biology. Major areas included are: cell structure and function, including biochemical principles, the cell surface, membranes, subcellular organelle systems, structural elements involved in protein synthesis and in DNA replication, and structures such as microtubules and microfilaments that are involved in cell motility and cell shape. Energetic processes such as respiration, fermentation, and photosynthesis and their utilization in biosynthesis are also emphasized. Because familiarity with methods is essential before data

can be evaluated, some attention is given to experimental techniques. Molecular genetics and molecular biology are emphasized since these subjects are integral to current courses in biology.

A. Cellular structure, function, and organization
1. Biological compounds: macromolecular structures and their linkages
2. Enzyme activity and regulation
3. ATP and energy-producing pathways (respiration, fermentation, and photosynthesis)
4. Membrane dynamics and cell surfaces (transport, transmitter substances, and specificity)
5. Organelles and other cellular components
6. Microfilaments, microtubules, and cell movement
7. Distinctions between prokaryotic and eukaryotic cells
8. Extracellular matrix (for example, plant cell walls and collagen)

B. Molecular biology and molecular genetics
1. Cell cycle: mitosis and meiosis
2. Mutations and chromosomal alterations
3. Replication of nucleic acids
4. RNA and protein synthesis
5. Regulation of gene expression (including molecular control of development)
6. Viruses
7. Genetic engineering and recombinant DNA
8. Molecular evolution

Organismal Biology

The morphology of plants and animals, their physiology, development, and behavior are addressed. Topics covered include nutrient procurement and processing, gas exchange, internal transport, regulation of body fluids, control mechanisms and effectors, and reproduction in autotrophic and heterotrophic organisms. Plant morphology, ranging from that of specialized tissues to the gross structure of organs, is included. For both invertebrates and vertebrates, the classic systems include: nervous, muscular, connective, cardiovascular, respiratory, excretory, digestive, endocrine, and reproductive. Perceptions of environmental stimuli and responses to light, temperature, sound, pressure, and chemicals are included and pertain to both animals and plants. Examples of developmental phenomena include Mendelian genetics and range from fertilization through differentiation and morphogenesis. The field of behavior — animal communication, orientation behavior, and biological clocks — is also covered.

A. Animal structure, function, and organization
1. Digestion and nutrition
2. Excretion
3. Gas exchange

4. Cardiovascular system
5. Skeleto-muscular system
6. Nervous system
7. Endocrine system and hormones
8. Control mechanisms (for example, homeostasis and biorhythms)
9. Immunity

B. Animal reproduction, growth, and development
1. Estrus and menstrual cycles and their hormonal regulation
2. Fertilization and ovulation
3. Implantation and placentation
4. Differentiation and morphogenesis
5. Abnormal development, cancer, and aging

C. Animal behavior

D. Plant structure, function, and organization
1. Roots, stems, leaves, and their tissues
2. Meristems and growth
3. Water relations (absorption, transport, and transpiration)
4. Mineral nutrition
5. Translocation and storage
6. Control mechanisms (for example, hormones, photoperiods, and tropisms)

E. Plant reproduction and development
1. Sex and alternation of generations
2. Flowers, fruits, and seeds

F. Biology of algae and fungi

G. Mendelian genetics in plants and animals
1. Probability and pedigree analysis
2. Segregation, recombination, and linkage
3. Polygenic inheritance

Ecology, Evolution, and Population Biology

Biology above the level of the individual — population, community, ecosystem, and biosphere — is the concern of this area. Topics include population ecology and genetics, distribution and dynamics, biomes, community ecology, ecosystem dynamics, and methods for their study. Questions in evolution are addressed, both as process and outcome — the genetic basis, population structure, selection, and speciation, along with the resultant evolutionary patterns, higher taxa, and phylogeny. At this level, ecology, genetics, and evolution merge in many questions; e.g., population ecology and genetics; selection at the individual level and its implications for populations and communities; behavior at the population level, coevolution, habitat selection, biogeography, and evolutionary patterns. Relevant historical aspects and some classical experiments are incorporated.

A. Environmental factors and global patterns
1. Biogeography (latitudinal and altitudinal zones; land, sea, and inland waters)
2. Biomes
3. Cycles and seasons

B. Population dynamics of single species
1. Habitat selection, tolerances, limiting factors, and dispersal
2. Demography and life history
3. Population regulation
4. Adaptations to various habitats

C. Interspecific relationships and communities
1. Competition, predation, parasitism, symbioses
2. Community structure, niche
3. Species diversity
4. Change and succession

D. Ecosystems
1. Energy flow and cycling of elements
2. Productivity

E. Behavioral ecology

F. Genetic variability
1. Origins (mutation, recombination, chromosomal alterations)
2. Distributions (polymorphism, clines, ecotypes)

G. Population structure and variability
1. Gene flow and genetic drift
2. Neutral variability
3. Balanced polymorphism

H. Natural selection
1. Hardy-Weinberg equilibrium
2. Heritability and fitness
3. Selection patterns
4. Levels of selection (for example, gene, group, species)
5. Coevolution

I. Speciation and isolating mechanisms

J. Patterns of evolution
1. Convergence, divergence, and adaptive radiation
2. Extinction
3. Evolution of higher categories
4. Evolutionary rates

K. Diversity of life
1. Origin of life
2. Plant and animal diversity
3. Systematics and phylogeny
4. Human evolution

Abilities

The examination is designed to evaluate the following abilities and background of the student.

- Knowledge of basic vocabulary and facts in several biological fields at the equivalent of an upper-level course
- Conceptual understanding of ideas, relationships, and processes
- Understanding of basic scientific research, procedures, and tools
- Capacity to read, evaluate, and draw conclusions from unfamiliar laboratory and field studies
- Understanding of the connections among biological fields and between biological fields and cognate sciences
- Some knowledge of the history of the biological fields

SAMPLE QUESTIONS

The sample questions included in this practice book are organized by content category and represent the types of questions included in the test. The purpose of these questions is to provide some indication of the range of topics covered in the test as well as to provide some additional questions for practice purposes. **These questions do not represent either the length of the actual test or the proportion of actual test questions within each of the content categories.** A time limit of 85 minutes is suggested to give you a rough idea of how much time you would have to complete the sample questions if you were answering them on an actual timed test. Correct answers to the sample questions are listed on page 45.

When you take the actual GRE test, you will be instructed to mark your answers on the separate answer sheet. The directions for the sample questions have been modified. For these questions, you may record your answers in one of two ways: 1) you can use the option bubbles at the bottom-right corner of each question or 2) you can use one of the sample answer sheets provided in this book.

Cellular and Molecular Biology

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case.

1. If sufficient amino nitrogen is supplied in the diet, the human organism can synthesize all of the following EXCEPT

   (A) glucosamine
   (B) coproporphyrin
   (C) thiamine
   (D) myosin
   (E) phosphohexoisomerase

   Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

2. The most important factor governing the upper limit of the size of a cell has to do with the

   (A) cell's need for room to carry out its functions
   (B) criteria which define life as not existing below the cellular level
   (C) fact that most organisms start life as single cells and grow to become multicellular
   (D) ratio of surface to volume, which decreases rapidly with decreasing cell volume
   (E) ratio of surface to volume, which decreases rapidly with increasing cell volume

   Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ