



# MAJOR FIELD TESTS

Colleges and universities use the Major Field Tests to measure student academic achievement and growth and to assess the educational outcomes of their major programs. In addition, academic departments use the Major Field Tests to evaluate their curricula and to measure the progress of their students. The tests also provide students with an assessment of their own level of achievement within a field of study compared to that of students in their program and to national comparative data.

## Background

Development of the Major Field Tests began in 1989, modeled on the development of the Graduate Record Examinations (GRE) Subject Tests. However, unlike the GRE Subject Tests, the Major Field Tests do not serve as a predictor of graduate school success, but are designed to measure the basic knowledge and understanding achieved by senior undergraduates in their major field of study. Each test is revised approximately every five years. Experienced teaching faculty members representing all the relevant areas of a discipline participate in determining test specifications, questions, and types of scores reported. ETS assessment experts subject each question to rigorous tests of sensitivity and reliability. In addition, every effort is made to include questions that assess the most common and most important topics and skills within each major field of study.

## Test Content

The Major Field Tests are designed to assess mastery of concepts, principles, and knowledge expected of students at the conclusion of an academic major in specific subject areas. In addition to factual knowledge, the tests evaluate students' abilities to analyze and solve problems, understand relationships, and interpret material. The tests may contain questions that require interpretation of graphs, diagrams, and charts based on material related to the field. Academic departments may add up to 50 additional locally written questions to test areas of a discipline that may be unique to the department or institution.

## Test Length

The tests are two-hour multiple-choice tests. The addition of optional, locally developed questions may require a longer testing period.

## Test Administration

Departments or schools choose when and where to give the tests; however, the tests are normally administered during the senior year when students have completed the majority of courses in the major. Many institutions administer the tests as part of the requirements of a capstone course.

## National Comparative Data

A Comparative Data Guide, published each year, contains tables of scale scores and percentiles for individual student scores, departmental mean scores, and any subscores or group assessment indicators that the tests may support. The tables of data are drawn from senior-level test takers at a large number of diverse institutions. More than 500 colleges and universities employ one or more of the Major Field Tests for student achievement and curriculum evaluation each year.

## Scores

Major Field Test score reports are sent directly to the office within an institution that purchases them, such as a department chairperson, dean, or director of testing. Results of the tests are reported for the entire group of test takers, as well as for individual students. Overall student scores are reported on a scale of 120-200; subscores (which many of the tests include) are reported on a scale of 20-100. Another score reported for most of the tests is based on group-level achievement in subfields of the discipline. These "assessment indicators" report the average percent of a subset of test questions answered correctly by all students tested. On Major Field Tests, only correct answers are scored, so students are not penalized for omissions or guesses.

## ***BIOLOGY***

# ***BIOLOGY*** (3W MF)

(Current form introduced in January 2000)

The Major Field Test in Biology contains about 150 multiple-choice questions, a number of which are grouped in sets and based on descriptions of laboratory and field situations, diagrams, or experimental results. The subject matter is organized into four major areas: cell biology; molecular biology and genetics; organismal biology; and population biology, evolution, and ecology. Some of the questions within each of the major areas are designed to test examinees' analytical skills.

The content distribution is as follows:

- 1) **Cell Biology** (20 percent of the questions)
  - A. Biochemistry and cell energetics (10 percent)
    - Biological compounds and macromolecules
    - Post-translational modification, transmembrane insertion, sorting of proteins
    - Enzyme activity and regulation
    - ATP and energy-producing pathways
    - First and second laws of thermodynamics
    - Cell-cell communication
  - B. Cellular structure, organization, and function (10 percent)
    - Organelles and other cellular components
    - Cytoskeleton and cell motility
    - Cell surfaces and membrane function
    - Extracellular space
    - Cell theory, germ theory
    - Distinctions among archaeobacteria, eubacteria, and eukaryotic cells
    - Cell growth, cell cycle, mitosis, and cytokinesis
- 2) **Molecular Biology and Genetics** (21 percent of the questions)
  - A. Molecular genetics (15 percent)
    - DNA replication and mutation
    - Gene structure, introns, and exons
    - Regulation of gene expression
    - RNA transcription and modification
    - Translation of mRNA
    - Bacteriophages and viruses
    - Control of normal development; cancer
    - Molecular aspects of immunology
    - Genetic engineering
  - B. Heredity (6 percent)
    - Meiosis and chromosomal alterations
    - Modes of inheritance
    - Probability and pedigree analysis
    - Segregation, recombination, and chromosome mapping
    - Polyploidy and aneuploidy
    - Sex determination
    - Non-Mendelian inheritance
    - Prokaryote genetics
- 3) **Organismal Biology** (31 percent of the questions)
  - A. Diversity of organisms (9 percent)
    - Phylogenetic relationships, classification, morphology, life histories, and general biology of
      - bacteria and archaea
      - protists
      - fungi
      - plants
      - animals
    - Origin of life and endosymbiont theory
    - Fossil record and human evolution
    - Systematics and molecular phylogeny
    - Adaptations of organisms to habitats
  - B. Animal organ systems (vertebrates and invertebrates): comparative structure, function, and organization (8 percent)
    - Digestion and nutrition
    - Excretion and osmoregulation
    - Gas exchange and ventilation
    - Circulatory systems
    - Support and movement
    - Nervous and endocrine systems
    - Integument
    - Immune system
    - Metabolic rates and energy

- C. Animal reproduction, growth, and development (4 percent)
    - Reproductive structures; gametogenesis
    - Fertilization, cleavage, and gastrulation
    - Comparative embryology
    - Reproduction in nonchordate animals
  - D. Plant organ systems (seed plants and nonseed plants): comparative structure, function, and organization (7 percent)
    - Roots, stems, leaves
    - Plant energetics
    - Water relations
    - Mineral nutrition
    - Translocation and storage
    - Hormones, photoperiods, and tropisms
    - Nonphotosynthetic strategies
  - E. Plant reproduction, development, and growth (3 percent)
    - Reproductive structures, gametogenesis, and sporogenesis
    - Fertilization and alternation of generations
    - Embryogeny and germination
    - Meristems and growth
- 4) **Population Biology, Evolution, and Ecology** (28 percent of the questions)
- A. Population genetics and natural selection (7 percent)
    - Genetic variability and polyploidy
    - Distributions of genetic variability
    - Hardy-Weinberg equilibrium, genetic drift
    - Heritability, fitness, and adaptation
    - Natural selection
  - B. Patterns of evolution (5 percent)
    - Modes of speciation
    - Isolating mechanisms
    - Convergence, divergence, and adaptive radiation
    - Extinction
    - Evolution of higher taxa
    - Evolutionary rates and punctuated equilibrium
    - Evidence for evolution
    - Molecular evolution
    - Neutral mutations
    - Coevolution
  - C. Environmental factors (2 percent)
    - Biogeographic and temporal patterns
    - Biomes
    - Climate
  - D. Population ecology (5 percent)
    - Habitat selection, tolerances, limiting factors, and resource acquisition
    - Demography and population dynamics
    - Animal behavior
  - E. Community ecology (4 percent)
    - Competition, predation, parasitism, and symbiosis
    - Community structure and niche
    - Species richness and species diversity
    - Change and succession
    - Introduced species
  - F. Ecosystems (4 percent)
    - Energy flow, biogeochemical cycling, and decomposition
    - Productivity
    - Food webs
  - G. Human impacts (1 percent)
    - Human demography
    - Resource depletion and pollution
    - Economic botany
    - Habitat modification and effects on organisms
    - Emerging diseases, endemic diseases
- 5) **Analytical Skills** (about 10-12 percent of the above questions)
- A. Science as a way of knowing
    - Understanding quantitative aspects and limitations of science
    - Understanding the place of hypotheses and theories in biology
    - Identification and testing of hypotheses
  - B. Experimental design
    - Identification of variables and establishing experimental controls
    - Ensuring that measured parameters are affected by phenomenon being studied
  - C. Interpretation, data analysis, inductive reasoning, and drawing conclusions from data
    - Application of information to solve a problem or make a prediction
    - Demonstration of proficiency with quantitative concepts and familiarity with units of measure
    - Demonstration of an understanding of probability theory and statistics
    - Interpretation of data, graphs, tables, and statistical analyses

Scores for the Biology Test are reported as follows:

**Total Score**

Reported for each student and summarized for the group.

**Subscores**

Reported for each student and summarized for the group.

- Cell Biology (30)
- Molecular Biology and Genetics (32)
- Organismal Biology (47)
- Population Biology, Evolution, and Ecology (42)

**Assessment Indicators**

Reported for the group\*only

- Biochemistry and Cell Energetics (15)
- Cellular Structure, Organization, Function (15)
- Molecular Biology and Molecular Genetics (22)
- Diversity of Organisms (14)
- Organismal-Animals (18)
- Organismal-Plants (15)
- Population Genetics and Evolution (18)
- Ecology (24)
- Analytical Skills (17 overlapping other areas)

Numbers in parentheses are approximate number of questions in each category.

\*A minimum of five students is required for assessment indicators to be reported.



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