Guidelines for Evaluating Undergraduate Education in Biology

Introduction

At the 1987 meeting of AMCBT a motion was adopted to develop a set of guidelines that could be used by the affiliate schools of the organization as an aid to help them establish acceptable programs in biology. After surveying member schools a set of guidelines were constructed using information from these surveys and model programs such as those used by the American Chemical Society. Following is the set of guidelines that came out of this effort. The intent of the organization is that they be used to encourage administrators to move in a positive direction towards improving their offerings in Biology.

In order to have an AMCBT Approved Biology Baccalaureate Program an institution should provide as a minimum:

- 480 Hours of classroom work in biology (33 Sem. Hrs.)
- 360 Hours of Laboratory/Field work in biology (One 3 Hr. lab per week per semester)
- A core curriculum that covers the principles of prokaryotic biology, eukaryotic biology, evolutionary biology, genetics, cellular/molecular biology, ecological biology, physiological biology, anatomical biology.
- One year of advanced work in biology or allied fields that is outside of the core.
- One year of physics.
- Two years of chemistry to include general chemistry, organic chemistry and biochemistry.
- One year of mathematics and computer science.
- An undergraduate capstone experience such as research, internship or other appropriate activity.

In addition, in order to be acceptable to the organization, an approved program must meet acceptable standards of:

- Faculty size—composition (minimum) four biologists, three-fourths of total to be full time with doctorates in Biology except for programs with a clinical component.
- Teaching loads (maximum) 12 contact hours per week including lab.
- Support for Faculty Development.
- Library collection (minimum of 20 subscriptions to refereed journals, access to biological abstracts).
- Facilities and equipment to include animal-care protocol.
- Budget and administrative structure.

Each department should regularly review the curriculum to include provision for:

- Examinations, syllabi, and student research reports (oral or written)
- Textbooks
- Placement of graduates

Guidelines Rationale

Introduction

The principle purpose of having a set of guidelines approved by AMCBT is to help individual Biology departments provide biology majors with a sound education in the fundamental areas of modern biology. The best approach to doing this is to establish a broad set of guidelines that will allow departments to develop programs that will emphasize the strength of the institution and faculty.
An important factor in the design of a curriculum is the academic preparation and potential for entering students. Introductory courses should encourage and accommodate students with different backgrounds, potential and career goals.

**Total Hours**

No four year curriculum can cover the whole of Biology. The **quality** of the education is thus more important than the precise content. An approved program in Biology, exclusive of courses in chemistry, physics and mathematics, normally comprises about one-third of a total undergraduate program of 120 hours. It is therefore felt that a graduate in biology should have the following experiences as an undergraduate.

1. **480 hours in classroom work.** Supervised reading courses, tutorials, active participation in seminars, and supervised self-study programs could also count.

2. **360 hours of laboratory work.** These hours may be a combination of research and course combined laboratory, but no more than one fifth may be research-based. This is to insure a broad base of laboratory experiences.

**Laboratory Work**

Laboratory work should give students hands-on knowledge of biology and the self-confidence and competence to:

a. plan and execute experiments through the use of literature,

b. be logical, organized and critical,

c. perform accurate quantitative measurements,

d. develop skills of observation, recognition and classification,

e. communicate effectively through oral and written reports,

f. analyze data statistically and access reliability of results,

g. interpret experimental results and draw reasonable conclusions, and

h. develop hypotheses that can be tested using the scientific method.

**Core Curriculum**

Programs of study in biology for majors and non-majors can be organized in many ways to reflect the institution's mission, the available facilities, and the interests and capabilities of the students and faculty. However organized, the core curriculum must include experience in prokaryotic biology, eukaryotic biology, systematic biology, cellular biology, environmental biology, physiological biology, and anatomical biology. The identification of areas in biology that should be studies has been kept intentionally broad to allow approaches that cover the same material in different ways. This core subsequently provides the student with 21 semester hours (excluding co-requisite lab hours) of the basic principles and theory of biology.

**Advanced Courses**

In addition to the core program students in biology should take a **minimum** of six semester hours of advanced work. This allows the student to develop additional skills and knowledge to begin specializing in one of the many areas of biology.

**Supplemental Course Work**

A competent graduate in biology must have a solid foundation in the underlying skills and theory of mathematics, chemistry and physics. They are so intertwined with modern biology that it is difficult to find an area that is not affected by them in one way or another. Students should have a firm foundation in the fundamentals and application of mathematics; an understanding of the basic principles of linear algebra and practical knowledge of statistics. Experience with computers is highly recommended.
Research

It is recommended that a carefully designed program of distinctively problem-oriented undergraduate research be developed. It should be recognized, however, that independent projects make heavy demands on institutional resources and faculty and student time. **Proper supervision of research requires much attention by a faculty advisor, for which allowances should be made in teaching assignment.** Well planned research should help undergraduates acquire a spirit of inquiry, inquisitiveness, independence, sound judgment, patience, persistence, alertness and the ability to use biology literature.

Faculty

At least 75% of the teaching faculty should have earned doctoral degrees in biology or should have equivalent experience. Their scientific and educational capabilities should be distributed over the major areas of biology so that upper level and advanced courses are taught by faculty qualified in each specialty. **Faculty size and competence must be adequate to teach on a regular basis the full range of biology courses needed for undergraduate professional education. The number of part time faculty should be kept to a minimum.** Sound policies regarding salaries, teaching loads, promotion, sabbatical leaves and tenure are essential. This is needed to maintain high faculty morale.

Teaching loads are particularly important. Loads should be at a level to allow faculty to keep abreast of developments in biology and related disciplines. Teaching loads should thus be kept to no more than 12 contact hours per week (including laboratory supervision). Supervision of a student laboratory commits the time and energy of a faculty member as fully as the the preparation for and presentation of a lecture. Also, part of the teaching load credit should be obtainable through guiding independent study and student research.

Facilities

The institution should have a library within or near the teaching building with holdings related to the size and nature of the biology program and research activities of staff and students. There should be a minimum of at least 20 current significant periodicals, with a significant back run, preferable 10 years, and a range of other reference material. In addition to primary sources, a significant secondary source such as Biological Abstracts ought to be available to teach students how to gain access to the biological literature. Access to computer terminals through which students may interact with bibliographic and data files is becoming increasingly desirable.

Laboratories should be well-lighted and ventilated and be equipped with such services as gas, water, and electric power. Hoods should be readily available and in working order. A chemistry laboratory standard established in California suggests 28 square feet and 42 square feet of working space per student for lower and upper division laboratories, respectively.

A resource room and self instruction center is strongly recommended. It could contain such thing as those found in the traditional reading room. Newer resources such as videotapes, audio courses, calculators and computer terminals might be included.

Revised and adopted by members attending the 1992 meetings of AMCBT.