

Required Courses in Biology at Teacher Training Institutions

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In this series of two articles, the author tells of his survey of the courses required of the future biology teacher among teacher colleges in the Midwest. The author is an Associate Professor of Zoology. In the second article he tells of the optimum curriculum which has some possibility of support.

The Problem

This paper is a report on (1) the variations in required courses in biology that prospective biology teachers in the midwest must take in their secondary curriculum, and (2) the attitudes of teachers and administrators in colleges and universities toward these variations. This study of the required courses in biology was conducted by questionnaire at state-supported teacher training institutions in Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, and Indiana.

Methods

The first step was the examination of the most recent available catalogs from each of 29 midwest institutions and the tabulation in semester hours of the required courses in biology. A copy of the required courses (Table I) was then sent to the administrators in charge of biology departments at each college or university, so that they could check the list for accuracy. After correction, the list of required courses and a questionnaire (summary in Table II) were mailed to all biology teachers listed in the catalogs.

Results

Table I shows a biology major in state-supported teacher training institutions in the midwest is required to take an average of 11.6 semester hours in introductory courses in biology, and an average of 19.1 semester hours in advanced courses. Advanced courses in this paper are defined as the courses in the field of biology other than general biology, general botany, and general zoology. The number of total required hours exclusive of methods and practice teaching ranges from a low of 24 to a high of 40 semester hours with an average of 30.7. This average has increased

2.0 semester hours since this study was started in 1957. The average number of semester hours required in methods of teaching is 2.4; in practice teaching an average of 7.9 semester hours is required.

Genetics is the only advanced course required as many as 8 times at the 29 institutions. Taxonomy of Plants or Taxonomy of Flowering Plants is required 5 times; while Microbiology (or Bacteriology) and Conservation are each required 4 times. Invertebrate Zoology is required at 3 institutions, yet at two of these it is part of the freshman sequence. Twelve other advanced courses are each required at only one or two institutions.

Discussion

Table I shows that each biology major at the 29 colleges and universities is required to take an average of 30.7 semester hours in his field exclusive of methods and practice teaching. This is very close to the recommendations of other groups. A committee representing the AAAS recommended 36-40 semester hours in biology for a biology major; group I of the 1959 meeting of the Association of Midwestern College Biology Teachers considered between 25 and 30

Table II

Listed below are the summaries of answers to the questionnaire concerning Table I.

I. Do you think that this variation is desirable?

(Chairmen and Heads of Biology Departments)

No	Maybe	Yes
13	5	9
48%	19%	33%

(Other members of Biology Departments)

No	Maybe	Yes
22	5	23
44%	10%	46%

II. What do you think is the cause of this variation?
 (Chairman and Heads of Biology Departments)

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|--|----|-----|
| A. Course is a state requirement | 2 | 7% |
| B. Variation in course needs vary from state to state | 8 | 30% |
| C. "Hand me down" curricula (from one biol. administration to next) | 16 | 60% |
| D. Administrators in Biology require courses in their own field | 7 | 26% |
| E. Administrators require courses in the areas in which staff is trained | 8 | 30% |

(Other members of Biology Departments)

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|--|----|-----|
| A. Course is a state requirement | 6 | 12% |
| B. Variation in course needs vary from state to state | 14 | 28% |
| C. "Hand me down" curricula (from one biol. administration to next) | 30 | 60% |
| D. Administrators require courses in their own field | 13 | 26% |
| E. Administrators require courses in the areas in which staff is trained | 11 | 22% |

semester hours best for a major. The Allerton House Conference report published in 1957 and edited by Dr. Harvey I. Fisher at Southern Illinois University recommended 24 semester hours in one area of science and 18 semester hours in two other areas. Some private institutions which require as much as 16 semester hours in religion and 16 semester hours in philosophy may find it difficult to allot as much as 30 semester hours in biology to their majors in biology. The writer believes that 30 semester hours in biology for a biology major with approximately 30 more hours in the other sciences and mathematics is all that can be allowed without the rest of the undergraduate program being deficient.

An average of 2.4 semester hours is required in methods of teaching science or methods of teaching biology. An average of 7.9 semester hours is required in practice teaching. There is a remarkable uniformity in these two areas.

In teacher training institutions of this study an average of 11.6 semester hours is required in introductory courses in (1) general biology, or (2) general botany and general zoology, or (3) general biology, general botany and general zoology. There is a range from 5.3 to 20 semester hours required in introductory courses at the 29 institutions. A large group of teachers at

the 1959 meeting of the Association of Midwestern College Biology Teachers agreed almost unanimously that the introductory course should be an 8 semester hour, fundamental, integrated biology course with laboratory for all students. Other biologists agree that the contents of introductory courses should be integrated so that students do not waste their time by duplication of study of cells, genetics, biological principles, etc. It is difficult to evaluate the number of hours needed in the beginning courses unless all subject matter for a major is considered. In some institutions an equivalent of 2 or 3 semester hours of genetics is studied in the introductory courses; in some colleges and universities only 1 or 2 days are spent in this area of biology. The latter is probably true in the 8 institutions which require a 3 semester hour genetics course. The genetics material covered in the curriculum may be approximately the same, but one group of students gets credit for genetics on their undergraduate record.

There are 13 institutions listed in Table I which require no advanced courses; the number and kinds of advanced courses at the other 15 institutions vary widely. The list of required advanced courses is probably misleading, for the only fair way to check those subjects that are required is to check the complete biology curricula of the graduates of a college or university under each administrator. If a course was taken by a certain percentage, possibly 95%, of those graduating with a biology major, it probably should be listed as a required subject. As an example, microtechnic and human physiology are not required at Eastern Illinois University, yet in the last 8 years, 96% of the 53 graduates in zoology have taken microtechnic and 83% have taken human physiology. Certainly microtechnic and possibly human physiology should be listed as required courses at Eastern. A study of courses taken by recent graduates at each institution would eliminate a major problem of this study—that of separating required and recommended courses. The writer did not list a course as required if there was a choice between even two courses. Many courses are neither required nor recommended, yet a high percentage of graduates take them; this is especially true

Table I (1961-62)

Required Courses in Biology for a Biology Major in Secondary Education at Midwest State-Supported Teacher Training Institutions
(All Numbers in Semester Hours)

	Minnesota					Wisconsin						Illinois					
	Bemidji	Mankato	Moorhead	St. Cloud	Winona	Whitewater	Superior	La Crosse	Oshkosh	Platteville	River Falls	Stevens Point	Eastern	Western	Northern	State Norm.	Averages
Total req. hours*	34.	26.7	32.	31.	28.	24.	28.	32.	34.	36.	24.	30.	40.	34.	33.	37.	30.7
General Biology	8.	2.7			2.7	10.								2.7			2.5
General Zoology		2.7	8.0	5.3	8.		5.	10.	10.	4.	6.7	5.	5.3	2.7	8.	3.	4.5
General Botany		2.7	8.	5.3	8.		5.	10.	10.	4.	6.7	5.	8.	2.7	8.	3.	4.6
Methods of Teaching Sci. or Biol.	2.	2.7	2.	2.7	2.7	2.	2.	2.	2.	2.	1.3	2.	2.7	2.7	3.		2.4
Practice Teaching	10.7	6.7	11.	11.	11.	10.	8.	8.	8.	10.	6.7	10.	8.	5.3	7.	10.	7.9
Genetics	2.7						3.		3.	3.				2.7	3.		
Vertebrate Zoology													8.				3**
Invertebrate Zoology	3.3												2.7				3***
Comp. Anatomy																	
Mammalian Anatomy																	
Human Anat. & Phy.		5.3															
Human Physiology																	
Embryology																	
Entomology											2.7		8.				
Field Biology														2.7			
Prin. of Biology																	
Seminar	1.3													2.			
Comp. Botany																6.	
Local Fauna																	
Microbiol. or Bact.		2.7								4.							
Tax. of Plants or Tax. Flow. Plants				2.7					3.		2.7						
Conservation				2.7													*

*Does not include Methods of Teaching & Practice Teaching

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Required Courses in Biology for a Biology Major in Secondary Education at Midwest State-Supported Teacher Training Institutions (All Numbers in Semester Hours)

	Missouri					Iowa	Michigan				Indiana				
	Southwest	Southeast	Central	Northwest	Northeast	St. Col. Ia.	Northern	Eastern	Central	Western	Indiana State (Comprehensive)	Indiana State (Restricted)	Ball State (Comprehensive)	Ball State (Restricted)	Averages
Total req. hours*	30.	30.	30.	30.	27.5	34.	24.	24.	30.	30.	40.	24.	40.	24.	30.7
General Biology	7.5	5.				4.	4.	4.	8.	8.			5.3	5.3	2.5
General Zoology		5.	6.	5.	5.	4.	4.	4.			6.	6.			4.5
General Botany		5.	6.	5.	5.	4.	4.	4.			6.	6.			4.6
Methods of Teaching Sci. or Biol.	2.5	2.5	2.	2.	2.5	3.	5.	2.	2.	2.	2.	2.	2.7	2.7	2.4
Practice Teaching	5.	5.	6.	5.	5.	8.	8.	8.	8.	8.	6.	6.	5.3	5.3	7.9
Genetics	2.5														
Vertebrate Zoology															
Invertebrate Zoology															
Comp. Anatomy															
Mammalian Anatomy													2.7		
Human Anat. & Phy.	5.														
Human Physiology											3.	3.	2.7		
Embryology													2.7	2.7	
Entomology															
Field Biology											3.	3.			
Prin. of Biology											3.	3.			
Seminar							1.				1.	1.			
Comp. Botany															
Local Fauna													2.7	2.7	
Microbiol. or Bact.	2.5										3.				
Tax. of Plants or Tax. Flow. Plants											2.	2.	2.7	2.7	
Conservation									3.				2.7	2.7	

*Does not include Methods of Teaching and Practice Teaching.
 ** & *** called Comparative Zoology.

in the smaller departments where the course offerings are limited.

One of the required advanced courses is conservation of natural resources; it is the only state-required course. A conservation course is required by Wisconsin law for all candidates for teaching certificates in science and social science. Genetics is required at 8 colleges and universities; this is the only advanced course required more than 5 times at the 29 institutions. The following courses were required or recommended in the questionnaire by some member of over half of the 29 colleges and universities: genetics, vertebrate zoology or comparative anatomy, animal physiology, entomology, bacteriology and plant physiology. Embryology and a conservation course were listed by almost half of the colleges and universities.

The writer believes some course with extensive field work should be included in the biology curriculum. Other biologists believe certain other courses should be included in an undergraduate biology curriculum. After studying the comments of 80 biologists replying to the questionnaire, the writer believes it would be very difficult to get complete agreement on any advanced course. He agrees with the policy of 13 of the 29 colleges and universities in the study; require the necessary basic courses in biology, then let the major in biology and his or her adviser evaluate the needs of the student and decide on the advanced courses which they believe will furnish a good background for a biology teacher. Here is a quotation of Dr. William C. VanDeventer, Chairman of the Department of Biology at Western Michigan University, "I do not consider a wide range of variation in the teaching major undesirable. It seems to me that so long as the teaching major includes (1) a good elementary course of one or two semesters, either types-based or principles-based; (2) a course in zoology, preferably involving both vertebrates and invertebrates; (3) a course in botany, involving general field identification; and (4) a methods course stressing utilization of subject matter, presentation in the classroom, evaluation and testing, and utilization of local materials and community resources; beyond these things, I think that the student's interest should

be allowed to play a part." Another head of a biology department who believes that a biology curriculum should be somewhat flexible, is Dr. Luther S. West, Northern Michigan College, Marquette, Michigan, who states "Except at the freshman level, I doubt the wisdom of uniformity. I would like to see much elective opportunity at all institutions. I would require some advanced work-content to be student's choice."

Of the 28 department heads and chairman replying to the questionnaire, only 13 thought the variation in required courses (Table II) was undesirable, while 9 thought it was not serious. These are the people who are mainly responsible for the variation. The other members of the biology departments were also about equally divided on the same question. A majority of the biologists attributed the variation in required courses to "hand-me-down" curricula. Others thought administrators required courses in an area in which a member of the biology department was best trained or in their own field. Only 1 of the 80 people who replied to the questionnaire mentioned the variation in areas of total required hours, the hours required in introductory courses, methods of teaching and practice teaching; except for this one comment, all were concerned with advanced courses.

Only after a student acquires a good background in the physical sciences, can he understand many of the basic biological laws and principles. Dr. James W. Unger, Head of the Department of Biology, Wisconsin State College, Oshkosh, expresses the feeling of many administrators when he states, "Most private citizens have no idea that training in the sciences must be broad to be of value—they need to realize it and demand it." The writer believes that breadth of training in biology, chemistry, physics, and mathematics is of much greater importance than the addition of certain individual advanced courses. Many advanced courses in biology should be reserved for the graduate program.

Literature Cited

Allerton House Conference on Education: Group IV-Physical and Biological Sciences, Dr. Harvey I. Fisher, Southern Illinois University, Editor (1957).

Minutes of the 1958 and 1959 meetings of the Association of Midwestern College Biology Teachers: Dr. Ted Andrews, Kansas State College, Emporia, Kansas (past president).

Recommendations on Undergraduate Curricula in the Biological Sciences, National Academy of Sci-

ences—National Research Council, Washington, D. C. (1958).

Improving Science and Mathematics Programs in American Schools, a joint report of American Association for the Advancement of Science and American Association of Colleges for Teacher Education. (1960).

A Curriculum for Training High School Biology Teachers Which Administrators of Teacher Training Institutions Will Support

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The Problem

In the preceding paper the required biology courses for training a high school biology teacher at 29 midwest institutions were studied in order to find the best allotment of time in the undergraduate curriculum for a major in biology. Using this material the writer has attempted to find a superior biology curriculum which a large percentage of the administrators in midwest state-supported teacher training institutions will support.

The Methods

For the preceding paper most of the college end university biology teachers in midwest state-supported teacher training institutions were contacted by questionnaire; they were asked to comment on the requirements in their biology curriculum and the required courses in the other 29 midwest colleges and universities. From these replies, from the suggested requirements of various organizations, and from the suggestions of other biologists, the writer attempted to make the best allotment of semester hours in the areas of the sciences and mathematics for a biology major. (See results of questionnaire in Table I.) In addition, the eight advanced biology courses most likely to be required were selected. The questionnaire in Table I was sent to the division chairman, department head, or senior member of the biology department in each of 29 state-supported teacher training colleges and universities in Iowa, Minnesota, Missouri, Illinois, Wisconsin, Michigan, and Indiana. (See the list of colleges and universities

which replied to this questionnaire at the end of this paper.)

Discussion of Results

Twenty-two of the questionnaires (79%) that were sent to the administrators were completed and returned.

The 22 biology administrators were almost unanimous in desiring a minimum of 1 year of college chemistry; only 50% of their departments actually required a minimum of 8 semester hours. One college required 15 semester hours of chemistry; four biology administrators commented that a second year should be required, although this was not a part of the questionnaire. There were 32% of the institutions with no chemistry requirement. About one-half of Section I (41 biologists) of the Association of Midwestern College Biology Teachers 1959 meeting believed a minimum of 2 years of college chemistry should be required; this group thought the second year should be mostly organic chemistry. The other half of Section I believed at least one year of chemistry should be required. The Allerton House Conference in 1957 (Dr. Harvey I. Fisher, Southern Illinois University, editor) recommended "(1) a major in one area of science of some 24 semester hours with 18 semester hours in each of two other areas or (2) a broad major in either physical or biological sciences with additional course work in other sciences to total a minimum of 60 semester hours in a four-year program." T. A. Nelson (University of Illinois, 1954) found in his doctoral study that high school superintendents and principals preferred broad training in