THE BIOLOGICAL SCIENCES IN MINNESOTA HIGH SCHOOLS.

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What is being done in the biological sciences in the high schools of Minnesota? To determine this point, a questionnaire was directed to 165 of the 240 high schools of the state during the spring of 1921. The purpose was primarily to secure information for guidance in organizing a teachers' course in zoology. The questionnaire included detailed questions relating to zoology and general biology, and less specific questions concerning botany and physiology. A few questions concerning general science were also included, since a small amount of biology is also included in that subject. Concerning these subjects, it was desired to know the attitude of educators of the state, what the demands were, what developments, if any, were taking place, and how the subjects were being conducted. 109 of the 165 questionnaires were returned with the information desired. These came from schools of all sizes ranging from a high school enrollment of 48 to that of 3,078, the greater number coming from schools of less than 500 enrollment. In order to inform those of the state who are interested as well as others who might wish to know something about the status of the biological sciences in Minnesota, a review of the facts obtained is herewith given.

GENERAL SITUATION.

By examining Table I, it will be seen that general biology, zoology, physiology, and botany are practically the only purely biological subjects taught. One school reported a course in sanitation.

Table I.

Table I shows the high schools heard from, arranged according to enrollment and showing the subjects offered in each high school. "X" indicates the subjects given and the dashes indicate those not given. The enrollments marked with an asterisk are taken from the state high school inspector's report for 1919-20, since some neglected to report the enrollment in the questionnaire.

No. of high science Zoology	No. of high science Zoology	Location school Gen. Botany	Location school Gen. Botany	Enrollment Gen. biology Physiology	Enrollment Gen. biology Physiology
1 Kasota.....	48	X	—	—	—
2 Bird Island.....	50	X	—	—	—
3 Morristown.....	50	X	—	X	X
4 Lyle.....	53	X	X	—	—
5 Adams.....	56	—	—	X	X
6 Rushford.....	58	X	—	—	—
7 Howard Lake.....	60	X	—	X	—

8	Cass Lake.....	63*	X	—	—	X	X
9	Henderson.....	65	X	—	—	—	—
10	Cottonwood.....	65	X	—	—	—	—
11	Morton.....	70	X	—	—	—	—
12	West Concord.....	70	X	—	—	—	—
13	Roseau.....	70	X	—	—	X	X
14	Red Lake Falls.....	70	X	X	—	—	—
15	Hawley.....	71	—	X	—	—	—
16	Lake Park.....	73	X	X	—	—	—
17	Sherburn.....	74	—	—	—	X	X
18	Fertile.....	74	X	—	—	—	—
19	New Richland.....	75	X	—	X	—	—
20	Annandale.....	75	X	—	—	—	—
21	Mt. Lake.....	80	X	—	—	—	—
22	Heron Lake.....	80	X	X	—	—	—
23	Warroad.....	83	—	—	X	X	—
24	Waterville.....	84	—	—	—	—	—
25	Dodge Center.....	85	X	—	X	—	—
26	Hayfield.....	85	—	—	—	X	X
27	North St. Paul.....	85	X	—	—	—	X
28	Blooming Prairie.....	90	X	—	X	—	—
29	Minneota.....	95	X	—	—	—	—
30	Barnesville.....	95	—	—	—	—	—
31	Monticello.....	104*	—	—	—	—	—
32	Zumbrota.....	108	X	—	—	—	—
33	Breckenridge.....	110	—	—	X	X	X
34	Preston.....	110	X	—	—	—	—
35	Sleepy Eye.....	110*	X	—	—	X	—
36	Fosston.....	110	X	X	—	—	—
37	Wells.....	110	X	X	—	—	—
38	Springfield.....	112	X	—	—	—	—
39	Harmony.....	115	—	—	—	—	—
40	Rush City.....	117*	—	X	—	—	X
41	Excelsior.....	117	—	—	—	—	—
42	Spring Grove.....	120	X	—	—	—	—
43	Renville.....	121*	—	—	—	—	—
44	Winnebago.....	123	X	—	X	X	—
45	Granite Falls.....	123	X	—	—	—	X †
46	Glencoe.....	125	X	—	—	—	—
47	Farmington.....	130	X	X	—	—	—
48	Hinckley.....	130	—	X	—	—	—
49	International Falls.....	131*	—	—	—	—	—
50	Pelican Rapids.....	133*	X	—	—	—	X
51	Elbow Lake.....	135	X	X	—	—	—
52	Ortonville.....	138	X	X	—	—	X
53	Cannon Falls.....	140	X	—	—	—	—
54	Buffalo.....	150	—	—	—	—	—
55	Tracy.....	156	X	—	X	—	—
56	Dawson.....	156	X	X	—	—	—
57	White Bear Lake.....	160	X	—	—	X	—
58	Kenyon.....	162	X	X	X	X	—
59	Princeton.....	165	—	—	X	—	X
60	Warren.....	165	X	—	—	—	X
61	Long Prairie.....	165	X	—	—	—	—
62	Blue Earth.....	170	—	—	X	—	X
63	Aitkin.....	170	X	—	—	—	—
64	Waseca.....	170	X	X	—	—	—
65	Staples.....	175	—	X	—	—	X
66	Luverne.....	175	—	X	—	—	—
67	Glenwood.....	176*	—	—	—	—	—
68	Madison.....	177	—	—	X	—	—
69	Windom.....	185	X	—	—	—	—
70	Canby.....	186	X	X	—	—	—

71	St. James.....	196	X	—	—	X	X
72	Gilbert.....	200	X	—	X	X	—
73	Litchfield.....	205	X	—	—	—	—
74	Lake City.....	210	X	—	—	—	—
75	Marshall.....	215	—	—	X	X	—
76	Redwood Falls.....	221	X	X	—	—	—
77	Worthington.....	223*	X	—	—	X	—
78	Hastings.....	225	X	—	—	—	—
79	South St. Paul.....	250	X	—	—	—	—
80	Detroit.....	250	X	—	—	X	—
81	Bemidji.....	275	X	—	—	X	X
82	Moorhead.....	296	—	X	—	—	—
83	Alexandria.....	300	—	—	X	X	X
84	Grand Rapids.....	300	—	X	—	X	X
85	Anoka.....	305	X	—	X	—	—
86	Brainerd.....	311	X	—	X	—	—
87	Willmar.....	315	X	—	—	—	—
88	Crookston.....	315	X	—	—	X	X
89	Rochester.....	316	X	—	X	—	—
90	Ely.....	316	—	X	—	—	—
91	Little Falls.....	325	—	—	X	—	—
92	Owatonna.....	335	X	—	—	—	—
93	Chisholm.....	344	X	X	—	—	—
94	Northfield.....	350	—	—	X	X	X
95	Red Wing.....	336*	X	X	—	—	—
96	Montevideo.....	365	X	—	—	X	—
97	Albert Lea.....	400	X	—	X	X	X
98	Eveleth.....	450	—	—	X	X	—
99	St. Cloud.....	451*	X	X	—	—	—
100	Hibbing.....	580	X	—	—	X	—
101	Winona.....	700	X	X	—	—	X
102	Denfield H. S., Duluth.....	800	—	X	—	—	—
103	Johnson H. S., St. Paul.....	828	—	X	—	—	—
104	Mechanic Arts H. S., St. Paul.....	1300	—	—	X	X	X
105	East H. S., Minneapolis.....	1650	X	X	—	X	—
106	West H. S., Minneapolis.....	1647*	X	X	—	X	—
107	North H. S., Minneapolis.....	2200	X	X	—	X	—
108	South H. S., Minneapolis.....	2200	X	X	—	X	—
109	Central H. S., Minneapolis.....	3078*	X	X	—	X	—

However, no school gave all of these subjects. Furthermore, there was no uniformity in the selection of the subjects for the curricula, some selecting one combination and some another.

Table II is a summary of the chief facts shown in Table I. An examination of Table II shows that of the 109 high schools heard from, 9 (8%) reported no biology of any kind. 26 others

Table II.

Table II is a summary of Table I, showing the number and per cent of schools offering no biology at all, those offering biology of some sort, and those offering each of the various biological sciences usually taught in high school.

Gen. Science	Gen. Biology	Zool-ogy	Bot any	Physi-ology	Total giving biology besides gen. science	No biol-ogy at all, or only gen. science	Total schools report-ing
76 schools	33	25	31	25	74	35	109
70%	30	23	28	23	68	32	100.

(24%) gave only the little biology occurring in general science, an amount not worth mentioning. So it may be said that 35 schools (32%) had little or no biology in their curricula. The remaining 74 schools (68%) offered courses in biology in some form or other.

GENERAL BIOLOGY.

One of the most interesting facts noted was the increasing popularity of general biology. It is finding its way into the high school curricula by leaps and bounds, and is equally popular with small and large schools. According to the report of the state high school inspector, less than 9% of the high schools of the state offered the subject in 1919-20 (see Table III). The past year, 30% of the high schools heard from reported it in their curricula. A great many more signified their intentions of introducing the subject in 1921-22 or soon, so that the per cent mentioned above will be greatly increased. This growing popularity indicates that general biology is filling a long-felt

Table III.

Table III is intended to show the trend of each of the biological sciences (including general science) since 1904. Figures for physics and chemistry are also included for comparison. The figures given are in per cent. The first four columns of figures were computed from information received from the state inspector of high schools directly and also from his official report for 1919-20. The last column was compiled from facts obtained in the questionnaire. The figures in this column are also found in Table II.

Subject	Per Cent of schools pursuing subject				
	1904-05	1914-15	1918-19	1919-20	1920-21
Gen. science.....	-----	8	45	50	70
Gen. biology.....	---	---	6	9	30
Zoology.....	37	40	31	28	23
Botany.....	49	62	49	47	28
Physiology.....	60	54	56	50	23
Physics.....	71	67	61	66	?
Chemistry.....	58	71	75	70	?

demand among educators for a general course embodying the fundamentals of all the biological sciences with much of the details and technicalities omitted.

There is a decided preference expressed for general biology over the usual courses given in zoology or botany. Some of the reasons mentioned for this preference follow

1. General biology is a course embodying the essential of all the biological sciences with much of the detail left out. Hence,

2. Greater economy of time and teaching force in the crowded curricula of the smaller schools especially.

3. Since the life processes are fundamentally the same in plants and animals, this fact can be better shown in a general course.

4. Greater correlation between the various biological sciences can be effected through a general course.

5. General biology is practical, broad in its scope, and less technical than either zoology or botany, and therefore better adapted to high school work.

However, general biology was also criticized on the following points:

1. It is too generalized, vague in content, and lacking in concreteness.

2. It is apt to be merely a snap course in the hands of a poorly prepared teacher.

3. It is often poorly organized.

4. While a fair idea of life processes may be obtained, an adequate idea of the plant and animal life of the community is hard to obtain because the course is too brief.

5. As an introductory course to more advanced work, or as a short course, it is good, but as a complete and all-sufficient course it falls far short.

General biology is most commonly given in the tenth grade. It is a year course. It is optional and given every year instead of in alternate years. The number of laboratory periods per week vary from no regular period (i. e., the laboratory work is inserted whenever and wherever convenient) to two double periods.

The preference in textbooks centered in Gruenberg's *Elementary Biology*. G. W. Hunter's *Essentials of Biology* and his *Civic Biology* have also been adopted to quite an extent.

ZOOLOGY.

By examining Table III, it will be seen that zoology enjoyed a fair amount of prominence in the high school curricula up to 1914-15. Since that time, there has been a steady reduction in number of schools offering the subject. Even since 1919-20, there has been a reduction from the 28% that were giving the subject that year (see Table III) to 23% that gave it last year (see Table II). There were indications that the per cent will be further reduced owing to the fact that zoology, together with botany and physiology, is being replaced by general biology in many places.

Evidently zoology has not been adapted to the demands of school administrators in the past and, therefore, is failing. It was thought by some to be too technical, specialized, and detailed for high school students. It was also criticized for its lack of practicability and its inclusion of too much material that is not of any benefit to the average student. However, there

are those who defend the subject and believe in its retention as a subject of real value in the curriculum.

Zoology is given usually in the tenth grade. It is an optional subject exclusively. In the smaller schools, it is usually given every other year, alternating with physiology or botany. Where the curriculum allows it, two double periods of laboratory work per week is the favorite arrangement. The subject matter emphasized is the economic and practical phase of the study, the habits and life processes of the various animals studied, together with some morphology.

A number of textbooks were mentioned. Colton's Descriptive and Practical Zoology was reported more than any other book. Others mentioned were Davison's Practical Zoology, Hegner's Practical Zoology, Linville and Kelly's Textbook in General Zoology.

OTHER BIOLOGICAL SUBJECTS.

Another prominent development noted is the growing popularity of general science. It has been increasingly prominent since its introduction and is still on the upward path. In 1919-20, 50% of the high schools of the state were offering it (see Table III). According to information given in the questionnaires, 70% of the schools offered the course last year (see Table II). It is usually given in the ninth grade, is a required subject exclusively, and a year course.

Botany is suffering the same fate as zoology. It has always held a greater prominence than zoology but like zoology is at present losing ground due, to a great extent, to the encroachment of general biology. In 1919-20, 47% of the high schools offered botany (see Table III). The past year, only 28% offered the course. Botany is subject to the same criticisms as zoology.

Even physiology is losing its prestige. A drop from 50% to 23% has been effected in the past year. (See Table III.)

The reduction in number of schools offering zoology, botany, and physiology is no doubt due to the rapid rise in popularity of general biology. Some of these subjects are being removed from the curricula in order to give place to general biology. This change is occurring mainly in the smaller schools. In the larger ones, general biology is merely one of the biological subjects given.

GENERAL DISCUSSION.

The presentation of the facts obtained from the questionnaire has been the main consideration up to this point. Personal

opinion has been studiously avoided in order not to confuse it with facts as reported in the questionnaires. But perhaps the humble opinions of a biology teacher with high school experience might not be amiss here.

When viewed from the standpoint of the number of schools giving biology in some form, the situation on the surface is not alarming, since the per cent of schools offering some form of biology (68%) measures up well with the per cent for other sciences. However, there are certain facts and tendencies that need serious consideration. It is to be regretted that as many as 32% of the high schools heard from should fail utterly in seeing the value and necessity of biology to high school students. In these days, the public is clamoring for the practical in high school curricula. What subjects are of more practical value than the biological sciences? Surely, to familiarize high school students with the plants and animals of their own community—a part of the environment with which they come in contact every day—to teach them the fundamental facts of life through a study of the life processes of plants and animals, and to teach them how to live, themselves, is of utmost practical value. To teach students to use their hands and make a living is practical, but of what use is this to them if they know not how to care for their bodies and to keep fit? Efficiency in work depends upon efficiency in living. This is a well established fact. Hence, the study of biology is fundamental and deserving of first consideration in preparing students for earning a livelihood. Not only should biology be given in every high school in the state, but it should be required of every student.

The rapid rise of general biology has been pointed out. Evidently this subject is filling a long-felt want for a general, practical, and untechnical course covering the whole field of biology in one year. It has proven a boon to the smaller schools with their problem of the crowded curriculum, since the whole subject of biology is treated in this one course. The fact must not be lost sight of, however, that general biology is only an elementary course and by no means an adequate one where it is possible to give more. A sufficient knowledge cannot be obtained of the plant and animal life of a community, of physiology, hygiene and sanitation, and fundamental processes of life, all in one year. The subject is a good, short course for those who are taking vocational courses and whose selection of the regular academic courses is limited. It should be required of these students.

But for those who are taking the regular academic work, a course in general biology is too meager; for these students, the usual courses in zoology, physiology, and botany are preferable and should be available. And at least some of them should be required.

The decrease in demand for zoology, physiology, and botany is to be regretted. The charges brought against these subjects seem to me unfounded. They are due to several causes: (1) The teachers themselves are largely to blame for the criticisms heaped upon the subjects. Their lack of sufficient preparation and consequent poor pedagogy, and their failure to see and appreciate the needs of the community and to adapt the courses thereto, have caused much of the criticism. (2) Many school administrators lack a knowledge of the biological subjects and are therefore unable to see the possibilities in them. (3) Mollycoddle ideas of education today demand a removal of technicalities and details from the subjects so that the courses are made very superficial, shallow, and inadequate. Those who entertain these ideas furnish much of the criticism of zoology and the other special biological sciences.

To say that zoology, physiology, and botany are impractical is a huge mistake. In the hands of a wide-awake, well-prepared teacher, they can be made just as live and applicable to daily life as any subject in the curriculum. Zoology and botany are studies of the living things of our environment. We are constantly coming in contact with these living things every day of our lives. This daily contact should be a strong argument for the practical nature of these subjects, just as the daily use of English is the oft-repeated argument for the practical value of that subject.

The study of plants and animals of the community only, a study of local pests and their control, the knowledge of the fundamentals of our own lives as learned through a study of the life of plants and animals, are all points of practical worth. Other points might be mentioned here to show the value of zoology and botany from the practical standpoint, but space does not permit further elaboration.

Can anyone doubt the practical value of knowing one's own body and how to care for it? Is it more necessary to know the operation of an engine in an auto, or how to operate a lathe, or how to construct a library table, than to know the mechanism of the human body and how to take care of it? Or is it more

necessary to teach high school students, through the study of agriculture, to care properly for the sanitation of cattle and hogs, and to prepare the soil properly for the sowing of clover, than to show them how to keep proper sanitation in their own habitation? Judging by the slump in interest on the part of school administrators toward physiology, hygiene and sanitation, one would be led to conclude that there are altogether too many who think thus. One needs only to visit the homes in one's own community to see the lack of knowledge of the principles of hygiene and sanitation and the need of more education along this one line. A good, solid course in physiology, sanitation and hygiene is not only practical but necessary and cannot be replaced by such a short course as general biology.

Some assail zoology and the other special biological sciences because of their so-called technicality. It is true that these subjects can be made very technical, or, much of the technicality can be omitted within certain limits at the discretion of the teacher. It would, of course, not do to transplant a college course in zoology to a high school because of the technicalities of such a course. The subject must be adapted to the age and need of the high school student. If zoology has failed in this in the past, it is because of the failure of the teachers in adapting the subject to high school needs, and not to the subject itself.

I have mentioned a very few of several criticisms that have been offered against zoology, botany, and physiology. On final analysis, the failure of these subjects is not due to the inherent nature of the subject matter, but to impractical, unadaptive pedagogy on the part of the teachers and to misconceptions as to the value of the biological studies by high school authorities. Any subject is just what the teacher makes of it. It is my opinion that the biological subjects have been unjustly criticized because of their contents, whereas the blame should have been placed in many cases on the teacher.

Much more could be said in defense of the special biological sciences. But better and more complete discussions on their value have appeared in former numbers of *School Science and Mathematics*. The purpose of this discussion was mainly to present the facts obtained in the investigation of conditions in Minnesota, but I could not refrain from expressing some of the opinions that suggested themselves in passing.