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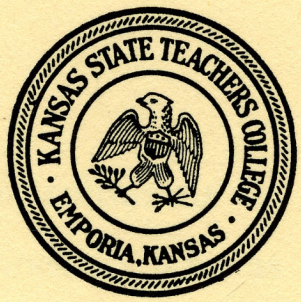

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Offerings and Enrollments in the Secondary School Sciences in Kansas in 1951-1952

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In the Forty-sixth Yearbook of the National Society for the Study of Education (1947) appears this statement: "In order to formulate a plan of education for prospective teachers of science in junior and senior high schools, it is advisable first to consider the kinds of positions and responsibilities science teachers generally fill." Since beginning teachers of science in Kansas high schools must adjust themselves to conditions existing in small schools where the typical science teacher teaches not only the sciences but one or more non-science courses, the prospective science teacher and his advisor should know the conditions under which the teacher must work. This paper presents some of the data we believe to be important in a consideration of various aspects of the job of the high-school science teacher.

The purpose of this study is to show (1) the offerings and enrollments in the sciences in Kansas high schools; (2) the subjects taught by Kansas high-school science teachers; (3) some of the trends as revealed by comparison with previous studies; and (4) some comparisons with the national situation in science education.

Previous Studies

Johnson (1950) published for the United States Office of Education a survey of the teaching of science in public high schools of the country. The study, based on returns from 715 public high schools, covered the school year 1947-1948. The randomly selected sample of schools was proportionate to the types and sizes of the schools in *the entire country.*

In 1952, Martin published a similar study, which was restricted to biology, based on returns from 786 public high schools, for the school year 1949-1950.

The Committee on Educational Trends of the Kansas Academy of Science has issued two reports. The first, Alm (1938), was based on a proportionate sample of 233 High-school Principal's Organization Reports for the year 1936-1937, and a sample of 1929-1930 reports from 70 schools in second-class cities. The second Academy

report, Reed (1951), was based on questionnaires received from a proportionate sample of 100 schools of various sizes.

Lessig (1942) presented, in a master's thesis, data from more than 200 questionnaires completed by Kansas biology teachers. In this study the schools were classified both as to type of organization and as to enrollment. The Lessig study was patterned after the national biology teaching survey conducted by Riddle (1942).

Ridgway (1931), in his study of the training and teaching combinations of Kansas high-school teachers, included a table showing the nonscience subjects taught by science teachers. Mathematics was taught by 24 percent of all science teachers; 15 percent taught science only.

A similar study by Irwin (1938) showed that 34 percent of the science teachers taught only science, while 35 percent taught science and mathematics.

Lockard (1946) found that 48 percent of the Kansas science teachers taught only science, a 14 percent increase over Irwin's (1938) study. Lockard found mathematics and science still the most frequent combination. In an unpublished extension of this study, Lockard tabulated the individual sciences taught in 140 high schools, selected so as to give a proportionate sample.

Wilson (1951) made a survey in which he included data, from 570 Nebraska high schools with an enrollment for 1949-1950 of 64,342, pertaining to offerings and enrollments in the high-school sciences.

Methods

This study was based on data found in the 1951 High-school Principal's Organization Reports on file at the State Department of Education.

For each school, the items recorded and tabulated were as follows: total school enrollment, enrollment in each section of each science taught, nonscience subjects taught by each science teacher.

The schools were divided into population classes corresponding to those used in the study of science teaching in the public high schools in the United States (Johnson, 1950).

Junior high schools were included in the tabulations if the report showed that ninth-grade science was taught. Seventh- and eighth-grade science courses were not included.

Acknowledgments

The writers wish to acknowledge the assistance of the State Department of Education and of Delta Kappa Chapter of Beta Beta Beta, honorary biology society. Without the assistance of the members of Beta Beta Beta, the completion of this study would have been impossible. Special credit is due Mrs. Robert Hodge, who tabulated most of these data.

Results

For the school year 1951-1952, 659 senior high schools and 59 junior high schools were accredited by the State Department of Education in Kansas. The present study included data from 654 (99%) of the senior high schools and 25 (42%) of the junior high schools. A few of the smaller senior high schools were not included, because their reports had not been received at the time of tabulating the data or because the reports were incomplete. Junior high schools with ninth grade science were included in this study because the ninth grade is usually included in the senior high school in Kansas. In 576 of the 659 high schools accredited for 1951-1952, the senior high school consisted of grades 9-12, with general science predominantly a ninth grade subject.

SCIENCES IN THE SCHOOLS OF VARIOUS SIZES

A few Kansas high schools offered no science at all in 1951-1952, whereas many offered four or more sciences. Table I shows the number of schools in each size group and the number of sciences offered by the schools.

It should be noted that more than 60 percent of all Kansas high schools had enrollments of less than 100.

The table also shows that the larger schools in general offered more science courses. The schools with 300 or more students which offered only one science course were nearly all junior high schools. In most cases, these offered general science in the ninth grade.

Several schools are shown as teaching no science at all. These were small schools which alternate science with some other course so that science appears in the High-school Principal's Organization Report in alternate years. In many of the smaller schools, certain science courses are alternated. For example, a number of schools offer general science one year and biology the next. Other common alternations are biology and physics, and physics and chemistry. Table I shows only courses actually taught in 1951-1952.

It will be noted that the number of science courses offered increased regularly with school size. Of the schools offering only one

TABLE I.—Number of schools in each size group and the number of science courses offered by the schools

Size of school (number of pupils)	Number of schools	Per-cent	Number of schools offering from one to four or more science courses:				
			None	1	2	3	4 or more
0—9	1	.15	0	1	0	0	0
10—24	36	5.3	1	15	20	0	0
25—49	170	24.7	7	53	80	27	3
50—74	136	20.1	3	27	62	36	8
75—99	85	12.4	0	8	41	30	6
100—199	125	18.8	0	7	22	65	31
200—299	46	6.7	0	3	4	17	22
300—499	37	5.5	0	7*	1	13	16
500—999	32	4.7	0	8*	0	6	17
1,000—2,499	10	1.5	0	4*	0	0	6
2,500—	1	.15	0	0	0	0	1
Totals	679		11	133	230	194	110

Read table thus: Reports were examined from 36 schools with enrollment from 10-24; this 36 constitutes 5.3 percent of the 679 reports examined; of the 36, 1 offered no science in 1951-52, 15 offered one science course, 20 offered 2, and none offered more than 2.

or two science courses, nearly 90 percent had enrollments of 100 or less, while nearly all of the schools offering four or more science courses had 100 or more.

SCHOOLS OFFERING DIFFERENT SCIENCES

The four most frequently offered sciences were general science, biology, chemistry, and physics. Table II shows the number of schools of each size group offering these sciences.

In all the schools studied, 83 percent offered general science, 71 percent offered biology, 31 percent offered chemistry, and 34 percent offered physics. Examination of Table II reveals that chemistry and physics were offered more frequently in schools with enrollments of 200 and above. General science and biology, on the other hand, were offered with about the same frequencies in all sized schools.

* These are separately accredited junior high schools which offer ninth grade general science, but no other science.

TABLE II.—Number of schools offering various sciences

Size of school	Number of schools	General science		Biology		Chemistry		Physics	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
0—9....	1	0	0	1	100	0	0	0	0
10—24...	36	22	61	16	45	3	8	7	11
25—49...	170	127	75	99	58	11	6	26	15
50—74...	136	128	95	94	74	15	11	35	25
75—99...	85	72	85	67	79	21	24	27	32
100—199..	125	123	99	104	83	66	53	57	46
200—299..	46	38	83	42	91	33	72	27	59
300—499..	37	25	68	29	78	30	81	25	68
500—999..	32	26	81	23	89	22	69	21	66
1,000–2,499	10	8	80	6	60	6	60	6	60
2,500—....	1	0	0	1	100	1	100	1	100
Totals...	679	569		482		208		232	

Read table thus: In schools from 10-24 enrollment: there were 36 such schools; 22, or 61 percent of these offered general science; 16, or 45 percent of these offered biology, etc.

Table III shows how these figures compare with those of the Reed (1951) study, based on data for the school year 1949-1950, the Johnson (1950) study, based on data for 1947-1948, and the Wilson (1951) study, based on data for 1949-1950.

TABLE III.—Comparison of present study with Reed (1951), Johnson (1950), and Wilson (1951) studies, as regards percentage of schools offering the four main sciences.

	Present study	Reed	Johnson	Wilson
General science.....	84	92 (82)	77	73
Biology.....	71	90 (74)	85	67
Chemistry.....	31	48 (33)	49	21
Physics.....	34	76 (53)	48	38

For the Reed study two numbers are shown. The first of these numbers is the percentage of schools reporting the science as "offered." Schools were included in this number if a science course was offered at all. The numbers in parentheses were obtained as follows: 92 percent of the schools reported offerings in general science, but only 72 percent offered it every year; the other 20 percent offered it in alternate years. For any given year the total percentage offering general science would be 72 percent plus half of 20 percent, or 82 percent. This figure is very near the 84 percent study, as are those for biology and chemistry. There is a discrepancy in the case of physics, where the 53 percent reported by Reed is well above the 34 percent offered in the year 1951-1952.

Since the Reed study was based on a sample of 100 returns out of 647 questionnaires, there is a possibility that the schools having better science programs were the ones which returned the questionnaire dealing with the science teaching. The schools with poorer science offerings were perhaps the ones that did not return the questionnaire.

For biology, the Martin (1952) study reported 809, or 95 percent of the 851 schools responding, as offering the subject. Of these, 729, or 86 percent of the total, offered biology each year, the other 80 teaching it in alternate years. These figures are somewhat higher than those of Johnson (1950) and much higher than the 71 percent shown by the present study.

SCIENCES OTHER THAN GENERAL SCIENCE, BIOLOGY, CHEMISTRY, AND PHYSICS

A variety of sciences other than the main four were offered in 1951-1952. Some of these were advanced offerings, while others represented special fields. Table IV shows the frequencies of these sciences in the various sized schools. A total of 169 schools, 25 percent of the 679 tabulated, offered courses in sciences other than the four main ones.

When these sciences are arranged into three broad groups, general science, biological science, and physical science, we note that 10 courses were offered in general sciences (senior science, practical science), 36 in physical science (physical geography, aeronautics, photography, physical science, electricity), and 123 in biological science (agriculture, physiology, health, botany). These figures differ markedly from those of the Johnson study, which included, out of 715 high schools studied, 49 courses of the general type, 61 in the physical sciences, and only 25 in the biological sciences. The

TABLE IV.—Schools offering science courses other than general science, biology, chemistry, and physics

SIZE OF SCHOOL	Agriculture	Physiology	Physical geography	Aeronautics	Health	Photography	Physical science	Senior science	Practical science	Botany	Electricity
0—9	0	0	0	0	0	0	0	0	0	0	0
10—24	3	4	1	0	1	0	2	....	....	....	....
25—49	18	12	7	3	2	0	0	0	1	1	0
50—74	20	3	2	3	3	....	....	....	....	1	1
75—99	6	5	1	....	4	....	....	....	....	....	....
100—199	7	7	1	2	....	1	1	3	....	....	....
200—299	2	8	....	1	....	....	....	....	1	....	1
300—499	1	3	....	....	....	2	1	1	....	....	....
500—999	1	5	....	1	....	1	....	2	1	1	1
1,000—2,499	1	3	....	1	....	1	....	1	....	....	....
2,500—	....	1	....	1	....	....	....	....	....	....	....
Totals	49	51	12	12	10	5	4	7	3	3	3

difference is accounted for in part by the much higher percentage of large schools in the Johnson study, and in part by the relatively higher frequency of physiology and agriculture in Kansas.

ENROLLMENT IN SCIENCE COURSES

More students were enrolled in biology than in any other science, although this was not true of all sized schools. In the smaller schools, general science had the largest enrollment, followed in order by biology, physics, and chemistry (Table V). In schools with enrollments above 100, however, more students were enrolled in chemistry than in physics. In schools with an enrollment of more than 200, there were more students enrolled in biology than in general science.

The true totals were slightly larger than those shown, because in each case a few principals neglected to report their class en-

TABLE V.—Total enrollments in the four main sciences in the 679 schools

SIZE OF SCHOOL	General science	Biology	Chemistry	Physics
0—9	0	3	0	0
10—24	182	120	13	26
25—49	1,502	1,114	83	230
50—74	1,825	1,264	149	367
75—99	1,430	1,180	229	270
100—199	3,143	2,806	911	689
200—299	1,413	1,827	893	310
300—499	2,029	2,312	778	582
500—999	2,341	2,508	855	499
1,000—2,499	1,098	1,499	484	349
2,500—	none	597	160	78
Totals	14,973	15,130	4,555	3,400

rollments. The numbers involved were small, however. The totals for each science were probably within 50 of the actual enrollments.

Table VI shows the average enrollment for each of the four main sciences. It will be noted that Reed's figures are much higher than those of the present study, probably indicating more returns from the schools with better science programs. The higher figures of the Johnson study reflect the higher percentage of larger schools used in his study. In the Johnson study 64 percent of the schools had enrollments of 100 or more and only 36 percent were below 100; only 37 percent of the Kansas schools had enrollments of 100 or more, while 63 percent were below 100.

Another comparison may be made on the basis of the percentage of enrollment in the class in which the science is most commonly offered. In Kansas, general science is most often taught in the ninth grade, biology in the tenth, chemistry and physics in the eleventh and twelfth. The 1951-1952 compilations of total grade enrollments were not available at the time of this writing, but the 1950-1951 figures were as follows: ninth grade, 24,369; tenth grade, 22,897,eleventh grade, 20,289; twelvth grade, 18,429. There

TABLE VI.—Number of students per school offering the course

	Present study			Reed study			Johnson study		
	Schools offering	Students enrolled	Average per school	Schools offering	Students enrolled	Average per school	Schools offering	Students enrolled	Average per school
General science	569	14,973	26	82	2,356	29	522	30,153	58
Biology	482	15,130	31	74	3,192	43	531	32,104	60
Chemistry	208	4,555	22	33	1,315	40	308	14,178	44
Physics	232	3,400	15	53	1,295	25	298	9,036	30

is some evidence that the 1951-1952 figures are somewhat higher. However, taking the 1950-1951 total enrollments as the basis, the 14,973 pupils in general science represent about 61 percent of the total enrollment of 24,369 in the ninth grade. The corresponding figure for biology is 65 percent. For chemistry and physics, which are offered about equally in the eleventh and twelfth grades, the total enrollment of 7,955 in the two sciences represents about 21 percent of the 38,718 pupils enrolled in the two grades.

In biology, Martin (1952) reported that in the tenth grade, where biology is most often taught, 76 percent of the total enrollment of this grade were enrolled in biology.

The Reed report did not include the total enrollments in each science and the averages he gave were obtained by averaging averages; they are not comparable, therefore, to the averages of either the present study or the Johnson study given in Table VI. For the Reed section of Table VI, the averages were obtained by calculation from data presented in Table VII of this study, which was compiled from Tables II, III, IV, and V of Reed's report. For example, general science in group I the number of pupils enrolled is $66 \times 14.9 = 990$; in group II, $22 \times 22.8 = 500$; in group III, $8 \times 77 = 616$; in group IV, $4 \times 62.5 = 250$; a total of 2,356 enrolled in the 82 schools offering the subject, or an average per school of 29. This is the figure that appears in the general science section of Reed's Study in Table VI.

TABLE VII.—Data, showing average enrollments, taken from Tables II, III, IV, and V of the Reed (1951) study

Average number enrolled in:	Group I n=66	Group II n=22	Group III n=8	Group IV n=4
General science	14.9	22.8	77.0	62.5
Biology	15.8	32.2	82.0	196.8
Chemistry	9.1	14.0	27.1	47.6
Physics	9.9	11.5	24.0	49.0

The averages shown in Nebraska by the Wilson (1951) study are almost identical with those of the present study (Table VI). In Nebraska 10,608 students were enrolled in general science, 12,028 in biology, 2,552 in chemistry, and 4,115 in physics. The average enrollments, per school offering the science, were 26, 31, 21, and 19, respectively.

CLASS SIZES

In general, class sizes increased fairly regularly with school size, from 8 to 33 in general science, from 3 to 31 in biology, from 3 to 27 in chemistry, and from 3 to 27 in physics (Table VIII).

For any one school size, the classes in general science and biology were larger than those in chemistry and physics. This is no doubt due to the usual placement of general science and biology in the ninth and tenth grades and the physical sciences in the eleventh and twelfth, together with the fact that general science and biology are often required while the physical sciences are usually elective.

The greatest number of sections of general science and of biology was offered in schools of less than 200 enrollment. The number of sections of chemistry and physics offered was about as great in schools of less than 200 as it was in schools over 200.

There were many more part-time than full-time science teachers in the schools with enrollment of 500 or less; even in the largest schools there were many part-time science teachers. Table IX shows the number of pupils of full-time science teachers. (A full-time science teacher is here defined as one who teaches four or more science classes daily, a part-time science teacher as one who teaches three or less.)

It should be noted that while the full-time teachers had more science students, there were so many more part-time science teachers in the state that the majority of science students in schools of small and medium enrollments were taught by part-time science teachers.

TABLE VIII.—Number of sections and class sizes in general science, biology, chemistry, and physics

SIZE OF SCHOOL	General science			Biology			Chemistry			Physics		
	No. of sections	Median size	Range	No. of sections	Median size	Range	No. of sections	Median size	Range	No. of sections	Median size	Range
0—9.....	0	0	0	1	3	3	0	0	0	0	0	0
10—24.....	21	8.5	2—16	16	6	1—15	3	3	3—7	7	3	2—7
25—49.....	130	11	2—37	100	12	4—29	11	8	2—13	26	7	5—16
50—74.....	120	17	5—39	100	13	4—28	16	10	5—15	35	10	4—24
75—99.....	66	20	3—33	72	18	4—36	20	11	4—20	28	9.5	1—25
100—199.....	148	21	5—38	160	19	5—37	65	14	4—28	62	11	5—26
200—299.....	61	23	6—40	85	21	9—49	39	14	4—23	28	13	3—27
300—499.....	77	25	5—71	93	25	12—45	41	20	6—34	34	16.5	7—37
500—999.....	89	29	10—43	97	26	15—37	44	20	12—38	29	20	11—28
1,000—2,499....	42	33	16—45	50	31	24—42	20	24	16—32	14	25.5	10—34
2,500—.....	.....	.....	.....	18	31.5	24—35	6	27	24—29	3	27	24—27

Read table thus: In schools of 10-24 enrollment, there were 21 sections of general science, with a median enrollment of 8.5; the largest science class had 16 and the smallest had two students; etc.

Of the 929 science teachers shown in Table IX, 177 or about 18 percent were full-time science teachers, whereas 752 or 83 percent were part-time.

TABLE IX.—The number of pupils of full-time (one who teaches four or more sections) science teachers as compared to the number of part-time science teachers

SIZE OF SCHOOL	Full-time teachers		Part-time teachers		Average number of science pupils per science teacher	
	Number	Percent	Number	Percent	Full-time	Part-time
0—9.....	0	0	1	100	0	3
10—24.....	0	0	38	100	0	10
25—49.....	1	1	215	99	23	15
50—74.....	5	3	187	97	42	20
75—99.....	2	2	96	98	80	32
100—199.....	31	35	58	65	95	85
200—299.....	25	28	64	72	84	34
300—499.....	34	38	56	62	101	36
500—999.....	46	58	33	42	109	53
1,000—2,499.....	24	63	14	37	133	50
2,500—.....	9	100	00	0	144	0
Totals.....	177		752			

Read table thus: In schools of 50-74 enrollment, there were 192 science teachers; 5 or 3 percent of these taught four or more classes in science, while 187 or 97 percent taught other subjects in addition to science. The average number taught daily by the 3 full-time science teachers was 42; the number of science students taught by the 187 part-time science teachers was 20.

COURSES TAUGHT BY SCIENCE TEACHERS

In the small schools where only one or two science courses are offered, the teacher who is in charge of the science must teach from two to four or more other classes. Sometimes these other classes were widely scattered, but certain trends and patterns were present. Some of these have been the subjects of previous studies: Irwin (1938), Ridgway (1931), Lockard (1946), and Reed (1951). In most previous studies, no distinction was made between one science and another.

Table X shows the nonscience courses taught by general science teachers. General mathematics, algebra, and geometry were the nonscience courses most frequently taught by general science teachers, with physical education and athletics next in order. General science teachers taught 243 courses in mathematics, 179 in physical education and athletics, 82 in food and clothing, and 78 in social studies.

Similar trends are evident in Table XI which presents the data for biology teachers. Biology teachers taught 164 courses in mathematics, 168 courses in physical education and athletics, 101 in social studies, and 72 in food and clothing.

The main difference in the chemistry data, Table XII, was in the smaller number of nonscience courses. The difference reflects the higher proportion of full-time teachers in chemistry, which is taught mostly in the larger schools. Chemistry teachers taught 79 courses in mathematics, 21 courses in physical education and athletics, 16 in food and clothing, and 12 in social studies.

The pattern for physics, Table XIII, was somewhat intermediate between those of biology and chemistry. Physics teachers taught 141 courses in mathematics, 42 in physical education and athletics, 27 in social studies, 15 in driver training, and 6 in food and clothing.

TABLE X.—Nonscience courses taught by general science teachers

SIZE OF SCHOOL	None	Math	Algebra	Geometry	Industrial arts	Woodwork, shop	Physical education	Athletics	History	Constitution	Citizenship	Music, band	Food, clothing	Library	Foreign language	Journalism, speech, English	Manual training	Driver training	Others
0—9	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
10—24	0	7	3	4	4	3	6	2	3	2	....	....	2	2	1	6	2	....	3
25—49	5	15	27	16	9	19	29	17	17	13	4	9	30	4	1	21	6	3	4
50—74	10	13	21	15	2	15	28	12	14	6	1	3	26	3	....	13	5	4	5
75—99	4	11	24	19	4	7	19	16	8	3	1	5	13	....	....	1	2	3	4
100—199	31	21	15	9	3	2	21	13	8	3	....	1	10	3	1	8	4	8	4
200—299	17	5	4	1	....	1	7	5	2	1	1	....	....	....	1	2	....	2	1
300—499	13	5	1	1	....	....	3	....	1	....	....	....	....	....	....	1	1	....	....
500—999	15	4	....	....	....	....	....	....	....	....	....	....	1	....	1	1	....	1	2
1,000—2,499	5	2	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
2,500—	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Totals	101	82	96	65	22	47	114	65	53	28	7	18	82	12	5	53	20	21	23

TABLE XI.—Nonscience courses taught by biology teachers

SIZE OF SCHOOL	None	Math	Algebra	Geometry	Industrial arts	Woodwork, shop	Physical education	Athletics	History	Constitution	Citizenship	Music, band	Food, clothing	Library	Foreign language	Journalism, speech, English	Manual training	Driver training	Others
0—9					1														
10—24		4	3	1	2	3	3	2	5	2	1	1	4	1	1				
25—49	6	10	17	7	7	12	23	18	16	13	6	8	22	7	2	25	4		5
50—74	10	10	13	11		7	25	9	16	9	2	4	23	4	2	16	2	4	6
75—99	8	9	21	17	2	2	20	14	10	7			11	3		2	1	6	4
100—199	28	18	11	5	2	1	21	12	9	2		2	9	5	1	9	2	5	4
200—299	20	1	1			1	8	8	1		1				1	1		3	
300—499	22	1	2	1			1	1	1				1	1	1				
500—999	16	1					2	1					2	1		2		1	1
1,000—2,499	6																		
2,500—	1																		
Totals	117	54	68	42	14	26	103	65	58	33	10	15	72	22	8	55	9	19	20

TABLE XII.—Nonscience courses taught by chemistry teachers

SIZE OF SCHOOL	None	Math	Algebra	Geometry	Industrial arts	Woodwork, shop	Physical education	Athletics	History	Constitution	Citizenship	Music, band	Food, clothing	Library	Foreign language	Journalism, speech, English	Manual training	Driver training	Others
0—9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
10—24	....	....	....	....	1	1	1	....	1	1	....	....	1	2	....	....	....	....	....
25—49	....	2	4	3	....	4	1	1	1	2	....	....	2	....	....	....	....	1	4
50—74	1	2	4	4	....	1	3	....	3	....	....	....	4	1	....	....	....	....	....
75—99	1	3	10	5	....	2	3	2	....	....	....	....	1	....	....	....	....	1	1
100—199	26	17	5	6	....	1	4	1	1	1	....	....	8	3	....	4	....	3	1
200—299	16	3	4	....	....	1	2	3	1	....	1	....	....	....	2	2	....	2	....
300—499	23	2	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....
500—999	17	1	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
1,000—2,499	5	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
2,500—	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Totals	90	31	30	18	1	10	14	7	7	4	1	....	16	6	2	6	....	8	7

TABLE XIII.—Nonscience courses taught by physics teachers

SIZE OF SCHOOL	None	Math	Algebra	Geometry	Industrial arts	Woodwork, shop	Physical education	Athletics	History	Constitution	Citizenship	Music, band	Food, clothing	Library	Foreign language	Journalism, speech, English	Manual training	Driver training	Others
0—9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
10—24	2	3	....	1	1	1	....	1	....	....	....	....	....	....	....	1	....	....	2
25—49	1	4	7	4	2	4	5	6	5	2	1	1	4	....	....	1	1	....	2
50—74	4	5	12	10	1	5	8	3	6	1	....	1	2	1	....	1	....	1	2
75—99	2	7	11	11	1	1	3	4	1	1	2	4	....	....	....	1	....	4	....
100—199	19	18	16	11	2	2	6	6	2	2	....	1	....	1	....	1	2	5	1
200—299	11	6	3	....	....	....	1	5	2	1	....	....	....	....	1	....	....	3	....
300—499	17	3	3	2	....	....	....	....	1	....	....	....	....	....	....	....	....	2	....
500—999	16	2	1	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
1,000—2,499	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
2,500—	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Totals	78	48	52	41	7	13	23	25	17	7	3	7	6	2	1	5	3	15	7

Trends

NUMBER OF SCIENCE TEACHERS

Ridgway (1931) reported that 1,080 different individuals were teaching science courses in 1930-1931. This is a larger number than has been reported since. Table XIV shows the number of science teachers as reported by Ridgway (1931), Irwin (1938), Lockard (1946), and the present study.

TABLE XIV.—Number of teachers teaching science and teaching science only

	Ridgway 1930-1931	Irwin 1937-1938	Lockard 1945-1946	Present study 1951-1952
Number of teachers teaching science...	1,080	919	792	929
Number of teachers teaching science only	110	209	169	177*
Percent teaching science only.....	10	23	21	19

* This figure is not exactly comparable, because it is the number of full-time science teachers (a teacher who teaches four sections of science). Thus a teacher might be teaching three classes in science and not appear in this figure; he would, however, have been counted in the other reports. Again, a teacher who has four science classes and one non-science class would not be counted in the other reports, but would be included in our 177.

Ridgway reported the 1,080 science teachers as teaching 1,695 science classes, or 1.6 classes each. The total number of classes was not listed by Irwin or Lockard. In 1951-1952, the 929 science teachers taught 2,371 science classes, or 2.6 classes each. Thus, while the number of different individuals teaching science decreased slightly, the total number of science classes was increasing by 676, or about 40 percent. The increase was due partly to a greater number of full-time science teachers and partly to a decrease in the number of teachers teaching only a single science course.

SCIENCES TAUGHT

The only data available for a comparison of the individual sciences were from an unpublished research paper by Lockard, who in 1946 studied 140 schools, selected to be a proportionate sample of Class A, Class B, and Class C high schools in Kansas. Tables XV and XVI show the comparison between Lockard's data and those of the present study.

TABLE XV.—Number of schools offering the four main sciences. Numbers in parentheses indicate schools sampled

	General science	Biology	Chemistry	Physics
Lockard study (140)...	103	71	30	65
Percent.....	74	65	21	46
Present study (715)...	569	482	208	232
Percent.....	83	71	31	34

These data show an increase in schools offering science courses, except physics, since World War II. Possibly the physics offerings had been increased because of the exceptional war time interest in the subject and have since settled back to "normal."

Table XVI shows somewhat the same trend, in terms of the total number of classes taught. Here again, there was an increase in all sciences except physics. While these data are spread over too short a duration to mean much, they do agree with a national trend in relative decrease in enrollments and offerings in specialized sciences and an increase in general sciences.

The trends as revealed by the Ridgway, Irwin, Lockard studies are in general agreement with those of the ten years from 1940 to

TABLE XVI.—The total number of classes offered in the four main sciences in the Lockard and the present study. Numbers in parentheses indicate schools sampled

	General science	Biology	Chemistry	Physics
Lockard (140).....	132	137	48	77
Classes per school.....	.94	.98	.34	.55
Present study (715)...	754	892	265	266
Classes per school.....	1.05	1.25	.37	.37

1950, as shown by the Reed report, although the actual figures are in most instances not comparable. For example, the schools offering general science changed from 86 percent in 1940 to 92 percent in 1950; biology changed from 70 percent to 90 percent; chemistry from 36 percent to 48 percent; and physics from 73 percent to 76 percent.

NUMBER OF STUDENTS ENROLLED

Since the Alm (1938) report was based on the High-school Principal's Organization Reports, it may be compared directly with the present study. Table XVII shows the number of students enrolled in the four main sciences in 1936-1937 and 15 years later.

TABLE XVII.—Number and percentage of students enrolled in general science, biology, chemistry, and physics

	General science	Biology	Chemistry	Physics
Alm (1938) enrollment	12,478*	12,718	3,856	6,414
Percent of total.....	15.9	13.3	4.0	6.7
Present study enrollment.....	14,973	15,130	4,555	3,400
Percent of total.....	15.0	15.0	4.5	3.4

* Ninth grade not counted in total enrollment of 15 schools in cities of the first class.

It may be noted for comparison that in Nebraska Wilson (1951) found that of the total enrollment in the high schools studied, 16.49 percent were taking general science, 18.69 percent were taking biology, 3.97 percent were taking chemistry, and 6.40 percent were taking physics.

The Alm report included a comparison of average enrollments per school in 1929-1930 and 1936-1937. Although the report was based only on schools in second-class cities, the trends were consistent with those observed in other studies. Table XVIII shows the comparison.

TABLE XVIII.—Total enrollment and average enrollment in the four main sciences in 70 schools in cities of the second class (Alm, 1938)

	General science	Biology	Chemistry	Physics
1929-1930 Total enrollment...	1,323	2,567	1,054	1,905
Average enrollment for school offering the science.....	34	50	33	30
1936-1937 Total enrollment..	2,653	4,146	1,474	1,655
Average enrollment for school offering the science.....	53	67	36	28

For biology some comparisons may be made between the results of the present study and the 1941-1942 study made by Lessig. In 187 schools, with an enrollment of 54,938, there were 11,108 or 20.1 percent enrolled in biology. Biology was offered by 478 schools in Kansas, and was taught by 509 teachers. In the present study, 15,130, or about 15 percent, of the total high-school enrollment of about 101,000 were enrolled in biology. Biology was offered in 482 high schools and was taught by 521 teachers. The decrease from 20 percent in the Lessig study to 15 percent in the present study may be more apparent than real, since the Lessig study was based on questionnaires returned by about 42 percent of the biology teachers to whom questionnaires were sent.

Comparable data were available for Nebraska. Wilson (1951) presented a comparison of the number and percent of students enrolled in the four main sciences for 1929-1930, 1939-1940, and 1949-1950. Table XIX, which is a part of Table 50, page 136, of the Wilson study, shows the trends.

What may be the beginning of a new trend in Kansas science teaching is the establishment of an additional science course. In 1948, the State Department of Public Instruction sponsored the establishment of a workshop in Science Education at Kansas State Teachers College, Emporia. This workshop has given most of its attention during the summers since 1948 to the production of a guide (Laboratory Science Handbook, State Department of Public Instruction, 1952) for a laboratory science course to follow ninth

TABLE XIX.—Enrollment trends in the four main sciences (Wilson, 1951)

COURSE	1929-1930		1939-1940		1949-1950	
	Total enrollment	Per-cent	Total enrollment	Per-cent	Total enrollment	Per-cent
General science	8,807	15.50	11,281	13.62	10,608	16.49
Biology	5,938	10.45	11,795	14.24	12,028	18.69
Chemistry	2,053	3.61	3,054	3.69	2,252	3.97
Physics	6,035	10.62	5,901	7.13	4,115	6.40

grade general science and to give laboratory experiences to pupils who are not interested in the more specific sciences.

Although the foregoing trends differ in detail, they seem to point toward the general conclusion that general science and biology are increasing or at least holding their own and that the physical sciences have undergone a decrease in emphasis. This agrees with the long range national trends as reported in the Johnson (1950) study. Table XX is Table V of the Johnson study.

TABLE XX.—Percent of pupils enrolled in sciences over the years. (Taken from page 6 of the Johnson, 1950, study)

YEAR REPORTED	Ninth grade General science	Biology	Chemistry	Physics
1890			10.10	22.21
1895			9.15	22.77
1900			7.72	19.04
1905			6.76	15.66
1910			6.89	14.61
1915		6.90	7.38	14.23
1922	18.27	8.78	7.40	8.93
1928	17.50	13.58	7.07	6.85
1934	17.75	14.60	7.56	6.27
1947	18.32	19.51	8.62	5.49

Implications

The science courses of the 679 high schools studied were taught by 929 different teachers. Of these only 177 were full-time science teachers. The future science teacher should, therefore, prepare himself in at least one other teaching area. The combination of courses most likely to be taught by science teachers has not changed materially since the Ridgway study in 1930.

Most of the full-time science teachers in Kansas teach both biological and physical sciences. The good science teacher will have to know enough of each to be able to handle the subject matter efficiently at the high school level. The National Society for the Study of Education recommended the following program for the education of high-school science teachers:

. . . "the areas of instructional techniques in which science teachers should be competent are . . .

A. For all prospective teachers of science in secondary grades:
   1. Survey of integrated course in biological science (drawing from anatomy, bacteriology, botany, ecology, entomology, health, physiology, and zoology, and possibly others, including lectures, laboratory, field work). 9 to 12 semester hours
   2. Survey or integrated course in physical science (drawing from astronomy, chemistry, geology, meteorology, and physics, and possibly others, and including lectures, laboratory, and field trips or excursions). 9 to 12 semester hours
   3. Survey or integrated course in social science (drawing from anthropology, the development of civilization, American history with emphasis on economic, geographic, and sociological factors, and the development of political and social institutions and problems—lectures, laboratory and field work using the community as a laboratory). 9 to 12 semester hours
   4. Algebra, plane geometry, and trigonometry. 2 high-school units or 9 semester hours

. . . . . .

B. In addition to the above, prospective teachers of general science in junior high-school grades would take:
   1. Courses in botany, human physiology, and/or zoology. 9 to 12 semester hours
   2. Courses in chemistry and/or physics. 9 to 12 semester hours
   3. Courses in astronomy, geology, meteorology, and/or physical geography. 9 to 12 semester hours

C. Prospective teachers of science in senior high school grades would take, in addition to the survey courses 1, 2, and 3, the following:
   1. Additional work in (*a*) biological sciences (including both botany and zoology), or (*b*) chemistry, or (*c*) physics to

obtain a total in one area including the corresponding survey course of at least 24 semester hours.

2. Additional work in the two areas not chosen in (1) to obtain with the other science survey an average of 18 semester hours in each or a total of 36 semester hours.

This recommendation of a minimum total of 60 semester hours in science, with 24 semester hours in one science and approximately 18 semester hours in each of two other sciences, is in close agreement with the recommendations of the Thirty-first Yearbook . . ."*

Much concern has been expressed both by scientists and educators about the relative decrease in emphasis on the physical sciences during the last fifty years. Detailed discussion of this is outside the scope of this paper, but it seems desirable to quote the following from the *Forty-sixth Yearbook of the National Society for the Study of Education:*

"Many 'fused' courses of physical science have been introduced into the senior high school during the last decade. Moreover, the number of such courses seems certain to increase. It is quite as logical to develop such a course at the present time as it was to begin the development of general biology about thirty-five years ago. The formulation of a satisfactory course in physical science, however, has been retarded by a variety of different approaches to the problem, reflecting nebulousness and confusion of ideas with respect to the nature and functions of such a course. The following considerations, therefore, are deemed to be fundamental to a satisfactory solution of the problem of providing a satisfactory course in physical science.

(*a*) The content should be planned so as to develop concepts and principles important not only in physics and chemistry but also in other branches of physical science. . . .

(*b*) Practical considerations dictate that the course should be planned for one year and not for two. . . .

(*c*) The values of a course of physical science are likely to be largely sacrificed if attempts are made to simplify it too greatly. Deeply concerned over the decreasing elections of physics and chemistry resulting from the formidable reputations of these subjects, some pioneers in the physical-science movement sought to assemble, under a variety of course and book titles designed to camouflage the nature of the course and thus to allay pupil prejudices against it, materials which would be easy enough for the

* The Forty-sixth Yearbook of the National Society for the Study of Education, Part I, 1947, Chapter XVI, pp. 283-284. Quoted by permission of the Society.

ready comprehension of any of the pupils. These efforts in some cases resulted in courses that were practically on the level of effortless entertainment. They were less demanding of pupil effort and thought and, on the whole, provided a less valuable orientation in physical science than does a good course in general science intended for the junior high school. The worth of many of these early physical-science courses was further lessened by the omission of laboratory work.

There are obviously grave difficulties in the way of organizing a course in physical science which will prove simple enough for ready comprehension by pupils of limited abilities and still retain the unique, intrinsic values attainable within this area. There seems no doubt, however, that a course of this nature can be evolved which can achieve its desired objectives through a much less technical and mathematical approach and with many more contacts with the daily lives of boys and girls than do the conventional present-day courses in physics and chemistry. If, however, physical science is to realize its full potentialities, it must be made to serve both as a 'college-preparatory' and as a terminal course.

The devising of satisfactory courses in physical science is one of the greatest challenges in the field of secondary-school science. Their development is especially important for the smaller schools in which the equipping and scheduling of separate courses in physics and chemistry is often a serious problem." **

If physical science courses are developed that will encourage smaller high schools to offer them and encourage high school students to select them, the demand for high school science teachers will be greatly increased. It seems reasonable to believe that about the same number of students should be enrolled in physical science as in biological science in the high schools, instead of twice as many students in biology as in physics and chemistry combined, as shown in the present study.

In the largest Kansas high schools, where science teachers commonly teach only a single science, an advanced degree is a common requirement, either by formal action of the school system or by virtue of competition for better jobs. The prospective science teacher who has ambitions for moving up to the larger schools should have enough concentration in a single science to provide a base for graduate study in that science.

** *Op. cit.*, Chapter III, pp. 45-46. Quoted by permission of the Society.

Department heads and other advisors in the colleges of teacher education in Kansas, and elsewhere, should inform themselves concerning placement opportunities for science teachers, so that they may help the student select courses that will fit him to select a teaching job to his best advantage. The balance between broad training in the sciences and concentration in a science is not easy to achieve. It requires the best co-operative effort of both student and teacher.

Summary

1. The High-school Principal's Organization Reports of 654 of the 659 accredited senior high schools and 25 of the 59 accredited junior high schools were examined for data concerning science teaching in Kansas high schools in 1951-1952.
2. Of the 679 schools whose reports were examined, 569 offered general science, 482 offered biology, 208 offered chemistry, and 232 offered physics.
3. The most common sciences other than general science, biology, chemistry, and physics were agriculture, physiology, physical geography, and aeronautics.
4. Of a total enrollment of about 101,000 in the high schools studied, the enrollments in the four main sciences were: general science (14,973), biology (15,130), chemistry (4,555), and physics (3,400).
5. There were 752 part-time science teachers and 177 full-time science teachers.
6. The science teachers in the 679 high schools taught a total of 2,242 nonscience courses. General science teachers taught 814 nonscience courses, biology teachers taught 810, chemistry teachers taught 258, and physics teachers 360.
7. The median class sizes ranged from 8.5 to 33 in general science, from 3 to 31.5 in biology, from 3 to 27 in chemistry, and from 3 to 27 in physics.

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