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**Offerings and Enrollments in the
Secondary School Sciences in
Kansas in 1965 - 1966**

By

John Breukelman

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Offerings and Enrollments in the Secondary School Sciences in Kansas in 1965-1966

by
John Breukelman*

Three comprehensive studies of the science offerings and enrollments in the secondary schools of Kansas have been published by the author and his associates (Breukelman and Andrews, 1953, 1956; Breukelman and Frazier, 1961). In these papers, hereinafter referred to as the 1953, 1956 and 1961 studies, respectively, we presented data we considered important not only to Kansas high school science teachers and administrators, but equally so to the colleges responsible for the preparation of science teachers for Kansas high schools.

The 1961 study was based on data for the 1960-61 school year. Five years of rapid change in education, and especially in science education, have elapsed. It seemed wise to repeat the study at this time, to see what new changes have occurred in Kansas high school science offerings and enrollments, and to what extent the trends evident in 1961 have continued.

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." This statement is as valid now as it was in 1947.

Beginning teachers of science in Kansas high schools must adjust themselves to varied conditions in the diverse schools of Kansas. Prospective science teachers and their advisors should know the circumstances under which the teachers must work.

The purposes of this study are to show (1) the offerings and enrollments in the sciences in Kansas junior and senior high schools, (2) the subjects taught by Kansas junior and senior high-school science teachers, and (3) some of the major trends in Kansas high school science teaching as revealed by comparison with previous studies.

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 1947-48. The randomly selected sample of schools was proportionate to the types and sizes of the schools in the entire country. Johnson divided the 715 schools into size groups which have been widely used for subsequent comparative studies.

Brown and Obourn (1958) studied science and mathematics offerings and enrollments in 4,254 public high schools, selected at random

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from a card file maintained by the Statistical Services Unit, U. S. Office of Education. They compared their findings with those of their earlier study (Brown and Obourn, 1956) of 2,375 public high schools selected at random from the schools listed in the *Directory of Secondary Day Schools*, 1951-52 (Rice, 1952). The schools in the sample were the same ones used in a survey by Brown (1954).

Breukelman and Frazier (1963) studied the offerings and enrollments in Kansas junior high school science, in 96 separately organized junior high schools and in the 7th, 8th, and 9th grades of 25 six-year junior-senior high schools. Breukelman (1964) reported on the teaching combinations of 666 senior high school and 15 junior high school biology teachers in Kansas.

Methods

This study was based, as were the aforementioned studies by the author and his associates, on data abstracted from the High School Principal's Organization Reports, on file at the State Department of Public Instruction.

For each school, the items recorded and tabulated were: school enrollment, enrollment by classes, enrollment in each section of each science taught, and non-science subjects taught by each science teacher. The schools were divided into size groups corresponding to those used by Johnson (1950) and also in the previous studies by the author and his associates.

The present study is like that of 1961 in that the senior high schools and junior high schools are treated separately. In the 1953 and 1956 studies, junior high schools were included in the tabulations if their reports showed that ninth-grade science was taught; seventh-grade and eighth-grade science courses were not included.

The Sample

At the time of going to press, the official list of Kansas senior and junior high schools accredited for 1965-66 by the State Department of Public Instruction was not yet available. Senior high schools, as used hereafter, include not only two-year, three-year, and four-year high schools, but also six-year high schools in which the junior high schools were not separately organized and accredited.

The majority of Kansas junior high schools are three-year schools, including grades seven, eight, and nine. Other types of organization exist, however, including one-year and two-year (some consisting of grades seven and eight, some eight and nine, and some nine and ten).

This study was based on data from 557 senior high schools and 110 separately organized junior high schools, substantially all of the accredited high schools in Kansas in 1965-66. Table I shows the number and percentage of junior and senior high schools used as the basis for this study, and organized by size categories.

TABLE I. NUMBER OF KANSAS JUNIOR HIGH SCHOOLS AND SENIOR HIGH SCHOOLS IN EACH SIZE GROUP, 1965-66.

Size of School	Total		Junior High School		Senior High School	
	Number of Schools	Per Cent	Number of Schools	Per Cent	Number of Schools	Per Cent
-24	14	2.1	....	....	14	2.5
25-49	74	11.1	....	....	74	13.3
50-74	98	14.7	1	.9	97	17.4
75-99	80	12.0	4	3.6	76	13.6
100-199	142	21.3	12	10.9	130	23.3
200-299	70	10.5	9	8.2	61	11.0
300-499	67	10.0	23	20.9	44	7.9
500-999	77	11.5	43	39.1	34	6.1
1000-2499	42	6.3	18	16.4	24	4.3
2500-	3	.4	....	....	3	.5
Totals	667	99.9	110	100.0	557	99.9

Read table thus: Reports were examined from 14 schools with enrollments below 24; this is 2.1% of the 667 schools studied. None of these was a junior high school. All 14 were senior high schools, and made up 2.5% of the 557 senior high schools.

Offerings in Enrollments in Senior High School

SCIENCES IN SENIOR HIGH SCHOOLS OF VARIOUS SIZES

Approximately 47% of all the Kansas senior high schools had enrollments of fewer than 100. In both 1951-52 and 1954-55, 61% of the schools had enrollments of fewer than 100. These data are not exactly comparable since the present study reports the junior high schools separately. In 1960-61, 55% of the senior high schools had enrollments of fewer than 100; this percentage is comparable to the 47% of the present study.

One frequently hears it said that "the average Kansas high school has only about 100 students." This is not true. It is true that almost half (47% in 1965-66) of the Kansas senior high schools have enrollments of fewer than 100, and that the *median* enrollment of the 557 senior high schools covered in this study was 113; however, these 557 schools had more than 132,000 students, or an *average* of 238. Undue emphasis on the small size of Kansas high schools may lead to some misconceptions con-

TABLE II. NUMBER OF KANSAS SENIOR HIGH SCHOOLS IN EACH SIZE GROUP AND THE NUMBERS OF DIFFERENT COURSES OFFERED BY THESE SCHOOLS, 1965-66.

Size of School	Number of Schools	Per Cent	Number of schools offering from one to four or more science courses:			
			1	2	3	4 or more
-24	14	2.5	3	6	4	1
25-49	74	13.3	2	32	35	5
50-74	97	17.4	5	28	45	19
75-99	76	13.6	2	13	38	23
100-199	130	23.3	....	11	56	63
200-299	61	11.0	....	2	29	30
300-499	44	7.9	....	1	16	27
500-999	34	6.1	....	....	20	14
1000-2499	24	4.3	....	....	6	18
2500-	3	.5	....	....	....	3
Totals	557	99.9	12	93	249	203

Read Table thus: 14 of the schools studied had enrollments below 24; 3 of these offered only one science; 6 offered 2; 4 offered 3; and 1 offered 4.

cerning the teaching situations of Kansas science teachers, and on the learning situations of the students. As will be noted in a later section, most of the classes in high school science in Kansas are taught by a minority of the Kansas high school teachers, and only a small minority of Kansas high school students attend schools with enrollments below 100.

Even the smallest schools taught science in 1965-66. In some of the smaller schools, certain science courses are alternated. 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 II shows only the number of science courses reported as taught in 1965-66. Of the 557 Kansas senior high schools included in this study, 12 offered only one science in 1965-66, whereas 93 offered two, 249 offered three, and 203 offered four or more sciences.

The number of science courses offered increased regularly with school size. Of the 105 schools offering only one or two science courses,

86% had enrollments of fewer than 100, while all except 48 of the 203 schools offering four or more science courses had enrollments of 100 or more.

Senior High Schools Offering Different Sciences

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

Of all the schools studied, 64% offered general science, 97% offered biology, 77% offered chemistry, and 64% offered physics. Examination of Table III reveals that only 17 Kansas senior high schools, all with enroll-

TABLE III. NUMBER OF KANSAS SENIOR HIGH SCHOOLS OFFERING THE FOUR MAIN SCIENCES, 1965-66

Size of School	Number of Schools	General Science		Biology		Chemistry		Physics	
		Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
-24	14	10	71.4	13	92.9	5	35.7	2	14.3
25-49	74	57	77.0	70	94.6	37	50.0	21	28.4
50-74	97	71	73.2	89	91.8	53	54.6	48	49.5
75-99	76	61	80.3	72	94.7	55	72.4	39	51.3
100-199	130	86	66.6	130	100	117	90.0	96	73.8
200-299	61	34	55.7	61	100	58	95.1	52	85.3
300-499	44	20	45.5	44	100	43	97.8	38	86.4
500-999	34	12	35.3	34	100	34	100	34	100
1000-2499	24	6	25.0	24	100	24	100	24	100
2500-	3	....	....	3	100	3	100	3	100
Totals	557	357	64.0	540	96.9	429	77.0	357	64.1

Read table thus: Of the 14 schools with enrollments below 24, 10 or 71% offered general science, etc.

ments below 100, lacked a biology course; that the great majority of all schools, except the very smallest, offered chemistry; and that nearly all of the schools with enrollments above 100 offered physics. The percentage of schools offering general science tended to be smaller in the schools of 300 or more enrollment because many of these larger schools do not have ninth-grade science.

TABLE IV. COMPARISON OF PRESENT STUDY WITH THE 1953, 1956, 1961, AND JOHNSON (1950) STUDIES, AS REGARDS PERCENTAGE OF SENIOR HIGH SCHOOLS OFFERING THE FOUR MAIN SCIENCES.

	Present Study (%)	1961 Study (%)	1956 Study (%)	1953 Study (%)	Johnson (1950) (%)
General Science	64	77	74	84	77
Biology	97	94	73	71	85
Chemistry	77	67	31	31	49
Physics	64	52	39	34	48

Table IV shows how the results of the present study compared with those of the Johnson (1950) study, based on national data for 1947-48, and the previous Kansas studies by the author and his associates. General science has lost the dominance it once had in Kansas; 84% of the schools were reported in the 1953 study to be offering this subject. Its popularity was waning by the time of the 1956 study, and it had slipped to second place in 1960-61. On the other hand, biology, chemistry, and physics have enjoyed increasing popularity since the 1953 study was made. Biology was reported to be offered by 71% of the senior high schools in the 1953 study, 73% of the schools in the 1956 study, by 94% of the schools in the 1961 study, and by 97% in the present study. Biology is now, as it was in 1960-61, the science course offered in the largest number of senior high schools.

The increase in the number of schools offering chemistry, from 31% (1953 and 1956 studies) to 78% (present study), represented the largest relative gain among the four major sciences. The gains made in the physics offerings, although not as large as those in chemistry, have been steady: from 34% in the 1953 study, to 39% in the 1956 study, to 52% in the 1961 study, to 64% in the present study.

The increased numbers of schools offering more science reflect an increased concern for science education on the part of scientists, teachers, students, school board members, and the population in general.

Science Other Than General Science, Biology, Chemistry, and Physics

Reference to Table V shows that the senior high schools of Kansas provided the opportunity to explore many sciences other than the customary four—general science, biology, chemistry, and physics. Some of these other sciences were advanced offerings; others represented specialized areas. Health, anatomy, physiology, agriculture, electronics, electricity, radio and television, and psychology were included as sciences

TABLE V. SCIENCE COURSES OTHER THAN GENERAL SCIENCE, BIOLOGY, CHEMISTRY, AND PHYSICS OFFERED BY KANSAS SENIOR HIGH SCHOOLS, 1965-66.

Size of School	Physical Science	Earth Science	Health, Anatomy, Physiology	Advanced Biology	Basic Science	Laboratory Science	Advanced or Modified Science	Zoology	Botany	Senior Science	Other
-24								1			
25-49	3	3		1		1	1	1		1	
50-74	10	6	2					1	1	2	2
75-99	5	4	2	3		1			1		1
100-199	15	12	12	9	2	3	3			2	2
200-299	11	14	4	2	1	3	1	2			5
300-499	10	10	3	3	3	6		1		1	2
500-999	11	5	5	9	3	3	2	2			7
1000-2499	8	4	13	11	9	4	2	1	5	1	15
2500-	2	2		1	5	1			1		2
Totals	75	60	41	39	23	22	9	9	8	7	36

if the high school principal listed them in his report as sciences. Health and physiology, however, were most often listed under physical education. Electronics, electricity, and radio and television were sometimes reported as industrial arts courses. Psychology was often included as a social science.

The courses offered most were in physical science. Most frequently mentioned was physical science (75 schools), followed by earth science (60 schools). Geology, astronomy, aeronautics, electricity, electronics, photography, advanced physics, radio and television, and radiation physics were also reported, in most cases by only one or two schools.

Of the courses that were essentially biological, those most often reported were anatomy, physiology, health, or some combination of these, by 41 schools; advanced biology by 39 schools, zoology by 9, and botany by 8. In addition, agriculture (not vocational agriculture) and conservation were reported a few times.

Courses of a more general nature were basic science (23 schools), lab science (22 schools), modern, or advanced, science (9 schools), and senior science (7 schools). Others reported were practical science, industrial science, and current science.

Enrollments in Senior High School Science Courses

Of the 58,327 students enrolled in the four major science courses taught in the secondary schools, almost 33,000 were taking biology (Table VI). Chemistry with 11,538 students ranked second; general

TABLE VI. TOTAL ENROLLMENTS IN THE FOUR MAIN SCIENCES IN KANSAS SENIOR HIGH SCHOOLS, 1965-66.

Size of School	General Science	Biology	Chemistry	Physics
-24	53	53	20	1
25-49	554	668	220	105
50-74	1231	1407	453	310
75-99	1111	1479	615	242
100-199	2072	4501	1752	701
200-299	1317	3368	1359	553
300-499	965	3896	1483	616
500-999	745	5852	2089	753
1000-2499	639	8951	2707	1436
2500-	.....	2721	840	399
Totals	8,677	32,896	11,538	5,116

science was in third place with 8,677, and physics fourth, with 5,116. Reference to the table reveals that this ranking held for all size groups except in the categories below 200, where general science outranked chemistry, and in the three largest categories, where physics outranked general science.

A few principals, who did not report their class enrollments in the organization reports, also failed to return our cards asking for this information; the true totals are, therefore, slightly larger than those shown. The

numbers involved were small, however. The total recorded for each science was probably within 150 or so of the actual enrollment.

The number of students enrolled in general science in senior high schools has shown a radical drop since the 1953 study, receding from 14,973 to 8,677, a loss of 43% (Table VII). This loss is accounted for in large part by the increase in separately organized and accredited junior high schools. Since general science is commonly taught in the ninth grade, an increasing number of general science enrollments will be counted in the junior high school and a decreasing number in the senior high school, as the ninth grade shifts to the junior high school.

Biology has shown a marked increase in enrollment, advancing from 15,130 students in 1951-52 to 32,896 in 1965-66, an over-all increase of 120%. Chemistry has made an even more spectacular rise, going from 4,555 students in 1951-52 to 11,538 in 1965-66, a growth of 153%. The increase in physics enrollments has not been as dramatic, but has grown by 50%, 3,400 students in 1951-52 to 5,116 in 1965-66.

The much larger total enrollments in biology and chemistry might lead one to expect similar differences in the average enrollments in the schools in which these sciences are offered. The differences do exist, but not in the same ratios, as is shown in Table VII. Thus, the average enrollment in biology has doubled while the total enrollment was increasing 120%; the average enrollment in chemistry has increased only from 22 to 27 while the total enrollment increased by 150%. The large increase in biology enrollment results from larger enrollments per school; the even greater increase in chemistry results from the great increase in the number of schools offering the subject. In physics, although the number of schools offering the subject has grown steadily, the average enrollment per school shows a slight decrease.

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 data gathered for the present study indicate that many of the medium-sized and large-sized high schools since 1953 have begun to offer science in the eighth grade and sometimes the seventh grade instead of, or preparatory to, the ninth grade. The 1965-66 compilations of total grade enrollments were not available at the time of going to press. However, it can be estimated from the 1964-65 data that the 8,677 students in general science in Kansas senior high schools represented less than 40% of the total enrollment in the ninth grade. (As noted in a later section, 9,561 students were enrolled in ninth-grade science in junior high schools.) The enrollment in biology was probably about 87% of the tenth grade. For chemistry and physics, which are offered about equally in the eleventh and twelfth grades, the total enrollment of 16,654 in the two sciences probably represented about 29% of the students enrolled in the two grades.

TABLE VII. AVERAGE NUMBER OF SCIENCE STUDENTS PER KANSAS SENIOR HIGH SCHOOL OFFERING THE FOUR MAIN SCIENCES, 1965-66.

	Present Study			1961 Study			1956 Study			1953 Study		
	Schools Offering	Students Enrolled	Average Per School	Schools Offering	Students Enrolled	Average Per School	Schools Offering	Students Enrolled	Average Per School	Schools Offering	Students Enrolled	Average Per School
General Science	357	8677	24	464	10481	23	507	14772	29	569	14973	26
Biology	540	32896	61	565	25021	44	500	19250	39	482	15130	31
Chemistry	429	11538	27	407	9671	24	214	5224	24	208	4555	22
Physics	357	5116	14	313	5220	17	265	4153	16	232	3400	15

TABLE VIII. NUMBER OF SECTIONS AND CLASS SIZES IN GENERAL SCIENCE, BIOLOGY, CHEMISTRY AND PHYSICS IN KANSAS SENIOR HIGH SCHOOLS, 1965-66.

Size of School	General Science			Biology			Chemistry			Physics		
	No. of Sections	Av. Size	Range	No. of Sections	Av. Size	Range	No. of Sections	Av. Size	Range	No. of Sections	Av. Size	Range
-24	10	5	2-10	13	4	1-8	5	4	1-10	2	1	.....
25-49	59	9	3-16	72	10	1-19	37	6	3-16	21	6	3-16
50-74	79	15	2-27	94	16	4-27	55	9	1-21	50	7	1-14
75-99	63	18	5-28	80	19	2-32	58	10	4-19	40	6	2-16
100-199	106	20	1-43	217	20	2-51	141	12	3-32	96	8	1-23
200-299	65	20	7-52	156	25	6-64	93	15	2-28	55	10	2-23
300-499	41	24	8-36	165	24	6-36	83	19	8-35	45	14	5-24
500-999	33	27	16-58	233	26	7-38	105	21	5-38	54	16	7-36
1000-2499	23	28	17-36	328	24	10-90	118	23	10-31	82	22	9-33
2500-	.....	.....	.....	78	35	14-50	35	24	13-30	16	25	16-30
Totals	479			1,436			730			461		

Read Table thus: In schools with enrollments below 24, there were 10 sections of general science, with an average size of 5; the smallest section had 2 and the largest 10 students; etc.

Class Sizes

With minor exceptions, average class sizes increased fairly regularly with school size, 5 to 28 in general science, 4 to 35 in biology, 4 to 24 in chemistry, and from 1 to 25 in physics (Table VIII).

In all size groups, the average class sizes in general science and biology were larger than those in chemistry and physics. The larger sections of general science and biology probably are due, in part, to the placement of these subjects in the ninth and tenth grades, whereas the physical sciences are usually taught in the eleventh and twelfth grades. Coupled with this is the fact that general science and biology often are required subjects, while chemistry and physics are usually electives.

More sections of general science were offered in schools with fewer than 200 enrollment than in schools from 200 up. General science is predominantly a subject of the 4-year high schools. Most of the larger schools are 3-year schools, which do not usually offer general science. The sections of biology tend to be in proportion to the total school enrollments; only 17% of them were in the schools with enrollments below 100.

Full-Time and Part-Time Teachers

A full-time science teacher is herein defined as one who teaches four or more science classes daily; a part-time science teacher as one who teaches three or fewer. On this basis there were more part-time (676) than full-time (486) science teachers in the Kansas senior high schools, although in schools with enrollments of 100 and up the number of full-time teachers (439) exceeded that of part-time teachers (332).

The average number of science students per full-time teacher (101) was much larger than the number per part-time teacher (28), but there were so many more part-time than full-time science teachers in the schools with enrollments below 100 that the majority of science students in these schools were taught by part-time science teachers. The average number of science students per science teacher increased steadily with school size, from 7 to 143 for full-time teachers, and from 7 to 66 for part-time teachers.

Of the 1,162 science teachers shown in Table IX, 486 or 42% were full-time science teachers, whereas 676 or 58% were part-time. The 1953 study reported 929 science teachers, 177 or 19% of whom were full-time science teachers, and 752 or 81% part-time. The 1956 study included data on 1,096 science teachers, of whom 20% were full-time and 80% part-time science teachers. The 1961 study included data on 1,136 science teachers, of whom 31% were full-time and 69% part-time. These comparisons show that both the number and the percentage of full-time science teachers has been steadily increasing—the number from 177 to 486 since 1951-52, and the percentage from 19 to 42 percent. This means also that the percentage of students taught by full-time science teachers is increasing.

TABLE IX. NUMBER OF FULL-TIME (ONE WHO TEACHES FOUR OR MORE SECTIONS) KANSAS SENIOR HIGH SCHOOL SCIENCE TEACHERS AS COMPARED TO THE NUMBER OF PART-TIME SENIOR HIGH SCHOOL SCIENCE TEACHERS, AND THE AVERAGE NUMBERS OF STUDENTS OF THESE TEACHERS, 1965-1966.

Size of School	Full-time Teachers		Part-time Teachers		Average number of science students per science teacher	
	Number	Per Cent	Number	Per Cent	Full-time	Part-time
-24	1	5.3	18	94.7	7	7
25-49	7	6.4	103	93.6	27	14
50-74	16	10.9	131	89.1	53	22
75-99	23	20.0	92	80.0	58	26
100-199	72	32.7	148	67.3	71	31
200-299	64	51.2	61	48.8	86	37
300-499	58	50.0	58	50.0	105	39
500-999	82	66.7	41	33.3	112	46
1000-2499	132	86.3	21	13.7	125	48
2500-	31	91.2	3	8.8	143	66
Totals	486	41.8	676	58.2	101	28

Read table thus: In schools with enrollments below 24, there were 19 teachers of science; one or 5.3% taught 4 science classes, and 18 or 94.7% taught 3 or fewer. The number of science students taught by the full-time science teacher was 7; the average number taught by the 18 part-time science teachers was 7.

Non-Science Courses Taught by Science Teachers

As was pointed out in the discussion of full-time and part-time teachers, 58% of the teachers taught three or fewer science classes. The majority of these part-time science teachers were found in the schools of under 200 enrollment. These part-time teachers taught a variety of other subject-matter fields, many not closely related to each other or to science.

Table X shows the non-science courses taught by general science teachers. Non-science courses in the fields of mathematics, health, physical education, and athletics; social science; woodworking, shop, driver education; and home economics, in descending order, were most

TABLE X. NON-SCIENCE COURSES TAUGHT BY KANSAS HIGH SCHOOL GENERAL SCIENCE TEACHERS, 1965-66.

Size of School	None	Mathematics	Algebra	Geometry	Health	Physical Education	Athletics	Social Sciences	Industrial Arts	Woodwork Shop	Driver Education	Home Economics	English, Journalism, Speech	Foreign Language	Others
-24	1	2	3	1	2	1	...	4	...	1	...	...	1	...	...
25-49	...	12	17	10	5	11	2	19	7	9	5	13	5	1	4
50-74	9	13	13	9	7	16	...	23	...	5	9	10	1	3	5
75-99	17	12	7	6	3	8	1	10	...	...	6	10	2	...	2
100-199	36	12	7	6	7	11	5	15	3	2	6	4	1	1	1
200-299	23	10	3	2	...	4	...	1	1	1	3	...	1	...	2
300-499	14	3	3	1	1	3	...	3	...	1	1	...	...	...	...
500-999	11	1	1	...	...	3	1	...	...	...	...	1	...	...	2
1000-2499	8	...	...	1	...	...	...	...	...	...	...	...	...	...	...
2500-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals	119	65	54	36	25	57	9	75	11	19	30	38	11	5	16

frequently taught by general science teachers. They also taught courses in English, foreign language, art, music, "unified studies," "core," and certain unidentified courses. Fifteen general science teachers served as principals, and 10 as librarians. It may be noted that 119 of the general

TABLE XI. NON-SCIENCE COURSES TAUGHT BY KANSAS HIGH SCHOOL BIOLOGY TEACHERS, 1965-66.

Size of School	None	Health	Physical Education	Athletics	Mathematics	Algebra	Geometry	Social Sciences	Industrial Arts	Woodwork, Shop	Driver Education	Home Economics	English, Journalism, Speech	Foreign Language	Business	Others
-24	1	2	2	...	3	4	3	4	1	2	...	2	1	...	...	...
25-49	2	8	14	2	7	13	12	28	3	9	7	13	10	2	4	7
50-74	10	9	21	4	13	11	10	26	4	5	8	14	3	5	2	4
75-99	21	5	15	1	11	8	7	16	2	2	10	9	4	...	2	3
100-199	64	10	22	6	8	4	4	27	...	1	11	1	3	2	...	8
200-299	41	2	8	3	4	1	2	6	...	...	...	...	2	3	...	2
300-499	89	4	3	...	1	...	...	4	...	...	2	...	...	3	...	6
500-999	49	...	12	...	2	2	2	3	...	...	1	...	...	...	...	1
1000-2499	84	...	1	...	1	...	...	...	...	...	...	...	...	...	...	5
2500-	17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals	328	40	98	16	50	43	40	114	10	19	39	39	23	15	8	36

science teachers taught no non-science courses. Most of these were full-time science teachers, but several were supervisors, librarians, or administrators whose only teaching assignment was one or more sections of general science.

Similar patterns are evident in Table XI, which presents the data for biology teachers. Non-science courses, in descending order of frequency with which they were taught, were: health, physical education, and athletics; mathematics; social science; industrial arts, and driver education; and home economics. The biology teachers also taught English, foreign language, business, speech, agriculture, conservation, art, music, religion, and other courses difficult to identify. A few taught unidentified courses in elementary school or junior college. Twenty-seven served as supervisors or principals and 11 as librarians. The 328 biology teachers who taught no non-science course represent more than a 40% increase over the corresponding 232 of five years earlier.

There is some duplication among these supervisors, principals, and librarians and those reported above. A few principals taught general science and biology, for example. One librarian taught general science, biology, and chemistry.

Two main differences are evident in the chemistry data, Table XII—the smaller proportion of non-science courses taught, and the concentration in the related field of mathematics. The first reflects the higher proportion of full-time teachers of chemistry in the larger schools, and the second reflects the mathematics preparation that most physical science teachers receive. The principal non-science courses other than mathematics, in descending order of frequency with which they were taught by chemistry teachers, were: social science, health and physical education, and home economics. In addition to a scattering of other courses, unidentified non-science courses were taught by chemistry teachers. Nine served as supervisors or principals, and 3 as librarians. The 223 chemistry teachers who taught no non-science course represent an increase of 40% over the 158 of 1961-62.

The pattern for physics (Table XIII) was about the same as for chemistry, but with even greater emphasis on mathematics. The non-science courses other than mathematics were mainly in social science, industrial arts, physical education, and foreign language. Some unidentified non-science courses were taught, along with a scattering of other courses. Only 8 physics teachers served as supervisors or principals, and only 2 as librarians. The 151 physics teachers who taught no non-science courses represent a 14% increase over the 130 of 1961-62.

Offerings and Enrollments in Junior High School

The 1953 and 1956 Breukelman and Andrew's studies on *Offerings and Enrollments* did not include separate data on the junior high schools of the state. Junior high schools were included in the tabulations of these two studies if the Principal's Organization Reports showed that ninth-grade science was taught. Seventh and eighth-grade science courses were not included. The 1953 study reported data on 25 (42%) of the accredited

TABLE XII. NON-SCIENCE COURSES TAUGHT BY KANSAS HIGH SCHOOL CHEMISTRY TEACHERS, 1965-66.

Size of School	None	Mathematics	Algebra	Geometry	Social Science	Physical Education	Athletics	Health	Woodwork, Shop	Driver Education	Industrial Arts	Home Economics	Foreign Language	English, Journalism, Speech	Others
-24	1	...	3	1	2	1	...	1	...	...	...	...	...	...	...
25-49	1	12	13	12	10	2	...	3	4	1	2	6	1	2	4
50-74	8	14	16	15	13	3	2	3	1	...	...	4	3	5	1
75-99	21	20	19	12	4	1	...	2	1	...	1	1	...	...	3
100-199	56	26	18	21	7	5	2	3	1	1	2	7	2	1	4
200-299	32	10	9	5	2	...	...	...	...	...	...	1	3	1	4
300-499	25	11	6	3	...	...	1	...	...	1	...	1	1	...	6
500-999	35	1	3	...	...	...	...	...	...	...	...	...	...	...	...
1000-2499	36	...	...	...	1	...	...	...	...	...	...	...	...	...	...
2500-	8	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals	223	94	87	69	39	12	5	12	7	3	5	20	10	9	22

junior high schools and the 1956 study included data from 37 (65%) of the schools.

The 1961 Breukelman and Frazier study dealt separately with the junior high school. The decision to report the junior high schools apart from the three, four, and six-year senior and junior-senior high schools

TABLE XIII. NON-SCIENCE COURSES TAUGHT BY KANSAS HIGH SCHOOL PHYSICS TEACHERS, 1965-66.

Size of School	None	Mathematics	Algebra	Geometry	Industrial Arts	Woodwork, Shop	Driver Education	Social Sciences	Physical Education	Athletics	Health	Foreign Language	English, Journalism, Speech	Others
-24	1	1	...	...	...	...	...	...	...	...	...	...	...	...
25-49	1	9	14	14	1	2	...	...	1	1	...	1	...	2
50-74	5	26	24	20	1	1	...	8	...	...	...	5	1	3
75-99	17	17	10	10	1	2	...	3	...	...	...	...	1	1
100-199	39	33	26	24	4	2	3	4	2	2	1	3	1	1
200-299	26	18	9	5	...	...	...	1	...	1	...	2	1	4
300-499	15	18	8	4	...	...	...	...	1	1	...	...	...	4
500-999	25	5	6	3	...	...	...	...	...	...	...	...	...	1
1000-2499	18	3	5	1	...	...	...	...	...	...	...	...	...	2
2500-	4	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals	151	130	102	81	7	7	3	16	4	5	1	11	4	18

was based on the steadily increasing number of separately organized and accredited junior high schools in Kansas (Table XIV) and hence their increasing importance as educational units. In 1963 Breukelman and Frazier published a more detailed study of junior high school science

offerings and enrollments in Kansas, based on data for the school year 1962-63.

The present study includes data from 110 separately organized junior high schools of the state, an increase of 3 over 1964-65 (Table XIV).

TABLE XIV. NUMBER AND TYPE OF SEPARATELY ORGANIZED AND ACCREDITED JUNIOR HIGH SCHOOLS IN KANSAS, 1951 TO 1965.

School Year	Type of School				Total
	1 year	2 year	3 year	4 year	
1951-1952		17	38	4	59
1952-1953		14	41	2	57
1953-1954		11	42	4	57
1954-1955		9	43	5	57
1955-1956		9	50	5	64
1956-1957		9	55	5	69
1957-1958		10	58	5	73
1958-1959		10	68	3	81
1959-1960		10	72	2	84
1960-1961		13	76	3	92
1961-1962		13	78	2	93
1962-1963	1	14	80	1	96
1963-1964	1	14	85		100
1964-1965	1	17	89		107

Junior High Schools Offering Science

Table XV reflects the fact that separately organized junior high schools occur most frequently in the larger population centers. Of the 110 junior high schools, 84 (76%) had enrollments exceeding 300 pupils, with 23 (21%) in the 300-499 category, 43 (39%) in the 500-999 category, and 18 (16%) in the 1,000-2,499 category. Only five schools reported enrollments of fewer than 100, and the remaining 21 schools were between 100 and 300 in school population.

Science was not offered in each of the three years by all of the junior high schools. Seventy-two (66%) of the schools provided science in the

TABLE XV. NUMBER OF KANSAS JUNIOR HIGH SCHOOLS IN EACH SIZE GROUP OFFERING SCIENCE IN THE SEVENTH, EIGHTH, AND NINTH GRADES, 1965-66.

Size of School	Number of Schools	7th Grade		8th Grade		9th Grade		Grade not specified	
		Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
-74	1	1	100.0	1	100.0	....	....	....	....
75-99	4	4	100.0	4	100.0	1	25.0	....	....
100-199	12	10	83.3	9	75.0	5	41.7	....	....
200-299	9	5	55.6	7	77.8	3	33.3	....	....
300-499	23	12	52.2	22	95.7	17	73.9	1	4.3
500-999	43	28	65.1	42	97.7	39	90.7	2	4.7
1000-	18	12	66.7	18	100.0	17	94.4	....	....
Totals	110	72	65.5	103	93.6	82	74.5	3	2.7

Read table thus: There were 4 schools with enrollments from 75 to 99; 4 or 100% of these offered science in the 7th grade, 4 also in the 8th grade, and 1 or 25% in the 9th grade.

seventh grade, 103 (94%) in the eighth grade, and 82 (75%) in the ninth grade.

TABLE XVI. NUMBER OF KANSAS JUNIOR HIGH SCHOOLS IN EACH SIZE GROUP OFFERING THE SCIENCES, BY GRADES, 1965-66.

Size of School	Number of Schools	7th Grade Only	8th Grade Only	9th Grade Only	7th and 8th	8th and 9th	7th, 8th, and 9th	7th + 8th, and 9th	Other
-74	1	...	...	...	1	...	...	...	...
75-99	4	...	...	...	3	...	1	...	...
100-199	12	2	...	1	5	1	3	...	...
200-299	9	1	1	1	4	2	...	...	...
300-499	23	1	2	...	2	9	8	...	1
500-999	43	1	...	...	2	14	24	...	2
1000-	18	...	...	...	1	6	9	2	...
Totals	110	5	3	2	18	32	45	2	3

Science Offerings by Grades

In the junior high school, the pattern of science offerings by grades was variable (Table XVI). The most common pattern was to offer science in all three years of the junior high school. Of the 45 schools that followed this pattern, the largest number (24) was in the 500-999 enrollment category. Of the other 21 schools offering science each year, 9 were in the 1,000-2,499 enrollment category, 8 were in the 300-499 category, and only 4 had enrollments of fewer than 200.

Thirty-two (29%) of the junior high schools offered science in the eighth and ninth grades, but not in the seventh grade; and 18 (16%) provided science in the seventh and eighth grades, but not in the ninth grade. A science course was offered during only one year of the three junior high school years by 10 of the schools, five in the seventh grade, three in the eighth, and two in the ninth.

A small number of schools combined grades. Two schools offered a combined seventh and eighth grade science, but maintained a separate ninth-grade science. Three combinations were reported which could not be precisely identified.

Science Taught in the Junior High School

There is, no doubt, a wide variation in the nature of the science courses. It cannot be assumed that the courses taught under the titles of *Seventh-grade Science*, *Eighth-grade Science*, and *Ninth-grade Science* are comparable in terms of subject matter. Table XVII shows that 70

TABLE XVII. KINDS OF SCIENCE COURSES TAUGHT AND NUMBER OF KANSAS JUNIOR HIGH SCHOOLS OFFERING EACH COURSE, 1965-66.

Size of School	Number of Schools	7th Grade	8th Grade	9th Grade	Biology	Earth Science	Physical Science	Lab Science	Other
-74	1	1	1	...	...	...	...	...	...
75-99	4	4	4	1	...	...	...	...	...
100-199	12	10	9	5	...	...	...	...	...
200-299	9	5	7	3	...	...	2	...	...
300-499	23	12	22	15	2	3	1	1	1
500-999	43	28	41	36	7	2	...	5	1
1000-	18	10	15	15	5	2	1	1	1
Totals	110	70	98	75	14	7	4	7	3
Per-centage		63.6	89.1	68.2	12.7	6.4	3.6	6.4	2.7

(64%) of the schools reported teaching seventh-grade science, 98 (89%) eighth-grade science and 75 (68%) ninth-grade science.

The offerings of biology as a ninth-grade subject have dropped slightly. Fourteen (13%) junior high schools indicated this course as a part of their curriculum, as compared to 17 (18%) in the 1961 study. The largest number of schools offering biology was in the 500-999 enrollment group, which is the group with the largest number of junior high schools.

Seven junior high schools had courses identified as earth science. There are no available data to indicate how much earth science is found in the seventh, eighth, and ninth-grade science courses.

Non-Science Courses Taught by Junior High School Science Teachers

Some junior high school science teachers are called upon to teach courses outside the area of science. This is particularly true in the smaller schools which may offer only single sections of their science courses. A teacher may spend the greater portion of his teaching time in other fields, and teach but one or two sections of science.

Altogether, 79 non-science courses were taught by junior high school teachers. Reference to Table XVIII makes evident the wide range of these courses. The 12 courses in health were included as non-science courses because they were so denoted in the Principal's Organizational Reports.

The non-science course most often taught was mathematics, which appeared in the Reports 33 times. The remainder of the non-science courses reported, in order of decreasing frequency, were physical education, social science, English, history, driver education, vocational agriculture, mechanical drawing, foreign language, shop, and music. It is noteworthy that 236 of the teachers taught no non-science courses.

Enrollments in Junior High School Science

More than 35,000 students were enrolled in science courses in the 110 junior high schools during the year 1965-66. The enrollment figures given in Table XIX are slightly lower than actuality because a few administrators failed to record the numbers of enrollees in the Organizational Reports.

The largest number of students (16,377) was enrolled in eighth-grade science, followed by 9,997 in seventh-grade science and 7,561 in ninth-grade science. There were 891 students enrolled in the combined seventh-grade plus eighth-grade science courses. Among the less frequently taught junior high science courses, biology had the largest number of enrollees (1,009). Laboratory science, (usually listed as "lab" science), physical science and earth science, had enrollments of 848, 324, and 267 respectively; a sprinkling of other courses enrolled a total of 552.

Number of Sections and Class Sizes

In general, the numbers of sections of science offered in the junior high schools increased in about the same proportion as the numbers of schools in each category increased. No discernible special patterns were evident, either in terms of average class sizes or ranges of sizes (Table XX).

Altogether, there were 358 sections of "seventh-grade science," with an average size of 28 students, and a range of from ten students in the smallest section to 40 in the largest. As would be expected, the eighth grade, which had the largest total enrollment, also had the largest number of sections of "eighth-grade science," 582. The average class size was also 28, and the range was from 10 to 48 students. There were fewer

TABLE XVIII. NON-SCIENCE COURSES TAUGHT BY KANSAS JUNIOR HIGH SCHOOL SCI-
ENCE TEACHERS, 1965-66.

Size of School	None	Mathematics	Health	Physical Education	Social Science	English	History	Driver Education	Vocational Agriculture	Mechanical Drawing	Foreign Language	Shop	Music
-74	1	1	...	...	...	...	...	...	...	...	...	...	...
75-99	2	...	1	...	1	...	...	...	...	...	...	...	...
100-199	3	3	3	5	2	...	1	1	...	1	...	...	...
200-299	9	1	...	1	...	2	...	...	1	...	...	...	...
300-499	39	7	...	1	2	1	1	...	...	...	...	...	...
500-999	109	15	5	4	3	1	1	1	1	...	1	1	...
1000-	73	6	3	...	...	...	...	...	...	...	...	...	1
Totals	236	33	12	11	8	4	3	2	2	1	1	1	1

sections of "ninth-grade science," 283, than in either of the other two grades. The number of sections of biology (37) was somewhat below that reported in the 1961 study (43) but the average class size remained the same (27).

Full-Time and Part-Time Teachers

For the purposes of this study, junior high school science teachers were designated as full-time teachers if they taught four or more science classes; and part-time teachers if they taught three or fewer science classes.

As might be expected, there were fewer full-time science teachers in the smaller schools than in the larger schools. The junior high schools with enrollments of fewer than 200 students had eight full-time teachers and 18 part-time teachers.

Above the 300 enrollment mark the number of full-time science teachers exceeded the number of part-time teachers. The ratio of full-time to part-time science teachers increased with school size; in the schools with 1,000 or more students 93% of the teachers were full-time teachers.

TABLE XIX. ENROLLMENTS IN KANSAS JUNIOR HIGH SCHOOL SCIENCE COURSES, 1965-66.

Size of School	7th Grade	8th Grade	9th Grade	7th and 8th Grades	Biology	Laboratory Science	Physical Science	Earth Science	Other
-74	19	22	...	...	...	...	...	...	...
75-99	142	144	24	...	...	...	...	...	...
100-199	577	456	97	...	...	...	...	...	...
200-299	292	668	61	...	...	...	80	...	...
300-499	1563	2359	919	156	180	154	62	65	7
500-999	4843	8022	3336	27	468	617	...	61	460
1000-	2461	4706	3124	708	361	77	182	141	85
Totals	9,897	16,377	7,561	891	1,009	848	324	267	552

TABLE XX. NUMBERS OF SECTIONS AND CLASS SIZES OF KANSAS JUNIOR HIGH SCHOOL SCIENCE,
1965-66.

Size of School	7th Grade			8th Grade			9th Grade			7th Plus 8th Grades		
	No. of Sections	Average Size	Range	No. of Sections	Average Size	Range	No. of Sections	Average Size	Range	No. of Sections	Average Size	Range
-74	1	19	....	1	22	....	....	....	....	....	....	....
75-99	6	24	23-25	6	24	19-30	1	24	....	....	....	....
100-199	23	21	10-35	18	26	14-39	6	16	10-25	....	....	....
200-299	12	24	19-29	26	26	19-30	3	20	10-28	....	....	....
300-499	53	29	14-38	86	27	19-36	36	25	11-35	6	26	21-28
500-999	174	29	14-38	289	28	14-39	129	26	11-37	1	27	....
1000-	89	28	16-40	156	30	10-48	108	29	13-40	22	32	28-37
Totals	358	28	10-40	582	28	10-48	283	27	10-40	29	31	21-37

TABLE XX, (Continued)

	Biology			Laboratory Science			Physical Science			Earth Science		
	No. of Sections	Average Size	Range	No. of Sections	Average Size	Range	No. of Sections	Average Size	Range	No. of Sections	Average Size	Range
-74	....	....	....	....	....	....	....	....	....	....	....	....
75-99	....	....	....	....	....	....	....	....	....	....	....	....
100-199	....	....	....	....	....	....	....	....	....	....	....	....
200-299	....	....	....	....	....	....	4	20	18-22	....	....	....
300-499	7	20	16-30	5	31	25-37	3	20	18-32	3	22	20-24
500-999	17	28	22-33	22	27	20-33	....	....	....	2	31	30-31
1000-	13	28	14-39	3	26	22-28	5	36	30-40	5	28	27-31
Totals	37	27	14-39	30	28	20-37	12	27	18-40	10	27	20-31

An apparent discrepancy between Tables XXI and XVIII should be noted at this point. Table XVIII shows 236 teachers who taught no non-science courses. A few of those were principals who taught one or more sections of science but no other classes. Table XXI shows 245 full-time

TABLE XXI. NUMBER OF FULL-TIME (ONE WHO TEACHES FOUR OR MORE SECTIONS) KANSAS JUNIOR HIGH SCHOOL SCIENCE TEACHERS AS COMPARED TO THE NUMBER OF PART-TIME JUNIOR HIGH SCHOOL SCIENCE TEACHERS, AND THE AVERAGE NUMBERS OF STUDENTS OF THESE TEACHERS, 1965-66.

Size of School	Full-time Teachers		Part-time Teachers		Average number of science students per science teacher	
	Number	Per Cent	Number	Per Cent	Full-time	Part-time
-74	....	....	1	100.0	....	41
75-99	2	50.0	2	50.0	93	63
100-199	6	28.6	15	71.4	111	31
200-299	7	46.7	8	53.3	122	31
300-499	37	74.0	13	26.0	134	39
500-999	117	82.4	25	17.6	141	56
1000-	76	92.7	6	7.3	151	62
Totals	245	77.8	70	22.2	141	44

science teachers, *i.e.*, they taught four or more science classes. Some of these taught a non-science course, usually mathematics, in addition; thus, they are included in mathematics or some other subject in Table XVIII.

The average number of science students taught by the full-time science teachers was greater in all cases than the average number of science students taught by the part-time science teacher. For all full-time teachers, the average was 141 students, and for all part-time teachers, the average was 44 students.

Trends

As already noted, the 1953 and 1956 studies on *Offerings and Enrollments* did not include separate data on the sciences in the junior high schools. The relatively few separately organized junior high schools would probably not have yielded significant data. At the time the data were

TABLE XXII. NUMBER AND PERCENTAGE OF KANSAS HIGH SCHOOLS IN EACH SIZE GROUP, 1953 TO 1966.

Size of Schools	1953 Study*		1956 Study**		1961 Study***		Present Study***	
	Number of Schools	Per Cent	Number of Schools	Per Cent	Number of Schools	Per Cent	Number of Schools	Per Cent
-24	37	5.5	42	6.1	15	2.5	14	2.5
25-49	170	25.0	163	23.7	135	22.4	74	13.3
50-74	136	20.0	140	20.4	116	19.2	97	17.4
75-99	85	12.5	75	10.9	74	12.3	76	13.6
100-199	125	18.4	132	19.2	136	22.5	130	23.3
200-299	46	6.8	43	6.3	50	8.3	61	11.0
300-499	37	5.4	29	4.2	28	4.6	44	7.9
500-999	32	4.7	51	7.4	32	5.3	34	6.1
1000-2499	10	1.5	10	1.5	17	2.8	24	4.3
2500-	1	0.1	2	0.3	1	0.2	3	0.5
Totals	679	99.9	687	100.0	604	100.1	557	99.9

*Includes 25 junior high schools.

**Includes 37 junior high schools.

***Senior high schools only.

being compiled for the 1961 study, the strong trend toward an increased number of separately organized junior high schools was evident (Table XIV). On this basis the data for the junior high schools were compiled, analyzed, and discussed separately.

Various significant trends and relationships will be recognizable in the future if the number of junior high schools continues to increase, a condition that seems highly probable.

Sizes of Schools

There were changes in total numbers as well as in sizes of senior high schools. While the 1953 and 1956 data are not exactly comparable with the 1961 and 1965 data because of the inclusion of 25 junior high schools in the 1953 study and 37 junior high schools in the 1956 study, the figures are sufficiently accurate to show trends. (The data will be compared in the remainder of this discussion on trends without further reference to the inclusion of the junior high schools in the two earlier studies.)

By grouping the schools into categories of enrollments fewer than 100, 100 to 299, and 300 and over, certain shifts in school size are evident. The 1953 study reported 428 schools (63%) with enrollments fewer than 100 and the 1956 study, 420 schools (61%). By the time the 1961 study was made, the number of senior high schools in this category had dropped to 340, which represented 56% of the Kansas senior high schools. The present study shows only 47%. In the 100 to 299 enrollment categories the 1953 study showed 171 schools (25%) and the present study 191 (34%). The 300 and above enrollment grouping gave figures of 80 (12%), 92 (13%), 78 (13%), and 105 (19%) for the four studies. Consolidation and unification have taken their toll of the smaller schools. The evidence indicates, although there are still many small schools in Kansas, a definite trend toward increased school size. Although it is not so apparent from the data in Table XXII there has been a considerable increase in the number of larger schools. (This trend is, of course, obscured because the 1953 and 1956 data included junior high schools which fell in the higher enrollment categories.)

Number of Science Courses Offered

Little change in the numbers of science courses offered by the senior high schools occurred between the 1953 and the 1956 studies, but a large shift in number of science courses offered occurred between the 1956 and 1961 studies, and this trend has continued, as shown in Table XXIII.

Each of the two earlier studies reported a few schools as offering no science. It probably is inaccurate to say that these few schools did not offer science; it is probable that they alternated a science course with a non-science course and were not offering science during the years the data were collected. Since no schools reported not offering a science in the fall of 1960 or 1965, it would appear safe to assume that the number of schools not offering science has decreased to the point of insignificance.

TABLE XXIII. NUMBERS OF SCIENCE COURSES OFFERED BY KANSAS HIGH SCHOOLS, 1953 to 1966.

Year of Study	Number of Schools	None		One		Two		Three		Four or more	
		Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
1953	679*	11	0.2	133	20	230	34	194	29	110	16
1956	687**	14	0.2	149	22	229	33	189	28	114	17
1961	604***	....	....	26	4	137	23	249	41	192	32
1966	557***	....	....	12	2	93	17	249	45	203	36

*Includes 25 junior high schools.

**Includes 37 junior high schools.

***Senior high schools only.

Of the 12 schools reported in the present study as offering but one science, all had enrollments of fewer than 100 students. The larger schools described in the two earlier studies were, for the most part, junior high schools. Since these were few in number, they do not affect the results appreciably. It is quite probable that the 12 schools of the present study alternate at least two sciences, many offering general science during one year and biology or some other science during the second year.

Fairly large increases in the numbers of schools offering three and four or more sciences have occurred. The 1953 study disclosed that only 29% of the schools offered three sciences, and the percentage in the 1956 study was virtually the same. By the time of the 1961 study, the percentage had increased to 41, and the present study shows 45%. The percentage of schools offering three or more sciences has risen from 45% in 1952-53 to 81% in 1965-66.

Schools Offering the Four Main Sciences

Although the percentage of change in the four main sciences was mentioned previously, the trends in the numbers of schools offering general science, biology, chemistry, and physics are of sufficient import to warrant noting once again.

Examination of Table XXIV reveals that general science, as a senior high school subject, has been losing ground. The other three have gained steadily, especially chemistry, which was taught in only 31% of the schools in 1951-52 and has increased to 77% in 1965-66. This represents an increase of 221 schools in 14 years, or an average of nearly 16 schools per year that have added chemistry to their program during these years.

As noted before, Table V indicates that a number of additional science courses are a part of the curricula of the high schools. Some of these, such as junior high science, basic science, laboratory science, physical science, and earth science, are taught at the ninth grade level. No doubt many of these courses are "general science" under another name, but many of the courses are quite different in content. It may be that the course entitled general science will level off at about this point. But this should not be interpreted as meaning that approximately one-fourth of the schools lack ninth-grade science. Rather, other kinds of ninth-grade courses are being developed in many schools to care for a wide variety of pupil needs.

The trend in the increased enrollments of biology has been evident for some time, and has almost reached the maximum, with 97% of the Kansas high schools offering this course in 1965-66. For many students it is the last science course, and in many cases the only laboratory science which they take.

The shift in the numbers and percentages of the physical science offerings is the most important trend to be noted. The increased demand for chemists, physicists, and engineers has impelled many schools, which had not done so in the past, to offer physics and chemistry. More than three-fourths of the schools now offer chemistry, in contrast to the fewer

TABLE XXIV. NUMBERS OF KANSAS HIGH SCHOOLS OFFERING THE FOUR MAIN SCIENCES, 1953 TO 1966.

Year of Study	Number of Schools	General Science		Biology		Chemistry		Physics	
		Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
1953	679*	569	84	482	71	208	31	232	34
1956	687**	507	74	500	73	219	32	265	39
1961	604***	464	77	565	94	407	67	313	52
1966	557***	357	64	540	97	429	77	357	64

*Includes 25 junior high schools.

**Includes 37 junior high schools.

***Senior high schools only.

than one-third that formerly offered it. Almost two-thirds of the schools are providing courses in physics.

Schools Offering Other Sciences

In terms of percentages there has been little or no change in the science course offerings other than the four main sciences. Approximately one-fourth of the schools in the past, as well as the present, had science courses in addition to general science, biology, chemistry, and physics as a part of their curricula.

Even though the over-all percentages of courses has not changed much, there have been changes in the kinds of courses offered. Some courses, such as agriculture and health, are seldom reported by the principals as science courses, although in the past this was more often done. Other sciences, such as physical geography, aeronautics, practical science, and physiology, have decreased in number.

A wide variety of advanced and specialized courses have been added in recent years; *e.g.*, advanced science, advanced biology, earth science, and geology. Just as chemistry, and to a lesser extent physics, has enjoyed increased popularity, so have other science courses which may be categorized as physical sciences.

Number of Teachers

Paralleling the increases in the numbers of schools offering science and the number of students enrolled in science has been an increase in the number of teachers necessary to teach this additional load.

The 1953 study reported 929 full-time and part-time science teachers on duty in Kansas high schools. By the time of the 1956 study, this number had increased to 1,096. The 1961 study reported 1,136 in the senior high schools, plus 216 in the junior high schools. Because some teachers work in both junior and senior high schools, the total is somewhat less than the sum of these two figures. The Reports do not always show the junior-senior high school assignments; there were about 27 in 1961-62. Thus, there were about 1,325 high school science teachers in 1961-62.

TABLE XXV. NUMBER OF KANSAS TEACHERS TEACHING HIGH SCHOOL SCIENCE, AND NUMBER OF FULL-TIME HIGH SCHOOL SCIENCE TEACHERS, 1953 TO 1966.

	1953 Study	1956 Study	1961 Study	1966 Study
Number of teachers teaching science	929	1096	1325	1477
Number of full time science teachers	117	219	507	731
Percentage of full time science teachers	12.6	20.0	37.5	49.5

The present study shows 1,162 teachers in senior high school and 315 in junior high school, with 19 holding double assignments, or a total of 1,458 high school science teachers (Table XXV).

More significant than numbers, however, is the change in the numbers and percentages of full-time science teachers employed. There were more than six times as many full-time science teachers in 1965-66 as there were in 1951-52. In 1951-52, only 12.6% of the science teachers were full-time science teachers; in 1965-66, this had increased to 49.5%. If this trend continues along its present lines, the not too distant future will see nearly all the Kansas high school science teachers on a full-time basis.

Number of Non-Science Courses

A comparison of the non-science courses taught by science teachers, as reported in the three studies, does not demonstrate significant trends. The proportion of general science teachers instructing in non-science areas has fluctuated but slightly since 1951-52.

Biology teachers have tended to teach fewer non-science courses, while chemistry and physics teachers have tended to teach proportionally more non-science courses. The non-science courses taught by chemistry and physics teachers have been increasingly in the area of mathematics; those taught by biology teachers have been more scattered. The number of unidentified non-science courses has increased for teachers of all four sciences, in some cases by a large margin. The trend for general science teachers to teach more non-science courses than are taught by the biology, chemistry, and physics teachers still continues.

Number of Students Enrolled

The changes in the numbers of schools offering general science, biology, chemistry, and physics have brought concomitant changes in the numbers and percentages of the students enrolled in these courses (Table XXVI).

The loss in enrollees in general science in senior high schools has been quite drastic in recent years. Between the 1953 study and the 1956 study the drop in actual numbers was slight, but the drop in percentage of students enrolled was noticeable. The apparent discrepancy is due to the overall increase in enrollments in the secondary schools of the state. The decrease in enrollments from 1951-52 to 1965-66, in terms of actual numbers, amounts to 6,296 students or a drop of 42% from the 14,973 students reported in 1953. The present study shows only 8,677 or 9% of the total enrollments of the schools studied. It must always be borne in mind that more and more ninth-grade students are finding themselves in junior high school, rather than in senior high school, and that general science has been, and is, a ninth-grade subject.

Biology and chemistry have made important gains, in terms of percentage, as well as actual numbers. Almost one-fourth of the total school population was reported to be enrolled in biology in the 1965

TABLE XXVI. NUMBER AND PERCENTAGE OF KANSAS HIGH SCHOOL STUDENTS ENROLLED IN EACH OF THE FOUR MAIN SCIENCES, 1953 TO 1966.

Year of Study	General Science		Biology		Chemistry		Physics	
	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
1953	14973	15.0	15130	15.0	4555	4.5	3400	3.4
1956	14772	12.5	19250	16.3	5224	4.4	4153	3.5
1961	10481	9.8	25021	23.4	9671	9.0	5220	4.9
1966	8677	8.7	32896	24.8	11538	8.7	5116	4.2

study, indicating that the great majority of students in the state take biology at some time during their three or four years of senior high school. The trend toward more physical science in high school is reflected in the more than 150% increase in chemistry since the 1953 study.

Physics has gained only moderately, from 3,400 in 1951-52 to 5,220 in 1960-61, and not at all since then. This discouraging facet of Kansas high school science enrollment has been studied by Abegg and Crumb (1966), who distributed questionnaires to 1,049 students in the chemistry classes in 14 Kansas and Nebraska high schools. Of the 473 who said they were not planning to take physics, 106 were graduating seniors or were unable to schedule physics. Of the remaining 367 students, 217 or nearly 60% said physics was not necessary for their future plans, they had no interest in physics, or had a poor background for it.

Abegg and Crumb concluded:

Could it be that counselors have a limited understanding of physics and its role in the future education of youth? Are science teachers taking the initiative in informing their colleagues of the need for science in the secondary school? Perhaps a concerted effort is needed on behalf of both science teachers and school counselors to provide up-to-date information concerning the importance of science in the life of our youth. They will not live in today's world but in that of the future which, without a doubt, will require more understanding of basic science and technical information than has ever existed.

Table XXVII provides a picture of what has happened to enrollments in science at the national level since statistics were first collected in 1890. The same enrollment trends noted in our study of Kansas are to be found in the enrollment trends in the Brown and Obourn study (1958) of high schools in the United States. The percentages of students enrolled in the four sciences are not directly comparable because they are calculated on somewhat different bases; the over-all changes are comparable. General science, which has been on the decline in Kansas, has also been declining in the nation. Biology, chemistry, and physics, on the increase in Kansas, are also on the increase in the entire country. Whatever the factors that are bringing about these trends, they seem to be operating generally and not to be confined to one state or region.

Implications

As noted in the discussion of trends, both the number and the percentage of full-time high school science teachers have increased significantly in recent years. The science courses of the 557 senior high schools included in this study were taught by 1162 different teachers, 486 or 41.8% of whom were full-time science teachers, and 676 or 58.2% of whom taught one or more non-science subjects. The persons making up this 58.2% must have had at least the minimum certification requirements for a non-science teaching field. Although many years will pass before substantially all high school science is taught by full-time science teachers, the time is not far off when the full-time science teachers will constitute a considerable majority. As the percentage of full-time science teachers increases, the colleges should increase their emphasis on preparation for full-time science teaching. This shift in emphasis does not necessarily mean that the prospective science teacher will take only more college science courses. He may use the credit formerly concentrated in a second

TABLE XXVII. PERCENTAGES OF STUDENTS IN THE LAST FOUR GRADES IN PUBLIC HIGH SCHOOL TAKING CERTAIN SCIENCE COURSES: 1889-90 THROUGH 1958-59 (TAKEN FROM PAGE 22 OF THE BROWN, OBOURN, 1958 STUDY*).

Year Reported	Ninth grade General Science	Biology	Chemistry	Physics
1890	....	....	10.1	22.8
1900	....	....	7.7	19.0
1910	....	1.1	6.9	14.6
1915	....	6.9	7.4	14.2
1922	18.3	8.8	7.4	8.9
1928	17.5	13.6	7.1	6.8
1934	17.8	14.6	7.6	6.3
1949	20.8	18.4	7.6	5.4
1954-55	....	19.6	7.3	4.6
1956-57	21.8	20.5	7.5	4.4
1958-59	21.2	21.3	8.9	5.0

*Brown, Kenneth E. and Ellsworth S. Obourn. "Offerings and Enrollments in Science and Mathematics in Public High Schools, 1958," (Pamphlet No. 5), p. 22, table 16, U.S. Department of Health, Education, and Welfare, Office of Education. Washington: U.S. Government Printing Office, 1961. 87 pages.

teaching field to extend in part his scientific background, and in part to strengthen his general education so as to help him develop the perspectives of a cultured citizen and to understand better the impact of science on the current social, economic, and political scene.

As compared to the senior high schools, the junior high schools have relatively more full-time science teachers, mainly because most of these schools are large enough to have at least one full-time teacher for each teaching field. Junior high school science is usually a type of "general" science, but biology has been introduced, as well as several other sciences, as shown in Table V. The full-time junior high school science teacher most often teaches a "general" type of science in grades seven to nine. In some cases he may teach biology, earth science, or some other specific science. The colleges must do more than they have in the past to plan programs designed especially for junior high school science teachers.

Full-time teaching in general science is more probable than full-time teaching in chemistry, physics, or physical science. The prospective physical science teacher is quite likely to have to teach biology or mathematics, for example. The prospective biology teacher has a much better chance of teaching biology only.

Many educators interested in science teaching, including representatives of both academic departments and departments of professional education, as well as officials of the certification agencies, have suggested that separate certification of high school biology, physical science, and general science teachers should be considered. The dominant position of biology as a senior high school science will result in greatly increased employment opportunities for those prepared for full-time biology teaching. This is the more true because biology is being moved into the junior high school in some systems. The earlier placement of biology may provide greater opportunity for interested students to take a second biology course in their junior or senior years, after they have had chemistry.

Furthermore, enrollments are so much larger in biology than in the other sciences that multiple sections of biology exist even in small and medium sized schools. With multiple sections come the opportunities for ability grouping of students, for accelerated classes, for advanced biology, and for other means of adjusting the biology courses to the abilities and interests of individual students. The BSCS second-level course has been introduced into many Kansas schools; this also will provide greater flexibility and more opportunity for full-time biology teaching.

All of the foregoing requires better preparation in biology if the teachers are to measure up to the challenges presented. Realistic certification requirements for biology teaching may well have to include specific mention of chemistry and physics, instead of merely a minimum number of hours "in the subject taught." The greater emphasis on the biochemistry of living things, especially in the BSCS Blue Version, makes an adequate background in chemistry as essential for the biology teacher of the future as is the biology itself.

Opportunities for full-time teaching in high school chemistry or physics are, and will continue to be, more limited. There will be, however, rapidly increasing numbers of full-time physical science teachers. These should perhaps be certified, not only on the basis of minimum hours in chemistry and in physics, but also on some realistic balance between the two, as well as specific requirements in mathematics. As both biology teaching and physical science teaching present greater challenges and more and more difficult problems, the preparation patterns of the two fields will inevitably diverge. Separate certification may become a practical necessity. It is not too early for serious thinking about this, as well as the certification of junior high school science or general science teachers.

In Kansas, general science will probably remain for a long time one of the main sciences in senior high schools, especially in those with enrollments below 300. In the smaller high schools, general science and biology,

or general science, biology, and an alternation of physics and chemistry are common patterns. A biology teacher with the chemistry and physics background usually considered necessary for a major in biology could, with the addition of from two to four courses in astronomy, geology, physical geography, or other earth sciences, qualify as a general science teacher. Perhaps two certification patterns will suffice – one for physical science and one for biology and general science.

In the larger high schools, where science teachers commonly teach only one science, an advanced degree is often required, either by formal action of the school system or as a result of competition for the better jobs. Many school systems, while not actually requiring advanced study, do have salary differentials which encourage teachers to take additional courses. The prospective teacher who has ambitions to move up to the larger schools should look forward to carefully planned graduate study leading to an advanced degree. His undergraduate work should include enough concentration in one field to allow him to start a graduate program without loss of time in making up undergraduate deficiencies. Graduate schools interested in teacher education should prepare programs of such a nature that the undergraduate work flows logically and smoothly into the graduate student's study program.

The American Association for the Advancement of Science, through its Cooperative Committee on the Teaching of Science and Mathematics, issued a report (AAAS, 1960) which made detailed recommendations for teacher preparation for teachers of biology, chemistry, physics, physical science, general science, and mathematics. These recommendations, with respect to courses and hours, are summarized in Table XXVIII, which was Table 6 of the AAAS report.

The report included a synoptic view emphasizing that a foundation background is common to the five science majors. Each major may then be thought of as consisting of this background plus additional preparation selected for the major involved. The common foundation as shown here is 31 semester hours; the exact number will vary in different colleges. The significant point is that this is about half the total major.

The report closed with the following statement:

Because there is so much in common among the five curricula in science, it is quite practical in at least two of the five science areas involved in this report. Specifically, it is quite practical for the prospective teacher of biology, chemistry, physics, or physical science, to add a few more courses and qualify also as a teacher of general science. This combination, known in some places as a 'comprehensive science major,' is an ideal preparation for the modern teacher of science to high school students, although it must be recognized that it does not prepare him for more advanced study.

For the four-year programs, the requirements are summarized in Table 6. This synthesis of recommendations also suggests multiple qualification in secondary school science—for example, a teacher prepared in biology could also qualify in general science by taking four additional units in physics and three additional units in related science. By the addition of ten units in physics and nine units in

TABLE XXVIII. SUMMARY OF TEACHER PREPARATION REQUIREMENTS, SUGGESTED BY AAAS.

Suggested courses	Common foundation	Major in				
		Biology	Chemistry	Physics	Physical Science	General Science
Biology	6	27	2	....	4
Chemistry	8	2	20	....	2
Physics	8	....	20	10	4
Related science	3	3	....	9	3
Mathematics	6	....	6	6	....
Subtotal	31	32	28	35	13	
Common total	....	31	31	31	31+16*
Grand total	....	63	59	66	60

*Sixteen units of upper division work selected from two or more of the four science fields (excluding mathematics) listed above.

related science, the major in chemistry could qualify for teaching physical science. (p. 1029)

In deliberations concerning the preparation of high school science teachers, the discussions frequently, and more or less automatically, turn to the fifth year. Most scientists and science educators think that a four-year program is inadequate to prepare a person for effective science teaching. If the teacher is preparing for only one field, *e.g.*, science, it is possible with careful planning to get both breadth enough to permit minimum qualifications for the four main sciences, and depth enough to enable the teacher to build for later graduate study. Even this is possible only if the colleges plan their curricula with the needs of the prospective teacher given uppermost priorities. Such needs must certainly include future graduate study in preparation for an advanced degree.

No matter what improvements are made in the pre-service preparation of high school science teachers, and no matter how promptly such improvements are made, the fact remains that during the next decade, the majority of high school science students will be taught by teachers who are already in service. One of the most important implications of the greatly increased emphasis on high school science, with the consequent enrollments and challenges of ability grouping, is that colleges must immediately take responsibility for in-service assistance to teachers who are now faced with science teaching problems they could not have anticipated when they were undergraduates ten, fifteen, twenty, or more years ago.

Entirely apart from increased offerings and enrollments, such in-service education must take into account the rapid changes that have occurred in all the sciences. The modern developments in science should be brought into high school science courses whenever practical and within the capabilities of the students involved. The developments are made known through newspapers and magazines, radio, and television. Students (and their parents) become curious about scientific advances. The teacher has the responsibility of interpreting the scientific "learning" that the student receives through the mass media, both to stimulate his further curiosity and to provide sound appraisal of the often inaccurate, exaggerated, and overglamorized "science" of these media. The in-service experiences of science teachers should enable them to keep abreast of new developments in science, to answer questions about these developments, to direct discussion of them, and to help the more interested students carry out individual projects or research problems.

Summary

1. The High School Principal's Organization Reports of 557 senior high schools and 110 junior high schools were examined for data concerning science teaching in Kansas high schools in 1965-66.
2. Of the 557 senior high schools whose Reports were examined, 357 offered general science, 540 offered biology, 429 offered chemistry, and 357 offered physics.
3. Of the 110 junior high schools studied, 70 offered seventh-grade "general" science, 98 eighth-grade "general" science, and 75 ninth-grade "general" science.
4. The most common sciences taught in the senior high schools, other than the four main ones—general science, biology, chemistry, and physics—were physical science and earth science.
5. In the 557 senior high schools studied, the enrollments in the four main sciences were: general science, 8,677; biology, 32,896; chemistry, 11,538; physics, 5116.
6. In the 110 junior high schools studied, the enrollments in the general science courses in the three grades were: seventh, 9,897; eighth, 16,377; ninth, 7,561.
7. The 577 senior high schools employed 676 part-time and 486 full-time science teachers; the 110 junior high schools employed 70 part-time and 245 full-time science teachers.
8. In the senior high schools the average class sizes ranged from 5 to 28 in general science, from 4 to 35 in biology, from 4 to 24 in chemistry, and from 1 to 25 in physics.
9. In the junior high schools the average class sizes in the general science courses ranged from 19 to 29 in the seventh grade, from 22 to 30 in the eighth, and from 16 to 29 in the ninth.
10. The results of the present study were compared to those of similar studies by the author and his associates, published in 1953, 1956, and 1961.
11. Trends in the offerings and enrollments in the secondary school sciences were pointed out and discussed.
12. Implications that were either deduced from or clearly shown by the study were presented, as well as personal opinions, concerning some of the possible improvements in the science teaching situation in Kansas high schools.

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