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Offerings and Enrollments in the Secondary School Sciences in Kansas in 1960-1961

John Breukelman and Ralph P. Frazier
Department of Biology, Kansas State Teachers College, Emporia

Two studies of the offerings and enrollments in the secondary school sciences in Kansas were published by Breukelman and Andrews (1953, 1956). These papers presented some of the data which the authors believed to be important to the high school science teacher, the high school administrator, and the institutions confronted with the responsibilities of preparing high school science teachers for the schools of Kansas.

The 1956 study was based on data for the 1954-55 school year. Five years have elapsed—years of rapid change in science education. It seemed wise to repeat the study at this time, to see what trends have occurred in Kansas high school science offerings and enrollments.

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." Because beginning teachers of science in Kansas high schools must adjust themselves to varied conditions in the diverse schools of Kansas, the prospective science teacher and his 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; (3) the major trends in science teaching as revealed by comparison with previous studies; and (4) certain 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, restricted to biology, based on returns from 786 public high schools, for the school year 1949-1950.

Brown and Obourn (1958) studied science and mathematics offerings and enrollments in 4,254 public high schools, selected at random 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, 1951-1952* (Rice, 1952). The schools in this sample were the same ones used in a survey by Brown (1954).

The Committee on Educational Trends of the Kansas Academy of Science has issued two reports dealing with offerings and enrollments, Alm (1938) and Reed (1951). Comparative studies of aspects of high school science teaching were made by Ridgway (1931), Irwin (1938), Lessig (1942), and Lockard (1946). While these served a useful purpose in directing attention to important problems at the time, they now have little application in view of the rapid post-war changes in science teaching in Kansas. The studies by Perry (1953) and Nellans (1954) reflect some of the changes, but both have restricted applications. The two Breukelman and Andrews' studies were based on High-school Principal's Organization Reports. The 1953 study included 654 accredited senior high schools and 25 accredited junior high schools; in the 1956 study the corresponding numbers were 650 and 37.

Methods

This study was based on data abstracted from the 1960 High-school Principal's Organization Reports, on file at the State Department of Public Instruction.

For each school, the items recorded and tabulated were: total 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 population classes corresponding to those used in the study of science teaching in the public high schools in the United States (Johnson, 1950) and also by the Breukelman and Andrews' studies.

The present study differed from the 1953 and 1956 investigations in that the senior high schools and junior high schools were treated separately. In the previous 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.

Acknowledgements

The writers wish to acknowledge the assistance of the State Department of Public Instruction and Dr. Robert Boles. Special credit is due students Nancy Dannevik and Ronald Aeschliman, who tabulated most of these data.

The Sample

For the school year 1960-61, 609 senior high schools and 91 junior high schools were accredited by the State Department of Public Instruction in Kansas. Senior high schools, as used hereinafter, includes not only

two-year (eleventh and twelfth grades), 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. In 1960-61, the State Department of Public Instruction accredited senior high schools with the following types of organization: two-year, 2; three-year, 38; four-year, 524; and six-year, 45. The present study included data from 604 (99%) of the accredited senior high schools.

The majority of Kansas junior high schools are three year schools, including grades seven to nine. Other types of organization exist, however. In 1960-61, 12 two-year schools were reported, a few consisting of grades seven and eight, some eight and nine, and some nine and ten. In a few cases it was not clear which grades were included. The three four-year junior high schools included grades seven to ten.

In the fall of 1960, 84 junior high schools were accredited by the State Department of Public Instruction. Eight other schools had applied for accreditation and were processed during 1960-61. Seven of these were

TABLE I. Number of junior high schools and senior high schools in each size group.

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	15	2	....	....	15	2
25-49	135	19	....	....	135	22
50-74	118	17	2	2	116	19
75-99	76	11	2	2	74	12
100-199	145	21	9	10	136	23
200-299	57	8	7	8	50	8
300-499	48	7	20	22	28	5
500-999	74	11	42	46	32	5
1000-2499	27	4	10	11	17	3
2500-	1	.1	....	....	1	.2
Totals	696		92		604	

Read table thus: Reports were examined from 118 schools, which is 17% of the total number of schools, with enrollments from 50-74; two were junior high schools, which is two per cent of the accredited junior high schools included in the study; 116 were senior high schools, which is 19% of the senior high schools included in the study.

accredited and one was not. This study included the data from 92 junior high schools, 91 accredited and one non-accredited.

Table I shows the number and per cent of junior and senior high schools used as the basis for this study and organized by size categories.

Offerings in Enrollments in Senior High School

SCIENCES IN SENIOR HIGH SCHOOLS OF VARIOUS SIZES

Of the 604 Kansas senior high schools, 26 offered one science in 1960-61, whereas 137 offered two, 249 offered three, and 192 offered four or more sciences. Table II shows the number of schools in each size group and the number of sciences offered by the schools.

TABLE II. Number of senior high schools in each size group and the numbers of different courses offered by these schools.

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	15	2	4	6	5	....
25-49	135	22	14	62	56	3
50-74	116	19	6	35	61	14
75-99	74	12	2	16	32	24
100-199	136	23	....	9	67	60
200-299	50	8	....	6	11	33
300-499	28	5	....	2	10	16
500-999	32	5	....	1	5	26
1000-2499	17	3	....	....	2	15
2500-	1	.2	....	....	....	1
Totals	604		26	137	249	192

Read table thus: There were 116 schools with enrollments between 50-74; this 116 constituted 19% of the 604 schools reported on; of the 116, six offered one science in 1960-61, 35 offered two sciences, 61 offered three sciences, and 14 offered four or more sciences.

Approximately 55% of all Kansas senior high schools had enrollments of fewer than 100. The two previous reports by Breukelman and Andrews showed that both in 1951 and 1954, 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.

Even the smallest schools taught science. In many of the smaller schools, certain science courses are alternated. A number of schools offer general science for one year with 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 1960-61.

The number of science courses offered increased regularly with school size. Of the schools offering only one or two science courses, about 24% had enrollments of fewer than 100, while all except 41 of the 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 per cent of schools of each size group offering these sciences.

In all the schools studied, 77% offered general science, 94% offered biology, 67% offered chemistry, and 52% offered physics. Examination of Table III reveals that the majority of the schools in the enrollment categories of 75 or more pupils offered physics. In the enrollment categories of

TABLE III. Number of senior high schools offering the four main sciences.

Size of School	Number of Schools	General Science		Biology		Chemistry		Physics	
		Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
-24	15	11	73	11	73	5	33	3	20
25-49	135	109	81	122	90	62	46	24	18
50-74	116	94	81	105	91	63	54	44	38
75-99	74	59	80	69	93	50	68	40	54
100-199	136	111	82	132	97	108	79	93	68
200-299	50	35	70	49	98	44	88	39	78
300-499	28	18	64	27	96	26	93	24	86
500-999	32	23	72	32	100	31	97	28	88
1000-2499	17	4	24	17	100	17	100	17	100
2500-	1	.....	....	1	100	1	100	1	100
Totals	604	464	77	565	94	407	67	313	52

Read table thus: In schools from 50-74 enrollment there were 116 schools; 94 or 81% offered general science; 105 or 91% offered biology; etc.

50 or more pupils, more than half of the schools, offered chemistry. With the exception of the schools enrolling fewer than 25 pupils, more than 90% of the schools in all categories offered biology. The percentage of schools offering general science tended to be less in the schools of 200 or more enrollment. This is because some of these larger schools do not have a ninth grade, or if they do have a ninth grade, they are replacing general science with biology at that level.

TABLE IV. Comparison of present study with the 1953, 1956, and Johnson (1950) studies, as regards percentage of senior high schools offering the four main sciences.

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

Table IV shows how the results of the present study compared with those of the Johnson (1950) study, based on data for the 1947-1948, the Breukelman and Andrews (1953, 1956) studies based on 1951-1952 and 1954-1955 data. (Hereafter, the Breukelman and Andrews' studies are referred to as the 1953 and 1956 studies).

General science has lost the dominance it enjoyed when 84% of the schools were reported in the 1953 study to be offering general science. Its popularity was waning by the time of the 1956 study, and it has slipped to second place in the 1961 study. 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, and by 94% of the schools in the 1961 study. The increase of 21% over 1956 made biology the science course offered in the largest number of schools.

The increase in the number of schools offering chemistry, from 31% (1953 and 1956 studies) to 67% (1961 study), represented the largest fluctuation in numbers 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.

The increased numbers of schools offering more science reflect an increased concern for science education at all educational levels on the part of scientists, teachers, students, and laymen.

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

In addition to the four main science offerings of general science, biology, chemistry, and physics, a number of other kinds of science courses are provided by the secondary schools of the state. Reference to Table V shows that 154 (26%) of the 604 schools provided the opportunity to explore 28 sciences other than the customary four sciences. Some of these were advanced offerings, others represented specialized areas. Health, physiology, agriculture, electronics, electricity, radio and television, and psychology were included as sciences if the high school principal listed them in his report as sciences. Health and physiology 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 agriculture listed here was not vocational agriculture.

Forty-three schools offered eight courses that were biological in na-

TABLE V. Science courses other than general science, biology, chemistry, and physics offered by senior high schools.

Size of School	Biological Science								General Science				
	Physiology	Advanced Biology	Botany	Zoology	Health	Conservation	Agriculture	Field Biology	Junior high Science	Basic Science	Advanced Science	Senior Science	Lab Science
-24												1	
25-49	1	1	1						1			1	
50-74	1					1			3			2	
75-99		1		1			1		3		2		
100-199	5	1			1			1	3			1	1
200-299	4								4		1		1
300-499	1								1	1	1	1	
500-999	3	1	1	1	1				3	4	5		1
1000-2499	7	3	2						4	4		1	
2500-	1	1	1							1			
Totals	23	8	5	2	2	1	1	1	22	10	9	7	3

TABLE V. Cont'd.

Size of School	Physical Science											Other Science			
	Physical Science	Earth Science	Geology	Astronomy	Aeronautics	Electricity	Electronics	Photography	Advanced Physics	Radio and TV	Radiation Physics	Industrial Science	Practical Science	Food Science	Psychology
-24															
25-49	4	1													
50-74	2	1					1								
75-99		2													
100-199	4	3			1										
200-299	5														
300-499	1	1				1						1	1		
500-999	9	2		1	1		1	1		1					1
1000-2499	3		3	2		1					1	1			
2500-			1	1					1						
Totals	28	10	4	4	2	2	2	1	1	1	1	1	1	1	1

ture. The most popular of these were: physiology in 23 schools; advanced biology in eight schools; botany in five schools; zoology and health in two schools; and conservation, agriculture, and field biology in one school each. Five different kinds of courses, categorized as general science, were offered by 51 schools. The 22 schools offering junior high science were the six-year high schools. Basic science (ten schools), advanced science (nine schools), senior science (seven schools), and laboratory science (three schools) were other courses included in this group.

Under the heading, physical science, were subsumed 11 different courses, scattered among 56 schools. The course most frequently mentioned was physical science (28 schools), followed by earth science (10 schools). Geology and astronomy were each recorded four times; aeronautics, electricity, and electronics, two times. One school in each case was listed as offering photography, advanced physics, radio and television, and radiation physics.

Under other sciences, are industrial science, practical science, food science, and psychology; each offered by one school.

ENROLLMENTS IN SENIOR HIGH SCHOOL SCIENCE COURSES

Of the 50,393 pupils enrolled in the four major science courses taught in the secondary schools, almost one-half or 25,021 were taking biology (Table VI). General science with 10,481 pupils ranked second; closely followed by chemistry with 9,671 pupils. Physics was in fourth place, enrolling 5,220 pupils.

In schools with enrollments of fewer than 24 and with enrollments between 50-74, more students were taking general science than biology. In all size rankings more pupils were enrolled in chemistry than in physics.

A few principals failed to report their class enrollments, or the totals would be slightly larger than those shown. The numbers involved were small, however. The total recorded for each science was probably within 100 of the actual enrollment.

TABLE VI. Total enrollments in the four main sciences in the senior high schools.

Size of School	General Science	Biology	Chemistry	Physics
-24	82	59	21	9
25-49	1121	1286	462	166
50-74	1530	1524	657	377
75-99	1081	1301	592	356
100-199	2870	4205	1610	915
200-299	1331	2816	1064	583
300-499	803	2330	955	465
500-999	1018	4816	1870	908
1000-2499	645	6277	2218	1342
2500-	....	407	222	99
Totals	10481	25021	9671	5220

The number of pupils enrolled in general science in senior high schools has shown a radical drop since the 1953 study, receding from 14,973 to 10,481, a loss of 30%. This loss is accounted for in large part by the great increase in separately organized and accredited junior high schools. Since general science is commonly taught in the ninth grade, an increasing number of 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 numbers, advancing from 15,130 pupils in 1953 to 19,250 pupils in 1956 to 25,021 pupils in 1961, an over-all advancement of 66%. Chemistry has made an even more spectacular rise, going from 4,555 pupils in 1953 to 9,671 in 1961, an expansion of 112%. The increase in physics enrollments has not been as dramatic as in chemistry, but has grown approximately 54%, or from 3,400 pupils in 1953 to 5,220 pupils in 1961.

The much larger total enrollments in biology and general science 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. Thus, while almost twice as many students were enrolled in general science as in physics (10,481 to 5,220), the *average* enrollment of general science *per school offering general science* was only about a third larger than the corresponding *average* for physics (23 to 17 per school). Table VII shows the average enrollments per school in each of the four main sciences compared with those of the 1953 and 1956 studies.

TABLE VII. Average number of students per school offering the four main sciences.

	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
General Science	464	10481	23	507	14772	29	569	14973	26
Biology	565	25021	44	500	19250	39	482	15130	31
Chemistry	407	9671	24	214	5224	24	208	4555	22
Physics	313	5220	17	265	4153	16	232	3400	15

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 during the present study indicated 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 1960-61 compilations of total grade enrollments for the senior high schools as released on September 15, 1960, by the State Department of Public Instruction were as follows: ninth grade, 20,690; tenth grade, 29,916; eleventh grade, 29,034; twelfth grade, 27,273. Using the 1960 enrollment figures as a base, the 10,481 pupils in

general science represented about 51% of the total enrollment of 20,690 in the ninth grade. The corresponding figure for biology was about 84%. For chemistry and physics, which are offered about equally in the eleventh and twelfth grades, the total enrollment of 14,891 in the two sciences represented about 26% of the 56,307 pupils enrolled in the two grades.

In biology, Martin (1952) reported that in the tenth grade, where biology is most often taught, 76% of the total enrollment of this grade were enrolled in biology. This figure is somewhat below the findings of the 1961 study.

CLASS SIZES

With minor exceptions, average class sizes increased fairly regularly with school size, from 7 to 29 in general science, from 5 to 28 in biology, from 4 to 24 in chemistry, and from 3 to 25 in physics (Table VIII).

For any one school size with less than 2,500 enrollment, 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, but chemistry and physics are elective subjects. In the school above 2,500 enrollment there were no classes in general science. The average enrollment in chemistry was smaller than in biology, while the reverse was true for physics.

Almost three times as many sections of general science were offered in schools with fewer than 200 enrollment as in schools with more than 200. The sections of biology were somewhat fewer in number in schools below 200 than they were for schools above this number. In schools with enrollments above 200, there were approximately the same number of sections of chemistry, but there were fewer physics sections offered than in the schools below 200 enrollment.

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. There were more part time (786), than full time (339) teachers in schools with enrollments less than 2,500. The largest school had 11 full time teachers, but no part time teachers.

There were more science students per each full time teacher, but 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. The average number of pupils per science teacher increased steadily with school size (with one exception). The increase in average number of pupils (30 to 129) was greater for full time science teachers than for part time science teachers (12-62).

TABLE VIII. Number of sections and class sizes in general science, biology, chemistry, and physics in the senior high schools.

Size of School	General Science			Biology			Chemistry			Physics		
	No. of Sections	Average Size	Range	No. of Sections	Average Size	Range	No. of Sections	Average Size	Range	No. of Sections	Average Size	Range
-24	11	7	4-12	11	5	3-10	5	4	2-8	3	3	2-4
25-49	111	10	2-21	118	11	2-31	62	7	2-14	24	7	2-13
50-74	100	15	3-28	107	14	5-32	65	10	2-19	44	9	2-20
75-99	65	17	5-29	81	16	3-30	54	11	4-32	42	8	3-28
100-199	138	21	5-38	210	20	3-38	117	14	3-29	96	10	3-21
200-299	59	23	8-36	119	24	8-37	64	17	4-31	42	14	3-31
300-499	36	22	9-44	90	26	12-43	51	19	9-37	27	17	6-30
500-999	39	26	10-40	186	26	12-39	95	20	7-36	50	18	10-36
1000-2499	22	29	18-36	223	28	17-36	93	24	10-32	57	24	10-35
2500-	...	...	...	18	23	19-26	10	22	19-25	4	25	22-26
Totals	581			1163			616			389		

Read table thus: In schools of 50-74 enrollment, there were 100 sections of general science, with an average enrollment of 15, the largest general science class had 28 and the smallest had three students; etc.

Of the 1,136 science teachers shown in Table IX, 350 or about 31% were full time science teachers, whereas 786 or 69% were part time. In the 1953 study there were 929 science teachers, 177 or 18% of whom were full time science teachers, and 752 or 83% were part time. The 1956 study included data on 1,096 science teachers, of which 219 or about 20% were full time science teachers and 877 or 80% were part time. These comparisons show that the number and percentage of full time science teachers are steadily increasing; thus the number and percentage of part time teachers are decreasing.

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	Per cent	Number	Per cent	Full time	Part time
-24	....	....	15	100	....	12
25-49	3	1	199	99	30	15
50-74	9	5	164	95	45	23
75-99	18	15	101	85	55	25
100-199	70	30	160	70	75	29
200-299	41	41	58	59	95	41
300-499	33	49	35	51	106	39
500-999	74	65	40	35	108	52
1000-2499	91	87	14	13	129	62
2500-	11	100	....	....	111	....
Totals	350	31	786	69	105	25

Read table thus: In schools of from 200-299 enrollment: there were 99 high school science teachers; 41 or 41% of these taught four or more classes in science, while 58 or 59% taught other subjects in addition to science. The average number of science students taught daily by the 41 full time science teachers was 95, the number of science students taught by the 58 part time teachers was 41.

NON-SCIENCE COURSES TAUGHT BY SCIENCE TEACHERS

As was pointed out in the discussion of full time and part time teachers, 69% of the teachers taught three or fewer science classes, and the majority of these part time science teachers were found in the schools of un-

der 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 780 non-science courses taught by general science teachers. Non-science courses in the fields of mathematics, physical education and athletics, woodworking and shop, home economics, and social science, in descending order, were most frequently taught by general science teachers. They taught 95 courses in physical education, 78 in algebra, 59 in geometry, 58 in general mathematics, 50 in athletics, 47 in woodworking and shop, 45 in food and clothing, and 35 in history. There were 122 other unidentified non-science courses taught by general science teachers.

Similar trends 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: physical education 106, algebra 80, geometry 52, athletics 52, food and clothing 46, general mathematics 43, driver training 43, history 42, and woodworking and shop 40. In addition to these, 140 unidentified non-science courses were taught by biology teachers.

Two 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 non-science courses, in descending order of frequency with which they were taught by chemistry teachers, were: algebra 92, geometry 60, and general mathematics 52. In addition to a scattering of other courses, 75 unidentified non-science courses were taught by chemistry teachers.

The pattern for physics teachers was about the same as for chemistry teachers, and for much the same reasons. The non-science courses, in descending order of frequency, were: algebra 102, geometry 69, and general mathematics 36. Fifty-seven unidentified non-science courses were taught, along with a scattering of other courses.

TABLE X. Non-science 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
-24	1	2	2	1	2	2	2	...	1	...	...	...	...	...	1	2	...	...	5
25-49	8	14	18	15	6	24	28	12	18	...	1	1	13	1	2	8	...	6	41
50-74	11	6	25	19	1	11	26	10	6	...	...	...	18	6	2	5	...	3	20
75-99	8	12	13	6	...	2	12	7	4	...	1	...	9	2	...	3	...	5	15
100-199	36	12	16	12	...	5	21	14	6	...	...	1	4	1	3	1	...	10	23
200-299	17	5	...	2	...	2	4	4	...	...	...	...	...	5	...	...	...	...	11
300-499	14	5	2	2	...	1	1	1	...	...	...	...	...	...	...	...	...	...	5
500-999	11	2	1	2	...	...	1	2	...	...	...	...	1	...	...	...	...	...	2
1000-2499	6	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2500-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals	112	58	78	59	9	47	95	50	35	...	2	2	45	15	8	19	...	24	122

TABLE XI. Non-science 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
-24	...	1	2	...	2	3	3	...	2	...	...	...	2	...	1	2	...	...	6
25-49	11	10	16	10	3	21	28	9	19	...	1	2	19	3	...	10	...	7	42
50-74	12	9	26	19	1	10	24	9	9	...	...	...	15	4	3	4	...	11	28
75-99	14	9	14	5	1	4	15	9	1	...	1	...	7	4	...	7	...	7	24
100-199	55	9	15	14	1	1	25	14	8	...	...	1	3	3	2	6	...	12	21
200-299	22	2	3	2	...	1	6	6	2	...	...	...	...	3	1	...	...	4	14
300-499	14	3	2	1	...	...	4	2	...	...	...	...	...	1	...	...	...	2	3
500-999	43	...	1	1	...	...	1	3	1	...	...	...	...	1	...	...	...	...	2
1000-2499	55	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2500-	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals	232	43	80	52	8	40	106	52	42	...	2	3	46	19	7	29	...	43	140

TABLE XII. Non-science 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
-24	....	2	1	....	....	1	....	....	1	....	....	....	....	....	....	1	....	....	2
25-49	4	12	20	13	2	11	6	2	8	....	....	1	7	....	1	3	3	....	12
50-74	7	4	23	16	....	4	11	3	1	....	....	1	5	1	1	4	....	1	21
75-99	10	11	15	9	....	....	4	1	5	....	1	....	2	1	1	5	....	1	12
100-199	46	11	16	17	....	3	6	7	2	....	....	....	3	2	3	1	....	5	12
200-299	23	4	9	3	....	....	....	1	1	....	....	....	1	2	1	....	....	....	10
300-499	15	4	2	2	....	....	....	1	....	....	....	....	....	1	....	....	....	....	4
500-999	25	4	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
1000-2499	25	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
2500-	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Totals	158	52	92	60	2	19	27	15	18	....	1	2	18	7	7	14	....	10	75

TABLE XIII. Non-science 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	
-24	1	1	1	1
25-49	4	1	12	8	...	3	2	...	2	...	...	...	1	...	1	3	...	1	10
50-74	10	5	23	15	...	2	2	3	...	...	...	...	...	2	...	3	...	...	12
75-99	12	7	19	12	...	2	1	...	...	...	...	...	1	1	1	3	...	3	5
100-199	34	14	26	23	...	4	4	4	...	...	...	...	1	1	3	1	...	6	16
200-299	22	3	7	4	...	...	...	...	1	...	...	...	1	1	1	...	...	...	6
300-499	12	3	7	2	...	...	1	1	...	...	...	...	...	...	...	...	...	1	5
500-999	17	2	6	3	...	...	1	...	...	...	...	...	...	...	...	...	...	...	2
1000-2499	17	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2500-	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals	130	36	102	69	1	11	11	8	3	...	...	...	4	5	6	10	...	11	57

Offerings and Enrollments in Junior High School

The 1953 and 1956 Breukelman and Andrews' 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 junior high schools and the 1956 study included data from 37 (65%) of the schools.

At the time the Principal's Organization Reports were submitted to the State Department of Public Instruction in 1960, there were 84 accredited junior high schools. During the school year 1960-61, eight junior high schools, either new or reorganized, made application for accreditation. Seven of these were accredited, while one was not. This study includes data from the 92 separately organized junior high schools of the state, 91 accredited, one non-accredited. The decision to report the junior high schools apart from the three, four, and six year senior high schools was based on the steadily increasing number of separately organized junior high schools; hence, their increasing importance as educational units.

JUNIOR HIGH SCHOOLS OFFERING SCIENCE

Table XIV shows that the separately organized junior high school occurred most frequently in the larger population centers. Of the 92 junior high schools, 72 (78%) had enrollments exceeding 300 pupils, with 20 (21%) in the 300-499 category, 42 (45%) in the 500-999 category, and 10 (11%) in the 1,000-2,499 category. Four schools reported enrollments of less than 100, and the remaining 16 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. Sixty (65%) of the schools provided seventh grade science, 70 (76%) eighth grade science, and 64 (70%) ninth grade science. A few schools, 22 (24%), offered science courses other than the usual general science, such as remedial science, laboratory science, and biology.

SCIENCE OFFERINGS BY GRADES

In the junior high school, the pattern of science offerings by grades was variable (Table XV). The most common pattern was to offer science in all three years of the junior high school. Of the 34 (37%) schools that followed this pattern the largest number (18) were in the 500-999 enrollment category. The remainder of the schools offering science each year were distributed, ten in the 300-499 enrollment category, four in the 1,000-2,499 category, one in the 200-299 category and one in the 100-199 category.

TABLE XIV. Number of junior high schools in each size group offering science in the seventh, eighth, and ninth grades.

Size of School	Number of Schools	7th Grade		8th Grade		9th Grade		Other	
		Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
-24	....	....	....	....	....	....	....	....	....
25-49	....	....	....	....	....	....	....	....	....
50-74	2	2	100	2	100	2	100	1	50
75-99	2	2	100	....	....	....	....	....	....
100-199	9	5	56	8	89	3	33	....	....
200-299	7	2	29	5	71	3	43	1	14
300-499	20	17	85	15	75	14	70	5	25
500-999	42	25	60	36	86	33	79	13	31
1000-2499	10	7	70	4	40	9	90	2	20
2500-	....	....	....	....	....	....	....	....	....
Totals	92	60	65	70	76	64	70	22	24

Read table thus: In schools from 200-299 enrollment: there were seven schools; two, or 29% of these offered seventh grade science; five, or 71% of these offered eighth grade science; etc.

Fifteen (16%) of the junior high schools offered science in the eighth and ninth grades, but not in the seventh grade; and 11 (12%) provided science experiences in the seventh and eighth grades, but not in the ninth grade. Three schools gave science in the seventh and ninth grades, but not in the eighth grade. A science course was offered during only one year of the three junior high school years by 21 of the schools, eight (9%) in the seventh grade, six (6%) in the eighth grade, and seven (8%) in the ninth grade.

A small number of schools combined grades. Two (2%) schools offered a combined seventh and eighth grade science, but maintained a separate ninth grade science. One (1%) school had a combined seventh and eighth grade science, and a separate seventh and eighth grade science. One school gave a combined seventh and eighth grade science and a separate seventh and ninth grade science. Four unidentifiable combinations were reported.

TABLE XV. Number of junior high schools in each size group offering the sciences by grades.

Size of School	Totals	7th Grade Only	8th Grade Only	9th Grade Only	7th and 8th	7th and 9th	8th and 9th	7th, 8th, 9th	7th+8th and 9th	7th+8th 7th and 8th	7th+8th 7th and 9th	Other
-24	...	...	...	...	...	...	...	...	...	...	...	...
25-49	...	...	...	...	...	...	...	...	...	...	...	...
50-74	2	...	...	...	...	...	...	...	2	...	...	...
75-99	2	2	...	...	...	...	...	...	...	...	...	...
100-199	9	...	2	1	4	...	1	1	...	...	...	...
200-299	7	...	2	...	1	...	1	1	...	...	...	2
300-499	20	3	...	...	2	1	2	10	...	1	...	1
500-999	42	2	2	...	4	...	11	18	...	...	1	1
1000-2499	10	1	...	3	...	2	...	4	...	...	...	...
2500-	...	...	...	...	...	...	...	...	...	...	...	...
Totals	92	8	6	7	11	3	15	34	2	1	1	4

Read table thus: In schools from 500-999 enrollment: there were two schools offering science in the seventh grade only; two schools offering science in the eighth grade only; etc.

SCIENCES TAUGHT IN THE JUNIOR HIGH SCHOOL

There is, no doubt, a wide variation in the nature of the science courses entitled *General Science*. It can be only assumed that the courses called seventh grade, eighth grade, or ninth grade *General Science* are reasonably comparable in terms of subject matter. Sixty (65%) of the schools reported teaching general science in the seventh grade, 70 (76%) the eighth grade, and 64 (70%) the ninth grade (Table XVI).

In addition, three (3%) schools reported teaching a course entitled *Natural History*, one (1%) school a course called *Laboratory Science*, and one (1%) school a course labeled *Remedial Science*.

The growth of *Biology* as a ninth grade subject is reflected in the fact that 17 (18%) junior high schools indicated this course as a part of their curriculum. The largest number of schools offering biology fell in the 500-999 enrollment group, the group with the largest number of junior high schools.

TABLE XVI. Kinds of science courses taught and number of junior high schools offering each course.

Size of school	Totals	7th	8th	9th	Biology	Natural Science	Laboratory Science	Remedial Science
-24	...	....	....	....	....	....	....	....
25-49	...	....	....	....	....	....	....	....
50-74	2	2	2	2	1	....	....	....
75-99	2	2	....	....	....	....	....	....
100-199	9	5	8	3	....	....	....	....
200-299	7	2	5	3	....	1	....	....
300-499	20	17	15	14	2	2	1	....
500-999	42	25	36	33	12	....	....	1
1000-2499	10	7	4	9	2	....	....	....
2500-	....	....	....	....	....	....	....	....
Totals	92	60	70	64	17	3	1	1
Percentage		65%	76%	70%	18%	3%	1%	1%

Read table thus: In schools from 300-499 enrollment: there were 20 schools; 17 schools offered seventh grade general science; 15 schools offered eighth grade general science; etc.

NON-SCIENCE COURSES TAUGHT BY JUNIOR HIGH SCHOOL SCIENCE TEACHERS

It often happens that 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 but from one to three science courses. Frequently, a teacher may spend the greater portion of his teaching time in other fields and teach but one or two sections of general science.

Altogether, there were 85 non-science courses taught by junior high school teachers. Reference to Table XVII makes evident the wide range of these courses. Elementary school science and senior high school science, both of which appeared twice, were included in this table because they are not taught at the junior high school level. The course in photography and

TABLE XVII. Non-science courses taught by junior high science teachers.

Size of School	None	Mathematics	Physical Education	Health	Athletics	Social Science	Algebra	Shop	Foreign Language	Library	History	Home Economics	Citizenship	Elementary School science	Senior High School science	Art	English	Driver Education	Crafts	Photography	Business	
-24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
25-49	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50-74	...	1	...	...	...	...	1	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...
75-99	...	...	...	...	...	...	1	...	...	2	...	...	1	...	...	1	...	...	...	...	...	...
100-199	...	...	3	4	...	1	1	...	...	...	...	...	1	...	...	...	...	1	...	...	...	...
200-299	4	4	1	1	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...
300-499	21	6	2	1	2	2	...	3	1	...	1	1	...	...	...	...	...	1	1	...	...	...
500-999	87	12	3	2	4	3	1	1	2	...	1	1	1	1	...	...	...	...	...	...	...	...
1000-2499	26	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...
2500-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Totals	138	27	9	8	6	6	4	4	3	2	2	2	2	2	2	1	1	1	1	1	1	1

the eight 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 27 times. The remainder of the non-science courses reported, in order of decreasing frequency, were: physical education, nine; health, eight; athletics, six; social science, six; algebra, four; shop, four; foreign language, three; library, history, home economics, and citizenship, each twice; and art, English, business, driver education, and crafts, once each.

ENROLLMENTS IN JUNIOR HIGH SCHOOL SCIENCE

Over 26,000 students were enrolled in some type of junior high science course during the fall of 1960. The enrollment figures given in Table XVIII are slightly lower than actuality because a few administrators failed to record the numbers of enrollees in their Organizational Reports.

The largest number of pupils (10,049) was enrolled in eighth grade general science, followed by 8,055 in seventh grade general science, and 6,258 in ninth grade general science. There were 318 pupils enrolled in the combined seventh plus eighth grade general science courses. Among the less frequently taught junior high science courses, biology had the largest number of enrollees (1,169). The remaining three science courses, natural history, laboratory science, and remedial science, had enrollments of 226, 71, and 13 respectively.

TABLE XVIII. Enrollments in junior high school science courses.

Size of School	7th Grade	8th Grade	9th Grade	7th plus 8th grades	Biology	Natural Science	Laboratory Science	Remedial Science
-24	...	...	...	...	...	...	...	...
25-49	...	...	...	...	...	...	...	...
50-74	...	...	33	76	24	...	...	...
75-99	60	...	...	...	...	...	...	...
100-199	234	391	152	...	...	...	...	...
200-299	199	551	171	...	...	109	...	...
300-499	1756	1407	875	22	66	117	71	...
500-999	4289	6508	3402	220	913	...	...	13
1000-2499	1517	1192	1625	...	166	...	...	...
2500-	...	...	...	...	...	...	...	...
Totals	8055	10049	6258	318	1169	226	71	13

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 pattern was evident, either in terms of average class sizes or ranges of sizes (Table XIX).

Altogether, there were 283 sections of seventh grade general science, with an average size of 28 students, and a range of from 14 students in the smallest section to 55 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 general science, 350. The average class size, 28 students, was the same as for the seventh grade general science, but the range of class size was from 12 to 49 students. There were fewer sections of ninth grade general science, 219, than in either of the other two grades. The average class size of 25 was slightly smaller than either the seventh or eighth grades and the range was from 11 to 49 students.

The combined seventh and eighth grades had an average class size of 25 in 12 sections, with a range of 18 to 34 students. There were 43 sections of general biology, ranging in size from 18 to 37 students, with an average class enrollment of 27. The six sections of natural science tended to be large, having an average of 42 pupils, with a range of 24 to 60. The distortion in class size is due to two very large sections which averaged about 55 pupils. Laboratory science had three sections, an average of 24 pupils, within a range of 17 to 31. The one section of remedial science had 13 students.

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 less than 200 pupils had three full time teachers and 12 part time teachers.

Once the 200 enrollment mark had been passed, the number of full time science teachers exceeded the number of part time teachers. In the schools of 200-299 enrollment there were six (75%) full time teachers and two (25%) part time teachers; in the 300-499 enrollment category, 26 (65%) full time teachers and 14 (35%) part time teachers; in the 500-999 enrollment category, 93 (77%) full time teachers and 28 (23%) part time teachers; and, in the 1,000-2,499 enrollment category, 29 (91%) full time teachers and three (9%) part time teachers.

The average number of science pupils taught by the full time science teacher was greater in all cases than the average number of science pupils taught by the part time science teacher. For all full time teachers, the average was 144 pupils, and for all part time teachers, the average was 59 pupils.

TABLE XIX. Numbers of sections and class sizes of junior high school science.

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
-24	....	....	....	....	....	....	....	....	....	....	....	....
25-49	....	....	....	....	....	....	....	....	....	....	....	....
50-74	....	....	....	....	....	....	2	17	8-25	3	25	23-27
75-99	3	20	19-22	....	....	....	....	....	....	....	....	....
100-199	8	29	22-55	13	30	13-41	7	22	15-25	....	....	....
200-299	6	33	30-35	21	26	12-36	6	29	11-47	....	....	....
300-499	63	28	15-46	52	27	15-49	35	25	13-35	1	22	°
500-999	152	28	14-43	220	30	15-40	117	29	19-37	8	28	18-34
1000-2499	51	30	17-41	44	27	19-35	52	31	12-49	....	....	....
2500-	....	....	....	....	....	....	....	....	....	....	....	....
Totals	283	28	14-55	350	28	12-49	219	25	11-49	12	25	18-34

Read table thus: In schools of 200-299 enrollment: there were six sections of seventh grade general science, with an average enrollment of 33, the largest general science class had 35 and the smallest 30 students; etc.

Trends

JUNIOR HIGH SCHOOLS

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

In 1951 there were 59 separately organized junior high schools and in 1954 this number had been reduced by two, to 57. In the fall of 1960 the State Department of Public Instruction had 84 accredited junior high schools on record. This figure was increased by seven accredited schools and one non-accredited school during the next few months, and it is the data from the 92 separately organized schools that are included in this study. More significant trends and relationships will be recognizable in the future if the number of junior high schools continues to increase, a condition that seems likely to prevail.

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 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

Biology			Natural Science			Remedial Science			Laboratory 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
....
....
1	24	°	....	....	....	....	....	....	....	....	....
....
....
....	....	....	2	55	49-60	....	....	....	....	....	....
2	33	32-34	4	29	24-32	....	....	....	3	24	17-31
33	28	18-37	....	....	....	1	13	°	....	....	....
7	24	20-27	....	....	....	....	....	....	....	....	....
....
43	27	18-37	6	42	24-60	1	13	°	3	24	17-31

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 less than 100, 100 to 299, and 300 and over, certain shifts in school size are evident. The 1953 study reported 428 schools (62%) with enrollments fewer than 100 and the 1956 study, 420 (62%) schools. By the time the 1961 study was made, the number of schools in this category had dropped to 340, which represented 55% of the Kansas high schools. In the 100 to 299 enrollment category the 1953 study showed 171 (26%) schools, the 1956 study 175 (25%), and the 1961 study, 186 (31%) schools. The 300 and above enrollment grouping gave figures of 80 (13%), 92 (12%), and 78 (13%) for the three studies. Consolidation and population increases have taken their toll of the smaller schools, and the evidence indicates that although there is still a great number of small schools in Kansas, there is a definite trend toward increased school size. Although it is not apparent from the data in Table XXI there is a small increase in the number of larger schools. This trend is obscured because the 1953 and 1956 data include 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. However, the shift in number of science courses offered is marked between the time of the 1956 study and today. On the basis of the data tabulated in Table XXII, there appears to be a trend to offer an increasing number of science courses at all levels of school population.

Each of the two earlier studies reported approximately .2 per cent of

the schools as offering no science. It probably is inaccurate to say that these few schools did not offer science; rather it is more probable to think that they alternated science with some other 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, it would appear safe to assume that the number of schools not offering science has decreased to the point of insignificance.

A conspicuous shift in the numbers of schools which formerly offered but one science has occurred. The 26 schools reported in the 1961 study as offering but one science had an enrollment 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 26 schools of the

TABLE XX. Number of full time (one who teaches four or more sections) junior high school science teachers as compared to the number of part time junior high school science teachers.

Size of School	Full time teachers		Part time teachers		Average number of science pupils per science teacher	
	Number	Per cent	Number	Per cent	Full time	Part time
-24	....	....	....	....	....	....
25-49	....	....	....	....	....	....
50-74	....	....	2	100	....	67
75-99	....	....	2	100	....	30
100-199	3	27	8	73	125	50
200-299	6	75	2	25	137	104
300-499	26	65	14	35	131	65
500-999	93	77	28	23	148	57
1000-2499	29	91	3	9	149	59
2500-	....	....	....	....	....	....
Totals	157	73	59	27	144	59

Read table thus: In schools of from 200-299 enrollment: there were eight junior high science teachers; six or 75% of these taught four or more classes in science, while two or 25% taught other subjects in addition to science. The average number of science students taught daily by the six full time science teachers was 137, and the average number of science students taught by the two part time science teachers was 104.

TABLE XXI. Number and per cent of schools in each size group.

Size of School	1953 Study		1956 Study		1961 Study	
	Number of Schools	Per Cent	Number of Schools	Per Cent	Number of Schools	Per Cent
-24	37	5	42	6	15	2
25-49	170	25	163	24	135	22
50-74	136	20	140	21	116	19
75-99	85	12	75	11	74	12
100-199	125	19	132	19	136	23
200-299	46	7	43	6	50	8
300-499	37	6	29	4	28	5
500-999	32	5	51	7	32	5
1000-2499	10	2	10	1	17	3
2500-	1	.2	2	.3	1	.2
Totals	679		687		604	

1961 study alternate at least two sciences, 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 occurred between the times of the two previous studies and the 1961 study. The 1953 study disclosed that but 29% of the schools offered three sciences, and the per cent in the 1956 study was virtually the same. By the time of the 1961 study, the percentage had increased to 41. The percentage rise in schools offering four or more sciences is comparably greater, almost doubling between the time of the earlier studies and the present one.

SCHOOLS OFFERING THE FOUR MAIN SCIENCES

Although the per cent of change in the four main sciences was discussed in a previous section of this report, the trends in the numbers of schools offering general science, biology, chemistry, and physics are of sufficient import to warrant mentioning once again.

Examination of Table XXIII reveals that general science, as a ninth grade subject, has been losing ground since the 1953 study was made. The slight increase in the per cent of schools offering general science between the 1956 study and the 1961 study is not sufficient evidence that general science at the ninth grade level is recovering its former popularity.

TABLE XXII. Number of science courses offered by the schools.

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

Reference to 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 are not teaching a 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 popularity of biology is very evident with 94% of the Kansas high schools offering this course. It is now the number one science offering in the state. For many students it is the last science course, and in many cases the only laboratory science of any significance which they will take.

The shift in the numbers and per cents 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, who had not done so in the past, to offer physics and chemistry. Two-thirds of the schools now offer chemistry in contrast to the less than one-third that formerly offered it. And more than one-half of the schools now 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

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

	General Science	Biology	Chemistry	Physics
1953 Study (679)	569	482	208	232
Per Cent	84	71	31	34
1956 Study (687)	507	500	219	265
Per Cent	74	73	31	39
1961 Study (604)	464	565	407	313
Per Cent	77	94	67	52

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 (Table XXIV).

Even though the over-all percentage of courses has not changed much, there have been changes in the kinds of courses offered. Some courses, such as agriculture and health, are no longer reported by the principals as science courses. Other sciences, such as physical geography, aeronautics, practical science, and physiology, have either decreased in number or have been dropped entirely from the curriculum.

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 physics and chemistry have enjoyed increased popularity, so have other science courses which may be categorized as physical sciences. One course labeled physical science has had a seven-fold increase since the 1953 study.

TABLE XXIV. Science offerings other than the four main sciences.

Year of Study	Agriculture	Physiology	Physical Geography	Aeronautics	Health	Photography	Physical Science	Senior Science	Practical Science	Botany	Electricity	Other Science	Total
1953	49	51	12	12	10	5	4	7	3	3	3	10	169
1956	37	38	8	5	18	2	3	13	10	6	5	32	178
1961	1	23	....	2	2	1	28	7	1	5	2	82	154

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 schools. By the time of the 1956 study, this number had increased by 167 to 1,096, and by the 1961 study by 140 to 1,136 (Table XXV). The significant trend is the sharp up-turn in the number of full time science teachers now being employed. The earlier studies reported approximately 20% of the teachers of science to be full time teachers, whereas the 1961 study reported 31% of the science teachers to be full time teachers. If this trend continues along its present lines, it is to be hoped that the not too distant future will see a majority of the science teachers on a full time basis.

TABLE XXV. Number of teachers teaching science and teaching science only.

	1953 Study	1956 Study	1961 Study
Number of teachers teaching science	929	1096	1136
Number of teachers teaching science only	117	219	350
Per cent teaching science only	19	20	31

NUMBER OF NON-SCIENCE COURSES

A comparison of the number of non-science courses taught by science teachers, as reported in the three studies, does not demonstrate any significant trends (Table XXVI). The proportion of general science teachers instructing non-science courses has fluctuated but slightly since the 1953 study. Biology and physics teachers have tended to teach fewer non-science courses, while chemistry teachers have tended to teach proportionally more non-science courses. The number of unidentified non-science courses has increased for 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 XXVII).

The loss in enrollees in general science has been quite drastic in recent years. There seems to be a trend away from teaching general science in the ninth grade. Between the 1953 study and the 1956 study the drop in actual numbers was slight, but the drop in per cent of students enrolled was noticeable. The apparent discrepancy is due to the over-all increase in enrollments in the secondary schools of the state. The decrease in enrollments since the 1953 study, in terms of actual numbers, amounts to 4,492 students or almost one-third of the 14,973 students reported at that time. According to the compilations made for the 1961 study, only 10,481 students or 9.8% were taking general science.

Biology, chemistry, and physics have made important gains, in terms of per cent, as well as actual numbers. Almost one-fourth of the total school population was reported to be enrolled in biology in the 1961 study,

TABLE XXVI. The number of non-science courses taught by general science, biology, chemistry, and physics teachers.

	Year	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	Total
General Science	1953	101	82	96	65	22	47	114	65	53	28	7	18	82	12	5	53	20	21	23	914
	1956	133	80	94	56	25	30	117	24	42	21	5	12	49	17	9	26	2	19	91	852
	1961	112	58	78	59	9	47	95	50	35	...	2	2	45	15	8	19	...	24	122	780
Biology	1953	117	54	68	42	14	26	103	65	58	33	10	15	72	22	8	55	9	19	20	810
	1956	147	42	57	25	21	26	123	37	49	30	8	18	56	19	8	45	4	25	103	843
	1961	232	43	80	52	8	40	106	52	42	...	2	3	46	19	7	29	...	43	140	944
Chemistry	1953	90	31	30	18	1	10	14	7	7	4	1	...	16	6	2	6	...	8	7	258
	1956	99	35	30	25	2	4	13	6	3	...	...	...	5	7	1	8	...	11	24	273
	1961	158	52	92	60	2	19	27	15	18	...	1	2	18	7	7	14	...	10	75	577
Physics	1953	78	48	52	41	7	13	23	25	17	7	3	7	6	2	1	5	3	15	7	360
	1956	92	52	73	49	10	8	24	15	8	5	1	...	5	8	2	3	1	11	28	395
	1961	130	36	102	69	1	11	11	8	3	...	...	...	4	5	6	10	...	11	57	464

indicating that the great majority of students in the state take biology at some time during their four years of high school.

The trend toward more physical science in high school is demonstrated by the more than doubled enrollment in chemistry, a gain of 5,116 students since the 1953 study. Although physics has not gained proportionately, the increase of 1,820 students to a total of 5,220 students, is of a sufficient importance as to warrant attention.

TABLE XXVII. Total number and percentage of students enrolled in general science, biology, chemistry, and physics.

	General Science	Biology	Chemistry	Physics
1953 study enrollment	14973	15130	4555	3400
†Per cent of total	15.0	15.0	4.5	3.4
1956 study enrollment	14772	19250	5224	4153
Per cent of total	12.5	16.3	4.4	3.5
1961 study enrollment	10481	25021	9671	5220
Per cent of total	9.8	23.4	9.0	4.9
*Net gain or loss	loss 4492	gain 9891	gain 5116	gain 1820

†Per cent based on total high school enrollment

*Compares the 1953 and 1961 figures

Table XXVIII 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 this study of one state are to be found in the enrollment trends in the Brown and Obourn study of the United States. The per cents of pupils enrolled in the four sciences are not directly comparable because they are calculated on different bases, but the over-all changes are comparable. General science, which has been showing a decline in Kansas, is also declining nation-wide. Biology, chemistry, and physics, on the increase in Kansas, are also on the increase over the entire country. Whatever the factors are that are bringing about these trends, they seem to be operating generally and are not confined to one state or region.

TABLE XXVIII.* Per cent of pupils 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.

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 604 accredited senior high schools were taught by 1,136 different teachers, 350 or 31% of whom were full time science teachers, and 786 or 69% of whom taught one or more non-science subjects. The persons making up this 69% must have at least the minimum certification requirements for a non-science field. Although many years will pass before all high school science is taught substantially by full time science teachers, the time is not far off when full time science teachers will be in the 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 teacher will take only more college science courses. He may use the credit formerly concentrated in a second

teaching field in part to extend 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.

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 area. Junior high school science is usually 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 usually teaches "general" science in grades from seven to nine. In some cases he may teach biology, also. However, colleges should plan programs designed specially for junior high school science teachers. Planning of such programs is the subject under consideration in the 1961-1962 Science Teacher Improvement Program of the Kansas Academy of Science. (Breukelman, 1960, Breukelman and Frazier, 1961).

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.

Several individuals interested in science teaching, including representatives of both academic departments and departments of professional education, as well as representatives of 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 to the junior high school in some school systems. This earlier placement of biology will provide an 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 medium sized schools. With multiple sections comes the opportunity for ability grouping of students, accelerated classes, "advanced" biology, and other devices for adjusting the biology course to the abilities and interests of the students. All of this requires better preparation in biology if the teachers are to measure up to the challenges presented. Realistic certification requirements for biology teachers might well include specific mention of chemistry and physics, instead of merely a minimum number of hours "in the subject taught."

Opportunities for full time teaching of high school chemistry or physics are, and will continue to be, more limited. There will be, however, increasing numbers of teachers of physical science. These should perhaps be certified, not only on the basis of minimum hours in chemistry and in physics, but also on a balance between the two, and on specific require-

ments in mathematics. As both biology teaching and physical science teaching present greater challenges and more difficult problems, the preparation patterns of the two fields will diverge. Separate certification may well become a practical necessity. It is not too early for serious thinking about this, as well as certification of junior high school science or general science teachers.

In Kansas, general science is, and will probably remain for a long time one of the main senior high school sciences. 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, by the addition of from two to four courses in astronomy, geology, physical geography or other earth sciences, qualify for general science teaching. Perhaps two overall certification patterns would suffice—one for physical science, the other for biology and general science.

In the larger senior 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 better jobs. Many school systems, while not requiring advanced study, do have a salary differential which encourages the teacher to take additional courses. The prospective science 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 preparation should provide programs of such a nature that the undergraduate work flows logically into the graduate's work.

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 XXIX, 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 shown in Table XXIX. 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,

TABLE XXIX. Summary of the requirements.

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

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

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 related science, the major in chemistry could qualify for teaching physical science."

In most deliberations concerning the preparation of high school science teachers, the discussion turns to the fifth year. Most scientists and science educators think that a four-year program is wholly inadequate to prepare a person for good teaching in more than one area. If English teachers must meet biology classes, or vice versa, either the English or biology is almost certain to be seriously neglected. 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 enough depth 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 the 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 immediately must take responsibility for in-service assistance to teachers who are now faced with science teaching problems that could not have been anticipated when they were under-graduates 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 the high school science courses wherever 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 what the student receives, both to stimulate further curiosity and to provide sound appraisal for the often in-

accurate and over-glamorized "science" of the mass 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 their discussion, and to help the more interested students carry out individual projects or research problems.

Summary

1. The High School Principal's Organization Reports of 604 of the 609 accredited senior high schools and 92 of the separately organized junior high schools were examined for data concerning science teaching in Kansas high schools in 1960-61.
2. Of the 604 senior high schools whose reports were examined, 464 offered general science, 565 offered biology, 407 offered chemistry, and 313 offered physics. Of the 92 junior high schools whose reports were examined, 60 offered seventh grade general science, 70 offered eighth grade general science, and 64 offered ninth grade general science.
3. The most common sciences taught in the senior high schools, other than general science, biology, chemistry, and physics, were physical science, physiology, earth science, and basic science.
4. Of the total enrollment of 106,913 in the senior high schools studied, the enrollments in the four main sciences were: general science, 10,481; biology, 25,021; chemistry, 9,671; and physics, 5,220. Of the total enrollment of 53,185 in the junior high schools studied, the enrollments in general science were: seventh grade, 8,055; eighth grade, 10,049; and ninth grade, 6,258.
5. There were 786 part time senior high school science teachers and 350 full time senior high school science teachers. There were 59 part time junior high school science teachers and 157 full time junior high school science teachers.
6. The science teachers in the 604 senior high schools taught a total of 2,765 non-science courses. General science teachers taught 780 non-science courses, biology teachers taught 944, chemistry teachers taught 577, and physics teachers taught 464. The science teachers in the 92 junior high schools taught a total of 85 non-science courses.
7. In the senior high school the average class sizes ranged from 7 to 29 in general science, from 5 to 28 in biology, from 4 to 24 in chemistry, and from 3 to 25 in physics. In the junior high school the average class sizes ranged from 20 to 33 in seventh grade general science, from 26 to 30 in eighth grade general science, and from 17 to 31 in ninth grade general science.
8. The results of the present study were compared to those of the 1953 and 1956 studies.
9. Trends in the offerings and enrollments in the secondary school sciences in Kansas were pointed out.
10. Implications that were either deduced from or clearly shown by the study were listed, and opinions as to some approaches that might be made to improve secondary school science offerings in Kansas were made.

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