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ABSTRACT

The public has recognized the importance of high quality science education as it relates to the development of personal life skills and the pursuit of technologically oriented professions. This report provides staffing and enrollment data for science education in schools in the state of Kentucky. The report identifies areas for needed staff development, science program needs, and teacher certification deficiencies. Chapter titles are: (1) "The Teacher"; (2) "Student Enrollment"; (3) "Types of Certificates Held by Teachers of Middle/Junior High School Science Courses"; and (4) "Types of Certificates Held by Teachers of High School Science Courses." A summary of the major findings concludes the document. A copy of the teacher certification standards for the state of Kentucky are contained in an appendix. (CW)

MESSAGE FROM THE SUPERINTENDENT OF PUBLIC INSTRUCTION

During recent years there has been a resurgence of interest in the quality of education in general and science education in particular. The public has recognized the importance of high quality science education as it relates to the development of personal life skills and the pursuit of technologically oriented professions. A strong program in science education is fundamental to Kentucky's ability to contribute to scientific research and compete in the economic arena.

This report provides current staffing and enrollment data for science education in Kentucky's schools. The report identifies areas for needed staff development, science program needs, and teacher certification deficiencies. This data, in concert with enrollment data from undergraduate science education programs, can also provide the basis for predicting future science teacher needs in Kentucky.

It is hoped that this report will not only provide a significant information base but stimulate planning for improved science instruction in the Commonwealth.

Alice McDonald

Superintendent of Public Instruction

A PROFILE OF

KENTUCKY SCIENCE TEACHERS

1984-1985

GRADES 7 -12

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February, 1986

PREFACE

This publication represents a first attempt to prepare a statistical profile of science teachers in Kentucky schools, grades 7-12. Data sources include information from PSD forms and teacher certification tapes. PSD forms are completed during the first month of the school year and teacher certification tapes are updated as teachers obtain or update certification. This information is as accurate as that which is placed on the PSD form by local personnel.

This report has direct implications for all local education personnel concerned with science instruction. It can be used to compare their program offerings and staffing patterns to those found throughout the Commonwealth. This report also provides the legislature, State Board of Education, Council on Higher Education, colleges and universities, and citizens with up-to-date information regarding the status of science education in grades 7-12. Such information could be invaluable to the formulation of policy, funding, and the development of long-range plans.

Special recognition and appreciation are extended to Wendell McCourt, Branch Manager, Division of Computer Services, and Fred Faulkner, Computer Programer, Division of Computer Services, for providing the information and extensive computer programing,. Appreciation is also extended to Ann Graves, Department of Curriculum and Instruction, at the University of Kentucky for typing several drafts of this report.

Frank B. Howard
J. Truman Stevens

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THE TEACHER

TABLE 1 Basic Teacher Information

Information is based on individuals who are teaching one or more science classes in grades 7-12 during the 1984-85 school year. This represents an unduplicated count of teachers. These data do not address the appropriateness or inappropriatness of the type of certification held by the individual. More specific data on teacher variables are presented in subsequent tables.

TABLE 2 Subjects by Gender of Teacher

Males outnumber females in science classrooms. The ratio of males to females is fairly consistent in specific subjects with the exception of physics. Seventy-three percent of physics teachers in Kentucky are male.

TABLE 3 Subjects Taught by Race or Ethnic Identity

A majority of science teachers in Kentucky is caucasian. Less than four percent of the teachers are from minority groups. Three percent (3.1%) of the teachers are black. With the exception of the earth sciences, there are fewer minority teachers in physical sciences than in biological sciences. The proportion of minority science teachers to the total number of science teachers is less than the proportion for the general population.

TABLE 1: BASIC TEACHER INFORMATION*

	Teacher Information		Number	Percentage
GENDER	Male		1151	55.4
	Female		925	44.6
		TOTAL	2076	
RACE OR ETHNIC IDENTITY	White		2005	96.6
	Black		64	3.1
	Hispanic		1	0.0
	Asian		4	0.2
	Indian		2	0.1
		TOTAL	2076	
CERTIFICATION	I	(Master's Degree + 30 hrs)	571	27.5
	II	(Master's Degree or Planned Fifth Year Program	1040	50.1
	III	(Bachelor's Degree)	464	22.4
	IV	(96 hrs and Above)	1	0.0
		TOTAL	2076	
SALARY + (185 Days)	Below $12,000		8	0.4
	$12,001 - $14,000		19	0.9
	$14,001 - $16,000		203	9.8
	$16,001 - $18,000		288	13.9
	$18,001 - $20,000		528	25.4
	$20,001 - $22,000		556	26.8
	$22,001 - $24,000		254	12.2
	$24,001 - $26,000		165	8.9
	$26,001 - $28,000		55	2.6
	$28,001 - $30,000		0	0.0
	Above $30,000		0	0.0
		TOTAL	2076	

+Mean Salary - $19,996

ual Teacher Count (unduplicated count)

TABLE 1: BASIC TEACHER INFORMATION (continued)

Teacher Information		Number	Percentage
YEARS OF TEACHING+	0 - 2	233	11.2
	3 - 5	179	8.6
	6 - 8	227	10.9
	9 - 11	295	14.2
	12 - 14	324	15.6
	15 - 17	251	12.1
	18 - 20	208	10.0
	21 - 23	160	7.7
	24 - 26	96	4.6
	27 - 29	52	2.5
	30 and Above	51	2.5
	TOTAL	2076	
+Mean Years Teaching Experience - 12.9			
AGE (Years)+	Invalid Data	5	0.2
	21 - 25	69	3.3
	26 - 30	240	11.6
	31 - 35	394	19.0
	36 - 40	501	24.1
	41 - 45	396	19.0
	46 - 50	208	10.0
	51 - 55	130	6.3
	56 - 60	84	4.0
	61 - 65	44	2.1
	Above 65	5	0.2
	TOTAL	2076	
+Mean Age (years) 39.7			

* Actual Teacher Count (unduplicated count)

TABLE 2: SUBJECTS BY GENDER OF TEACHER*
1984-85

	SUBJECT	NUMBER OF MALES	PERCENTAGE MALES	NUMBER OF FEMALES	PERCENTAGE FEMALES	TOTAL
2502	Elementary Science **	9	52.9	8	47.1	17
2536	Integrated Science	358	54.2	302	45.8	660
2511	Intro. Bio. Science	228	53.5	198	46.5	426
2563	Intro. Earth Space Science	178	54.4	149	45.6	327
2530	Intro. Chemistry-Physics	184	56.4	142	43.6	326
2517	Biology I	339	55.2	275	44.8	614
2521	Chemistry I	163	56.8	124	43.2	287
2532	Physics I	135	73.4	49	26.6	184
2561	Earth Science	77	58.8	54	41.2	131
2510	Anatomy & Physiology	75	54.7	62	45.3	137
2516	Biology II	82	51.6	77	48.4	159
2538	Physics II	4	100.0	0	0.0	4
3524	Chemistry II	49	60.5	32	39.5	81
2512	Sp. Topics Biology	15	45.5	18	54.6	33
2564	Sp. Topics Phy. Science	11	57.9	8	42.1	19
	TOTAL*	1,907	56.0	1,498	44.0	3,405

* Considerable duplication exist in the 3,405 teacher count. In fact, 1,329 (3,405 - 2,076 = 1,329) of that number represent duplicated counts. This occurs when a teacher teaches more than one science course. For example, if a teacher teaches Biology I and Chemistry I, that person represents two of the 3,405 count - one for each type course taught, regardless of the number of classes taught.

** Coded as Elementary Science but taught at 7th or 8th Grade.

TABLE 3: SUBJECTS TAUGHT BY RACE OR ETHNIC IDENTITY*
1984-85

	SUBJECT	NUMBER OF TEACHERS	PERCENTAGE				
			WHITE	BLACK	HISPANIC	ASIAN	INDIAN
2502	Elementary Science **	17	100.0	0.0	0.0	0.0	0.0
2536	Integrated Science	660	96.8	3.2	0.0	0.0	0.0
2511	Intro. Bio. Science	426	95.0	4.0	0.2	0.5	0.2
2563	Intro. Earth Space Science	327	96.6	3.0	0.0	0.0	0.3
2530	Intro. Chemistry-Physics	326	98.2	1.2	0.0	0.3	0.3
2517	Biology I	614	97.1	2.6	0.0	0.2	0.2
2521	Chemistry I	287	97.9	1.7	0.0	0.4	0.0
2532	Physics I	184	99.5	0.0	0.0	0.5	0.0
2561	Earth Science	131	94.7	5.3	0.0	0.0	0.0
2510	Anatomy & Physiology	137	94.9	5.1	0.0	0.0	0.0
2516	Biology II	159	97.5	2.5	0.0	0.0	0.0
2538	Physics II	4	100.0	0.0	0.0	0.0	0.0
2524	Chemistry II	81	97.5	2.5	0.0	0.0	0.0
2512	Sp. Topics Biology	33	100.0	0.0	0.0	0.0	0.0
2564	Sp. Topics Phy. Science	19	100.0	0.0	0.0	0.0	0.0
	TOTAL*	3,405	96.9	2.7	0.0	0.0	0.0

* See duplication footnote from Table 2.
** Coded as Elementary Science but taught at 7th or 8th grade.

TABLE 4 Subjects Taught by Rank of Teachers

Fifty percent of the science teachers hold Rank II classification. Rank II is obtained by completing a master's degree or planned fifth year program. Twenty-seven percent have Rank I certification (bachelor's degree + 60 hours or master's degree + 30 hours). Rank I teachers are more likely to be teaching high school science. Rank II classification is evenly distributed among subjects taught. Only 22% of the science teachers are below the Rank II classification. The educational attainment of Kentucky's science teachers is high.

TABLE 5 Salaries of Kentucky Science Teachers

Eight science teachers earn less than $12,000 per year. No science teacher in Kentucky earns more than $28,000. The average salary for 1984-85 is $19,996.

One thousand eighty-four teachers (52%) earn between $18,000 and $22,000. The graph illustrates the distribution of salaries. Salaries are based upon 185 days of employment. Science teacher salaries are lower than salaries from jobs requiring comparable educational backgrounds.

TABLE 6 Years Teaching Experience of Kentucky Science Teachers

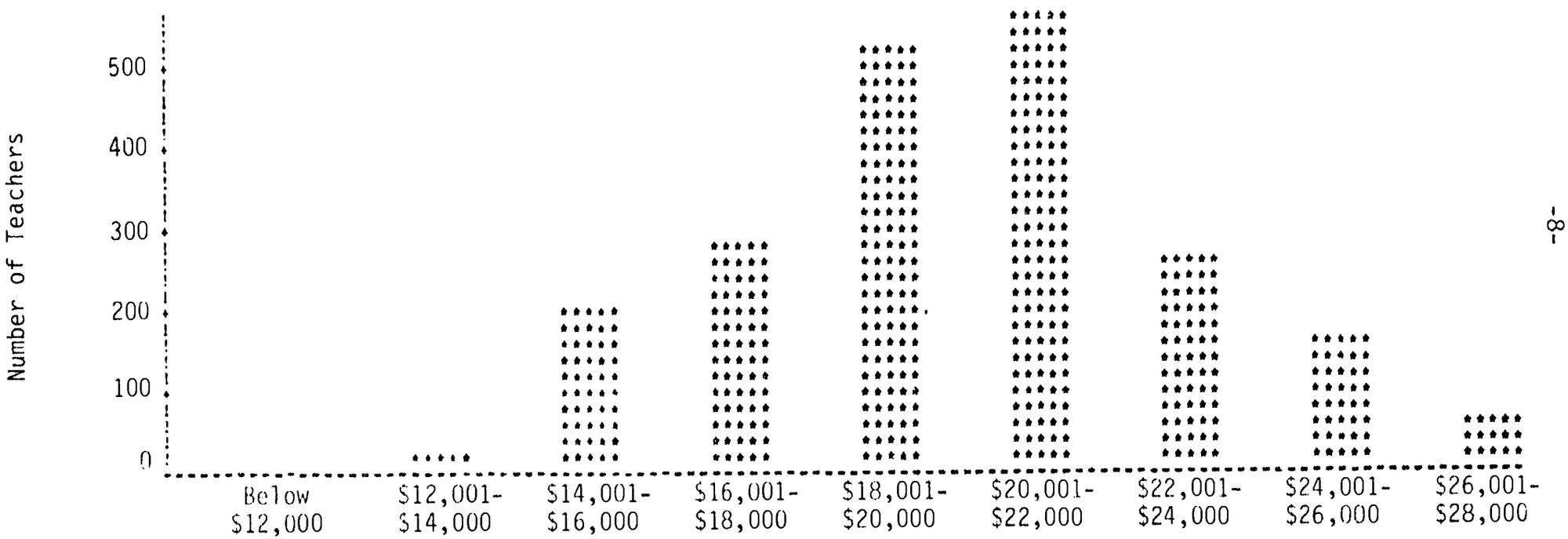
This graph shows years teaching experience. There is a heavy concentration of teachers in the middle of professional careers. Combining

TABLE 4: SUBJECTS TAUGHT BY RANK OF TEACHERS*
1984-85

	SUBJECT	NUMBER OF TEACHERS	PERCENTAGE			
			RANK I	RANK II	RANK III	RANK IV
2502	Elementary Science **	17	0.0	64.7	35.3	0.0
2536	Integrated Science	660	25.6	50.0	24.2	0.2
2511	Intro. Bio. Science	426	23.7	50.7	25.6	0.0
2563	Intro. Earth Space Science	327	24.2	48.0	27.8	0.0
2530	Intro. Chemistry-Physics	326	28.8	48.5	22.7	0.0
2517	Biology I	614	29.2	50.7	20.2	0.0
2521	Chemistry I	287	30.0	51.2	18.8	0.0
2532	Physics I	184	32.6	56.5	10.9	0.0
2561	Earth Science	131	22.9	51.2	26.0	0.0
2510	Anatomy & Physiology	137	29.2	53.3	17.5	0.0
2516	Biology II	159	32.1	49.1	18.9	0.0
2538	Physics II	4	50.0	50.0	0.0	0.0
2524	Chemistry II	81	34.6	50.6	14.8	0.0
2512	Sp. Topics Biology	33	42.4	51.5	6.1	0.0
2564	Sp. Topics Phy. Science	19	15.8	47.4	36.8	0.0
	TOTAL*	3,405	27.5	50.5	21.9	0.0

* See duplication footnote from Table 2.
** Coded as Elementary Science but taught at 7th or 8th grade.

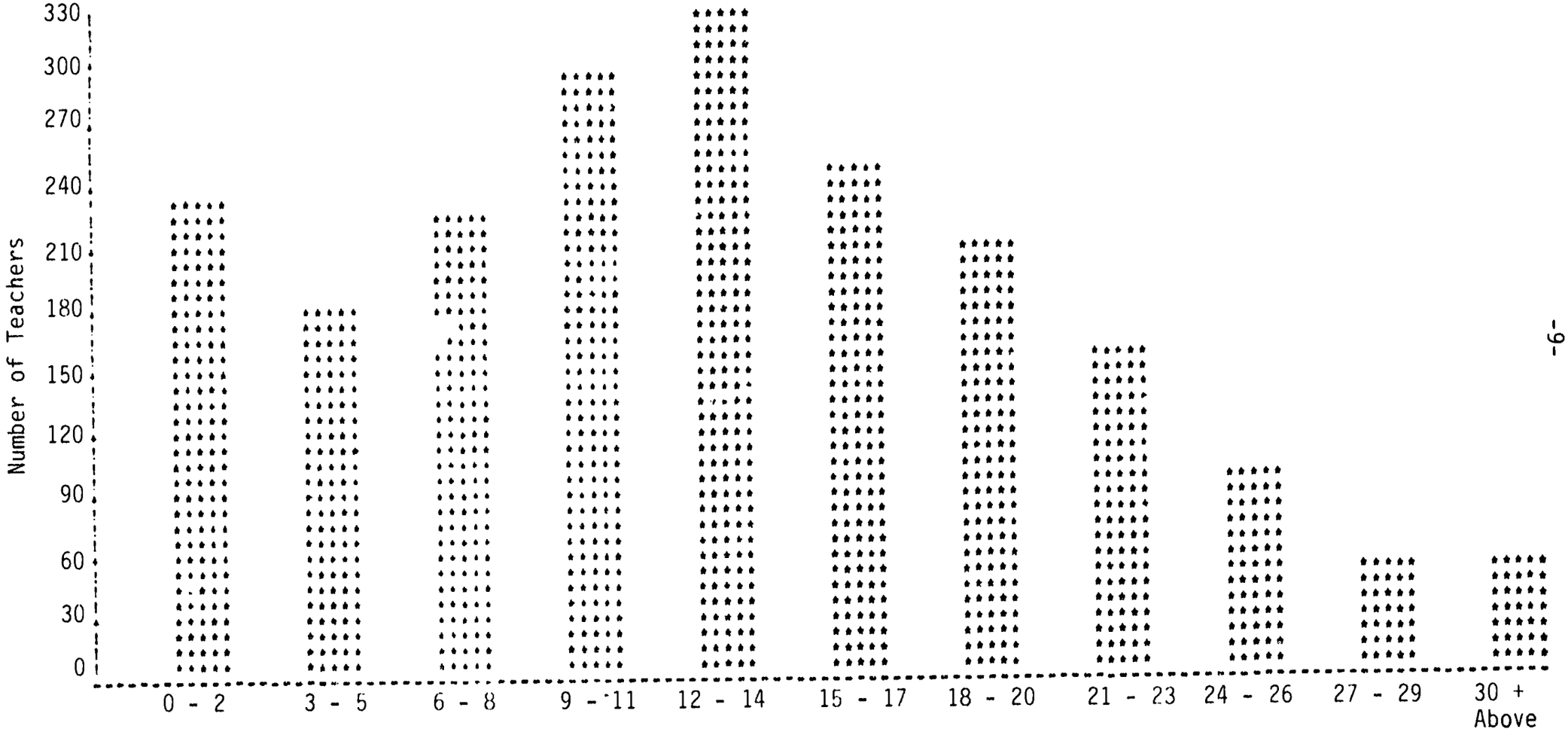
TABLE 5: SALARIES OF KENTUCKY SCIENCE TEACHERS



Salaries (Dollars)

Mean Salary -- $19,996

TABLE 6: YEARS TEACHING EXPERIENCE OF KENTUCKY SCIENCE TEACHERS



Teaching Experience (Years)

Mean Teaching Experience -- 12.9 Years

these data with projections of future school membership should provide useful information regarding the demand for new science teachers. In making these projections one should note that many of the teachers are out-of-field. Projections should include the number of teachers needed to reduce out-of-field assignments as well as the number needed to replace retirees. The mandatory age for retirement is seventy; however, teachers may retire after thirty years of service. While the immediate demand to replace eligible retirees is not high, one should note the logrithmic shape of the curve for the right half of the graph. A crisis situation is developing. The current production of new science teachers will not meet replacement demands during the next twelve years. Again these figures do not include variables such as out-of-field assignments, increasing student membership in lower grades, and attrition of teachers by means other than retirement. More research is needed to refine projection data on needs for future science teachers.

TABLE 7 Teaching Experience by Gender

This table lists teaching experience by gender. Note that the percentages of males as compared to females are lower for new teacher groups (0-5 years). It appears that fewer males are starting science teaching careers.

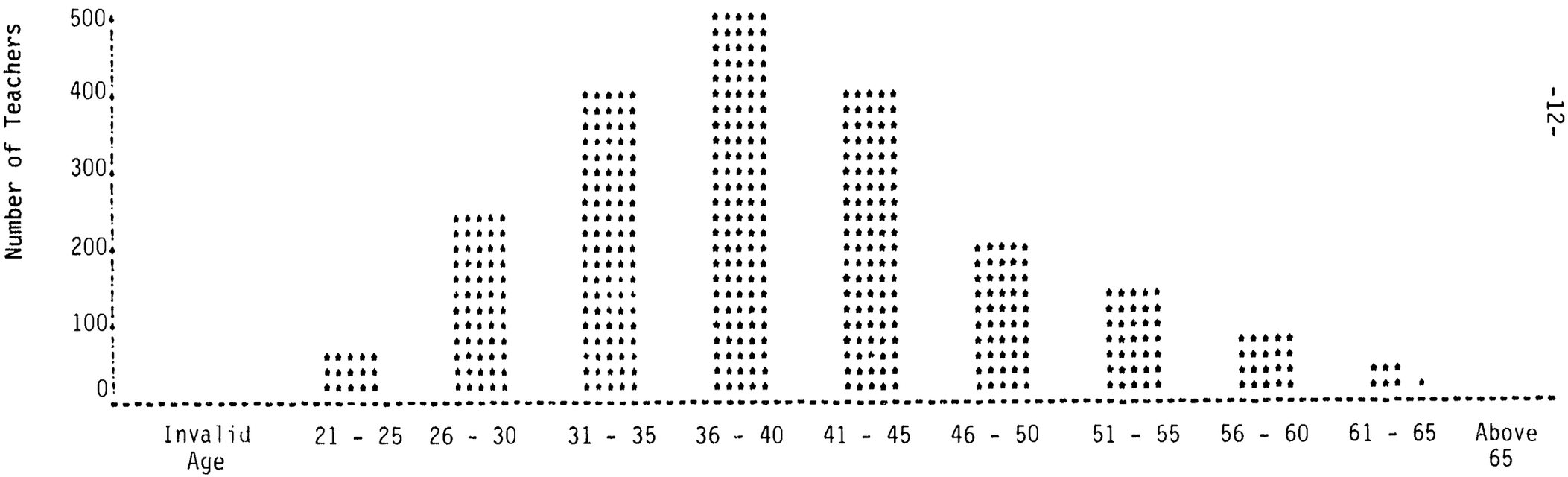
TABLE 8 Ages of Kentucky Science Teachers

This graph contains information regarding science teacher ages. The graph

TABLE 7: TEACHING EXPERIENCE BY GENDER

YEARS OF EXPERIENCE	NUMBER OF MALES	PERCENTAGE OF MALES	NUMBER OF FEMALES	PERCENTAGE OF FEMALES	TOTAL
0 - 2	105	45.1	128	54.9	233
3 - 5	76	42.5	103	57.5	179
6 - 8	115	50.7	112	49.3	227
9 - 11	159	53.9	136	46.1	295
12 - 14	179	55.3	145	44.8	324
15 - 17	157	62.6	94	37.5	251
18 - 20	126	60.6	82	39.4	208
21 - 23	104	65.0	56	35.0	160
24 - 26	68	70.8	28	29.2	96
27 - 29	32	61.5	20	38.5	52
30 and Above	30	58.8	21	41.2	51
TOTAL	1151		925		2076

TABLE 8: AGES OF KENTUCKY SCIENCE TEACHERS



Mean Age -- 39.7 Years

is predictable considering experience data presented in Table 6. The mean age is 39.7. While this type of data is not available for previous years, it appears that the mean age is rather high.

TABLE 9 Ages of Science Teachers by Subjects Taught

It is difficult to see clear patterns in the distribution of age ranges by subject taught. However, older teachers tend to teach high school biology, chemistry, and physics. The frequencies of teachers in the age ranges from 51-65 are higher in these subjects than in other subject areas and grade levels.

TABLE 10 Science Teachers Eligible for Retirement

Fifty-one science teachers have 30 or more years teaching experience and are eligible for immediate retirement. Could these individuals be replaced by new teachers with appropriate science certification?

TABLE 11 Types of Certification Required to Teach Courses from the Kentucky Program of Studies (Science)

The publication, Program of Studies for Kentucky Schools, lists and describes each of the science courses that may be offered by the public schools. The grade level or range of grade levels at which a course may be offered is included. Within each course description there is a list of the

TABLE 9: AGES OF SCIENCE TEACHERS BY SUBJECT TAUGHT*
1984-85

	SUBJECT	Age Range (years)										
		21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	Over 65	Invalid Data
2536	Integrated Science	27	85	132	166	101	71	34	28	12	2	2
2511	Intro. Bio. Science	10	65	86	93	88	40	29	8	6	0	1
2563	Intro. Earth Space Science	12	50	61	76	59	26	22	13	8	0	0
2530	Intro. Chemistry-Physics	20	46	65	75	64	24	15	8	7	1	1
2517	Biology I	19	56	109	137	138	59	48	31	13	2	2
2521	Chemistry I	11	34	43	76	58	27	13	15	9	1	0
2532	Physics I	3	11	27	60	37	25	5	10	5	1	0
2561	Earth Science	8	13	32	24	22	9	11	6	5	0	1
2510	Anatomy & Physiology	4	12	27	30	29	15	12	4	3	0	1
2516	Biology II	6	11	28	48	30	17	8	9	2	0	0
2538	Physics II	0	0	2	1	0	1	0	0	0	0	0
2524	Chemistry II	0	8	12	25	15	11	4	3	3	0	0
2512	Sp. Topics Biology	0	4	5	8	8	2	4	2	0	0	0
2564	Sp. Topics Phy. Science	1	2	7	1	3	2	1	1	1	0	0

* For a given subject (line), an unduplicated count is provided.

TABLE 10: SCIENCE TEACHERS ELIGIBLE FOR RETIREMENT
1984-85

AGE	NUMBER OF TEACHERS WITH 30+ YEARS OF EXPERIENCE
Invalid Age	3
54	1
55	2
56	8
57	3
58	2
59	5
60	7
61	3
62	4
63	3
64	3
65	3
66	1
67	1
68	0
69	2
TOTAL	51

TABLE 11: TYPES OF CERTIFICATION REQUIRED TO TEACH COURSES FROM THE KENTUCKY PROGRAM OF STUDIES (SCIENCE) 1984-85

Certification Codes / Types of Certification

PROGRAM OF STUDIES — CERTIFICATION TYPES FOR PROGRAM OF STUDIES (X)

Course Code	Grade Range	Course Title	MAJORS: B51 Biology	B54 Biology - Health	B52 Chemistry	B56 Earth Science	B23 Geography - Geology	B53 Physics	B50 Science	J50 Junior High Science	AREAS: R51 Science Limited to Biology	R52 Science Limited to Chemistry	R56 Science Limited to Earth Science	R53 Science Limited to Physics	A70 Math-Physical Science	A50 Science	MINORS: C51 Biology	C52 Chemistry	C56 Earth Science	C23 Geography-Geology	C57 Geology	C53 Physics	D50 Letter of approval for Teaching General Science	ELE Elementary Certification (1-8)
2536	7 - 9	Integrated Science	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X*
2511	7	Intro. Bio. Science	X	X					X	X	X					X	X							X
2563	8	Intro. Earth Space Sci.				X	X		X	X			X		X	X			X	X	X			X
2530	9 - 12	Intro. Chemistry-Physics			X			X	X	X**		X		X	X	X		X				X		
2517	9 - 12	Biology I	X	X					X	Y**	X					X	X							
2521	10 - 12	Chemistry I			X				X			X			X	X		X						
2532	10 - 12	Physics I						X	X					X	X	X						X		
2561	10 - 12	Earth Science				X	X		X				X		X	X			X	X	X			
2510	10 - 12	Anatomy & Physiology	X	X					X		X					X	X							
2516	11 - 12	Biology II	X	X					X		X					X	X							
2538	11 - 12	Physics II						X	X					X	X	X						X		
2524	11 - 12	Chemistry II			X				X			X			X	X		X						
2512	10 - 12	Special Topics in Biology	X	X					X		X					X	X							
2564	10 - 12	Special Topics in Physical Science			X	X		X	X			X	X	X	X	X		X	X		X	X		

* NOT CERTIFIED FOR GRADE 9

** NOT CERTIFIED FOR GRADES 10-12

types certification (majors, minors, or areas of concentration) eligible to teach this course. Certification types not included in the lists are considered out-of-field. More information about Kentucky certification requirements is found in the Appendix. Table 11 defines types of certification needed to teach science courses offered in Kentucky schools.

Information from Table 11 is used in subsequent tables where specific courses are examined for types of certification held by teachers. Highly specialized courses like biology, chemistry, and physics have a limited number of certifications eligible to teach these courses. More general courses like integrated science may be taught by a larger number and more diverse set of science certifications. Judgements may be made regarding the desirability of types of certificates eligible to teach a given subject. For example, physics majors, physics minors, and areas of concentration in mathematics and physical science are among the types eligible to teach physics. A physics major may be a more desirable certification for teaching Physics I or II while an area of concentration in mathematics and physical science may be more desirable for teachers of the course, Introduction to Chemistry and Physics. Several certifications may be considered in-field for a given subject but the quality of staffing may be partially inferred from the type of certification held. Some certificates held by teachers would be clearly out-of-field.

STUDENT ENROLLMENT

TABLE 12 Subject and Student Membership

Number of classes, student membership, and average class size is listed for each course from the Program of Studies for Kentucky Schools. Junior high/middle school sciences [Integrated Science, Introduction to Biological Science, Introduction to Earth-Space Science (including Earth Science), and Introduction to Chemistry and Physics] and Biology I are, by far, the largest enrollment courses. This is shaped, primarily, by the State Board of Education requirement of two units of science for high school graduation. Large numbers of students are ending science studies when minimum requirements have been met.

Biology I is generally taught in the tenth grade. Tenth grade membership in 1984-85 is 48,085. In 1984-85, 48,928 students are enrolled in Biology I. Therefore, one may conclude that 100% of the students are taking high school biology. The slight discrepancy in numbers can be explained by the fact that some schools offer Biology in the 9th grade and/or students may elect to take Biology I after the 10th grade. The important point is that virtually all high school students are taking a biology course.

Student membership in junior and senior classes totals 84,640 with an average membership of 42,320 at either grade levels. With 15,276 students enrolled in Chemistry I, it may be determined that 36.1% of the students are taking a high school chemistry course. This may be favorably compared to other states and national percentages. One report says, "Unlike mathematics,

TABLE 12: SUBJECT AND STUDENT MEMBERSHIP*
1984-85

	SUBJECT	NUMBER OF CLASSES	STUDENT MEMBERSHIP	AVERAGE CLASS SIZE
2536	Integrated Science	1,935	53,284	27.5
2511	Intro. Bio. Science	1,220	32,990	27.0
2563	Intro. Earth Space Science	981	26,529	27.0
2530	Intro. Chemistry-Physics	778	20,667	26.6
2517	Biology I	1,829	48,928	26.8
2521	Chemistry I	644	15,276	23.7
2532	Physics I	234	4,562	19.5
2561	Earth Science	325	8,831	27.2
2510	Anatomy & Physiology	200	4,754	23.8
2516	Biology II	232	4,939	21.3
2538	Physics II	7	137	19.6
2524	Chemistry II	109	2,106	19.3
2512	Sp. Topics Biology	48	1,022	21.3
2564	Sp. Topics Phy. Science	31	715	23.1
	TOTAL	8,573	224,740***	26.2**

* Does not include Elementary Science (2502) taught in 7th or 8th grade. Thirteen teachers improperly coded their courses.
** Represents student membership (224,740) divided by classes (8,573).
*** Duplicated count (An individual student may take more than one science class.)

only limited statistical information is readily available on science course enrollments nationwide." (Mathematics Science and Computer Education, Grades 7-12: A Report on the New Hampshire Mathematics and Science Education 1983 Status Survey, 1984, p. 20). The same publication reports a national chemistry enrollment of 37% and 35.6% for New Hampshire. In interpreting data in this report, one must be aware of the high percentage of high school dropouts in Kentucky. This figure (dropouts) has been placed at around 30%. When dropouts are included, the overall picture is less encouraging. Also, one may ask the question, "can't more than 36% of our students benefit from a chemistry course?" These students will be living and working in a highly technological society. Do enough students have the scientific knowledge and technical skills to contribute to their personal development and the economic growth of the Commonwealth?

Physics enrollment is even more dismal. Four thousand five hundred sixty-two students are enrolled in Physics I. Dividing this number by the average junior or senior class membership (42,320) it is determined that 10.8% of the eligible student population is taking physics. One in ten students takes a course in high school physics. New Hampshire reports a state physics enrollment of 21.2% and a national physics enrollment of 19%. (Mathematics Science and Computer Education, Grades 7-12: A Report on the New Hampshire Mathematics and Science Education 1983 Status Study, 1984, p.20). As with chemistry, physics enrollments must be considered with reference to the dropout rate. These percentages need to be increased! Do we have new

teachers (certified to teach physics) available to teach these courses?

Additional information related to schools offering and not offering chemistry and physics will be provided in a subsequent section of this report. Questions like those asked about chemistry enrollments need to be asked about physics. Is physics to be offered to small elite groups of students or is it important to individuals and society to significantly increase the number of students taking an introductory physics course?

Class size decreases from seventh grade science (Integrated Science or Introduction to Biological Science) to high school science offerings. Class size does not appear to be a major problem. Average class size ranges by subject from 19.3 to 27.5. Average class size for all science subjects combined is 26.2. If average class size is 26.2, it may be inferred that some classes in Kentucky are too large to provide effective instruction and safety insured laboratory experience. However, this figure is somewhat realistic in that funding for classroom units in Kentucky is based upon 28 students per unit.

TYPES OF CERTIFICATES HELD BY TEACHERS OF MIDDLE/JUNIOR HIGH SCHOOL SCIENCE COURSES

TABLE 13 Integrated Science (Grades 7-9)

Data in Table 13 cover information on teachers and students in Integrated Science (grades 7-9). This general science course accommodates more types of science teacher certification than other courses prescribed by the Program of Studies. At its best, the course provides an opportunity for schools to integrate concepts and skills from several science disciplines over a period of three years. On a less optimistic note, schools sometimes elect to use this course title for other science courses in order to reduce the number of out-of-field, teacher assignments. This second application does nothing to improve the quality of instruction for middle/junior high school science students.

Six hundred sixty teachers teach Integrated Science. Types of certification are quite varied; however, the predominant certifications include biology majors (235) and minors (121) -- approximately 54% of the teachers. There is a notable absence of junior high science majors; physics majors and minors; chemistry majors and minors; and earth science majors and minors. Note that percentages are calculated for each type of certification by number of teachers, number of students, and number of classes. Eight thousand eleven students are being taught by teachers (elementary) with less

TABLE 13: 2536 INTEGRATED SCIENCE AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

	CERTIFICATION	NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
J50	Junior High Science	4	0.6	448	0.8	15	0.9
A50	Science Area	18	2.7	1,409	2.6	51	2.6
B50	Science Major	5	0.8	262	0.5	9	0.5
R51	Science Limited to Biology	3	0.5	230	0.4	8	0.4
R52	Science Limited to Chemistry	0	0.0	0	0.0	0	0.0
R53	Science Limited to Physics	0	0.0	0	0.0	0	0.0
R56	Science Limited to Earth Science	1	0.2	60	0.1	2	0.1
B51	Biology Major	235	35.6	18,333	34.4	663	34.3
B52	Chemistry Major	33	5.0	2,138	4.0	79	4.1
B53	Physics Major	8	1.2	427	0.8	16	0.8
B54	Biology - Health Major	3	0.5	278	0.5	11	0.6
B56	Earth Science Major	12	1.8	1,039	1.9	39	2.0
A70	Math - Physical Science Area	1	0.2	32	0.1	1	0.1
C51	Biology Minor	121	18.3	9,537	17.9	353	18.2
C52	Chemistry Minor	3	0.5	290	0.5	11	0.6
C53	Physics Minor	5	0.8	334	0.6	12	0.6
C56	Earth Science Minor	4	0.6	329	0.6	12	0.6
C57	Geology Minor	1	0.2	90	0.2	3	0.2
D50	Letter of Approval	13	2.0	1,357	2.5	50	2.6
Elementary Grades 1-8		98	14.8	8,711	16.4	313	16.2
	Out-of-field	92	13.9	7,980	15.0	287	14.8
	TOTAL	660		53,284		1,935	

than a minor in one of the sciences. In addition, 7,980 students are taught by out-of-field teachers. Out-of-field teachers also have less than a minor in one of the sciences.

The following list contains majors and frequencies of majors reported as out-of-field for Integrated Science:

Physical Education/Health Major	29
Social Science Major	22
Home Economic Major	17
Agriculture Major	13
Business Major	6
Psychology Major	2
Art, English, Industrial Arts Majors	3
Total	92

TABLE 14 Introduction to Biological Science (Grade 7)

Forty-six percent (45.5%) of the students in this course are taught by biology majors (30.5%) and minors (15.0%). Elementary teachers teach 8,199 students (24.9%). Nine thousand forty-five students (27.4%) are taught by out-of-field teachers.

The following list contains majors and minors (including frequencies) reported as out-of-field for Introduction to Biological Science:

Science Major or Minor	
Chemistry Major	2
Earth Science Major	2
Physics Major	1
Chemistry Minor	2
Physics Minor	2
Total	9

TABLE 14: 2511 INTRODUCTION TO BIOLOGICAL SCIENCE AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

CERTIFICATION		NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
B51	Biology Major	115	27.0	10,062	30.5	374	30.7
R51	Science Limited to Biology	1	0.2	29	0.1	1	0.1
B54	Biology-Health Major	1	0.2	28	0.1	1	0.1
C51	Biology Minor	59	13.8	4,949	15.0	179	14.7
A50	Science Area	7	1.6	596	1.8	25	2.0
B50	Science Major	0	0.0	0	0.0	0	0.0
J50	Junior High Science	2	2.5	82	0.2	3	0.2
Elementary	Grades 1-8	114	26.8	8,199	24.9	298	24.4
	Out-of-field	127	29.8	9,045	27.4	339	27.8
	TOTAL	426		32,990		1,220	

Non-science Major or Minor

Physical Education/Health Major	43
Home Economics Major	24
Social Studies Major	16
Letter of Approval (D50)	12
Agriculture Major	7
Business Major	5
English Major	3
Psychology Major	3
Art and Music Majors	2
Math and Industrial Arts Majors	2
Total	116

TABLE 15 Earth Science (Introduction to Eart Space Science and Earth Science)

The Program of Studies lists Introduction to Earth Space Science as an 8th grade course. Earth Science is listed as a science elective for grades 10, 11, or 12. There is much confusion at the school level as to the appropriate coding for earth science courses. In most cases, only one course is taught and it is taught at the eighth grade level. It would be appropriately coded as Introduction to Earth Space Science (Code Number 2563). Due to the considerable confusion regarding the coding of earth science courses, this report combines all earth science data.

Of all subjects included in the Program of Studies, earth science is the course which is in the most need of immediate attention. The number of students taught by out-of-field teachers is alarming. Seventeen teachers have an earth science or geography/geology major. Fifteen teachers have earth science or geology minors. Twenty-three percent (22.8%) of the students

TABLE 15: EARTH SCIENCE COURSES (2561 AND 2563)* AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

CERTIFICATION		NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
B56	Earth Science Major	12	2.6	1,052	3.0	40	3.1
R56	Science Limited to Earth Science	0	0.0	0	0.0	0	0.0
B23	Geography - Geology Major	5	1.1	380	1.1	13	1.0
C56	Earth Science Minor	13	2.8	1,035	2.9	41	3.1
C57	Geology Minor	2	0.4	203	0.6	7	0.5
C23	Geography - Geology Minor	0	0.0	0	0.0	0	0.0
A70	Math - Physical Science Area	4	0.9	258	0.7	10	0.8
A50	Science Area	16	3.5	1,703	4.8	59	4.5
B50	Science Major	6	1.3	383	1.1	16	1.2
J50	Junior High Science	4	0.9	260	0.7	11	0.8
Elementary Grades 1-8		108	23.6	8,065	22.8	290	22.2
	Out-of-field	288	62.8	22,021	62.3	819	62.7
	TOTAL	458		35,360		1,306	

* As a result of incorrect coding of earth science classes by local school districts, this table combines the two courses.

(8,065) are taught by elementary teachers. Sixty-two percent (62.3%) of the students (22,021) are taught by out-of-field teachers. While there is a severe national need for certified earth science teachers, Kentucky's problem appears to be more severe than in some states. For example, North Carolina reports that 48.5% of their earth science classes are taught by appropriately certified teachers (North Carolina Science Teacher Profile: Grades 7-12, 1983, p. 10).

The following list contains majors and minors (including frequencies) reported as out-of-field for earth science courses:

Science Major or Minor

Biology Major	105
Biology Minor	39
Biology Area	4
Chemistry Major	15
Chemistry Minor	1
Physics Major	2
Physics Minor	4
Total	170

Non-science Major or Minor

Physical Education/Health Major	42
Physical Education/Health Minor	2
Home Economics Major	26
Social Studies Major	13
Letter of Approval (D50)	12
Agriculture Major	7
English Major	4
Business Major	3
Art Major	3
Psychology and Industrial Arts Majors	3
Undetermined and Math Majors	3
Total	118

These data suggest that considerable attention be given to staff development activities, undergraduate programs, and graduate programs. Production of new teachers, endorsements for out-of-field teachers, additional work for elementary certified teachers, and in-service/staff development will be needed to approach a partial solution to a problem of this magnitude.

TABLE 16 Introduction to Chemistry and Physics
(Physical Science, Grades 9-12, Primarily Grade 9)

As with courses discussed previously, there are staffing problems in physical science classes. However, there are some positive features. Eighty-four of 326 teachers have a chemistry major, physics major, or an area in mathematics-physical science. Ninety teachers have a chemistry or physics minor. Sixty-four percent of the physical science teachers are appropriately certified to teach physical science. Considering the number of chemistry and physics majors teaching this course, one might assume that many of these teachers are also teaching high school chemistry and physics.

Even though there is evidence of good staffing in Introduction to Chemistry and Physics, 35.9% of the teachers are teaching out-of-field. Note that out-of-field teachers include 57 biology majors, 25 biology minors, and 3 biology areas. Additional college courses in the physical sciences could significantly reduce the number of out-of-field assignments. Conceivably, this upgrading could be accomplished within a reasonable period of time. The distribution of out-of-field teachers follows:

TABLE 16: 2530 INTRODUCTION TO CHEMISTRY AND PHYSICS AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

	CERTIFICATION	NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
A70	Math- Physical Science Area	6	1.8	321	1.6	12	1.5
B52	Chemistry Major	62	19.0	3,513	17.0	129	16.6
B53	Physics Major	16	4.9	924	4.5	36	4.6
R52	Science Limited to Chemistry	0	0.0	0	0.0	0	0.0
R53	Science Limited to Physics	0	0.0	0	0.0	0	0.0
C52	Chemistry Minor	83	25.5	5,111	24.7	193	24.8
C53	Physics Minor	7	2.1	479	2.3	17	2.2
A50	Science Area	28	8.6	1,904	9.2	69	8.9
B50	Science Major	2	0.6	206	1.0	7	0.9
J50	Junior High Science	5	1.5	528	2.6	22	2.8
	Out-of-field	117	35.9	7,680	37.2	293	37.7
	TOTAL	326		20,667		778	

Science Major or Minor

Biology Major	57
Biology Minor	25
Area in Biology	3
Earth Science Major	1
Total	86

Non-science Major or Minor

Physical Education/Health Major	11
Home Economics Major	6
Social Studies Major	5
Math Major	3
Letter of Approval (D50)	3
Agriculture Major	2
English Major	1
Total	31

TYPES OF CERTIFICATES HELD BY TEACHERS OF HIGH SCHOOL SCIENCE COURSES*

TABLE 17 Biology I (Grades 9-12)

Biology is well staffed by appropriately certified teachers. Almost all classes are taught by biology majors or minors. Majors outnumber minors three to one. Only 24 teachers in the Commonwealth are teaching out-of-field.

* Introduction to Chemistry and Physics can be taught in grades 9-12. For this report, the course was discussed in the middle/junior high school section.

TABLE 17: 2517 BIOLOGY I AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

	CERTIFICATION	NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
B51	Biology Major	415	67.6	34,076	69.6	1,278	69.9
B54	Biology-Health Major	2	0.3	136	0.3	6	0.3
R51	Science Limited to Biology	3	0.5	167	0.3	7	0.4
C51	Biology Minor	138	22.5	10,629	21.7	392	21.4
A50	Science Area	31	5.0	2,612	5.3	92	5.0
B50	Science Major	1	0.2	52	0.1	2	0.1
J50*	Junior High Science	0	0.0	0	0.0	0	0.0
	Out-of-field	24	3.9	1,256	2.6	52	2.8
	TOTAL	614		48,928		1,829	

* For 9th Grade Only

Out-of-field majors and minors follow:

Science Major or Minor

Chemistry Major	2
Physics Major	1
Chemistry Minor	1
Total	4

Non-science Major or Minor

Physical Education/Health Major	8
Agriculture Major	5
Home Economics Major	4
Social Studies and English Major	3
Total	20

TABLE 18 Biology II (Grades 10-12)

Only two teachers are out-of-field. Majors outnumber minors 4 to 1.

Non-Science Major or Minor

Agriculture Major	1
Social Studies Major	1
Total	2

TABLE 19 Anatomy and Physiology (Grades 10-12)

Ten teachers out of 137 are teaching out-of-field. Sixty-six percent (65.6%) of the teachers have a biology major.

Non-science Major or Minor

Physical Education/Health Majors	9
Agriculture Major	1
Total	10

TABLE 18: 2516 BIOLOGY II AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

CERTIFICATION		NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
B51	Biology Major	120	75.5	3,947	79.9	182	78.4
B54	Biology-Health Major	0	0.0	0	0.0	0	0.0
R51	Science Limited to Biology	1	0.6	7	0.1	1	0.4
C51	Biology Minor	27	17.0	726	14.7	35	15.1
A50	Science Area	9	5.7	193	3.9	11	4.7
B50	Science Major	0	0.0	0	0.0	0	0.0
	Out-of-field	2	1.3	66	1.3	3	1.3
	TOTAL	159		4,939		232	

TABLE 19: 2510 ANATOMY AND PHYSIOLOGY AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

CERTIFICATION		NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
B51	Biology Major	90	65.7	3,067	64.5	131	65.5
B54	Biology-Health Major	1	0.7	28	0.6	1	0.5
R51	Science Limited to Biology	1	0.7	17	0.4	1	0.5
C51	Biology Minor	24	17.5	1,033	21.7	40	20.0
A50	Science Area	11	8.0	321	6.8	15	7.5
B50	Science Major	0	0.0	0	0.0	0	0.0
	Out-of-field	10	7.3	288	6.1	12	6.0
	TOTAL	137		4,754		200	

TABLE 20 Special Topics in Biological Science (Grades 10-12)

This is a low enrollment course (48 classes and 1,022 students). Twenty-six of 33 teachers are biology majors. There are 2 out-of-field teachers.

Non-Science Major or Minor

Physical Education/Health Major	1
Agriculture Major	1
Total	2

TABLE 21 Chemistry 1 (Grades 10-12)

Thirty-eight percent of Chemistry I teachers have a major in chemistry; forty-one percent have chemistry minors. As compared to previously discussed courses, a significant shift has occurred. More teachers are teaching with a minor as compared to a major.

Many teachers with a minor would benefit from opportunities to increase their chemistry minor to a major. While teachers with a chemistry minor hold different types of majors, the biology major is more prevalent.

Discussions of previous courses have not compared certification by number of teachers, number of students, and number of classes. Compare these figures for chemistry majors teaching Chemistry I. While 38.0 percent of the teachers have a major, 44.3% of the students are taught by a chemistry major and majors teach 43.8% of the classes. This suggests that schools are effective using the more qualified teachers to teach this course.

TABLE 20: 2512 SPECIAL TOPICS IN BIOLOGICAL SCIENCE AND TEACHER CERTIFICATION
(BY TEACHER, STUDENTS, AND CLASSES)
1984-85

CERTIFICATION		NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
B51	Biology Major	26	78.8	851	83.3	40	83.3
B54	Biology-Health Major	0	0.0	0	0.0	0	0.0
R51	Science Limited to Biology	0	0.0	0	0.0	0	0.0
C51	Biology Minor	2	6.1	36	3.5	2	4.2
A50	Science Area	3	9.1	64	6.3	3	6.3
B50	Science Major	0	0.0	0	0.0	0	0.0
	Out-of-field	2	6.1	71	6.9	3	6.3
	TOTAL	33		1,022		48	

TABLE 21: 2521 CHEMISTRY I AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

	CERTIFICATION	NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
B52	Chemistry Major	109	38.0	6,774	44.3	282	43.8
R52	Science Limited to Chemistry	2	0.7	64	0.4	3	0.5
C52	Chemistry Minor	117	40.8	6,011	39.3	250	38.8
A70	Math - Physical Science Area	8	2.8	405	2.7	17	2.6
A50	Science Area	27	9.4	1,165	7.6	52	8.1
B50	Science Major	1	0.3	88	0.6	3	0.5
	Out-of-field	23	8.0	769	5.0	37	5.7
	TOTAL	287		15,276		644	

Eight percent of the teachers are teaching out-of-field. Out-of-field majors and minors follow:

Science Major or Minor

Biology Major	14
Biology Minor	2
Physics Major	2
Total	18

Non-Science Major or Minor

History, English, Home Economics	3
Math Major and Minor	2
Total	5

There is a need for teacher education institutions to actively recruit and certify new chemistry majors for high school teaching.

TABLE 22 Chemistry II (Grades 11-12)

As it should be, more majors than minors are teaching this course. Only one person is teaching out-of-field.

Non-Science Major or Minor

English Major	1
Total	1

TABLE 23 Physics I (Grades 10-12)

For science courses in grades 10-12, Physics I is the course most frequently taught by out-of-field teachers. Fifty-six people (30.4%) are out-of-field for Physics I.

TABLE 22: 2524 CHEMISTRY 11 AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

	CERTIFICATION	NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
B52	Chemistry Major	42	51.6	958	45.5	51	46.8
R52	Science Limited to Chemistry	0	0.0	0	0.0	0	0.0
C52	Chemistry Minor	26	32.1	761	36.1	38	34.9
A70	Math - Physical Science Area	4	4.9	64	3.0	4	3.7
A50	Science Area	7	8.6	194	9.2	11	10.1
B50	Science Major	1	1.2	62	2.9	2	1.8
	Out-of-field	1	1.2	67	3.2	3	2.8
	TOTAL	81		2,106		109	

TABLE 23: 2532 PHYSICS 1 AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

	CERTIFICATION	NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE TEACHERS
B53	Physics Major	44	23.9	1,399	30.7	66	28.2
C53	Physics Minor	45	24.5	1,126	24.7	56	23.9
A70	Math-Physical Science Area	9	4.9	237	5.2	12	5.1
A50	Science Area	27	14.7	717	15.7	37	15.8
B50	Science Major	3	1.6	120	2.6	4	1.7
	Out-of-field	56	30.4	963	21.1	59	25.2
	TOTAL	184		4,562		234	

Out-of-field majors and minors follow:

Science Major or Minor

Biology Major	20
Chemistry Major	20
Chemistry Minor	4
Total	44

Non-Science Major or Minor

Math Major	10
English Major	2
Total	12

Currently enrolled physics students could be better served if out-of-field teachers added physics certification. If, as recommended, physics enrollments increase, staffing problems could become even more critical. Data not included in this report, suggest that large numbers of physics teachers are approaching retirement. Combining this information with data indicating a low production of new physics teachers, highlights future needs in this area.

TABLE 24 Physics II (Grades 11-12)

Only seven classes of Physics II (Advanced Physics) are offered in Kentucky. No teachers are out-of-field.

TABLE 25 Availability of Chemistry I and Physics I Courses in Kentucky High Schools

Of 255 schools in Kentucky, 223 offer Chemistry I; thirty-two do not. Six of the thirty-two schools would not be expected to offer chemistry in that they are alternative and performing arts schools. Therefore, the modified percentage of schools offering Chemistry I is 89.58.

TABLE 24: 2538 PHYSICS II AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

	CERTIFICATION	NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
B53	Physics Major	3	75.0	121	88.3	6	85.7
R53	Science Limited to Physics	0	0.0	0	0.0	0	0.0
C53	Physics Minor	1	25.0	16	11.7	1	14.3
A70	Math - Physical Science Area	0	0.0	0	0.0	0	0.0
A50	Science Area	0	0.0	0	0.0	0	0.0
B50	Science Major	0	0.0	0	0.0	0	0.0
	Out-of-field	0	0.0	0	0.0	0	0.0
	TOTAL	4		137		7	

TABLE 25: AVAILABILITY OF CHEMISTRY I AND PHYSICS I
COURSES IN KENTUCKY HIGH SCHOOLS
1984-85

SUBJECT	NUMBER OF SCHOOLS OFFERING	PERCENTAGE SCHOOLS OFFERING	NUMBER SCHOOLS NOT OFFERING	PERCENTAGE SCHOOLS NOT OFFERING
Chemistry I	223	89.5 (87.5)*	26 (32)*	10.4 (12.5)*
Physics I	180	72.3 (70.6)*	69 (75)*	27.7 (29.4)*

* Includes 6 schools where Chemistry I and Physics I would not be appropriate course offerings (i.e., alternative and perfoming arts schools).

One hundred eighty schools offer Physics I. Sixty-nine schools that might be expected to offer physics do not do so. Therefore, modified percentage of schools offering Physics I is 72.3%.

An inspection of school enrollment data for schools not offering chemistry and/or physics, reveals that these schools tend to be small (i.e., 250-650 students) and rural. Several schools appeared on both lists (not offering chemistry and not offering physics). One may infer that these schools offer neither of these subjects. A few schools teach chemistry and physics on alternate years. When 1985-86 data become available, the number of schools using an alternating plan will be known.

The number of schools in Kentucky not offering chemistry and physics is alarming. It is difficult to imagine that some students would have no experience with advanced physical science courses in their high school years. What opportunity do these students have to participate as scientifically literate citizens of the community? Students aspiring to attend institutions of higher education face formidable, possibly insurmountable, obstacles.

TABLE 26 Special Topics in Physical Science (Grades 10-12)

This is another low enrollment course (31 classes). It is primarily taught by chemistry majors and minors. A proportionately large number of teachers (6 of 19) are out-of-field. Out-of-field majors and minors follow:

Science Major or Minor	
Biology Major	2
Biology Minor	2
Total	4
Non-Science Major or Minor	
Physical Education/Health Major	1
English Major	1
Total	2

TABLE 26: 2564 SPECIAL TOPICS IN PHYSICAL SCIENCE AND TEACHER CERTIFICATION
(BY TEACHERS, STUDENTS, AND CLASSES)
1984-85

	CERTIFICATION	NUMBER OF TEACHERS	PERCENTAGE TEACHERS	NUMBER OF STUDENTS	PERCENTAGE STUDENTS	NUMBER OF CLASSES	PERCENTAGE CLASSES
A70	Math- Physical Science Area	0	0.0	0	0.0	0	0.0
B52	Chemistry Major	4	21.1	226	31.6	8	25.8
B53	Physics Major	1	5.3	20	2.8	1	3.2
B56	Earth Science Major	0	0.0	0	0.0	0	0.0
R52	Science Limited to Chemistry	0	0.0	0	0.0	0	0.0
R53	Science Limited to Physics	0	0.0	0	0.0	0	0.0
R56	Science Limited to Earth Science	0	0.0	0	0.0	0	0.0
C52	Chemistry Minor	6	31.6	211	29.5	9	29.0
C53	Physics Minor	1	5.3	32	4.5	2	6.5
C56	Earth Science Minor	0	0.0	0	0.0	0	0.0
C57	Geology Minor	0	0.0	0	0.0	0	0.0
A50	Science Area	1	5.3	12	1.7	1	3.2
B50	Science Major	0	0.0	0	0.0	0	0.0
	Out-of-field	6	31.6	214	29.9	10	32.3
	TOTAL	19		715		31	

SUMMARY

Major findings of this report have been presented and discussed on a table by table basis. For the convenience of the reader some of the findings are listed in this section.

1) Two thousand seventy-six teachers teach one or more science classes in Kentucky.
2) Minority groups represent only 3.4% of the Kentucky science teaching population.
3) Seventy-eight percent of Kentucky's science teachers have a Rank II or above classification.
4) The mean salary is $19,996.
5) The mean age is 39.7 and mean years teaching experience is 12.9.
6) A lower percentage of males is entering the science teaching profession.
7) Immediate needs to replace retiring teachers are moderate. Projected needs follow a logrithmic pattern. Immediate needs for teachers would be very high if out-of-field science teachers were reassigned to specialty areas.
8) Fifty-one science teachers have 30 or more years experience and are eligible for retirement.

9) Older and more experienced teachers tend to teach high school biology, chemistry and physics.

10) There are 8,573 science classes with a total student membership of 224,740 students in grades 7-12. The average class size is 26.2 students.

11) Chemistry I enrollment represents 36.1% of the available student population; Physics I represents 10.8%. These percentages do not take into account the dropout rates in Kentucky high schools.

12) Middle/junior high science courses are heavily staffed with elementary certified (1-8) and out-of-field teachers.

13) Class size is largest in middle/junior high classes.

14) Middle/junior high classes are staffed by younger and less experienced teachers.

15) Earth science classes have more out-of-field teachers than appropriately certified teachers. Two hundred eighty-eight teachers are out-of-field in earth science classes.

16) Thirty-six percent of Introduction to Chemistry and Physics teachers are teaching out-of-field.

17) Biology classes are generally taught by appropriately certified teachers. Biology majors outnumber minors 3 to 1.

18) There are more chemistry minors teaching Chemistry I than chemistry majors.

19) Eight percent of Chemistry I teachers are out-of-field.

20) Thirty percent of Physics I teachers are out-of-field.

21) There is an equal number of physics majors and minors teaching Physics I.

22) Ten percent of Kentucky high schools did not offer Chemistry I in 1984-85.

23) Twenty-eight percent of Kentucky high schools did not offer Physics I in 1984-85.

Appendix

CERTIFICATION

Kentucky statutes provide that "all certificates...shall be issued in accordance with the published rules and regulations of the State Board of Education through the Superintendent of Public Instruction." (KRS 161.030).

Certification is issued to individuals by the Division of Teacher Education and Certification, Kentucky Department of Education, upon the recommendation of a college or university after the individual has successfully completed an approved teacher education program.

The major provisions relating to science certification are included for clarification and understanding of the profile of Kentucky science teachers. A detailed description of the standards for certification is contained in the 1984 Kentucky Teacher Preparation and Certification Handbook.

ELEMENTARY SCHOOL TEACHER PREPARATION - CERTIFICATION

A. Provisional Elementary Certificate
704 KAR 20:090
Section 1.

(3) The Provisional Elementary Certificate shall be valid for teaching in grades one (1) through eight (8).

MIDDLE GRADE SCHOOL TEACHER PREPARATION - CERTIFICATION

Provisional Certificate for Teaching In the Middle Grades
704 KAR 20:080

Section 1.
(3) The Provisional Certificate for Teaching in the Middle Grades shall be valid for teaching in grades five (5) through nine (9) and shall be endorsed for grades nine (9) through twelve (12) for any subject assignment in which the teacher holds a regular high school teaching major or minor.

Section 3.
The specialization component of the curriculum for the Provisional Certificate for Teaching in the Middle Grades shall include a minimum of 60 semester hours' credit distributed among two middle grade teaching fields of 24 semester hours each and one additional subject concentration of 12 semester hours' credit.

SPECIALIZATION FOR HIGH SCHOOL CERTIFICATE: AREAS OF CONCENTRATION
TEC 40.1

Section 8. MATHEMATICS-PHYSICAL SCIENCE
An area of concentration in the mathematics-physical science combination shall consist of a minimum of 48 semester hours' credit including chemistry, physics, and mathematics with no fewer than 15 semester hours' credit in each.

Section 9. SCIENCE
An area of concentration in science shall require a minimum of 48 semester hours' credit which includes the core requirements. The core courses must be those which normally count toward a minor in the respective disciplines listed. Also included must be a minor(s) of 21 semester hours in at least one of the disciplines listed in the core. The core requirements shall include: biology, two courses; chemistry, two courses; earth science, two courses; and physics, two courses. Laboratory experience must be afforded in at least one course each of biology, chemistry, earth science, and physics. A course is defined to afford at least three semester hours. A teacher with such preparation would be certified to teach only in the major (30 semester hours) or minor (21 semester hours) disciplines and all general interdisciplinary science courses taught at the secondary classification level. A major or additional minors may be taken with the area.

(NOTE: The following area has been discontinued but is held by a few practicing teachers: Science, A50.)

SPECILIZATION FOR HIGH SCHOOL CERTIFICATE: TEACHING MAJORS
TEC 40.2

Section 1.
Each teaching major in a single subject shall require 30 semester hours' credit.

Section 2.
(1) The following teaching majors are designated for the specialization component for high school certification:

Biology
Chemistry
Earth Science
Physics

(NOTE: The following majors have been discontinued but are held by a few practicing teachers: Geography-Geology, B23; Biology-Health, B54; and Science, B50).

SPECILIZATION FOR HIGH SCHOOL CERTIFICATE: TEACHING MINORS
TEC 40.3

Section 1.
Each teaching minor in a single subject shall require 21 semester hours' credit unless otherwise indicated.

Section 2.
(1) The following teaching minors are designated for the specialization component for high school certification including the additional preparation where indicated::

Biology
Chemistry
Earth Science
Geology
Physics

(The following minors have been discontinued but are held by a few practicing teachers: Geography-Geology, C23.)

(3) Effective with the entering freshmen students for the 1979-80 school term, teaching minors in the natural sciences may be taken in connection with another one of the following specializations: the area of concentration in science, the area of concentration in mathematics-physical science, or a teaching major in either mathematics, biology, chemistry, earth science, or physics.

Section 4.
The middle grade teaching fields shall be identified as follows, and each field shall require a minimum of 24 semester hours' credit including the preparation as described.

(5) Science: Preparation shall include 6 semester hours' credit in each of physical sciences, biological sciences, and earth sciences; at least one biological science and one physical science course must be accompanied by a laboratory requirement.

Section 5.
The 12-semester-hour subject concentrations required as a part of the specialization component shall be selected from the following subjects: any one foreign language, art, biology, business (must include typewriting), chemistry, dramatics, economics, geography, geology, health, history, journalism, mathematics, physics, political science, sociology, and speech.

(NOTE: Information above was in effect for 1984-85. These requirements have been changed and new requirements will go into effect in September, 1985).

HIGH SCHOOL TEACHER PREPARATION-CERTIFICATION

Provisional High School Certificate
704 KAR 20:070

Section 1.
(3) The Provisional High School Certificate shall be valid for teaching in grades seven (7) through twelve (12).