A SURVEY OF THE BRANCHES OF SCIENCE PURSUED BY TEACHERS IN INDIANA WHO HAVE BEEN LICENSED TO TEACH GENERAL SCIENCE

by

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

Courses of study in general science are written under the assumption that the teacher has a scientific background in each branch of science. Teachers of general science, lacking such a broad training, are faced with the problem of deficient academic preparation when attempting to teach the entire course of study. Many teachers conscientiously try to teach all the units suggested, approaching the fields in which they have no training with timidity.

I. THE PROBLEM

Statement of the problem. It was the purpose of this study (1) to find out what branches of science the teachers of Indiana who have been licensed to teach general science have pursued; (2) to find out how adequate their training is; (3) to discover the points of greatest weakness; and (4) to compare the preparation of these teachers and the scope of science branches expected to be covered as indicated by texts in general science.

Justification of the study. It has long been an accepted fact that science is a tool for efficient living. The need for trained scientific workers, altogether obvious when a nation is at peace, becomes extremely apparent when a nation is at war. It is, therefore, the task of the teacher of general science to present this orientation course with such skill as will insure an adequate number of students who will become permanently interested in some branch of scientific study.

The assumption is that there are many teachers who, though licensed to teach general science, are really thoroughly prepared to teach only certain branches of science. They are partially prepared to teach other sciences and totally unprepared in various branches included in the courses of study for general science.

Such inadequacies cannot fail to reflect themselves in terms of pupil products, in deficiencies which have their roots in basic training, and in public criticism of the efficiency of our educational system. Cubberly says:

> The principles and practices, the theory and the art of education, are constantly undergoing, in common with all other phases of civilization, modification and development. Likewise the field of education in which instruction is given, and the habits which education seeks to form, are always changing. It is necessary, therefore, if the institution of education is to render its full service to humanity, if the public schools are to perform their full duty in the promotion of civilization, that every teacher, in so far as his power lies, shall keep abreast of this development and change. No matter what the initial equipment of a teacher may be, he should be progressively efficient during his entire period of service. This means not that he should grow merely in those ways which are inseparably connected with his own

> individual experience, but rather that he should profit by the experience of the race in so far as it affects his own work.[1]

A movement for the reorganization of secondary education began at about the turn of the century. "No phase," says Edmonson, "of secondary education is more significant and far reaching than the administration of the curriculum."[2]

There have been in recent years some distinct trends in the programs of studies in the secondary schools.

> Many schools have substituted general courses for specialized subjects of study. In English, this displacement is reflected by the rapid disappearance from the programs of courses with such names as, grammar, composition, reading, spelling, and penmanship and the emergence in their place of courses in the two main phases, language and literature. Similar changes have occurred in the social studies, mathematics, and the sciences.[3]

The emphasis in secondary school teaching becomes largely exploratory in nature. Teachers are constantly being called upon to let down the bars of subject fields and to integrate the areas of learning. Efficient integration depends largely upon preparation.

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[1] Ellwood P. Cubberly, _Public School Administration_ (New York: Houghton Mifflin Company, 1916), pp. 231-232, citing H. Updegraff, in _Proceedings of the National Education Association_, 1911, p. 434.

[2] J. B. Edmonson, Joseph Roemer, and Francis L. Bacon, _The Administration of the Modern Secondary School_ (New York: The Macmillan Company, 1941), p. 357.

[3] _Ibid._, p. 369.

> To meet the demands of a curriculum planned for general education, we see that the best teachers are not specialists narrowly trained in some one field of science, but capable persons with a good general education themselves; wide interests and accurate knowledge in the different areas of science.[4]

Eikenberry,[5] in attempting to discover the reason for the prevalence of specialists in our secondary schools points out that the rapid progress of scientific discovery has been accompanied by highly specialized science departments in the colleges and universities and that to these departments has fallen the task of preparing teachers for the high schools. Naturally, they have prepared specialists. The author said that, as a result:

> A student of mathematics is expected to be conversant with the whole field of mathematical science and in the high school would be almost equally ready to teach any one of the mathematical subjects; a teacher of French is expected to instruct in any grade of French offered in the high schools, if indeed an equal familiarity with modern language in general is not required; but a teacher of physics or chemistry may be wholly ignorant of biological science, and a teacher of biology may have devoted little or no time to the physical sciences or indeed to biological sciences other than his major. It is a corrollary of such specialization that each teacher thinks first of his own subject and is little concerned with other sciences or with correlation

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[4] A Report of the National Commission on Cooperative Planning, 1941 (New York: D. Appleton-Century Company, 1941), p. 135.

[5] W. L. Eikenberry, The Teaching of General Science (Chicago: The University of Chicago Press, 1922), p. 21.

> between the sciences, with the result that few teachers have a grasp of the educational possibilities of the whole field of science for education. . . .[6]

The average high school has little need for specialists. Very few teachers instruct in one subject only. During a recent year "only 13.53 per cent of the teachers of science in Illinois were instructing in one subject only, and but 21.8 per cent in only two subjects. If the city of Chicago be eliminated from consideration the percentages become 6.22 and 13.1 respectively. . . ."[7]

General science becomes, finally, not a substitute for the special sciences but an introduction to them and to life.[8] The teacher finds that

> it is the mission of general science to explain for those pupils those natural phenomena that have interest and significance for them, and to impart such additional knowledge as their interests and needs demand; to encourage the pupils to solve the simpler problems themselves as a beginning of scientific thinking; and to develop such easily comprehended principles as apply to the local environment and the pupils' interests. Secondary aims, conditioned by local circumstances, will include the mastery of particular scientific facts and principles useful as a preparation for economic-vocational activities, training in important habits, mastery of underlying principles preparatory to later science work, the encouragement of recreative interests, and the

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[6] Eikenberry, loc. cit.

[7] Ibid., p. 22.

[8] Ibid., pp. 63-64.

creation of social-civic ideals.[9]

Such broad aims require an adequate and comprehensive preparation on the part of the teacher who would direct learning to these goals.

The preparation of a teacher is never complete.[10] Preston says that this is true for two reasons especially:

> The first is that there is nothing static about teaching, more particularly the teaching of such a subject as science. Our knowledge both of the subject itself and of how to teach it is being constantly modified and improved through research. We must, therefore, think in terms of trends rather than of fixed points. . . .
>
> The second reason why the individual preparation of a teacher is never ideal or complete is that, at best, the time is too short. The number of years one can devote to preparing for lifework depends largely upon the rate of compensation to be received in service. Years of study are years of financial outgo, representing an investment made in expectation of an adequate income later on. Large expenditures thus made with the prospect of a very meager living in return do not seem economically justified. The preparation of a teacher, at least at the beginning of his active service, is therefore always a compromise between what he would like to have and what he can afford. . . .[11]

While no education is ever complete, there are certain fundamentals of preparation which are basic.[12] Among the

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[9] Ibid., p. 65.

[10] Carleton E. Preston, The High School Teacher and His Work (New York: McGraw-Hill Book Company, 1936), p. 6.

[11] Ibid., pp. 6-8.

[12] Ibid., p. 9.

fundamentals Preston names "Knowledge of the Special Field." He says a teacher should possess

> thorough knowledge of the subjects that constitute the teacher's special field. No one can teach anything that he does not know. And it is one thing to know a subject well enough to secure a passing mark as a student, and quite another to know it well enough to teach it to others, straightening out all their misconceptions and making plain the difficult ideas, conscious even at the end that the depth of one's knowledge has not been sounded, that the well is not drained dry. A sense of security such as this only the well prepared teacher feels. From this reserve he is able to draw when the unexpected question arises; his knowledge gives him confidence in himself when he is most in need of it; in return confidence is engendered in his pupils in proportion as they find him a real master of his work, and through this security he gains the respect and trust of parents and public.
>
> The amount of college preparation advised in a subject of this group, in addition to the usual secondary schoolwork, is seldom if ever less than a full year's work, preferably much more. Some writers advocate as many as three full years. As yet, however, it is too frequently the case that in some subjects at least, a teacher is found to be hardly more than one or two stages in advance of his pupils.[13]

The need, then, for the training of general science teachers becomes a problem of many issues, both individual and educational. It becomes wholly apparent why Eikenberry stressed the need for teachers "with good general education"[14] and with "accurate knowledge in the different areas of

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[13] Ibid., pp. 10-11.

[14] Eikenberry, op. cit., p. 21.

science."[15]

Brownell, in turning to a consideration of professional preparation on the part of those who are teachers of science in the small high schools of the country adds to the point at issue:

> . . . deplorable conditions are not infrequently noted. Any permanent betterment of these conditions must come at least through efforts of leaders among science teachers possessed of a vision of what must be made true concerning science instruction before its educational values become a notable asset in high school teaching.[16]

It is well in this connection to visualize the condition that of 16,000 and more high schools in the United States two-thirds of them have seventy-five pupils or less apiece, and but five per cent of the high schools have an attendance exceeding 500 pupils.[17]

> Where science teachers in these smaller high schools have had some preparation for their teaching, it is quite likely to be inadequate in breadth of vision of the whole field of science as it affects the lives and interests of pupils. It is more likely to have been an intensive rather than an extensive preparation in subject matter for teaching.[18]

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[15] Eikenberry, *loc. cit.*

[16] Herbert Brownell and Frank B. Wade, *The Teaching of Science and the Science Teacher* (New York: The Century Company, 1925), pp. 140-141.

[17] Bulletin No. 19 (1920), Bureau of Education, Washington, D. C., cited by Herbert Brownell and Frank Wade, *loc. cit.*

[18] Herbert Brownell and Frank Wade, *op. cit.*, 141.

It is possible that the conditions that prevail in Indiana are representative of the picture just given for the United States.

Studies made at the Indiana State Teachers College reveal a picture of the situation as it applies to Indiana. These studies are reviewed in Chapter III.

II. DEFINITIONS OF TERMS USED

The branches of science. The branches of science are interpreted as meaning the various sciences as they appeared on the transcripts and other official records in the files of the Department of Education in the Division of Teacher Training and Licensing at Indianapolis, Indiana. No attempt has been made to reclassify these branches of science in the tabulations, but for the purposes of interpretation and recommendation, various groupings have been made in the analysis of the data.

The branches of science as they occurred on the records are:

1. Astronomy
2. Bacteriology
3. Biology
4. Botany
5. Chemistry
6. Economic geography

7. Geology
8. Human physiology
9. Hygiene
10. Nature study
11. Physical geography
12. Physics
13. Zoology

The branches of science pursued. A teacher was considered to have pursued a branch of science if he had received any credit for that science which counted toward a license in general science.

Teachers in Indiana. This study includes teachers teaching in Indiana schools, trained in the colleges of Indiana, and holding a license in general science.

CHAPTER II

DATA PERTINENT TO THE STUDY AND METHODS OF RESEARCH

I. DATA PERTINENT TO THE STUDY

A survey of the items necessary for such a study revealed the necessity for available records and a data sheet.[1] The items concerning each teacher decided upon as necessary to this study were:

1. Name of the teacher
2. Name of the county where employed
3. License held and date issued
4. Science courses pursued
5. Term or semester hours of training in each branch of science pursued
6. Total term or semester hours of training
7. Related and unrelated teaching combinations
8. Colleges attended
9. Degree or diploma received
10. Number of years of experience

II. METHODS OF RESEARCH

In choosing a method of procedure in the collection

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[1] A sample of the data sheet used in this study will be found in the Appendix.

of data three options were considered:

Option One

1. To look in the Indiana School Directory, (1941-1942), for the names of teachers who are licensed to teach general science
2. To take a sampling--two teachers from county schools and two teachers from city schools in each county
3. To get permission from the State Superintendent of Public Instruction to find out from the licensing files in Indianapolis what the training of the teachers has been

Option Two

1. To proceed as in steps (1) and (2) in option one
2. To restrict the sampling to teachers trained at the Indiana State Teachers College
3. To get permission from the registrar of the Indiana State Teachers College to get the data from the files there

Option Three

1. To proceed as in steps (1) and (2) in option one
2. To send out questionnaires to the teachers selected as in option one, step (2)

III. CHOOSING AN OPTION

Since it has been difficult for many students of research to obtain a return from questionnaires sufficient to permit a valid study, the personal survey method outlined in option one was chosen as a method of procedure. The choice of this option was made possible through the permission of the State Superintendent of Public Instruction and the Director of the Division of Teacher Training and Licensing.

Without this permission the study would have been limited to teachers trained only at the Indiana State Teachers College and would, therefore, have been a picture of the problem as it relates to teachers trained at one institution. On the other hand, should the questionnaire plan of option three have been followed, there would have been difficulties in getting an adequate return and in getting such detailed data from the teachers as this study required.

While some data were not available in the records, the data that were obtained are probably the most reliable that could be gathered for this study for the following reasons:

1. The licenses were issued on the data contained in this study.

2. The personal element of error has been reduced through placing the collection and the recording of facts in the hands of one person.

IV. THE SELECTION OF CASES

Two teachers of science from county schools and two teachers of science from city schools in each county were selected. (Teachers holding a license in any science are licensed in general science.) This selection yielded 366 cases as one county did not have any city schools.

After tracing each teacher's records in the numerical and alphabetical files in the State House, 244 cases (or 66.7 per cent) were found available for this study.

It was found that the records of fifty-six teachers showed the branches of science pursued, with no itemized record or total record of term or semester hours given.

The final cases represented ninety-two counties.

All semester hours of training were converted to term hours, counting each major fraction as a unit term hour.

CHAPTER III

RELATED LITERATURE

I. THESES AND OTHER STUDIES

Theses. Houk[1] collected data concerning the academic and professional training of science teachers in various cities, compared the findings, and interpreted them in relation to state laws and regulations. In the light of the findings the author reported that few new teachers are entering the field of science in the cities studied. "This is perhaps explained," says Houk, "by the reduction of teaching force, because of the depression, tenure and 'blanket licenses.'"[2]

This thesis, an investigation of the preparation of teachers instructing in any branch of science, is not a specific study in relation to teachers of general science. The author reported the academic preparation, however, of three teachers of general science and found that teacher 5-a had pursued physiology, zoology, physics, and chemistry;

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1 Willa Mae Houk, "A Study of Science Teachers and Science Instruction in a Selected Group of Indiana Cities," (unpublished Master's thesis, The Indiana State Teachers College, Terre Haute, 1937), 87 pp.

2 Ibid., p. 55.

teacher 4-b had pursued botany, physiology, and geology; teacher 3-d had pursued biology, botany, zoology, physiology, and physics.

In regard to teacher 4-b Houk says, "Teacher 4-b is best prepared in botany, but as listed in the yearbook in 1934, he was teaching general science."[3]

Adams[4] (1) made a study of surveys indicating the changing tendencies in the content of general science; (2) made a survey of the teacher training institutions that are members of the American Association of Teachers Colleges to determine the extent to which nature study, elementary science, and general science are offered for training in the field of science; and (3) made a survey of certain universities of Central United States to determine the extent to which nature study, elementary science, and general science are offered for training in the field of science.

The author[5] found that earlier studies showed

> that general science was heavily weighted with physical sciences; that teachers colleges offer the most courses in nature study, elementary science, or general science;

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[3] *Ibid.*, p. 46.

[4] Willis L. Adams, "Teachers' Training for Nature Study, Elementary Science, and General Science," (unpublished Master's thesis, The Indiana State Teachers College, Terre Haute, 1936), p. 6.

[5] *Ibid.*, p. 160.

that the universities studied offer more courses in general science than in nature study or elementary science.[6]

Adams' study presents teacher training from the point of view of the possibilities for great breadth of preparation in science provided by teacher training institutions and does not attempt to survey the actual courses pursued by the teachers in anticipation of receiving a license in general science.

The writer could find no other thesis related to the present problem.

Studies on teacher placement. While the scope of this problem does not embrace the intricacies of the history of teacher licensing in Indiana, some attention must be directed toward this field since any attempt to improve the scholastic status of the general science teacher must come, in the main, through "the cooperation of employing officials, administrators and training institutions"[7] with better licensing laws as their goal.

Some consideration must be given not only to the preparation of teachers in the branches of science but also to related teaching fields which serve as a background for the

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[6] *Ibid.*, pp. 160-162.

[7] Harry E. Elder, "Subjects Taught by 507 Teachers of 93 Small Indiana High Schools During the School Year of 1931-1932," A Report of the Department of Teacher Training and Licensing, State Department of Education, Indianapolis, Indiana, 1932, pp. 1-8.

well prepared teacher. Elder[8] found that mathematics combined most frequently of all subjects with science; physical education, social studies, and English combining with decreasing frequency in the order named. The author says in addition that "more careful planning with respect to license combinations will reduce materially the number of temporary permits and insure better teaching in the high schools of the state. . . ."[9]

A second study was made to determine the license combinations required to meet the teaching assignments of teachers in Indiana high schools. Elder reports:

> . . . that the five subjects to which most high school teachers are assigned are Social Studies, English, Physical Education, Science, and Mathematics while the five fields requiring fewest teachers are Art, Agriculture, French, German, and Spanish; the middle group consists of Commerce, Latin, Home Economics, and Industrial Arts.[10]

Certain teaching combinations increase the possibility of teacher placement accomplishing, therefore, a double purpose, namely: (1) providing broader training and (2) contributing to the teacher's economic security. In this

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[8] *Ibid*., p. 3, Table I.

[9] *Ibid*., p. 2.

[10] Harry E. Elder, "Teaching Assignments of 8413 Teachers in Indiana High Schools During the School Year of 1936-1937," A Report of the Department of Teacher Placement, The Indiana State Teachers College, Terre Haute, 1937, pp. 1-4.

connection Elder[11] found that with science, the first additional teaching assignment was mathematics, the second, social studies, and the third, physical education. Science was the first additional subject for mathematics, agriculture, and industrial arts.

It is readily seen that a teacher licensed in science will increase his opportunities for assignment in Indiana schools more by adding mathematics than by adding any other subject group. It can also be readily seen that a teacher who adds mathematics provides a rich background of useful information to science teaching since mathematics is in itself a science of the first quality.

While all of these studies are valuable and while all contribute to the problems relating to the teacher of science, the writer thought that the development of the present problem would supplement rather than duplicate the fields of research surveyed in that it would (1) relate specifically to the teacher of general science; (2) show the preparation of these teachers in certain branches of science; and (3) point out the possible teaching combinations of teachers licensed in general science.

In order to find an organizing principle upon which

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11 Ibid., p. 3, Table II.

to build, the writer surveyed general science textbooks in a typical general science classroom to determine the scope of the areas of science which a teacher might face. Communications with the publishers and personal interviews with representatives showed that three of the textbooks were widely used in Indiana.

An analysis of these books will be found in the following chapter.

CHAPTER IV

A REVIEW OF UNITS COVERED BY TEXTBOOKS IN GENERAL SCIENCE

I. FACTORS DETERMINING THE REVIEW

In determining the breadth of preparation that a teacher of general science requires, it seemed advantageous to review current textbooks in general science to find out:

1. What units a teacher of general science might be required to teach
2. The general range of the units through the various areas of science
3. The emphasis given to the branches of science in terms of page limits

II. RELATED LITERATURE

In an analysis of textbooks Eikenberry[1] cites an investigation by Webb as follows:

Astronomy . . . . 0.0 to 10.5

Biology . . . . 1.0 to 22.3

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[1] W. L. Eikenberry, The Teaching of General Science (Chicago: The University of Chicago Press, 1922), pp. 100-101, citing Hanor A. Webb, General Science Instruction in the Grades. Peabody College for Teachers, "Contributions to Education," No. 4, 1921.

Chemistry	1.4 to 23.0
Household Art	0.0 to 12.7
Physics	13.5 to 43.4
Physiography	2.7 to 56.2
Physiology	0.7 to 26.7
Miscellaneous	0.0 to 6.9
Unclassified	0.0 to 30.8

Further analysis of the report by Webb[2] revealed the order rank of the sciences as follows:

Physics	1
Physiography	3
Biology	3
Physiology	4.5
Chemistry	4.5
Household Art . . .	6
Astronomy	7

Curtis[3] says that in a study to determine the content of general science textbooks Overn in 1921 analyzed twelve textbooks and Iler analyzed thirteen additional textbooks in

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[2] *Ibid.*, p. 102.

[3] Francis D. Curtis, *Second Digest of Investigations in the Teaching of Science* (Philadelphia: P. Blakiston's Son and Company, 1931), pp. 72-73, citing Elliot R. Downing, "A Summary of Masters Theses by O. E. Overn, Ernest Iler and Ailsie M. Heinemann," *General Science Quarterly*, 12:509-516, May, 1928.

1927. Curtis[4] adds that "the subject matter of these twenty-five textbooks was analyzed on the basis of twenty major topics subdivided into 131 minor topics" listed as follows:

1. Mechanics
2. Weather and climate
3. Plants
4. Electricity and magnetism
5. Bacteria and sanitation
6. Water, uses, supply
7. Heat
8. Food, nutrition
9. Light
10. Human body
11. Earth as a planet
12. Combustion, fuels
13. Elements, compounds, mixtures
14. Life in general
15. Lower animals
16. Air, ventilation
17. Rocks, minerals
18. Erosion, soil formation
19. Sound
20. Household chemistry

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[4] Curtis, loc. cit.

Studies made by Webb[5] listed seventy-nine groups of topics while Downing[6] reported ninety-three principles of science found in twenty textbooks in general science.

The importance of a science in the estimation of an author may be established by determining the total number of pages given to the science.[7] Studies made by Webb[8] included physics, physiography, biology, physiology, chemistry and astronomy with physics leading. Physiography, biology, physiology, chemistry, astronomy followed in the order named.

III. A REVIEW OF UNITS IN GENERAL SCIENCE TEXTBOOKS

While the literature reviewed on the scope of science branches as presented in textbooks in general science showed that the training of a general science teacher should be comprehensive, Tables I, II, and III were made to show the relation of the findings to the specific branches of science as defined in Chapter One of this study for the purposes of comparison with the data in Chapter Five.

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[5] W. L. Eikenberry citing Hanor A. Webb, op. cit., p. 103.

[6] Francis D. Curtis citing Elliot R. Downing, op. cit., pp. 75-79.

[7] W. L. Eikenberry, op. cit., p. 102.

[8] W. L. Eikenberry citing Hanor A. Webb, op. cit., pp. 102-103

TABLE I

THE RELATION OF THE CONTENT IN GENERAL SCIENCE TEXTBOOKS TO THE BRANCHES OF SCIENCE DEFINED IN THIS STUDY
CASE A

Chapters			Branches of science to which the chapter content is principally related												
	Pages covered		Astronomy	Bacteriology	Biology	Botany	Chemistry	Economic Geography	Geology	Human Physiology	Hygiene	Nature Study	Physical Geography	Physics	Zoölogy
	Number	Rank													
1	38	5.0	x	x	x	x	x	x	x	x	x	x	x	x	x
2	34	6.5							x				x		
3	30	8.5		x			x				x	x			x
4	26	10.5			x	x				x	x		x		x
5	58	1.0			x	x									x
6	30	8.5	x										x		
7	34	6.5					x			x	x			x	
8	48	3.0												x	
9	48	3.0					x							x	
10	48	3.0			x	x						x			x
11	26	10.5		x						x	x				
Number of chapters related to each science			2	3	4	4	4	1	2	4	5	3	4	4	5

TABLE II

THE RELATION OF THE CONTENT IN GENERAL SCIENCE TEXTBOOKS TO THE BRANCHES OF SCIENCE DEFINED IN THIS STUDY
CASE B

Chapters	Pages covered Number	Pages covered Rank	Astronomy	Bacteriology	Biology	Botany	Chemistry	Economic Geography	Geology	Human Physiolo-by	Hygiene	Nature Study	Physical Geography	Physics	Zoölogy
1	30	12	x	x	x	x	x	x	x	x	x	x	x	x	x
2	52	5					x								
3	54	4					x							x	
4	46	7.5						x			x				
5	60	3			x	x		x							x
6	34	10.5	x												
7	68	1					x								
8	46	7.5												x	
9	64	2												x	
10	48	6			x	x									x
11	34	10.5									x				
12	37	9	x		x	x	x	x	x	x	x	x	x	x	x
Number of chapters related to each science			3	1	4	4	5	4	2	2	4	2	2	5	4

TABLE III

THE RELATION OF THE CONTENT IN GENERAL SCIENCE TEXTBOOKS TO THE BRANCHES OF SCIENCE DEFINED IN THIS STUDY
CASE C

Chapters	Pages covered Number	Pages covered Rank	Astronomy	Bacteriology	Biology	Botany	Chemistry	Economic Geography	Geology	Human Physiology	Hygiene	Nature Study	Physical Geography	Physics	Zoölogy
1	31	1											x		
2	15	13				x						x	x		
3	29	2.5										x	x		x
4	25	5								x	x		x		
5	16	10.5	x										x		
6	14	15.5			x	x									x
7	17	9				x						x			
8	12	17										x			x
9	26	4	x												
10	23	6		x	x	x									x
11	15	13			x	x				x					x
12	21	8												x	
13	15	13										x			x
14	14	15.5								x				x	
15	29	2.5												x	
16	22	7					x							x	
17	16	10.5												x	
18	10	18												x	
Number of chapters related to each science			2	1	3	5	1	0	0	3	1	5	5	6	6

<u>Case A</u>. Bernice K. Levell[9] reported that this text, Case A, is widely used in Indiana and elsewhere. Key cities of the state have led in its use, its popularity being further attested by the fact that the 1941 sales tripled the 1940 figure.

Table I shows that the content of this text is related to every branch of science defined in this study. The following sciences are particularly emphasized: physics, physical geography, hygiene, human physiology, chemistry, and biology (botany and zoology).

Fifty-eight pages are given to a discussion of biological concepts, biology taking first rank in the number of pages covered while physics and chemistry rank third in emphasis with relation to the number of pages covered.

Chapters IV and XI rank lowest in the number of pages covered, but the concepts developed in these chapters, namely: those related to biology, human physiology, hygiene and physical geography, are also developed in other chapters as follows:

Biology--three other chapters

Human physiology--three other chapters

Hygiene--four other chapters

Physical geography--three other chapters

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[9] Citing Bernice K. Levell, Representative of the Macmillan Company, in a personal interview.

The correlation and integration of science areas is at once apparent from chapter to chapter and within each chapter. The authors assume, therefore, that the teacher is prepared to guide the student toward these learning goals; that the teacher is trained well enough in each science to help the student to see the relation of one science to another.

Case B. This text, widely used in Indiana, is steadily growing in popularity.[10] Table II shows that chemistry ranks first in the number of pages covered and is also discussed with more or less emphasis in four other chapters. Physics ranks second, being also developed in four other chapters. The biological sciences rank third in this text.

The other sciences follow, but their specific ranks are lost since there is much over-lapping of concepts from chapter to chapter, shown by the fact that Chapter V develops biological concepts in relation to economic geography and Chapter IV develops economic geography in relation to personal hygiene.

A shifting of rank is at once evident since the branches of science are not isolated in the discussion. The table shows, therefore, only relative and general rankings and are not in

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[10] Ibid. (Personal interview)

themselves final analyses. Such a fine analysis is not within the scope of this study. However, in a relative sense the table shows the scatter of the branches of science which a teacher of general science would meet if he used this book as a text or as one of a group of texts in his classes.

Case C. The publisher of Case C reported that this textbook "is used widely and successfully in the state of Indiana and elsewhere."[11]

Table III shows that physical geography ranks first in the number of pages covered and is discussed in four other chapters. Again the specific rankings of particular sciences are lost since there is much over-lapping of the areas, ideas, and principles presented. The scatter and breadth of the field is at once evident since eleven of the thirteen branches of science defined in this study are discussed in Case C.

Particular emphasis is placed upon zoology and physics, each developed in six chapters as well as upon physical geography and botany, each of which is discussed in five chapters. Nature study, essentially biological in concept, and therefore over-lapping into other areas is discussed in five chapters.

The need for broad training in each branch of science

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[11] E. Stephens, Educational Department, Charles Scribner's Sons, Chicago, 1943.

becomes more apparent since this text which is widely used in Indiana challenges the teacher to prepare in at least eleven science areas.

The number of core ideas and principles of science developed in general science texts reflect in a large measure the need for broad teacher training. Watkins and Perry[12] summarize 301 principles as "Some Things to Remember" in twelve units as follows:

Unit One

1. The scientist tries to prove his proposed solution to a problem by means of observable and measureable evidence.

2. The scientist is anxious to find evidence which will disprove as well as prove his hypothesis.

3. It is not scientific to jump at conclusions.

4. It is possible for two things to exist together without one being the cause of the other.

5. A problem arises out of a difficulty which needs to be solved.

6. A problem must be defined and limited before it can be solved.

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[12] Ralph K. Watkins and Winifred Perry, Science for Human Control (New York: The Macmillan Company, 1940), pp. 29-30; 81-82; 133-135; 180-182; 240-242; 274-275; 341-343; 388-390; 452-454; 501-502; 534-536; 572-574. By permission of the Macmillan Company, publishers.

7. Some problems can be solved by finding out whether or not a proposed solution fits the known facts better than any other solution.

8. The kind of measure used and the way in which the measure is used have much to do with the proof of the solution to a problem.

9. Many advertising claims, that are supposedly based upon scientific evidence, conflict with well-established principles of science.

10. The seller is always interested in the merits of his products. The buyer should seek evidence of value from someone not interested in the sale.

11. There are many reliable sources of scientific information. The student should learn to distinguish between reliable and false sources of scientific information.

Unit Two

1. Either directly or indirectly all the things that we use come from the earth.

2. Materials of the earth are not destroyed in use but changed into other forms.

3. Use often changes the form of substances so that these are no longer valuable for our needs.

4. Silica and clay are very abundant in the earth's crust.

5. Many parts of our houses and many of the articles that we use every day are made of earth materials as common as sand and clay.

6. Our civilization is in an age of the use of metals. At present iron is our most important metal.

7. The development of electrical power has increased the use of copper. There is a limited supply of copper in the earth.

8. Some day we may consider metal war equipment as a waste of materials greatly needed for other purposes.

9. The working of metals requires heat. Fuels are needed to produce the heat. Our most important fuels are coal, oil, and gas.

10. There is a limited amount of mineral fuel in the earth.

11. War uses of fuel may be considered as waste. Oil has become a very important material for modern warfare.

12. Erosion is constantly at work to destroy topsoil. Weathering produces and destroys soil for our purposes.

13. Much of our land is unfit for good crop production.

14. Marginal lands should be kept in forests or grasses.

15. Plants are the great soil binders.

16. Forests help prevent both soil erosion and floods.

17. Good soil can be maintained if the farmer takes

care of it properly.

18. Tilled crops make it more difficult to prevent soil erosion than grasses or other broadcast crops.

19. Soil erosion tends to destroy the value of water-power developments by filling up the streams behind dams.

20. The saving of all our natural resources depends largely on the cate which we give to keeping a good topsoil over as large a part of the earth as we can.

Unit Three

1. If it were not for the blanket of air about the earth, living things would perish.

2. We are dependent upon the air for our oxygen supply.

3. It is probable that human beings will never be able to control the movements of the air over the surface of the earth.

4. We may be able to make more accurate prediction of weather changes in the future.

5. The study of movements in the upper air helps in predicting air movements.

6. The pressure of the atmosphere is less at greater heights above the earth.

7. Movements of the air are due to uneven heating of the air by the sun.

8. Water vapor is lighter than the same volume of air.

9. The prevailing winds over most of the United States blow from the west.

10. Rainfall and daily weather changes depend largely upon movements of large masses of air.

11. Important instruments for measuring weather changes are the weather vane, the anemometer, the thermometer, the barometer, the hygrometer, and the rain gauge.

12. Much progress has been made in exploring the upper atmosphere by means of sounding balloons equipped with radio-sending apparatus.

13. Weather exploration stations near the poles and in other out of way places gather information that aids in our knowledge of air movements.

14. Air conditioning means the control of the movement of air in buildings, control of air temperature, its humidity, and the filtering of foreign substances in the air.

15. Air expands when heated.

16. A given volume of warm air is lighter than the same volume of cold air.

17. A temperature of 68 to 70 F. is a desirable temperature for indoor air in the winter.

18. Air indoors should be kept as nearly dust free as possible.

19. The wind can be used to turn machinery to do work useful for human beings. Wind power offers an inexhaustible

supply of energy for many kinds of work.

20. Air pressure devices depend upon the pressure of the atmosphere to give the needed power.

21. Atmospheric pressure is approximately 15 pounds per square inch at sea level.

22. Atmospheric pressure at sea level will support a column of water approximately 30 feet high.

23. Air can be compressed enormously. When the pressure is released, air will expand to fill any container.

24. When the pressure is released, compressed air expands with considerable force.

25. Air is elastic.

26. Air can be pumped from one place to another with relatively simple pumps.

27. A balloon floats in air if it is filled with enough of a gas lighter than air. The weight of the volume of gas in the balloon, plus the weight of the balloon and its equipment, must be less than the weight of an equal volume of air, if the balloon is to float.

28. An airplane stays up in the air because of increased pressure below its wings and a decrease in the air pressure above the wings.

29. If the velocity of movement of air is increased, the pressure is decreased. If the velocity of movement of air is decreased, the pressure will be increased.

30. The air forced back over an airplane wing by the propeller moves with greater velocity over the top of the wing and with a lower velocity under the wing. Therefore, the pressure above the wing is less than the pressure under the wing.

31. Under very great pressure and at very low temperature air can be turned into liquid air. Other substances can be frozen quickly by exposure to the low temperature of liquid air.

32. Oxygen, nitrogen, and neon can be separated readily from liquid air because they boil at different temperatures.

33. Air is a relatively poor conductor of heat. If air can be kept from moving it is a good insulator from heat. Many insulating materials used in building and for clothing depend upon the air for their insulating properties.

Unit Four

1. The available water supply has been a decisive factor in choosing the location of many towns and cities.

2. Rain and snow are the sources of most water supplies.

3. Ground water is obtained from wells and springs.

4. The most important quality of a water supply is its safety.

5. Typhoid fever epidemics are reduced when cities

provide a supply of safe water.

6. Untreated lake or river water usually contains disease germs.

7. Cities must provide sufficient pressure to force the water to all parts of the city.

8. Much water is wasted through faulty plumbing fixtures.

9. Water in storage tanks is heated by convection currents.

10. Proper sewage disposal is necessary for a healthful city.

11. Bacteria are necessary for the operation of septic tanks and sewage filter beds.

12. Water is hard when it contains certain compounds of calcium and magnesium.

13. The power from running water is due to the fact that water has weight and that it flows.

14. A pint of water weighs approximately one pound.

15. Water flows from higher to lower levels.

16. The heat of the sun raises water to higher elevations by evaporating the water so that it rises as water vapor.

17. Water pressure is the force with which water presses on any given unit of surface area. In the English system, water pressure is measured in pounds per square foot, or in pounds per square inch.

18. Water pressure on the bottom of a container increases in proportion to the depth of the water.

19. If a series of containers are connected, water will rise to the same level in all the containers, regardless of their shape.

20. At any given depth under the surface of a body of water, the pressure is exerted equally in all directions.

21. An object will float in water if its weight is less than the weight of the water which would occupy the same space.

22. The specific gravity of a substance refers to its weight as compared with the weight of an equal volume of water at 4 C.

23. As the fuel supplies are exhausted, electricity derived from water power may replace power derived from burning fuels.

24. Many crops are grown under irrigation.

25. By the process of erosion water destroys land that is not protected by a covering of vegetation, such as that afforded by forests, natural grass lands, or meadows.

26. Many forms of plant and animal life disappear when lakes and swamps are drained, or dry up in times of drought.

27. The world's commerce is dependent upon water transportation.

Unit Five

1. All food comes directly or indirectly from green plants.

2. There are five phyla or main divisions in the plant kingdom.

3. Seeds furnish the most nutritious of all plant foods.

4. Fruits develop from the blossoms or flowers of plants.

5. Plants that are used in the decoration of parks and grounds must be adapted to the soil and climate where they are grown.

6. Many important plants grown in the United States have been introduced from other countries.

7. When plants are introduced into the United States they must be sent to a locality with a climate similar to that of their native homes.

8. Our forests are being cut down faster than they are being replenished.

9. Forests aid in conservation of water and prevent erosion.

10. Many valuable medicines are derived from plants.

11. Cotton, the most widely used clothing material, requires a warm, moist climate.

12. Best fibers of the flax plant are used for making linen.

13. Microscopic examination is one method of distinguishing linen and cotton fibers.

14. Rayon is a synthetic or artificial plant fiber.

15. The best rubber comes from the latex of the hevea tree.

16. Plants differ from animals in the composition of their cells walls.

17. Vertebrates are animals that have skeletons.

18. Invertebrate animals do not have skeletons.

19. There are ten phyla or main divisions of animals.

20. Wool furnishes the warmest clothing material, because it is a poor conductor of heat.

21. Sheep, goats, camels, and alpacas furnish wool fibers that are made into clothing materials.

22. The silkworm is the only useful caterpillar.

23. Cattle are the most important domestic animals in this country.

24. Domestic animals furnish necessary fats and proteins.

25. Many of the most destructive insect and weed pests have been introduced into the United States.

26. The grasshopper is one of the most serious insect pests at the present time.

27. There are many state and government agencies that help farmers and gardners to combat insect pests and the plants that destroy cultivated crops.

Unit Six

1. Copernicus taught that the sun is the center of the solar system.

2. Galileo invented the astronomical telescope.

3. Refracting telescopes employ lenses to enlarge a distant object.

4. Reflecting telescopes have a concave mirror which enlarges distant objects.

5. The Yerkes Observatory of the University of Chicago is the home of the world's largest refracting telescope.

6. The 200-inch telescope of the Observatory on Palomar Mountain is the world's largest reflecting telescope.

7. The United States Naval Observatory broadcasts time signals twenty times each day. These signals are useful to people on land and at sea and may be used by pilots of planes.

8. Important scientific discoveries are made at each total eclipse of the sun.

9. Helium was first discovered in the sun during the total eclipse of 1868.

10. The planets have atmospheres in proportion to

their sizes.

11. There is little possibility of the existence of life on any of the planets except the earth.

12. Other stars may have solar systems.

13. Light travels at a speed of 186,000 miles a second.

14. The distances of stars and nebulae from the earth are reckoned in light years.

15. Star magnitudes refer to their brightness.

16. The hottest stars are white or bluish-white.

17. A nebula is usually considered to be a mass of gases.

18. The Milky Way is a galaxy or a star system.

19. The prism breaks up light into the spectrum colors.

20. The spectroscope gives the chemical composition of any incandescent substance.

21. The distant nebulae in the southern hemisphere have not been photographed.

22. Many new discoveries in astronomy will be made through the use of the new 200-inch telescope.

Unit Seven

1. We recognize substances, or distinguish one substance from another, by means of physical and chemical properties.

2. Those properties which we recognize by means of

our senses or by ordinary measuring instruments are physical properties.

3. The ability of a substance to unite with another to form a new one is a chemical property.

4. All of our common fuels contain carbon and hydrogen.

5. Most chemical elements are secured by separating them from compounds.

6. Nearly pure water may be prepared by distillation.

7. Liquids with different boiling points often can be separated by distillation.

8. A solid not dissolved in a liquid can be removed from the liquid by filtering.

9. An element can often be released from a chemical compound by bringing the compound into contact with some other substance.

10. Heat hastens a chemical change.

11. Chemical compounds are formed when two or more chemical elements unite to form a new substance.

12. Compounds are also formed when elements from one compound leave it to unite with elements from another compound.

13. Elements are either active or inert.

14. Compounds are stable or unstable.

15. Active elements form many compounds.

16. Unstable compounds readily break up into other substances.

17. For any one chemical compound, the same elements are always present and in the same proportions.

18. Ninety-eight per cent of the earth's crust is composed of eight elements. Oxygen is the most abundant element.

19. Carbohydrates, cellulose, alcohols, and fats are compounds of carbon, oxygen, and hydrogen.

20. Soaps are made by treating fats or oils with sodium hydroxide (sometimes with potassium hydroxide).

21. Perfumes, antiseptics, and many other substances added to soap, do not increase their value as soaps.

22. Any good soap and water make a mild antiseptic.

23. Salt and baking soda can be used with safety as tooth or mouth washes.

24. Common tooth pastes are mixtures of soaps, prepared chalk and flavoring. Some tooth pastes contain "soapless soaps."

25. Carbon dioxide makes breads and cakes rise. Baking powders contain chemicals which form carbon dioxide under certain condition of moisture and heat.

26. Salt solution, ethyl alcohol, and a solution of baking soda are mild, safe antiseptics.

27. An alcoholic solution of iodine is the preferred antiseptic for small cuts and wounds.

28. Most disinfectants are poisonous and should be used with care.

29. Foods preserved with certain questionable chemical preservatives should be avoided if possible.

30. Salt, sugar, and vinegar are usually safe chemical preservatives.

31. Medicines, drugs, and antiseptics should show clearly the ingredients used in preparing them. Poisonous substances should be plainly labeled.

32. A new or unfamiliar medicine, antiseptic, or drug should be used only upon the recommendation of a trained physician. Newspaper, magazine, and radio advertising, quoting supposed physicians, is not to be taken as reliable recommendation for the product advertised.

33. Many foodstuffs are colored or bleached. Avoid these if possible. Labels on food should show with what chemicals the food has been treated.

34. Wash fruits and vegetables before eating them. Many fruits and vegetables are sprayed with poisonous chemicals to kill insects or prevent plant diseases and some trace of them may remain.

35. Many new and useful substances are now being made from familiar raw materials and substances that were once considered as waste.

36. The way to conservation of our supplies of priceless substances on earth may be to learn to make these substances, or substitutes for them, from inexhaustible materials.

37. The possibility of making our new substances from simpler materials must come through better knowledge of the very small elementary divisions of matter, such as the molecule, the atom, and the electron.

Unit Eight

1. Work is done when a thing is moved over some definite distance.

2. Ordinary movement, as we know it, is with reference to the surface of the earth on which we live.

3. A body that is at rest tends to remain at rest unless some outside force acts upon it. A body that is in motion tends to continue in motion in the direction of the original force, unless some other force interferes to check it or change its direction.

4. Friction is the resistance produced when one surface rubs against another in moving.

5. All objects in the universe attract one another. This attraction is in proportion to the masses of the objects and decreases as the distance between the objects increases. Since the earth is much larger than the objects on them, it pulls all of the objects on its surface towards its center.

6. Turning or spinning objects tend to throw any substance on the surface away from the center of the spinning.

7. If a moving thing continues to move, the forces pulling it forward must exceed the forces which pull it back.

8. After a thing begins to move, if more force is applied than is needed to keep it moving, the speed of movement will be increased. It takes less force to keep a thing in motion than it does to start it.

9. Gravity, friction and initial inertia often keep things from moving.

10. Things are often kept from moving by being anchored to the earth.

11. Brakes operate by means of friction and pressure.

12. A light car can be stopped more readily than a heavy one moving at the same rate of speed.

13. Brakes do not stop a moving car immediately.

14. A slowly moving car can be stopped more readily than a rapidly moving one of the same weight.

15. High speed increases the dangers of automobile driving.

16. Modern industry is made possible by the rapid movement of goods brought about by the use of power-driven machinery for pulling loads.

17. Water transportation is usually cheap transportation.

18. Increased speed in travel is expensive.

19. Modern steamship and railway travel are comparatively safe.

20. In the long run the cheapest and most inexhaustible source of power for manufacturing in most parts of the country is water power.

21. The use of power machinery in manufacturing has made mass production possible.

22. Mass production with power machinery has made the cost of many useful things relatively low.

23. Assembly-line manufacture has made workingmen machine tenders rather than craftsmen.

24. New labor-saving machines often make it necessary for workers to find new employment.

25. After coal and oil are burned, the energy released cannot be recovered for further use.

26. In order to conserve our water-power projects, it is necessary to preserve the soil and plant life in the territory from which the streams are fed.

Unit Nine

1. A thermometer measures the intensity of heat, not the amount.

2. The freezing point of water is 0 Centigrade (32 F.). The boiling point of water is 100 C. (212 F.).

3. A calorie is the amount of heat required to raise the temperature of one gram of water through 1 C.

4. The fuel value of foods is measured in large calories. A large calorie is 1000 small calories.

5. One B. T. U. is the amount of heat required to raise the temperature of one pound of water through 1 F.

6. The heat values of common fuels are measured in B. T. U.

7. The cost of a given fuel depends upon the B. T. U. of heat which it will give and the price.

8. Any change produced in the natural condition of a relatively small amount of air is air conditioning.

9. A mechanical refrigerator cools by the rapid expansion of a compressed liquid into a gas.

10. The efficiency of any refrigerator depends largely upon the insulating materials in the construction of the box.

11. Double sash for windows, weather stripping, of openings, and the use of insulating materials in walls and ceilings can make buildings hold heat in winter and keep out unwanted heat in summer.

12. An internal-combustion engine is driven by the rapid expansion of a gas burned in the cylinders of the motor.

13. Energy from heat is used to carry on a great many of our present-day industrial processes.

14. Water power to produce electrical energy can in part replace energy now taken from fuels in the form of heat.

15. It is possible to make gas engines which can be operated by fuel alcohol made from plant wastes.

16. Heat, light, and electricity are all forms of energy. One form of energy can be changed into other forms.

17. Heat, light, and electricity can be radiated as waves of energy through space. The frequency of vibration of the waves determines the form of energy.

18. Indirect, or diffused, lighting is the best for the eyes.

19. Direct lighting is less expensive but hard on the eyes.

20. Color from an opaque substance is made by the part of white light that is reflected by the particular substance.

21. The color of transparent substances is made by the part of white light that passes through the substances.

22. A photoelectric cell is a vacuum tube with an element sensitive to light, so that small electric current is produced in it when light falls on the sensitive element.

23. When a coil of wire is turned or moved in a magnetic field, an electric current is set up in the coil. This is the principle of the electric generator.

24. Direct current is an electric current flowing in one direction.

25. Alternating current is a high-frequency pulsating current flowing first in one direction and then in the other.

26. Most of the current used for household purposes is alternating current.

27. The voltages of alternating-current circuits can be stepped-up or -down with a transformer.

28. Power lines transmit alternating current at high voltages. The high-voltage current is made possible by transformers. Transformers step the current down for ordinary uses, as for household lighting and appliances.

29. Radio receivers use vacuum-tube detectors to pick up radio-electric waves sent out from sending stations.

30. Sound pictures produce sound by variations in sound waves photographed on the margin of the film. A photo-electric cell changes these back into variations in electric current that can be made to operate a radio speaker.

Unit Ten

1. Many plants are reproduced by asexual methods.

2. Seeds are the result of sexual reproduction in plants.

3. Plants and animals resemble their ancestors, because they inherit their traits or characteristics.

4. No two plants or animals are exactly alike.

5. A mutation is a sudden change in a species.

6. Gregor Mendel discovered certain laws of heredity.

7. The genes in the chromosomes of egg cells and sperm cells are the carriers of hereditary characteristics.

8. A seed develops from a fertilized egg cell.

9. A hybrid is the offspring of parents that differed from each other in one or more hereditary characteristics.

10. Plants and animals are improved by the process of artificial selection.

11. New plants asexually reproduced may be patented.

12. Plant growth may be hastened by the use of electricity for producing additional warmth and radiant energy.

13. The fertility of the soil may be maintained by crop rotation and proper soil management.

14. Different kinds of animals require different feeding.

15. Human beings inherit the desirable and undesirable traits of their ancestors.

16. Wildlife is conserved through the co-operation of federal, state, and local governments and the public.

Unit Eleven

1. On the average, people live to an older age than they did one hundred years ago, because of modern science.

2. Infectious diseases are communicable diseases.

3. Bacteria are microscopic one-celled plants.

4. Protozoa are microscopic one-celled animals.

5. Louis Pasteur was the father of the germ theory of disease.

6. Molds are a kind of fungi.

7. Tuberculosis is preventable and arrestable.

8. Robert Koch, a German, discovered the tubercle bacillus.

9. Typhoid fever is spread through impure water and milk.

10. Diphtheria may be prevented by inoculating a person with antitoxin.

11. Yellow fever has become rare in many countries.

12. Malaria is spread by anopheles mosquitoes.

13. Smallpox could be made extinct if vaccination were required of everyone.

14. Rabies is spread through the bites of animals, most often dogs, that have the disease.

15. The common cold is the most prevalent disease at the present time.

16. Measles is a serious disease in children.

17. Scarlet fever may leave children deaf, or with weakened hearts and kidneys.

18. Organic diseases are due to improper functioning of some organ or tissue. They are not caused by disease germs.

19. More people die of heart disorders than from any other one disease.

20. Cancer is curable if discovered in its early stages.

21. The cause of poliomyelitis is unknown.

22. Insulin has saved the lives of thousands of diabetes victims.

23. Pernicious anemia can be controlled by using liver extract.

24. Most accidents are due to carelessness.

25. Alcohol is responsible for many automobile accidents.

26. We are all protected by the activities of the United States Public Health Service.

27. State and local health departments are a vital part of government.

28. Sufficient sleep is necessary for mental and physical health.

29. Narcotics destroy health and the sense of social responsibility. They should not be used except under unusual circumstances and upon a physician's prescription.

30. Excessive drinking of alcohol has a variety of far-reaching and undesirable consequences.

31. Tobacco is more harmful to growing young people than to adults.

32. Patent medicines frequently contain alcohol and other habit-forming drugs.

Unit Twelve

1. Scientific investigators must first discover scientific principles and facts before useful inventions are possible.

2. Many scientific inventions have become useful tools by means of which the scientists have been able to make an increased number of far-reaching useful discoveries.

3. A scientist is interested in finding out something new about how the things of the world are put together or how they behave.

4. A scientist is interested in finding out something new about how the things of the world are put together or how they behave.

5. An inventor is concerned with combining ideas and principles that are known into some contrivance that is useful to people in their everyday affairs.

6. A scientific discovery is some new fact, principle, or law, that adds to the accumulation of human knowledge and is proved to be true.

7. An invention is some new machine, substance, or formula, which makes use of existing knowledge and is proved to be true.

8. The standard of living is what people feel they must have in order to satisfy their ordinary wants.

9. Scientific discoveries and inventions have made enormous changes in the standards of living of large numbers of people.

10. The discovery of how to use energy from sources other than that of our own bodies is most significant in producing changes in ways of living.

11. Shortened working periods are the result of the use of power-driven machines.

12. The use of machines has made it necessary for large numbers of people to change occupations.

13. The use of certain kinds of new machines makes new work for large numbers of people.

14. It is not certain whether machines create opportunities for work or decrease the number of people employed.

15. Scientific inventions and discoveries have made it possible to produce enough of the things that we know how to produce for every person.

16. We have not yet learned how to make it possible for the majority of people to benefit from the increased production of our land and our factories.

17. New methods of transportation and communication have made us near neighbors of most people in the world.

18. Modern means of transportation and communication are superior to the ancient natural barriers to the movement of human beings.

19. Military uses of science may often be considered as an abuse of knowledge that could be used for the welfare of people rather than for the destruction of our present civilization.

20. We have not yet learned to make the best uses of the findings of science. In a modern physical world, our thinking about how to live with others is in the stone age.

IV. FINDINGS

1. Textbooks in general science used widely in Indiana cover broad scientific areas.

2. The authors do not agree upon the sciences that should receive the greatest emphasis.

3. The texts examined show much integration of the branches of science from chapter to chapter and within each chapter.

CHAPTER V

PRESENTATION OF DATA

INTRODUCTION

The findings in Chapter IV indicate that general science teachers require broad training. In relation to the teachers of Indiana the writer raised the following problems:

1. How many branches of science have the teachers pursued who have been licensed to teach general science?

2. Are there many teachers who have no training in certain branches of science?

3. What is the condition or breadth of training in each of the thirteen branches?

4. Do these teachers hold degrees?

5. What are their teaching combinations?

6. What type of institution gives the broadest training?

In answering these questions this chapter presents (1) the academic preparation in science of teachers licensed to teach general science in Indiana; (2) the training of these teachers in each of the thirteen branches of science as defined in this study; (3) the general training of these teachers as indicated by the degrees they hold; (4) their teaching majors or teaching combinations; and (5) a comparison of teacher training institutions with respect to the breadth of preparation offered general science teachers.

I. THE ACADEMIC PREPARATION IN SCIENCE OF TEACHERS LICENSED TO TEACH GENERAL SCIENCE IN INDIANA

Number of branches of science pursued. Table IV shows the number of branches of science pursued by 244 teachers in Indiana who have been licensed to teach general science. The data are open to the following discrepancies:

1. Sampling may not be truly representative of the total population in any category.

2. Data could not be obtained in twenty-one cases.

Only two teachersc according to Table IV, had pursued ten branches of science, more than half of the teachers pursuing four or more branches. The records of eight teachers showed only one branch of science pursued. In these cases the records may have been incomplete or the license may have been issued upon other credentials than term or semester hours of preparation.

The mode in this distribution is "four," forty-seven teachers having prepared in each of four branches of science. The percentages, on the other hand, show a popularity range of three branches of science, or 12.2 per cent, pursued by thirty teachers to four branches, or 19.9 per cent, pursued by forty-seven teachers to five branches, or 18.0 per cent,

TABLE IV

NUMBER OF BRANCHES OF SCIENCE PURSUED

Number of branches	Teachers	
	Number of teachers	Percentages
10	2	0.8
9	1	0.4
8	7	2.8
7	20	8.1
6	45	18.4
5	44	18.0
4	47	19.9
3	30	12.2
2	19	7.7
1	8	3.2
?	21	8.6

pursued by forty-four teachers to six branches, or 18.4 per cent, pursued by forty-five teachers.

The extremities of the distribution carry low percentage ranges from 0.8 to 0.4 in the ninth and tenth deciles to 3.2 per cent and 7.7 per cent in the first and second deciles, the lowest percentages being found, therefore, in the ninth and tenth deciles. With the elimination of the twenty-one questionable cases, the profile of the distribution approaches normalcy.

Percentages of teachers having no training in certain branches of science. Table V shows the number and percentages

TABLE V

PERCENTAGES OF TEACHERS HAVING NO TRAINING
IN CERTAIN BRANCHES OF SCIENCE

Science	Teachers	
	Number of teachers	Percentages
Astronomy	175	95.1
Bacteriology	177	96.2
Biology	113	61.4
Botany	76	41.3
Chemistry	70	38.0
Economic geography	170	92.0
Geology	162	88.0
Human physiology	106	57.6
Hygiene	176	95.7
Nature study	173	94.0
Physical geography	138	75.0
Physics	67	36.4
Zoology	96	52.2

of teachers who had no training in certain branches of science. In this part of the study 184 cases were available for comparison.

Table V can best be interpreted by comparison with Table VI which shows the preparation of teachers by science areas:

1. The Biological Sciences
2. The Physical Sciences
3. The Earth and Sky Sciences

While Table V gives a startling picture of the lack of preparation in specific branches of science, that lack is

TABLE VI

TEACHER PREPARATION BY SCIENCE AREAS

Biological sciences		Physical sciences		Earth and sky sciences	
Three areas		Two areas		One area	
Teachers		Teachers		Teachers	
Number	Percentage	Number	Percentage	Number	Percentage
66	27.0	124	50.8	31	12.7

somewhat alleviated on the inspection of Table VI which shows that slightly more than half of the teachers were prepared in two science areas; more than one-fourth of the teachers studied were prepared in three areas; approximately one-eighth pursued sciences in one area.

Table VII shows the preparation of the teachers in three specific areas which listed for this table are:

A. The Biological Sciences

1. Biology
2. Botany
3. Zoology
4. Bacteriology
5. Hygiene
6. Physiology
7. Nature Study

B. The Physical Sciences

1. Chemistry

TABLE VII

TEACHER PREPARATION IN THREE AREAS OF SCIENCE

Biological sciences			Physical sciences			Earth and sky sciences		
Teachers			Teachers			Teachers		
Number of sciences pursued	Number	Percentages	Number of sciences pursued	Number	Percentages	Number of sciences pursued	Number	Percentages
0	55	22.5	0	56	22.9	0	143	58.6
1	44	18.0	1	83	34.0	1	71	29.0
2	50	20.4	2	105	43.0	2	27	11.0
3	45	18.4				3	3	1.2
4	32	13.1						
5	12	4.9						
6	4	1.6						
7	2	0.8						

2. Physics

C. The Earth and Sky Sciences

1. Astronomy

2. Geography

3. Geology

In addition the records of two teachers showed preparation in genetics, and four teachers had pursued courses in embryology. These are listed separately, since they were too few to list in the thirteen branches defined earlier in this study.

Table VII, on analysis, reveals the following facts:

1. Fifty-five teachers, or 22.5 per cent, had no training in the biological sciences.

2. Fifty-six teachers, or 22.9 per cent, had no training in the physical sciences.

3. One hundred forty-three teachers, or 58.6 per cent, had no training in the earth and sky sciences.

4. Of the seven biological sciences listed, the largest number of teachers had studied only two such sciences, being exceeded only by those who had studied no biological science.

5. From four biological sciences to five pursued, a sharp drop of 8.2 per cent is indicated, tapering to 0.8 per cent for seven biological sciences studied by two teachers.

6. The preparation of the teachers surveyed showed that 9.0 per cent more teachers prepared in two physical sciences than prepared in one.

7. More teachers lacked training in the earth and sky sciences than in either the biological or the physical sciences.

8. Over twice as many teachers had training in one phase of the earth and sky sciences as had training in two phases.

9. Only 1.2 per cent of the teachers had training in

three phases of the earth and sky sciences.

II. THE ACADEMIC PREPARATION OF 184 TEACHERS IN THIRTEEN BRANCHES OF SCIENCE

The records showed term and semester hours of training for 184 teachers. Semester hours of training were converted to term hours.[1] These data are given, science branch by science branch, and named as they appeared on the teachers' transcripts in the State House for the reasons which follow:

1. Teachers who need training for efficient teaching in general science find that their deficiencies lie in specific knowledges rather than in broad science areas: A broad knowledge of fungi does not prepare a teacher to present a good unit on the poisonous snakes of Indiana, though both topics may be classed as biological. A teacher well prepared to present the household uses of a sodium hypochlorite solution might have great difficulty in explaining the underlying principles of common kitchen levers, though both are physical science concepts. A knowledge of geology is not snynonymous to a knowledge of astronomy.

2. The data are more susceptible to comparison from the point of view of the individual teacher. (See the Appendix for the data obtained at the State House.)

[1] See the Appendix for semester hour equivalents.

<u>Teacher preparation in astronomy</u>. Table VIII shows the preparation of 184 teachers in astronomy, giving term hours of training, the number of teachers, and the equivalent percentages. Only 4.7 per cent of the teachers studied had any training in this field, the range being from four to six term hours. Though courses of study in general science usually include a unit in this area and though children as a rule are extremely interested in the starry heavens, 95.1 per cent of the teachers had no training in astronomy. (See the Appendix, Teachers 39-100-103-108-122-153-166 and 178.)

TABLE VIII

TEACHER PREPARATION IN ASTRONOMY

Term hours	Teachers of astronomy	
	Number of teachers	Percentages
6	4	2.1
5	1	0.5
4	4	2.1
0	175	95.1

<u>Teacher preparation in bacteriology</u>. Table IX presents the preparation of 184 teachers in bacteriology. (See the Appendix, Teachers 107-143-147-158-159-162 and 177.) As a separate subject, 177 teachers, or 96.2 per cent, had no training in bacteriology.

These data are, however, constantly offset by the facts

TABLE IX

TEACHER PREPARATION IN BACTERIOLOGY

Term hours	Teachers of bacteriology	
	Number of teachers	Percentages
8	1	0.5
7	0	0.0
6	0	0.0
5	2	1.0
4	3	1.6
3	1	0.5
2	0	0.0
1	0	0.0
0	177	96.2

previously presented in Tables VI and VII.

According to Table IX, three teachers had pursued four term hours of training, two teachers, five term hours, and one teacher, eight hours.

Teacher preparation in biology. Table X shows the preparation of 184 teachers in biology. Biology in this sense means the combined instruction and interrelation of botanical and zoological concepts on one course.

Term hours in the table are given in intervals of five hours and should be read as follows:

1. Fifteen teachers pursued from five to nine term hours of biology.

2. Eight teachers pursued from ten to fourteen term

TABLE X

TEACHER PREPARATION IN BIOLOGY

Term hours	Teachers of biology	
	Number of teachers	Percentages
55	1	0.5
50	4	2.1
45	2	1.0
40	1	0.5
35	5	2.7
30	10	5.4
25	5	2.7
20	9	4.9
15	11	5.9
10	8	4.3
5	15	8.2
0	113	61.4

hours of biology.

3. Eleven teachers pursued from fifteen to nineteen term hours of biology.

Table VII shows that 22.5 per cent of 244 teachers had no training in the biological sciences. The comparison of these data with the data in Table X disclosed 61.4 per cent of 184 teachers who had no training in biology. However, presentation of data concerning teacher preparation in botany and zoology must be made before any valid conclusions can be drawn from Table X. (See the discussion on teacher preparation in botany and zoology.)

<u>Teacher preparation in botany</u>. Table XI presents the preparation of 184 teachers in botany with term hours in intervals of four hours. The table should be read similarly to Table X as follows:

1. The records of thirteen teachers showed four to seven term hours credit in botany.

2. Eleven teachers had eight to eleven term hours of credit in botany.

3. Forty-three teachers had twelve to fifteen term hours in botany.

While Table VII shows that 22.5 per cent of 244 teachers had no training in any biological science, Table XI shows that over two-fifths, or 41.3 per cent of 184 teachers, had no training in botany. On the other hand, the findings in Chapter IV indicate that concepts related to botany are included in all the general science textbooks surveyed.

The table shows a wide range of preparation, 0 to 58, with the mode at 43, eliminating the seventy-six teachers who had no training in botany. More than half of the teachers showed a preparation in botany of less than twelve term hours. The mean of the distribution is 10.9 term hours, the greater percentage of the preparation piling up close to zero. The distribution is, therefore, skewed positively and is asymmetrical.

The median for this distribution is 9.09 term hours;

TABLE XI

TEACHER PREPARATION IN BOTANY

Term hours	Teachers of botany: Number of teachers	Teachers of botany: Percentages
58	1	0.5
54	0	0.0
50	0	0.0
46	1	0.5
42	1	0.5
38	0	0.0
36	0	0.0
32	4	2.1
28	8	4.3
24	6	3.3
20	4	2.1
16	16	8.7
12	43	23.4
8	11	5.9
4	13	7.1
0	76	41.3

the standard deviation is 50.4, and so the amount or degree of skewness (SK) is easily approximated by means of the formula:

$$SK = \frac{3\,(\text{Mean} - \text{Median})}{\sigma}$$

$$SK = \frac{3\,(10.9 - 9.09)}{50.4}$$

$$SK = .06$$

The positive value (.06) indicates that the scores are piled up on the right side of the curve, the distribution lacking .06 approaching a curve of the probability type. This amount of skewness is small, the measures of central tendency being significant in this distribution. We conclude, then, that from the mean (10.9) $\pm 1\sigma$, approximately 68.26 per cent of the cases lie.

-1σ	M	$+1\sigma$
- 39.5	10.9	61.3

Further implications concerning teacher training in botany must be derived from the viewpoint of the number of hours which may be considered adequate for instructional purposes. To solve this phase of the problem research not within the scope of this study is needed.

Is a mean of 10.9 term hours adequate preparation in botany? What constitutes adequacy?

<u>Teacher preparation in chemistry</u>. Table XII shows the preparation of 184 teachers in chemistry. Reference to Table VII discloses that 34.0 per cent of 244 teachers had studied in one physical science, and 43.0 per cent had training in two physical science areas: chemistry and physics. More than two-fifths of the teachers surveyed had training, therefore, in both chemistry and physics.

Table XII, a specific table for the training of 184 teachers in chemistry, shows that seventy teachers, or 38.0 per cent, had no training in chemistry. The records of the remaining 114 teachers indicate a range of five to ninety

TABLE XII

TEACHER PREPARATION IN CHEMISTRY

Term hours	Teachers of chemistry	
	Number of teachers	Percentages
90	1	0.5
85	1	0.5
80	0	0.0
75	0	0.0
70	1	0.5
65	0	0.0
60	4	2.1
55	2	1.0
50	4	2.1
45	2	1.0
40	1	0.5
35	6	3.3
30	6	3.3
25	13	7.1
20	24	13.1
15	20	11.0
10	12	6.5
5	17	9.2
0	70	38.0

term hours of preparation.

The mean number of term hours in chemistry for Table XII is 16.7; the median number of term hours, 12.1; the standard deviation is 63.0. These measures of central tendency and variability indicate that the distribution is skewed positively, the scores or term hours piling up to the right or upper end of the distribution. The amount of skewness or deviation from a normal distribution is as follows:

$$SK = \frac{3\ (\text{Mean} - \text{Median})}{\sigma}$$

$$SK = \frac{3\ (16.7 - 12.1)}{63.0}$$

$$SK = .22$$

This degree of skewness (less than .25) is small enough to allow the application of the measures of variability and central tendency. From the mean, then, $\pm 1\sigma$, approximately two-thirds of the cases lie:

$-\ 1\sigma$	M	$+\ 1\sigma$
-- 46.3	16.7	79.7

This degree of normalcy permits the following observations:

1. The popularity range of teacher preparation in chemistry clusters near the lower end of the distribution from the second to the fifth interval. (Five to twenty-five term hours)

2. These intervals represent 46.9 per cent of the teachers surveyed.

3. More teachers were prepared in twenty to twenty-five term hours than in any other hour range.

4. The average preparation in chemistry is expressed by the mean, 16.7 term hours.

5. Comparison with other branches of science shows that teachers are moderately well trained in chemistry.

<u>Teacher preparation in economic geography</u>. Table XIII shows an unusual distribution in which the mean and the median fall in the lowest interval, being 1.7 and 1.1 term hours, respectively. Some idea of the deviation from a normal scatter of values can be seen by finding as in the preceding discussions the degree of skewness.

$$SK = \frac{3\ (\text{Mean} - \text{Median})}{\sigma}$$

$$SK = \frac{3\ (1.7 - 1.1)}{5.2}$$

$$SK = .35$$

Since a degree of skewness of .35 indicates a great deviation from a normal distribution, the application of any measures of central tendency or variability to the distribution fail to have any significance.

On the other hand the data are immediately open to other deductions of great import.

It is highly significant that the mean and median fall in the lowest interval, especially (1) when that interval represents 92.4 per cent of the cases surveyed and (2) when that interval represents from zero to two term hours of preparation.

The data lead to the following deductions:

1. The teachers are unprepared in economic geography.

2. Approximately 8.0 per cent of the teachers prepared in two or more term hours of economic geography.

TABLE XIII

TEACHER PREPARATION IN ECONOMIC GEOGRAPHY

Term hours	Teachers of economic geography	
	Number of teachers	Percentages
20	1	0.5
18	0	0.0
16	4	2.1
14	0	0.0
12	1	0.5
10	0	0.0
8	2	1.0
6	1	0.5
4	3	1.6
2	2	1.0
0	170	92.4

3. The findings are modified by the data in Chapter IV which show that economic geography is relatively little stressed in textbooks in general science used widely in Indiana.

<u>Teacher preparation in geology</u>. Table XIV, a study of the preparation of 184 teachers in geology, shows 88.0 per cent having no training in geology. It can readily be seen that the mean of this distribution falls in the lowest interval. (See Table XIII.)

Similar deductions as given for Table XIII can be made:

TABLE XIV

TEACHER PREPARATION IN GEOLOGY

Term hours	Teachers of geology	
	Number of teachers	Percentages
20	1	0.5
18	0	0.0
16	0	0.0
14	1	0.5
12	0	0.0
10	0	0.0
8	2	1.0
6	2	1.0
4	12	6.5
2	5	2.7
0	162	88.0

1. The teachers surveyed are unprepared in geology.

2. Chapter IV challenges whether wide preparation in this field is warranted.

Teacher preparation in human physiology. Table XV presents the preparation of 184 teachers in human physiology. With the exception of Teacher 79, (See Appendix), the distribution indicates a range of zero to twenty-four term hours. One hundred six, or 57.6 per cent of the teachers surveyed for preparation in human physiology, had less than five term hours of credit in this branch of science. Only one teacher had more than twenty-four term hours, this teacher having, according to the records obtained, no other science area pursued.

TABLE XV

TEACHER PREPARATION IN
HUMAN PHYSIOLOGY

Term hours	Teachers of human physiology	
	Number of teachers	Percentages
50	1	0.5
45	0	0.0
40	0	0.0
35	0	0.0
30	0	0.0
25	0	0.0
20	2	1.0
15	15	8.2
10	10	5.4
5	50	27.2
0	107	58.2

(See Appendix, Teacher 79.)

The findings indicate a zero deficiency of more than 50.0 per cent in the training of teachers in human physiology, though the textbooks surveyed showed an increasing emphasis in this field of science, especially in relation to public health.

More than one-fourth of the teachers surveyed for training in this branch of science showed a preparation of five to nine term hours. Canceling the 106 cases of the zero interval, these fifty cases represent the mode for this distribution with five to nine term hours indicated.

A valid interpretation of these data necessitates further research in an appraisal of what constitutes an adequate amount of training.

Teacher preparation in hygiene. Table XVI, paralleling very closely the profiles of the distributions in Tables XIII, XIV, and XV, shows the preparation of 184 teachers in hygiene.

Similar conclusions may be drawn:

1. The teachers surveyed are deficient in training for the teaching of hygiene.

2. The integration and overlapping of other biological subject groups alleviates the deficiency.

TABLE XVI

TEACHER PREPARATION IN HYGIENE

Term hours	Teachers of hygiene	
	Number of teachers	Percentages
5	1	0.5
4	3	1.6
3	3	1.6
2	1	0.5
1	0	0.0
0	176	95.7

Teacher preparation in nature study. Table XVII shows the preparation of 184 teachers in nature study. The term hours given are not listed by intervals as in the preceding tables; they should be read as follows:

TABLE XVII

TEACHER PREPARATION IN NATURE STUDY

Term hours	Teachers of nature study	
	Number of teachers	Percentages
8	2	1.0
5	1	0.5
4	7	3.8
2	1	0.5
0	173	94.0

1. Of the teachers surveyed 123, or 94.0 per cent, had no training in nature study.

2. One teacher, or 0.5 per cent had pursued two term hours in nature study.

The findings are these:

1. There seems to be a great deficiency in the training of teachers in nature study.

2. Teacher preparation in other biological areas alleviates the deficiency.

Teacher preparation in physical geography. Of the teachers surveyed 75.0 per cent had pursued less than four term hours of training in physical geography. Table XVIII reveals, in addition, that one-fourth of the teachers surveyed had taken from four to thirty-six term hours of training in physical geography, eight term hours constituting the highest

TABLE XVIII

TEACHER PREPARATION IN
PHYSICAL GEOGRAPHY

Term hours	Teachers of physical geography	
	Number of teachers	Percentages
36	2	1.0
32	1	0.5
28	0	0.0
24	2	1.0
20	1	0.5
16	1	0.5
12	4	2.1
8	18	9.8
4	17	9.2
0	138	75.0

percentages above that indicated for zero.

The distribution shows a positive skewness, the mean clearly falling in the lowest interval. The common measures of central tendency and variability have little significance in this distribution as instruments of analysis.

Deductions from the raw data, however, can readily be made.

1. Three-fourths of the teachers surveyed had less than four term hours of preparation in physical geography.

2. Only 3.0 per cent of the teachers had pursued twenty or more term hours of training in physical geography.

3. The total range of training was from zero to

thirty-six term hours.

Teacher preparation in physics. The measures of central tendency and variability respecting the data in Table XIX showing teacher preparation in physics are:

M 14.1

Mdn 10.8

σ 60.0

These measures are significant in as much as the deviation from a normal distribution is less than 0.25.

$$SK = \frac{3\ (M - Mdn)}{\sigma}$$

$$SK = \frac{3\ (14.1 - 10.8)}{60.0}$$

$$SK = .165 \text{ or } .17$$

The average number of term hours of preparation in physics, according to the data derived from Table XIX, is 14.1 term hours. The profile of the distribution shows positive skewness, revealing the drawing out of the distribution toward the upper ranges and the piling up of the data toward the lower end of the distribution. These data show, therefore, that though the mean term hour preparation in physics is 14.1, nearly half of the teachers, 48.4 per cent, had less than ten term hours of training.

The significance of the findings are further emphasized by the results of the survey of textbooks in Chapter IV

TABLE XIX

TEACHER PREPARATION IN PHYSICS

Term hours	Teachers of physics	
	Number of teachers	Percentages
90	1	0.5
85	0	0.0
80	0	0.0
75	0	0.0
70	1	0.5
65	0	0.0
60	0	0.0
55	0	0.0
50	0	0.0
45	2	1.0
40	2	1.0
35	4	2.1
30	7	3.8
25	6	3.3
20	38	20.7
15	16	8.7
10	18	9.8
5	22	12.0
0	67	36.4

which showed a popularity of treatment toward the concepts of the physical sciences.

Further application of the measures of central tendency and variability show that between + 74.1 and -- 45.9 term hours approximately two-thirds of the cases lie. The negative figure (-- 45.9) shows that within the two-thirds of the distribution representing the central tendency, many cases in which teachers had no training in physics lie.

Findings:

1. On an average teachers are fairly well trained in physics. (This finding is given by comparison with the average training in the other branches of science surveyed and is not an attempt to set any number of term hours as being adequate training.)

2. Nearly half of the teachers had less than ten term hours of training in physics.

3. Over 36.0 per cent of the teachers had less than five term hours of training in physics.

4. The data show the teachers slightly better prepared in chemistry than in physics.

Chemistry M = 16.7

Physics M = 14.1

Teacher preparation in zoology. Table XX shows the preparation of 184 teachers in zoology. The table shows that the median falls within the zero interval.

$$\frac{N}{2} = 92$$

Here again, as has been pointed out in relation to Tables XIII, XIV, XV, XVI, XVII, and XVIII, the measures of central tendency and variability have little significance in the interpretation of the data. The raw data give rise to the following conclusions:

TABLE XX

TEACHER PREPARATION IN ZOOLOGY

Term hours	Teachers of zoology	
	Number of teachers	Percentages
30	2	1.0
28	0	0.0
26	1	0.5
24	4	2.1
22	1	0.5
20	5	2.7
18	5	2.7
16	8	4.3
14	14	7.6
12	25	13.6
10	3	1.6
8	10	5.4
6	3	1.6
4	6	3.3
2	1	0.5
0	96	52.2

1. More than half of the teachers surveyed had less than two term hours of preparation in zoology.

2. The findings from Table VII alleviate the preceding findings since a teacher trained in biology would receive training in zoology and botany.

3. The findings of Table X confirm the finding given above (item 1), since 61.4 per cent of the teachers surveyed had no training in biology.

III. DEGREES, A BASIS FOR EVALUATING THE TRAINING OF 212 TEACHERS

Table XXI shows the educational status by degrees obtained by 212 teachers of this study during the period from 1910 to 1942.

The totals paint a bright picture since the period beginning in 1920, showing a sudden change from two Bachelor degrees obtained in the first period (1910-1920) to forty-four degrees, including Master's degrees, in the second period (1920-1930). Changes in the license law account for the trends toward degrees since 1923.

This table, showing a steady rise in the number of degrees held, justifies these conclusions:

1. The general training of the teachers as evidenced by the number of degrees held seems adequate.

2. Teachers seem to be trying to improve their scholastic status.

IV. TEACHING COMBINATIONS, A MEANS OF EVALUATING THE SCHOLASTIC STATUS OF 184 TEACHERS

Any estimate of the scholastic status of teachers licensed to teach general science must take into consideration their teaching combinations since it is generally agreed that certain subject matter areas contribute largely to the general

TABLE XXI

DEGREES AND WHEN OBTAINED

Degree	1910 to 1920	1920 to 1930	1930 to 1942	Date not given	Total
A. B.	1	23	49	6	79
B. S.	1	12	67	11	91
B. Ed.	0	0	3	0	3
B. S. A.	0	1	10	0	11
A. M.	0	3	5	1	9
M. S.	0	5	12	2	19
Total	2	44	146	20	212

preparation of any teacher.

Table XXII shows the teaching combinations of 184 teachers with equivalent percentages for each combination with science. An inspection of the column of percentages discloses the following facts:

1. Mathematics combines most often with science as a teaching combination.

2. Social studies ranks second as a combining factor with science.

3. Studies made by Elder,[2] cited in Chapter III, verify the findings given above.

[2] Harry E. Elder, _op. cit._, p. 17 and p. 18.

TABLE XXII

TEACHING COMBINATIONS OF GENERAL SCIENCE TEACHERS

	Art	Commerce	English	Foreign language	Home economics	Industrial arts	Social studies	Mathematics	Physical education	Library science	Agriculture	Total cases	Percentages
1					4							4	2.1
2								4				4	2.1
3									9			9	4.9
4							25					25	13.6
5											16	16	8.7
6		1						1				1	0.5
7							6		6			6	3.3
8			8									8	4.3
9				3				3				3	3.3
10								34				34	18.4
11				2					2			2	1.0
12								5	5			5	2.7
13				4			4					4	2.1
14		1										1	0.5
15						4		4				4	2.1
16						1						1	0.5
17								1			1	1	0.5
18						1					1	1	0.5
19			5				5					5	2.7
20							5	5				5	2.7
21	1				1							1	0.5
22			2		2							2	1.0
23			6					6				6	3.3
24			2	2								2	1.0
25			1				1	1				1	0.5
26	1											1	0.5

TABLE XXII (continued)

	Art	Commerce	English	Foreign language	Home economics	Industrial arts	Social studies	Mathematics	Physical education	Library science	Agriculture	Total cases	Percentages
27			1							1		1	0.5
28				1								1	0.5
29			1	1				1				1	0.5
30							1	1	1			1	0.5
31			1			1						1	0.5
32				1			1	1				1	0.5
33									Not indicated			26	14.1
									Total cases			184	

The table is to be read as follows:

(1) Four teachers in column (1) combined science with home economics (or 2.1 per cent).

(2) Five teachers in column (19) combined science with English and social studies (or 2.7 per cent).

V. TOTAL TERM HOURS OF PREPARATION OFFERED BY TEACHER TRAINING INSTITUTIONS

Table XXIII shows the breadth of training offered by three types of teacher training institutions in a survey of the records of 141 teachers.

1. Teachers' Colleges and Normal Schools
2. Liberal Arts Colleges
3. Technical Colleges

According to the data obtained, the following facts can be derived from Table XXIII:

1. Technical colleges offer slightly more training in science than teachers' colleges and normal schools.

Means expressed in term hours:

Technical Colleges	76.9
Teachers' Colleges and Normal Schools	65.8

2. Teachers' colleges and normal schools offer slightly more training in science than liberal arts colleges.

Means expressed in term hours:

Teachers' Colleges and Normal Schools	65.8
Liberal Arts Colleges	59.3

3. Liberal arts colleges offer less training in science than either technical colleges or teachers' colleges

TABLE XXIII

TOTAL TERM HOURS OF PREPARATION IN SCIENCE OFFERED BY TEACHER TRAINING INSTITUTIONS

Term hours of preparation	Types of teacher training institutions		
	Teachers' Colleges and Normal Schools	Liberal Arts Colleges	Technical Colleges
	Number of teachers	Number of teachers	Number of teachers
150	0	0	1
140	0	0	0
130	0	0	0
120	1	2	1
110	1	0	0
100	0	5	1
90	2	1	3
80	6	3	4
70	9	6	2
60	13	13	3
50	6	16	2
40	10	7	2
30	0	12	1
20	2	4	1
10	0	1	0
Total cases	50	70	21
Medians	65.4	59.6	77.5
Means	65.8	59.3	76.9
Ranges			
High	129	120	129
Low	24	18	21
R	105	102	108

and normal schools.

Means expressed in term hours:

Liberal Arts Colleges	59.3
Technical Colleges	76.9
Teachers' Colleges and Normal Schools	65.8

SUMMARY OF FINDINGS

A. How many branches of science have the teachers pursued who have been licensed to teach general science?

1. Only two teachers had pursued as many as ten branches of science defined in this study.
2. More than half of the teachers had pursued four or more branches of science.
3. The records of eight teachers showed only one branch of science pursued.
4. More teachers prepared in four branches of science than in any other number grouping.

B. Are there many teachers who have no training in certain branches of science?

1. There were more teachers who had no training in astronomy, bacteriology, hygiene, nature study, and economic geography than had no training in any of the other branches named in this study.

2. An analysis of three science areas (biological sciences, physical sciences, and earth and sky sciences) showed that slightly more than half of the teachers were prepared in two science areas; more than one-fourth were prepared in three areas; approximately one-eighth pursued sciences in one area.
3. Nearly one-fourth of the teachers had no training in the biological sciences.
4. Nearly one-fourth of the teachers had no training in the physical sciences.
5. More than half of the teachers had no training in the earth and sky sciences.
6. Of the seven biological sciences listed, the largest number of teachers had studied only two such sciences. They were exceeded only by those who had studied no biological science.
7. More teachers prepared in two physical sciences than prepared in one.
8. More teachers lacked training in the earth and sky sciences than in either the biological sciences.
9. Over twice as many teachers had training in one phase of the earth and sky sciences as had training in two phases.

10. Very few teachers had training in three phases of the earth and sky sciences.

C. What is the condition or breadth of training of the teachers in each of the thirteen branches of science defined in this study?

Astronomy

1. Only 4.7 per cent of the teachers had any training in astronomy as a separate science.
2. More than 95.0 per cent of the teachers had no training in astronomy as a separate science.

Bacteriology

1. More than 96.0 per cent of the teachers had no training in bacteriology as a separate science.
2. Teachers, no doubt, received training in bacteriology in other biological courses.

Biology

1. Fifteen teachers (8.2 per cent) pursued from five to nine term hours of biology.
2. Eight teachers (4.3 per cent) pursued from ten to fourteen term hours of biology.
3. Eleven teachers (5.9 per cent) pursued from fifteen to nineteen term hours of biology.
4. Teacher preparation in botany and zoölogy

augments the findings given above, showing that the teachers are as well prepared in the biological sciences as in the physical sciences.

Botany

1. The mean number of term hours of preparation in botany was found to be 10.9.
2. More than two-fifths of the teachers had no training in botany as a separate subject.
3. Nearly one-fourth of the teachers had from twelve to sixteen term hours of credit in botany.
4. Only slightly more than 3.0 per cent of the teachers had more than thirty-two term hours of credit in botany.

Chemistry

1. The popularity range of teacher preparation in chemistry clusters near the lower end of the distribution, representing five to twenty-five term hours.
2. This range represents 46.9 per cent of the teachers surveyed.
3. More teachers prepared in twenty to twenty-five term hours of chemistry than in any other hour range.

4. The average preparation in chemistry is expressed by the mean, 16.7 term hours.

Economic Geography

1. More than 90.0 per cent of the teachers had no training in economic geography.
2. The finding given above is alleviated by the data in Chapter IV which shows that economic geography is relatively little stressed in general science textbooks used widely in Indiana.

Geology

1. More than 80.0 per cent of the teachers had no training in geology.
2. The data of Chapter IV challenges whether wide preparation in this field is warranted.

Human Physiology

1. Over half of the teachers surveyed had no training in human physiology.
2. The data of Chapter IV emphasizes the need for more training in this branch of science.

Hygiene

1. Over half of the teachers had no training in hygiene as a separate subject.
2. The overlapping of other biological subject groups alleviates the deficiency.

Nature Study

1. More than 90.0 per cent of the teachers surveyed had no training in nature study.
2. Teacher training in other biological areas alleviates the deficiency.

Physical Geography

1. Three-fourths of the teachers surveyed had less than four term hours of credit in physical geography.
2. Only 3.0 per cent of the teachers had pursued twenty or more term hours of training in this science.
3. The total range of training was zero to thirty-six term hours.

Physics

1. Nearly half of the teachers had less than ten term hours of training in physics.
2. Over 36.0 per cent of the teachers had less than five term hours of training in physics.
3. The data show the teachers slightly better prepared in chemistry than in physics.
4. The average preparation in physics in terms of the mean is 14.1 hours.

Zoology

1. More than half of the teachers surveyed had

less than two term hours of preparation in zoology.

2. Teacher training in biology alleviates the finding given above.

3. The findings of Table X augments finding (1).

D. Do these teachers hold degrees?

1. From 1910 to 1920 two teachers surveyed obtained degrees.

2. From 1920 to 1930 forty-four teachers obtained degrees.

3. From 1930 to 1942 there were 146 teachers who obtained degrees.

4. There were twenty other teachers who obtained degrees, though the dates were not given.

5. Of the 212 degrees found in the records of the teachers, twenty-eight were Master's degrees and 184 were Bachelor's degrees.

E. What are the teaching combinations of these teachers?

1. Mathematics combined most often with science as a teaching combination.

2. Social studies ranked second as a combining factor with science.

F. What type of institution gives the broadest training?

1. Technical colleges offered 76.9 mean-term hours of training in science.
2. Teachers colleges and normal schools offered 65.8 mean-term hours of training in science.
3. Liberal arts colleges offered 59.3 mean-term hours of training in science.

CHAPTER VI

REPRESENTATIVE CASES OF TEACHER PREPARATION IN THIRTEEN BRANCHES OF SCIENCE

INTRODUCTION

While Chapter V presents <u>en masse</u> the preparation of teachers licensed to teach general science in Indiana, this chapter is a study of individual cases which represent the broad patterns of teacher preparation discussed in the preceding chapter.

Thirty-seven cases have been selected to represent the thirteen branches of science defined in Chapter I, these cases symbolizing, as closely as possible, the lower, middle, and upper quartiles of the distributions which are found, science branch by science branch, in Chapter V.

The data are given as they appeared on the records in the State House with the exceptions that (1) semester hours have been converted to term hour equivalents, counting any major fraction thereof as a unit term hour in order to keep the data discrete for statistical purposes; and (2) the names of the teachers and counties are given, for obvious reasons, in code.

It is the purpose of this chapter to present thirty-seven individual, representative cases of teacher preparation in science in order to give a clearer picture of the differences in teacher training by using certain specific cases, to show to what extent these cases are representative of the quartile range from which they are taken, and to acknowledge other factors in teacher preparation:

1. Years of experience
2. Degrees held
3. Teaching combinations
4. Teacher training institutions attended

Other factors in growth, not of chief concern in this study, contribute largely to the in-service training of teachers. Among these may be mentioned the following:

1. Reading professional literature
2. Attending and participating at professional meetings
3. Collecting illustrative material
4. Planning for improvement
5. Writing units
6. Exchanging ideas with others
7. Observing master teachers at work

These factors are mentioned as the writer is aware that teacher preparation cannot be measured wholly in terms of term or semester hours of college credit.

I. PRESENTATION OF INDIVIDUAL CASES

The remainder of the chapter presents, with brief comments, thirty-seven cases of teacher preparation in the thirteen branches of science in the order named: astronomy, bacteriology, biology, botany, chemistry, economic geography, geology, human physiology, hygiene, nature study, physical geography, physics, and zoology.

REPRESENTATIVE CASES IN ASTRONOMY

DATA SHEET

I. Teacher 178

II. County where employed 247

III. License held Regular H. S. Date issued 1941

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	36
B. Botany	
C. Zoology	
D. Chemistry	12
E. Physics	36
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	
*I. Astronomy	6
Total	90

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	___
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Ed. . . .	___
5. Home Economics . .	___	11. Social Studies . .	___
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma B. S.
Normal ______ Teachers College x Liberal Arts
College ___ Other Institution ______

VII. Experience
Number of years Not given

VIII. Comments This case represents one among the best prepared teachers in astronomy. Are six hours adequate training?

* Note: The asterisk is used to designate the science being considered.

DATA SHEET

I. Teacher 153

II. County where employed 37

III. License held Regular H. S. Date issued 1939

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	
C. Zoology	
D. Chemistry	12
E. Physics	
F. Physical Geography	39
G. Economic Geography	
H. Human Physiology	
*I. Astronomy	4
Total	90

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	x
3.	English.		9.	Music.	
4.	Foreign Language .	x	10.	Physical Ed. . . .	
5.	Home Economics . .		11.	Social Studies . .	
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma A. B. Normal ___
Teachers College ___ Liberal Arts College x
Other Institution ___

VII. Experience
Number of years Not given

VIII. Comments
Four teachers, or 2.1 per cent, had four hours of credit in astronomy.

DATA SHEET

I. Teacher 113

II. County where employed 290

III. License held Regular H. S. Date issued 1936

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	
C. Zoology	
D. Chemistry	12
E. Physics	10
F. Physical Geography	12
G. Economic Geography	
H. Human Physiology	6
I. Geology	4
J. Physiography	4
Total	48

V. Related and unrelated subject groups (Check)

1. Art.		7. Library Science. . .	
2. Commercial Subj. .		8. Mathematics. . . .	x
3. English.		9. Music.	
4. Foreign Language .		10. Physical Ed. . . .	
5. Home Economics . .		11. Social Studies . .	
6. Industrial Arts. .		12	

VI. Training Degree or diploma A. B. Normal ___
Teachers College ___ Liberal Arts College x
Other Institution ___

VII. Experience
Number of years 5

VIII. Comments

This teacher, with no college credit in astronomy, is representative of 95.1 per cent of the cases surveyed.

A REPRESENTATIVE CASE IN BACTERIOLOGY

DATA SHEET

I. Teacher 143

II. County where employed 136

III. License held Regular H. S. Date issued 1929

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	4
B. Botany	16
C. Zoology	12
D. Chemistry	
E. Physics	4
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	8
*I. Bacteriology	4
Total	48

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	___
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Ed. . . .	___
5. Home Economics . .	___	11. Social Studies . .	___
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma A. B.--M. S.
Normal ___ Teachers College x Liberal Arts College x
Other Institution ___

VII. Experience
Number of years 8

VIII. Comments

This teacher represents three other cases with four term hours in bacteriology. This case represents the mode, the teachers with no preparation in bacteriology being eliminated.

REPRESENTATIVE CASES IN BIOLOGY

DATA SHEET

I. Teacher 33

II. County where employed 213

III. License held Regular H. S. Date issued ______

IV. Science courses pursued

	Name of course	Total credits in term hours
*A.	Biology	42
B.	Botany	12
C.	Zoology	
D.	Chemistry	
E.	Physics	
F.	Physical Geography	
G.	Economic Geography	
H.	Human Physiology	5
	Total	59

V. Related and unrelated subject groups (Check)

1.	Art.	___	7.	Library Science. .	___
2.	Commercial Subj. .	___	8.	Mathematics. . . .	___
3.	English.	___	9.	Music.	___
4.	Foreign Language .	___	10.	Physical Ed. . . .	___
5.	Home Economics . .	___	11.	Social Studies . .	x
6.	Industrial Arts. .	___	12.		___

VI. Training Degree or diploma A. B.
Normal ___ Teachers College ___ Liberal Arts
College ___ Other Institution ______

VII. Experience Number of years Not given

VIII. Comments Only 4.1 per cent of the cases surveyed had more than forty term hours of credit in biology as a separate subject. Preparation in other biological branches discredits the apparent lack of training in this branch of science.

DATA SHEET

I. Teacher 146

II. County where employed 308

III. License held Regular H. S. Date issued 1929

IV. Science courses pursued

	Name of course	Total credits in term hours
*A.	Biology	28
B.	Botany	8
C.	Zoology	
D.	Chemistry	
E.	Physics	
F.	Physical Geography	
G.	Economic Geography	
H.	Human Physiology	8
I.	Nature Study	4
	Total	48

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	
3.	English.		9.	Music.	
4.	Foreign Language .		10.	Physical Ed. . . .	x
5.	Home Economics . .		11.	Social Studies . .	x
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma B. S. Normal ___
Teachers College x Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years 5

VIII. Comments

This teacher's training appears restricted to biological sciences.

DATA SHEET

I. Teacher 162

II. County where employed 44

III. License held Regular H. S. Date issued 1935

IV. Science courses pursued

	Name of course	Total credits in term hours
*A.	Biology	6
B.	Botany	12
C.	Zoology	4
D.	Chemistry	8
E.	Physics	24
F.	Physical Geography	8
G.	Economic Geography	
H.	Human Physiology	8
I.	Geography	2
J.	Bacteriology	3
	Total	75

V. Related and unrelated subject groups (Check)

1. Art. . . . . ___
2. Commercial Subj. . ___
3. English. . . . . . ___
4. Foreign Language . ___
5. Home Eonnomics . . ___
6. Industrial Arts. . ___
7. Library Science. . ___
8. Mathematics. . . . ___
9. Music. . . . . . . ___
10. Physical Ed. . . . ___
11. Social Studies . . ___
12. ___

VI. Training Degree or diploma B. S. Normal ___
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience Number of years 5

VIII. Comments Among the teachers who had training in biology as a separate science branch, more teachers had training in five to ten term hours than in any other hour range.

REPRESENTATIVE CASES IN BOTANY

DATA SHEET

I. Teacher 66

II. County where employed 228

III. License held Special H. S. Date issued 1927

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
*B. Botany	48
C. Zoology	
D. Chemistry	18
E. Physics	
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	18
Total	84

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	
3.	English.		9.	Music.	
4.	Foreign Language .		10.	Physical Ed. . . .	
5.	Home Economics . .	x	11.	Social Studies . .	
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma B. S. Normal ___
Teachers College x Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years 4

VIII. Comments

This teacher is one of the best prepared in botany.

DATA SHEET

I. Teacher 21

II. County where employed 52

III. License held Regular H. S. Date issued 1931

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
*B. Botany	12
C. Zoology	12
D. Chemistry	
E. Physics	24
F. Physical Geography	4
G. Economic Geography	
H. Human Physiology	12
I.	8
Total	72

V. Related and unrelated subject groups (Check)

1.	Art.	___	7.	Library Science. .	___
2.	Commercial Subj. .	___	8.	Mathematics. . . .	___
3.	English.	___	9.	Music.	___
4.	Foreign Language .	___	10.	Physical Ed. . . .	___
5.	Home Economics . .	___	11.	Social Studies . .	___
6.	Industrial Arts. .	x	12.		___

VI. Training Degree or diploma B. S.--M. S. Normal ___
Teachers College x Liberal Arts College ___
Other Institution ___

VII. Experience Number of years ___

VIII. Comments Among the teachers who had any training in botany more had twelve to sixteen term hours of credit than any other term hour range.

DATA SHEET

I. Teacher 11

II. County where employed 89

III. License held Regular H. S. Date issued ______

IV. Science courses pursued

Name of course	Total Credits in term hours
A. Biology	8
*B. Botany	4
C. Zoology	
D. Chemistry	16
E. Physics	24
F. Physical Geography	
G. Economic Geography	16
H. Human Physiology	12
Total	80

V. Related and unrelated subject groups (Check)

1.	Art.	___	7.	Library Science. .	___
2.	Commercial Subj. .	___	8.	Mathematics. . . .	x
3.	English.	___	9.	Music.	___
4.	Foreign Language .	___	10.	Physical Education	___
5.	Home Economics . .	___	11.	Social Science . .	___
6.	Industrial Arts. .	___	12.		___

VI. Training Degree or diploma B. S. Normal x
Teachers College ___ Liberal Arts College ___
Other Institution ______________________

VII. Experience
Number of years 2

VIII. Comments

There were seventy-six teachers, or 41.3 per cent, who had less than four hours of credit in botany.

REPRESENTATIVE CASES IN CHEMISTRY

DATA SHEET

I. Teacher 38

II. County where employed 223

III. License held Blanket Date issued 1924

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	
C. Zoology	
*D. Chemistry	60
E. Physics	12
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	
Total	72

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	x
3.	English.		9.	Music.	
4.	Foreign Language .		10.	Physical Education	
5.	Home Economics . .		11.	Social Studies . .	
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma A. B.--A. M. Normal ___
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience Number of years 11

VIII. Comments This teacher is prepared in the physical sciences. The blanket license covers the preparation in the other sciences. Blanket licenses are fast disappearing.

DATA SHEET

I. Teacher 121

II. County where employed 80

III. License held Special H. S. Date issued ______

IV. Science courses pursued

	Name of course	Total credits in term hours
A.	Biology	12
B.	Botany	9
C.	Zoology	15
*D.	Chemistry	15
E.	Physics	15
F.	Physical Geography	6
G.	Economic Geography	6
H.	Human Physiology	5
I.	Plant Biology	9
J.	His. Biology	3
	Total	95

V. Related and unrelated subject groups (Check)

1. Art. . . . . ___
2. Commercial Subj. . ___
3. English. . . . . . ___
4. Foreign Language . ___
5. Home Economics . . ___
6. Industrial Arts. . ___
7. Library Science. . ___
8. Mathematics. . . . ___
9. Music. . . . . . . ___
10. Physical Education ___
11. Social Studies . . ___
12. ___

VI. Training Degree or diploma ___ Normal ___
Teachers College ___ Liberal Arts College ___
Other Institution ______________________

VII. Experience Number of years Not given

VIII. Comments

More teachers were prepared in fifteen to twenty-five term hours of chemistry than in any other hour range.

DATA SHEET

I. Teacher 60

II. County where employed 129

III. License held Regular H. S. Date issued 1937

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	12
B. Botany	8
C. Zoology	9
*D. Chemistry	5
E. Physics	5
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	
Total	39

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	
3.	English.		9.	Music.	
4.	Foreign Language .	x	10.	Physical Education	x
5.	Home Economics . .		11.	Social Studies . .	
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma A. B.--B. S. Normal ___
Teachers College ___ Liberal Arts College x
Other Institution ___

VII. Experience
Number of years 4

VIII. Comments This case represents 41.2 per cent of the teachers having five or less term hours of credit in chemistry.

REPRESENTATIVE CASES IN ECONOMIC GEOGRAPHY

DATA SHEET

I. Teacher 83

II. County where employed 308

III. License held Regular H. S. Date issued 1939

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	
C. Zoology	8
D. Chemistry	27
E. Physics	38
F. Physical Geography	
*G. Economic Geography	
H. Human Physiology	12
I.	4
Total	89

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	x
3.	English.	x	9.	Music.	
4.	Foreign Language .		10.	Physical Education	
5.	Home Economics . .		11.	Social Studies . .	
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma A. B. Normal ___
Teachers College ___ Liberal Arts College x
Other Institution ___

VII. Experience Number of years Not given

VIII. Comments This case represents 92.4 per cent of the cases surveyed, 170 teachers having no preparation in economic geography as a separate science.

DATA SHEET

I. Teacher 140

II. County where employed 129

III. License held Regular H. S. Date issued 1924

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	12
B. Botany	12
C. Zoology	
D. Chemistry	
E. Physics	
F. Physical Geography	
*G. Economic Geography	4
H. Human Physiology	4
I. Geology	12
Total	44

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	___
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Education	___
5. Home Economics . .	___	11. Social Studies . .	___
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma ___ Normal ___
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years 5

VIII. Comments Only 7.6 per cent of the cases had more than three term hours of credit in economic geography.

DATA SHEET

I. Teacher 53

II. County where employed 280

III. License held Regular H. S. Date issued 1940

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	
C. Zoology	18
D. Chemistry	18
E. Physics	36
F. Physical Geography	24
*G. Economic Geography	12
H. Human Physiology	
Total	108

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	x
3.	English.		9.	Music.	
4.	Foreign Language .		10.	Physical Education	
5.	Home Economics . .		11.	Social Studies . .	
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma B. S. Normal ___
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years Not given

VIII. Comments This case represents 3.1 per cent of the teachers, having twelve or more term hours of credit in economic geography. This teacher is one of the best prepared among those surveyed.

REPRESENTATIVE CASES IN GEOLOGY

DATA SHEET

I. Teacher 40

II. County where employed 216

III. License held Regular H. S. Date issued 1925

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	57
C. Zoology	
D. Chemistry	
E. Physics	
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	2
*I. Geology	15
Total	74

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	x
3.	English.	x	9.	Music.	
4.	Foreign Language .		10.	Physical Education	
5.	Home Economics . .		11.	Social Studies . .	
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma ___ Normal ___
Teachers College ___ Liberal Arts College x
Other Institution ___

VII. Experience
Number of years Not given

VIII. Comments

This teacher is one of the best prepared in geology.

DATA SHEET

I. Teacher 173

II. County where employed 133

III. License held Regular H. S. Date issued 1928

IV. Science courses pursued

	Name of course	Total credits in term hours
A.	Biology	36
B.	Botany	
C.	Zoology	
D.	Chemistry	22
E.	Physics	
F.	Physical Geography	
G.	Economic Geography	
H.	Human Physiology	
*I.	Geology	8
	Total	66

V. Related and unrelated subject groups (Check)

1. Art. . . . . ___
2. Commercial Subj. . . ___
3. English. . . . . . . ___
4. Foreign Language . . ___
5. Home Economics . . . ___
6. Industrial Arts. . . ___
7. Library Science. . . ___
8. Mathematics. . . . . ___
9. Music. . . . . ___
10. Physical Education ___
11. Social Studies . . ___
12. ___

VI. Training Degree or diploma A. B. Normal ___
Teachers College ___ Liberal Arts College x
Other Institution ___

VII. Experience
Number of years 3

VIII. Comments

Only 2.0 per cent of the cases had more than six term hours of credit in geology.

DATA SHEET

I. Teacher 39

II. County where employed 323

III. License held Regular H. S. Date issued 1929

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	
C. Zoology	
D. Chemistry	72
E. Physics	24
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	
I. Astronomy	6
*J. Geology	3
Total	105

V. Related and unrelated subject groups (Check)

1. Art.		7. Library Science. .	
2. Commercial Subj. .		8. Mathematics. . . .	
3. English.	x	9. Music.	
4. Foreign Language .		10. Physical Education	
5. Home Economics . .		11. Social Studies . .	
6. Industrial Arts. .		12.	

VI. Training Degree or diploma A. B. Normal ___
Teachers College ___ Liberal Arts College x
Other Institution ___

VII. Experience Number of years 2

VIII. Comments Among the teachers who had any training in geology as a separate science, more had two to four term hours of credit than any other hour range.

REPRESENTATIVE CASES IN HUMAN PHYSIOLOGY

DATA SHEET

I. Teacher 79

II. County where employed 105

III. License held Special H. S. Date issued 1941

IV. Science courses pursued

	Name of course	Total credits in term hours
A.	Biology	
B.	Botany	
C.	Zoology	
D.	Chemistry	
E.	Physics	
F.	Physical Geography	
G.	Economic Geography	
*H.	Human Physiology	54
	Total	54

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	
3.	English.		9.	Music.	
4.	Foreign Language .		10.	Physical Education	
5.	Home Economics . .		11.	Social Studies . .	
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma B. S. Normal ___
Teachers College x Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years Not given

VIII. Comments

This teacher has specialized in one science branch.

DATA SHEET

I. Teacher 1

II. County where employed 300

III. License held Regular H. S. Date issued 1939

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	28
C. Zoology	16
D. Chemistry	24
E. Physics	12
F. Physical Geography	
G. Economic Geography	
*H. Human Physiology	16
Total	96

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	x
3.	English.		9.	Music.	
4.	Foreign Language .		10.	Physical Education	
5.	Home Economics . .		11.	Social Studies . .	
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma ___ Normal ___
Teachers College x Liberal Arts College ___
Other Institution ___

VII. Experience Number of years 2

VIII. Comments Only 9.2 per cent of the teachers had more than fifteen term hours of credit in human physiology.

DATA SHEET

I. Teacher 161

II. County where employed 237

III. License held Regular H. S. Date issued 1940

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	9
B. Botany	8
C. Zoology	
D. Chemistry	16
E. Physics	16
F. Physical Geography	8
G. Economic Geography	
*H. Human Physiology	4
I. Hygiene	1
Total	62

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	___
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Education	___
5. Home Economics . .	___	11. Social Studies . .	___
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma ___ Normal ___
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years 5

VIII. Comments There were 107, or 58.2 per cent of the cases, having less than five term hours of credit in human physiology.

REPRESENTATIVE CASES IN HYGIENE

DATA SHEET

I. Teacher 36

II. County where employed 226

III. License held Regular H. S. Date issued 1922

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	15
C. Zoology	15
D. Chemistry	8
E. Physics	
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	5
*I. Hygiene	5
Total	48

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	x
2.	Commercial Subj. .		8.	Mathematics. . . .	
3.	English.		9.	Music.	
4.	Foreign Language .	x	10.	Physical Education	
5.	Home Economics . .		11.	Social Studies . .	
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma A. B. Normal ___
Teachers College ___ Liberal Arts College x
Other Institution ___

VII. Experience
Number of years 3

VIII. Comments

Only 2.1 per cent of the teachers had more than three term hours of credit in hygiene.

DATA SHEET

I. Teacher 119

II. County where employed 69

III. License held Regular H. S. Date issued ______

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	3
B. Botany	15
C. Zoology	12
D. Chemistry	39
E. Physical Geography	
F. Physics	5
G. Economic Geography	
H. Human Physiology	15
I. Genetics	3
J. Embryology	5
K. Geology	3
*L. Hygiene	3
Total	103

V. Related and unrelated subject groups (Check)

1.	Art.	___	7.	Library Science. .	___
2.	Commercial Subj. .	___	8.	Mathematics. . . .	___
3.	English.	x	9.	Music.	___
4.	Foreign Language .	___	10.	Physical Education	___
5.	Home Economics . .	___	11.	Social Studies . .	___
6.	Industrial Arts. .	___	12.		___

VI. Training Degree or diploma A. B.--M. S. Normal ___
Teachers College ___ Liberal Arts College x
Other Institution ______

VII. Experience Number of years Not given

VIII. Comments

Preparation in other biological sciences alleviates the apparent deficiency in hygiene.

DATA SHEET

I. Teacher 96

II. County where employed 107

III. License held Regular H. S. Date issued 1926

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	8
B. Botany	.
C. Zoology	4
D. Chemistry	20
E. Physics	20
F. Physical Geography	4
G. Economic Geography	
H. Human Physiology	
Total	56

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	x
3.	English.		9.	Music.	
4.	Foreign Language .		10.	Physical Education	
5.	Home Economics . .		11.	Social Studies . .	x
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma A. B. Normal x
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years Not given

VIII. Comments

This case represents 95.7 per cent of the teachers who had no training in hygiene as a separate subject.

REPRESENTATIVE CASES IN NATURE STUDY

DATA SHEET

I. Teacher 150

II. County where employed 300

III. License held Regular H. S. Date issued ______

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	4
B. Botany	16
C. Zoology	12
D. Chemistry	
E. Physics	
F. Physical Geography	12
G. Economic Geography	
H. Human Physiology	12
*I. Nature Study	8
Total	64

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	___
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Education	___
5. Home Economics . .	___	11. Social Studies . .	x
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma B. S. Normal ___
Teachers College x Liberal Arts College ___
Other Institution ______________________

VII. Experience
Number of years 10

VIII. Comments There were only two teachers whose records showed more than five term hours of training in nature study. Preparation in other biological sciences alleviates the deficiency.

DATA SHEET

I. Teacher 148

II. County where employed 100

III. License held Regular H. S. Date issued 1931

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	4
B. Botany	16
C. Zoology	
D. Chemistry	
E. Physics	4
F. Physical Geography	8
G. Economic Geography	2
H. Human Physiology	4
I. General Science	4
*J. Nature Study	4
Total	46

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	___
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Education	___
5. Home Economics . .	___	11. Social Studies . .	___
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma B. S. Normal ___
Teachers College x Liberal Arts College ___
Other Institutions ___

VII. Experience
Number of years 5

VIII. Comments More teachers, with the exception of those who had no training, had four hours of preparation in nature study than any other hour tabulated.

DATA SHEET

I. Teacher 120

II. County where employed 143

III. License held Regular H. S. Date issued 1939

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	18
C. Zoology	18
D. Chemistry	
E. Physics	12
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	18
I. Bio. Prob.	6
Total	72

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	x
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Education	___
5. Home Economics . .	___	11. Social Studies . .	___
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma A. B. Normal ___
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years Not given

VIII. Comments This case represents 94.0 per cent of the teachers surveyed having no training in nature study as a separate subject.

REPRESENTATIVE CASES IN PHYSICAL GEOGRAPHY

DATA SHEET

I. Teacher 85

II. County where employed 127

III. License held Regular H. S. Date issued 1940

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	18
C. Zoology	18
D. Chemistry	18
E. Physics	18
*F. Physical Geography	23
G. Economic Geography	21
H. Human Physiology	18
Total	134

V. Related and unrelated subject groups (Check)

1. Art.		7. Library Science. .	
2. Commercial Subj. .		8. Mathematics. . . .	
3. English.		9. Music.	
4. Foreign Language .		10. Physical Education	x
5. Home Economics . .		11. Social Studies . .	
6. Industrial Arts. .		12.	

VI. Training Degree or diploma A. B. Normal ___
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years Not given

VIII. Comments

This teacher is one of the best prepared in physical geography.

DATA SHEET

I. Teacher 139

II. County where employed 231

III. License held H. S. Principal Date issued 1927

IV. Science courses pursued

	Name of course	Total credits in term hours
A.	Biology	
B.	Botany	16
C.	Zoology	16
D.	Chemistry	4
E.	Physics	16
*F.	Physical Geography	8
G.	Economic Geography	
H.	Human Physiology	10
	Total	70

V. Related and unrelated subject groups (Check)

1.	Art.		7.	Library Science. .	
2.	Commercial Subj. .		8.	Mathematics. . . .	
3.	English.		9.	Music.	
4.	Foreign Language .		10.	Physical Education	
5.	Home Economics . .		11.	Social Studies . .	x
6.	Industrial Arts. .		12.		

VI. Training Degree or diploma B. S. Normal x
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years 3

VIII. Comments This case represents 9.8 per cent of those surveyed and, with the exception of the teachers with no preparation, represents the mode for the distribution from which it is taken.

DATA SHEET

I. Teacher 130

II. County where employed 28

III. License held Regular H. S. Date issued 1937

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	12
C. Zoology	12
D. Chemistry	
E. Physics	24
*F. Physical Geography	4
G. Economic Geography	
H. Human Physiology	8
I. Human Physiology	4
J. Human Physiology	2
Total	66

V. Related and unrelated subject groups (Check)

1. Art.		7. Library Science. .	
2. Commercial Subj. . .	x	8. Mathematics. . . .	
3. English.		9. Music.	
4. Foreign Language .		10. Physical Education	
5. Home Economics . .		11. Social Studies . .	
6. Industrial Arts. .		12.	

VI. Training Degree or diploma B. S. Normal ___
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years 9

VIII. Comments

There were 155, or 84.2 per cent, of the teachers who had less than eight term hours of preparation in physical geography.

REPRESENTATIVE CASES IN PHYSICS

DATA SHEET

I. Teacher 45

II. County where employed 181

III. License held Regular H. S. Date issued 1933

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	24
C. Zoology	
D. Chemistry	24
*E. Physics	72
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	
Total	120

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	___
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Education.	___
5. Home Economics . .	___	11. Social Studies . .	___
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma A. B. Normal ___
Teachers College ___ Liberal Arts College x
Other Institution ___

VII. Experience
Number of years 11

VIII. Comments This teacher's years of experience should add much in preparation in other science branches. This teacher is exceptionally well prepared in physics.

DATA SHEET

I. Teacher 14

II. County where employed 323

III. License held Regular H. S. Date issued ______

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	
C. Zoology	
D. Chemistry	
*E. Physics	36
F. Physical Geography	
G. Economic Geography	8
H. Human Physiology	
Total	44

V. Related and unrelated subject groups (Check)

1.	Art.	___	7.	Library Science. .	___
2.	Commercial Subj. .	___	8.	Mathematics. . . .	x
3.	English.	___	9.	Music.	___
4.	Foreign Language .	___	10.	Physical Education	___
5.	Home Economics . .	___	11.	Social Studies . .	___
6.	Industrial Arts. .	___	12.		___

VI. Training Degree or diploma A. B. Normal ___
Teachers College x Liberal Arts College ___
Other Institution ______

VII. Experience
Number of years Not given

VIII. Comments

This teacher is among the best prepared in physics.

DATA SHEET

I. Teacher 149

II. County where employed 300

III. License held Regular H. S. Date issued 1939

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	12
C. Zoology	12
D. Chemistry	24
*E. Physics	
F. Physical Geography	12
G. Economic Geography	
H. Human Physiology	4
I. Nature Study	4
J. Geography	2
Total	70

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	___
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Education	___
5. Home Economics . .	___	11. Social Studies . .	___
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma A. B. Normal ___
Teachers College x Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years 14

VIII. Comments

Nearly two-fifths of the teachers had no training in physics.

REPRESENTATIVE CASES IN ZOOLOGY

DATA SHEET

I. Teacher 4

II. County where employed 136

III. License held Regular H. S. Date issued ______

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	16
*C. Zoology	24
D. Chemistry	4
E. Physics	24
F. Physical Geography	
G. Economic Geography	8
H. Human Physiology	
Total	76

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	___
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Education	___
5. Home Economics . .	___	11. Social Studies . .	x
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma B. S. Normal ___
Teachers College x Liberal Arts College ___
Other Institution ______________________

VII. Experience
Number of years Not given

VIII. Comments

This teacher represents those best prepared in zoology.

DATA SHEET

I. Teacher 10

II. County where employed 69

III. License held Regular H. S. Date issued 1939

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	
B. Botany	16
*C. Zoology	24
D. Chemistry	
E. Physics	
F. Physical Geography	
G. Economic Geography	
H. Human Physiology	8
Total	48

V. Related and unrelated subject groups (Check)

1. Art.		7. Library Science. .	
2. Commercial Subj. .		8. Mathematics. . . .	x
3. English.		9. Music.	
4. Foreign Language .		10. Physical Education	
5. Home Economics . .		11. Social Studies . .	x
6. Industrial Arts. .		12.	

VI. Training Degree or diploma B. S. Normal ___
Teachers College ___ Liberal Arts College ___
Other Institution ___

VII. Experience
Number of years 5

VIII. Comments Among the teachers who had training in zoology, more prepared in twelve to sixteen term hours than in any other hour range.

DATA SHEET

I. Teacher 152

II. County where employed 47

III. License held Regular H. S. Date issued ______

IV. Science courses pursued

Name of course	Total credits in term hours
A. Biology	12
B. Botany	4
*C. Zoology	4
D. Chemistry	
E. Physics	
F. Physical Geography	24
G. Economic Geography	4
H. Human Physiology	16
I. Science 24-67	8
Total	72

V. Related and unrelated subject groups (Check)

1. Art.	___	7. Library Science. .	___
2. Commercial Subj. .	___	8. Mathematics. . . .	___
3. English.	___	9. Music.	___
4. Foreign Language .	___	10. Physical Education	___
5. Home Economics . .	___	11. Social Studies . .	___
6. Industrial Arts. .	___	12.	___

VI. Training Degree or diploma ___ Normal ___
Teachers College x Liberal Arts College ___
Other Institution ______

VII. Experience
Number of years 17

VIII. Comments

More than half of the teachers had less than five term hours of credit in zoology.

II. FINDINGS

1. There are wide differences in training among the teachers studied.

2. The individual cases are representative of the distributions from which they are taken.

3. Factors contributing to teacher training are present in the individual cases selected.

   a. The teachers have had experience.

   b. The teachers hold degrees.

   c. Their teaching combinations give breadth of vision.

   d. The teachers have attended recognized teacher training institutions.

CHAPTER VII

SUMMARY AND CONCLUSIONS

This investigation has collected data from 244 teachers of science in Indiana to bring together certain facts relating to teachers licensed to teach general science in the schools of this state.

I. THE PROBLEM

The problem was (1) to collect data concerning the academic training of these teachers; (2) to find out how adequate the training of the teachers is; (3) to discover the points of greatest weakness; and (4) to compare the preparation of these teachers and the scope of science branches expected to be covered in the curriculum as indicated by texts in general science widely used in Indiana.

II. GENERAL FINDINGS

A. Adequacy of academic training

1. More than half of the teachers pursued four or more branches of science.
2. Only two teachers pursued as many as ten branches of science defined in this study.
3. More teachers prepared in four branches of science than in any other number of sciences.

4. An analysis of three science areas (biological sciences, physical sciences, and earth and sky sciences) showed that slightly more than half of the teachers were prepared in two science areas; More than one-fourth were prepared in three areas; approximately one-eighth pursued sciences in one area.

B. Points of greatest weakness

1. There were more teachers who had no training in astronomy, bacteriology, hygiene, nature study, and economic geography than had no training in any of the other branches of science named in this study.

2. Nearly one-fourth of the teachers had no training in the biological sciences.

3. Nearly one-fourth of the teachers had no training in the physical sciences.

4. Nearly half of the teachers had no training in the earth and sky sciences.

C. Comparison of findings with the scope of science branches expected to be covered in the curriculum as indicated by texts in general science widely used in Indiana.

1. While textbooks in general science widely used in Indiana cover broad scientific areas, many teachers licensed to teach general science

have pursued less than four branches of science.

2. Since the authors do not agree upon the sciences that should receive the greatest emphasis, it was difficult to determine which science should receive the greatest emphasis in training. This finding emphasizes, then, the need for broad preparation.

3. The texts examined showed much integration of the branches of science from chapter to chapter and within each chapter, and to some extent the training of the teachers selected for this study showed an integration of preparation.

III. CONCLUSIONS

In the light of the findings the following conclusions seem justified:

Wider academic preparation. Although the integration of science branches is desirable for instructional purposes, much of the subject matter is specific and requires, therefore, direct preparation and specific training on the part of the teacher. To meet this demand the teacher must have wide preparation in the academic fields of science. Too many of the teachers selected for this study are inadequately prepared to teach general science effectively.

<u>In-service training</u>. At least half of the teachers surveyed should raise their academic preparation in science through in-service training together with other means of scholastic improvement and growth.

<u>Revision of teaching assignments</u>. Many teachers are well prepared to teach one or more phases of general science. In schools where there are enough teachers so prepared, students would profit by being taught general science by more than one teacher.

<u>Licensing</u>. Much improvement has been made in the general preparation of secondary teachers through the revision of the teacher licensing laws. The disappearance of the blanket license and the examination as means of teacher certification has improved the scholastic status not only of the general science teacher but of many other secondary and elementary teachers in the state.

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APPENDIX A

DATA OBTAINED FROM THE STATE HOUSE

Teacher	License* held	Date issued	Branches of science pursued and term hours		Related and unrelated subject groups	Place of training	Degree or diploma	Years' experience
1	Regular high school	1939	Botany	28	Mathematics	Teachers College		2
			Zoology	16				
			Chemistry	24				
			Physics	12				
			Human Physiology	16				
			Total	96				
2	Regular high school		Biology	8	Mathematics	Liberal Arts College	A. B. B. S.	2
			Botany	10				
			Zoology	10				
			Physics	20				
			Human Physiology	8				
			Total	56				
3	Regular high school	1939	Botany	24	Mathematics	Teachers College	B. S.	
			Chemistry	24				
			Zoology	24				
			Economic Geography	16				
			Total	88				
4	Regular high school		Botany	16	Social Studies	Teachers College	B. S.	
			Zoology	24				
			Chemistry	4				
			Physics	24				
			Economic Geography	8				
			Total	76				

* The license listed here is the last license the teacher received to August, 1942. (The files in the State House are keyed to the last license received.)

DATA OBTAINED FROM THE STATE HOUSE (continued)

5	Regular high school	1939	Zoology Chemistry Physics Physiology Total	4 20 24 20 68	Commercial Subjects Mathematics	Teachers College	B. S.	
6	Regular high school	1933	Botany Zoology Chemistry Physics Total	25 25 10 30 90	English		A. B.	16
7	Regular high school	1938	Chemistry Physics Total	24 24 48	Foreign Language Mathematics		A. B.	
8	Regular high school		Biology Botany Zoology Human Physiology Geography Total	4 16 12 9 14 55	Social Studies	Teachers College	B. S.	26
9	Regular high school	1924	Chemistry Physics Total	38 28 66	Mathematics	Technical College	B. S.	5
10	Regular high school	1939	Botany Zoology Human Physiology Total	16 24 8 48	English Social Studies			

DATA OBTAINED FROM THE STATE HOUSE (continued)

11	Regular high school	1926	Biology	8	Mathematics	Normal	B. S.	2
			Botany	4				
			Chemistry	16				
			Physics	24				
			Economic Geography	16				
			Human Physiology	12				
			Total	80				
12	Regular high school	1924	Physics	32	Mathematics		A. B.	2
13	Regular high school		Biology	5		Teachers College Liberal Arts College	B. S.	5
			Botany	24				
			Chemistry	12				
			Physics	28				
			Zoology	12				
			Total	81				
14	Regular high school	1934	Physics	36	Mathematics	Teachers College	A. B.	
			Geography	8				
			Total	44				
15	Regular high school	1932	Biology	4	Social Studies	Liberal Arts College	B. S.	1
			Botany	16				
			Zoology	10				
			Physics	16				
			Economic Geography	8				
			Total	54				

DATA OBTAINED FROM THE STATE HOUSE (continued)

16	Regular high school	1937	Biology	8	Mathematics	Normal	B. S.
			Botany	12	Physical Education		
			Zoology	12			
			Human Physiology	8			
			Total	40			
17	Regular high school		Biology	32	Commercial Subjects	Teachers College	B. S.
			Economic Geography	4			
			Human Physiology	4			
			Total	44			
18	Regular high school	1938	Botany	4		Normal	A. B.
			Chemistry	15			
			Physics	15			
			Physical Geography	8			
			Human Physiology	4			
			Total	46			
19	Regular high school	1937	Chemistry	32	Mathematics	Teachers College	
			Physics	32			
			Physical Geography	4			
			Total	68			
20	Regular high school	1936	Biology	12	Industrial Arts	Teachers College	B. S.
			Botany	12			
			Physics	24			
			Human Physiology	16			
			Total	64			

DATA OBTAINED FROM THE STATE HOUSE (continued)

21	Regular high school	1931	Botany	12	Industrial Arts	Teachers College	B. S.	
			Zoology	12				
			Physics	24				
			Physical Geography	4				
			Human Physiology	12				
				8				
			Total	72				
22	Regular high school	1934	Botany	12	Mathematics	Teachers College	B. S.	7
			Zoology	12				
			Chemistry	24				
			Physics	8				
			Human Physiology	4				
			Science 72?	4				
			Total	64				
23	Blanket	1928	Zoology	10		Liberal Arts College	A. B.	
			Chemistry	54				
			Physics	5				
			Total	69				
24	Regular high school	1924	Botany	12		Liberal Arts College	B. S. M. S.	
			Zoology	18				
			Chemistry	12				
			Physical Geography	9				
			?	9				
			?	15				
			Total	75				
25	Regular high school	1936	Biology	21	Mathematics	Technical College	B. S.	
			Chemistry	87				
			Physics	12				
			Human Physiology	9				
			Total	129				

DATA OBTAINED FROM THE STATE HOUSE (continued)

26	Regular high school	1938	Biology	33		Technical College	B. S.
			Chemistry	9			
			Physics	12			
			Economics Geography	9			
			Total	63			
27	Regular high school	1938	Biology	15	Social Studies	Teachers College	B. S.
			Botany	15			
			Chemistry	15			
			Physics	8			
			Human Physiology	8			
			Total	61			
28	Vocational Agriculture	1939	Biology	24	Agriculture	Technical College	B. S. A.
			Botany	29			
			Chemistry	27			
			Physics	5			
			Total	85			
29	Regular high school	1938	Biology	21	English Home Economics	Technical College	B. S.
			Chemistry	30			
			Physics	6			
			Human Physiology	9			
			Total	66			
30	Regular high school	1939	Chemistry	33	Mathematics	Liberal Arts College	A. B.
			Physics	24			
			Human Physiology	5			
			Total	62			

DATA OBTAINED FROM THE STATE HOUSE (continued)

31	Regular	1928	Biology	27	Agriculture	Liberal	B. S.	1
	high		Botany	12		Arts	M. S.	
	school		Zoology	12		College		
			Physics	5				
			Chemistry	27				
			Economic Geog-raphy	12				
			Total	95				
32	Regular	1939	Biology	51	Social	Technical	B. S.	2
	high		Zoology	24	Studies	College		
	school		Chemistry	54				
			Physics	12				
			Human Physiology	9				
			Total	150				
33	Regular		Biology	42	Social	Liberal	A. B.	
	high		Botany	12	Studies	Arts		
	school		Human Physiology	5				
			Total	59				
34	Regular	1924	Chemistry	30	Mathemat-	Liberal	A. B.	
	school		Physics	32	ics	Arts		
			Total	62		College		
35	Regular	1926	Chemistry	60	Mathemat-	Liberal	A. B.	1
	high		Physics	5	ics	Arts		
	school		Total	65		College		
36	Regular	1922	Botany	15	English	Liberal	A. B.	3
	high		Zoology	15	Library	Arts		
	school		Chemistry	8	Science	College		
			Human Physiology	5				
			Hygiene	5				
			Total	48				

DATA OBTAINED FROM THE STATE HOUSE (continued)

37	Regular high school	1927	Biology	9	Social Studies	Liberal Arts College	A. B.	5
			Botany	6				
			Zoology	15				
			Physics	12				
			Total	42				
38	Blanket	1924	Chemistry	60	Mathematics		A. B.	11
			Physics	12				
			Total	72				
39	Regular high school	1929	Chemistry	72	English	Liberal Arts College	A. B.	2
			Physics	24				
			Astronomy	6				
			Geology	3				
			Total	105				
40	Regular high school	1925	Botany	57	English	Liberal Arts College		
			Human Physiology	2	Mathematics			
			Geology	15				
			Total	74				
41	Regular high school	1941	Botany	18	English	Liberal Arts College	A. B.	
			Zoology	20	Foreign Language			
			Chemistry	39	Social Studies			
			Physics	24				
			Total	101				
42	Regular high school	1937	Biology	39	English	Technical College	B. P. E.	
			Chemistry	9	Mathematics			
			Economic Geography	9	Social Studies			
			Total	57				

DATA OBTAINED FROM THE STATE HOUSE (continued)

43	Regular high school	1936	Biology Botany Chemistry Total	32 30 27 89	English Social Studies Agriculture		B. S.	5
44	Regular high school	1932	Biology Botany Chemistry Physics Human Physiology Forestry Total	18 30 9 9 9 6 81	Social Studies	Technical College		5
45	Regular high school	1933	Botany Chemistry Physics Total	24 24 72 120	Industrial Arts Mathematics	Liberal Arts College	A. B.	11
46	Regular high school		Botany Physical Geography Economic Geography Geology Total	32 3 3 15 53	English Foreign Language	Liberal Arts College		5
47	Regular high school	1939	Chemistry Physics Geology Total	30 5 3 38	Foreign Language Mathematics	Liberal Arts College	B. S.	8

DATA OBTAINED FROM THE STATE HOUSE (continued)

48	Regular high school	1941	Botany	24	Physical Education	Teachers College	A. B.	
			Zoology	30				
			Chemistry	36				
			Physics	18				
			Total	108				
49	Regular high school	1938	Biology	32	English Mathematics	Liberal Arts College	B. S.	4
			Physics	23				
			Total	55				
50	Special high school	1934	Chemistry	57		Liberal Arts College	B. S.	5
			Physics	8				
			Total	65				
51	Special high school	1938	Biology	15	Home Economics	Technical College		
			Chemistry	18				
			Physics	6				
			Total	39				
52	Regular high school	1939	Biology	26	Agriculture	Technical College	B. S. A.	
			Botany	29				
			Physics	27				
			Physical Geography	5				
			Total	87				
53	Regular high school	1940	Zoology	18	Mathematics		B. S.	
			Chemistry	18				
			Physics	36				
			Physical Geography	24				
			Economic Geography	12				
			Total	108				

DATA OBTAINED FROM THE STATE HOUSE (continued)

54	Regular high school	1940	Chemistry	30	Mathematics	Liberal Arts College	A. B.	5
			Physics	90			A. M.	
			Total	120				
55	Special high school	1939	Biology	28	Agriculture	Technical College	B. S.	
			Botany	23				
			Chemistry	39				
			Total	90				
56	Regular high school	1924	Chemistry	8	Mathematics	Technical College	B. S.	9
			Physics	13	Agriculture			
			Total	21				
57	Regular high school	1935	Biology	36	Agriculture	Technical College	B. S.	8
			Botany	34			M. S.	
			Chemistry	23				
			Total	93				
58	Regular high school	1929	Botany	20	Physical Education	Liberal Arts College	A. B.	7
			Zoology	20				
			Human Physiology	18				
			Total	58				
59	Special high school	1933	Biology	32	Agriculture	Technical College	B. S. A.	5
			Botany	28				
			Chemistry	23				
			Total	83				
60	Regular high school	1937	Biology	12	Foreign Language	Liberal Arts College	A. B.	4
			Botany	8	Physical Education		B. S.	
			Zoology	9				
			Chemistry	5				
			Physics	5				
			Total	39				

DATA OBTAINED FROM THE STATE HOUSE (continued)

61	Regular high school	1939	Physics	30	Mathematics	Liberal Arts College		5
62	Regular high school	1939	Botany Zoology Chemistry Physics Total	15 20 53 12 100	Social Studies	Liberal Arts College		
63	Regular high school	1937	Biology Chemistry Total	33 9 42	Agriculture	Technical College	B. S. M. S.	5
64	Special high school	1940	Biology Chemistry Physics Total	48 18 37 103	Mathematics Agriculture	Technical College	B. S. B. S. A.	5
65	Regular high school	1937	Botany Zoology Chemistry Human Physiology Total	20 26 30 8 84	English		B. S.	4
66	Special high school	1927	Botany Chemistry Human Physiology Total	48 18 18 84	Home Economics	Teachers College	B. S.	4
67	Special high school	1940	Biology Botany Chemistry Physics Total	30 32 27 5 94	Agriculture		B. S. A.	5

DATA OBTAINED FROM THE STATE HOUSE (continued)

68	High school principal	1938	Biology Botany Chemistry Total	3 15 8 26		Liberal Arts College	A. B.	5
69	Regular high school	1938	Biology Chemistry Physics Total	54 9 11 74		Technical College	B. S. M. S.	
70	Regular high school	1924	Biology Botany Chemistry Physics Total	21 5 14 9 49	Agriculture		B. S.	8
71	Regular high school	1927	Physics	18	Mathematics Social Studies.	Liberal Arts College	A. B.	8
72	Regular high school	1924	Biology Chemistry Total	24 9 33	Art Home Economics		B. S.	9
73	Regular high school	1929	Biology Zoology Chemistry Physics Total	54 41 41 12 148	Agriculture		B. S.	4
74	Regular high school		Biology Physics Total	30 48 78	Industrial Mathematics	Liberal Arts College		5

DATA OBTAINED FROM THE STATE HOUSE (continued)

75	Special high school	1927	Biology	21	Agriculture		B. S.	5
			Botany	12				
			Zoology	17				
			Chemistry	27				
			Physics	5				
			Human Physiology	12				
			Total	94				
76	Regular high school	1931	Botany	19		Normal	A. B.	6
			Zoology	19				
			Chemistry	19				
			Physics	11				
			Economic Geography	4				
			Human Physiology	4				
			Total	76				
77	Regular high school	1942	Zoology	6	Foreign Language	Liberal Arts College	A. B.	
			Chemistry	23	Physical Education			
			Physics	23				
			Human Physiology	15				
			Total	67				
78	Regular high school	1941	Biology	54	Social Studies	Teachers College	B. S.	
79	Special high school	1941	Human Physiology	54	Home Economics	Teachers College	B. S.	
80	Regular high school		Physics	41		Teachers College	A. B. M. A.	11

DATA OBTAINED FROM THE STATE HOUSE (continued)

81	Special high school	1925	Biology	12	Social Studies	Liberal Arts College	A. B.	
			Botany	12				
			Physics	12				
			Total	36				
82	Regular high school	1931	Biology	4	Social Studies	Teachers College	B. S.	5
			Botany	8				
			Zoology	12				
			Chemistry	24				
			Physical Geography	8				
			Human Physiology	7				
			Total	63				
83	Regular high school	1939	Zoology	8	English Mathematics	Liberal Arts College	A. B.	
			Chemistry	27				
			Physics	38				
			Human Physiology	16				
			Total	89				
84	Regular high school	1938	Botany	16	Physical Education		A. B.	
			Zoology	12				
			Chemistry	12				
			Human Physiology	4				
			Hygiene	4				
			Genetics	4				
			Total	52				
85	Regular high school	1940	Botany	18	Physical Education		A. B.	
			Zoology	18				
			Chemistry	18				
			Physics	18				
			Physical Geography	23				
			Economic Geog.	21				
			Human Physiology	18				
			Total	134				

DATA OBTAINED FROM THE STATE HOUSE (continued)

86	Regular high school	1937	Biology	15			A. B.	
			Chemistry	50				
			Physics	27				
			Total	92				
87	Vocational Agriculture	1939	Biology	26	Agriculture		B. S. A.	
			Botany	29				
			Chemistry	29				
			Physics	5				
			Total	89				
88	Regular high school	1932	Physics	30	Ehglish Mathematics	Liberal Arts College	A. B.	
89	Permit	1938	Biology	21	English Social Studies	Technical College	B. S.	
			Physics	9				
			Physical Geography	12				
			Total	42				
90	Regular high school	1933	Biology	30	Agriculture	Technical College	B. S. A.	5
			Botany	32				
			Chemistry	27				
			Physics	5				
			Total	94				
91	Special high school	1938	Biology	45	Agriculture	Technical College	B. S. A.	16
			Chemistry	18				
			Physics	9				
			Total	72				

DATA OBTAINED FROM THE STATE HOUSE (continued)

92	Regular high school supt.	1925	Botany Zoology Chemistry Human Physiology Total	14 15 20 8 57	Social Studies	Liberal Arts College	A. B. M. S.	1
93	Regular high school	1932	Biology Botany Zoology Human Physiology Total	15 9 8 8 40		Liberal Arts College	A. B. M. S.	
94	Regular high school	1941	Chemistry	60	English Mathematics	Teachers College	B. S.	1
95	Regular high school	1933	Chemistry Physical Geography Total	16 12 28	Physical Education Social Studies		B. S.	
96	Regular high school	1926	Biology Zoology Chemistry Physics Physical Geography Total	8 4 20 20 4 56	Mathematics Social Studies	Normal	A. B.	
97	Blanket	1924	Chemistry Physical Geog. Human Physiology Total	12 8 4 24	Home Economics	Normal Teachers College	A. B.	

DATA OBTAINED FROM THE STATE HOUSE (continued)

98	Regular high school	1938	Chemistry	22	Physical Education	Technical College	B. S.	5
			Physics	22	Mathematics			
			Human Physiology	10				
			Total	54				
99	Regular high school	1929	Botany	10	English	Liberal Arts College	A. B.	6
			Zoology	14	Mathematics			
			Chemistry	2				
			Physics	16				
			Geology	4				
			Geology	3				
			Total	49				
100	Regular high school	1937	Physics	26	Foreign Language	Liberal Arts College	A. B.	4
			Astronomy	4	Mathematics			
			Total	30	Social Studies			
101	Regular high school	1930	Botany	12	Mathematics	Liberal Arts College	A. B.	5
			Zoology	12				
			Physics	24				
			Human Physiology	6				
			Anatomy	6				
			Total	60				
102	Regular high school	1935	Botany	12	Mathematics	Liberal Arts College	A. B.	5
			Zoology	12	Physical Education			
			Chemistry	17				
			Physics	22				
			Human Physiology	6				
			Anatomy	6				
			Total	75				

DATA OBTAINED FROM THE STATE HOUSE (continued)

103	Regular high school	1932	Biology	8	English	Liberal Arts College	B. S.	6
			Botany	6	Mathematics			
			Zoology	12	Social Studies			
			Chemistry	45				
			Physics	4				
			Human Physiology	6				
			Astronomy	5				
			Total	86				
104	Regular high school	1933	Biology	8	English	Normal	B. S.	4
			Botany	12	Industrial Arts			
			Zoology	8	Agriculture			
			Chemistry	4				
			Physics	12				
			Economic Geog.	16				
			Human Physiology	16				
			Geology	4				
			Total	80				
105	Regular high school	1932	Botany	14	Physical Education		B. S.	10
			Zoology	14	Social Studies			
			Astronomy	2				
			Human Physiology	8				
			Ed. Hygiene	4				
			Total	42				
106	Regular high school	1941	Biology	12	English	Normal	B. S.	
			Chemistry	24	Mathematics			
			Physics	24				
			Anatomy	8				
			Total	68				

DATA OBTAINED FROM THE STATE HOUSE (continued)

107	Regular high school	1930	Biology Botany Zoology Chemistry Physics Human Physiology Bacteriology Total	4 12 16 24 12 16 4 88	Physical Education	Teachers College	B. S.	
108	Regular high school	1935	Botany Zoology Physics Astronomy Geology Total	15 15 15 4 5 54	Industrial Arts Mathematics	Liberal Arts College	A. B.	11
109	Regular high school	1932	Biology Botany Zoology Human Physiology Total	4 12 16 8 40	Mathematics Physical Education Social Studies	Normal	B. S.	
110	Regular high school	1935	Chemistry Physics Human Physiology Mettallurgy Total	24 28 12 3 67	Mathematics	Teachers College	A. B.	
111	Regular high school		Biology Botany Zoology Chemistry Geology Total	5 10 12 13 9 49	Mathematics Social Studies	Liberal Arts College	A. B.	

DATA OBTAINED FROM THE STATE HOUSE (continued)

112	Regular high school		Botany	12	English Home Economics	Liberal Arts College	B. S.	
			Zoology	10				
			Chemistry	15				
			Human Physiology	18				
			Neurology	4				
			Total	59				
113	Regular high school	1936	Chemistry	12	Mathematics	Liberal Arts College	A. B.	5
			Physics	10				
			Physical Geog.	12				
			Economic Geog.	6				
			Human Physiology	4				
			Physiography	4				
			Total	48				
114	Regular high school		Biology	13	Mathematics Physical Education	Liberal Arts College		4
			Zoology	4				
			Chemistry	45				
			Physics	16				
			Human Physiology	12				
			Hygiene	4				
			Total	94				
115	Regular high school		Biology	4	Social Studies	Liberal Arts College	B. S.	12
			Botany	6				
			Zoology	12				
			Human Physiology	10				
			Nature Study	2				
			Hygiene	4				
			Total	38				

DATA OBTAINED FROM THE STATE HOUSE (continued)

116	Regular high school		Chemistry	24	Mathematics	Teachers College	B. S. M. S.	3
			Physics	24				
			Physical Geog.	8				
			Human Physiology	4				
			Nature Study	4				
			Science 102	2				
			Total	66				
117	Regular high school	1939	Botany	12	Social Studies	Liberal Arts College	B. S.	6
			Zoology	8				
			Physics	20				
			Physical Geog.	4				
			Human Physiology	8				
			Geography	2				
			Total	54				
118	Regular high school	1937	Biology	8	Mathematics	Normal	B. S.	13
			Botany	8				
			Zoology	8				
			Physics	16				
			Nature Study	4				
			Human Physiology	4				
			Anatomy	8				
			Physiology and Hygiene	4				
			Total	60				
119	Regular high school	1939	Biology	3	English	Liberal College	A. B. M. S.	
			Botany	15				
			Zoology	12				
			Chemistry	39				
			Physics	5				
			Human Physiology	15				

DATA OBTAINED FROM THE STATE HOUSE (continued)

			Genetics	3				
			Embryology	5				
			Geology	3				
			Hygiene	3				
			Total	103				
120	Regular high school	1939	Botany	18	Mathematics		A. B.	
			Zoology	18				
			Physics	12				
			Human Physiology	18				
			Bio. Prob.	6				
			Total	72				
121	Special high school		Biology	12				
			Genetics	9				
			Zoology	15				
			Chemistry	15				
			Physics	15				
			Physical Geog.	6				
			Economic Geog.	6				
			Human Physiology	5				
			Plant Bio.	9				
			Hi. Bio.	3				
			Total	95				
122	Regular high school		Biology	5	Mathematics	Liberal Arts College	B. S.	9
			Chemistry	21				
			Physics	21				
			Geology	6				
			Mineralogy	3				
			Astronomy	6				
			Total	62				

DATA OBTAINED FROM THE STATE HOUSE (continued)

123	Regular high school	1926	Biology	9		Technical College	B. S. A. M.	3
			Chemistry	21				
			Physics	27				
			Human Physiology	9				
			Geology	3				
			Total	69				
124	Regular high school	1938	Biology	4	Social Studies	Normal	B. S.	8
			Botany	12				
			Zoology	16				
			Geography	8				
			Human Physiology	8				
			Total	48				
125	Regular high school	1939	Botany	12	Mathematics	Teachers College	B. S.	6
			Chemistry	4				
			Physics	4				
			Geography	4				
			Total	24				
126	Regular high school	1938	Biology	8	Physical Education	Teachers College		
			Botany	8				
			Zoology	2				
			Zoology	2				
			Science	6				
			Total	26				
127	Regular high school	1941	Botany	12	Social Studies		B. S.	
			Zoology	12				
			Physics	20				
			Physical Geog.	4				
			Human Physiology	8				
			Science 201-301	8				
			Total	64				

DATA OBTAINED FROM THE STATE HOUSE (continued)

128	Regular high school	1929	Chemistry	28	Mathematics	Teachers College	A. B.	5
			Physics	32				
			Physical Geog.	16				
			Total	76				
129	Regular high school		Biology	7	Physical Education		B. S.	4
			Botany	12	Social Studies			
			Zoology	6				
			Physical Geog.	4				
			Human Physiology	4				
			Personal Hy.	4				
			Agriculture	2				
			Total	39				
130	Regular high school	1937	Botany	12	Commercial Subjects		B. S.	9
			Zoology	12	Physical Education			
			Physics	24				
			Physical Geog.	4				
			Human Physiology	14				
			Total	66				
131	Supt. Regular high school		Zoology	4	Library Science		A. B. M. S.	5
			Chemistry	8				
			Physical Geog.	9				
			Human Physiology	4				
			Total	25				
132	Regular high school	1937	Botany	24	Social Studies		B. S.	
			Zoology	16				
			Chemistry	4				
			Physics	24				
			Physical Geog.	8				
			Human Physiology	8				
			Total	84				

DATA OBTAINED FROM THE STATE HOUSE (continued)

133	Regular	1932	Biology	4	Physical		B. S.	5
	high		Botany	4	Education			
	school		Chemistry	28				
			Physics	24				
			Human Physiology	8				
			Total	68				
134	Regular	1938	Botany	20	Foreign		A. B.	20
	high		Zoology	12	Language		M. S.	
	school		Chemistry	12	Social			
			Physics	16	Studies			
			Physical Geog.	8				
			Human Physiology	8				
			Total	76				
135	Regular	1924	Physical Geog.	47	Mathematics		A. B.	11
	high							
	school							
136	Regular	1939	Botany	4	Mathematics	Teachers	B. S.	4
	high		Zoology	16	Social	College		
	school		Chemistry	24	Studies			
			Physical Geog.	4				
			Physics	24				
			Human Physiology	8				
			Total	80				
137	Regular	1932	Botany	15	English	Teachers	A. B.	
	high		Zoology	15	Library	College		
	school		Chemistry	28	Science			
			Human Physiology	8				
			Total	66				

DATA OBTAINED FROM THE STATE HOUSE (continued)

138	Regular high school	1932	General Science	68	Mathematics	Teachers College	A. B.	
139	High school prin.	1927	Botany	16	Social Studies	Normal	B. S.	3
			Zoology	16				
			Chemistry	4				
			Physics	16				
			Physical Geog.	8				
			Human Physiology	10				
			Total	70				
140	Regular high school	1924	Biology	12		Liberal Arts College		5
			Botany	12				
			Geology	12				
			Economic Geog.	4				
			Human Physiology	4				
			Total	44				
141	Regular high school	1941	Chemistry	25	Mathematics	Teachers College	A. B. M. A.	5
			Physics	26				
			Physical Geog.	7				
			Total	58				
142	Supt. regular high school	1928	Biology	4	Mathematics	Normal		5
			Botany	16				
			Zoology	8				
			Physics	24				
			Physical Geog.	8				
			Human Physiology	6				
			Total	66				

DATA OBTAINED FROM THE STATE HOUSE (continued)

143	Regular high school	1929	Biology	4		Teachers College	A. B. M. S.	8
			Botany	16				
			Zoology	12				
			Physics	4				
			Human Physiology	8				
			Bacteriology	4				
			Total	48				
144	Regular high school	1930	Biology	4	Mathematics	Teachers College	B. S.	5
			Botany	12				
			Zoology	8				
			Physics	24				
			Physical Geog.	10				
			Human Physiology	4				
			Nature Study	4				
			Total	66				
145	Regular high school	1939	Botany	12	Foreign Language Social Studies	Liberal Arts College	A. B.	9
			Zoology	12				
			Physics	24				
			Human Physiology	6				
			Embryology	6				
			Science	3				
			Total	63				
146	Regular high school	1929	Biology	28	Physical Education Social Studies	Teachers College	B. S.	5
			Botany	8				
			Human Physiology	8				
			Nature Study	4				
			Total	48				
147	Regular high school		Biology	21		Liberal Arts College	A. B.	2
			Chemistry	36				
			Human Physiology	12				

			Bacteriology	4				
			Nature Study	4				
			Total	77				
148	Regular high school	1931	Biology	4	Mathematics	Teachers College	B. S.	5
			Botany	16				
			Physics	4				
			Physical Geog.	8				
			Geography	2				
			Human Physiology	4				
			General Science	4				
			Nature Study	4				
			Total	46				
149	Regular high school	1939	Botany	12	English	Teachers College		14
			Zoology	12				
			Chemistry	24				
			Physical Geog.	12				
			Human Physiology	4				
			Nature Study	4				
			Geo.	2				
			Total	70				
150	Regular high school	1932	Biology	4	Social Studies		B. S.	10
			Botany	16				
			Zoology	12				
			Physical Geog.	12				
			Human Physiology	12				
			Nature Study	8				
			Total	64				
151	Regular high school	1934	Geography	32	English Social Studies	Normal	A. B.	
			Physiology	4				
			Geology	4				
			Total	40				

DATA OBTAINED FROM THE STATE HOUSE (continued)

152	Special Voca-tional Regular high school Permit		Biology	12		Teachers College		17
			Botany	4				
			Zoology	4				
			Physical Geog.	24				
			Economic Geog.	4				
			Human Physiology	16				
			Science 24-67	8				
			Total	72				
153	Regular high school	1939	Chemistry	12	Foreign Language Mathematics	Liberal Arts College	A. B.	
			Physical Geog.	39				
			Astronomy	4				
			Total	55				
154	Voca-tional agriculture	1924	Botany	3	Agriculture	Liberal Arts College	B. S.	8
			Zoology	11				
			Chemistry	22				
			Physics	22				
			Physical Geog.	33				
			Human Physiology	7				
			Geology	3				
			Total	101				
155	Regular high school	1932	Botany	12	English	Liberal Arts College	M. S. B. S.	5
			Zoology	8				
			Human Physiology	3				
			Geology	3				
			Natural Geog.	2				
			Total	28				
156	Regular high school	1929	Botany	10	Mathematics	Liberal Arts College		
			Zoology	14				
			Chemistry	2				

DATA OBTAINED FROM THE STATE HOUSE (continued)

			Human Physiology	4				
			Geology	3				
			Total	33				
157	Regular high school		Botany	10	Mathematics	Liberal Arts College	B. S.	
			Zoology	10				
			Chemistry	8				
			Physics	13				
			Embryology	3				
			Human Physiology	10				
			Hygiene	2				
			Genetics	2				
			Total	58				
158	Regular high school	1939	Biology	2			A. B.	
			Chemistry	42				
			Physics	15				
			Human Physiology	5				
			Bacteriology	5				
			Total	69				
159	Regular high school	1938	Biology	13		Liberal Arts College	A. B.	2
			Botany	10				
			Zoology	10				
			Chemistry	5				
			Bacteriology	5				
			Total	43				
160	Regular high school	1929	Botany	12		Teachers College	A. B. M. S.	1
			Zoology	12				
			Chemistry	15				
			Physics	24				
			Physical Geog.	4				

			Economic Geog.	8				
			Hygiene	4				
			Total	79				
161	Regular high school	1940	Biology	9	Physical Education	Liberal Arts College	A. B.	5
			Botany	8				
			Chemistry	16				
			Physics	16				
			Physical Geog.	8				
			Human Physiology	4				
			Hygiene	1				
			Total	62				
162	Regular high school	1935	Biology	6			B. S.	5
			Botany	12				
			Zoology	4				
			Chemistry	8				
			Physics	24				
			Physical Geog.	8				
			Human Physiology	8				
			Geography	2				
			Bacteriology	3				
			Total	75				
163	Regular high school	1938	Biology	34	Physical Education	Teachers College	B. S.	
			Human Physiology	8				
			General Science	28				
			Total	70				
164	Special high school	1926	Biology	4		Teachers College	A. B.	4
			Botany	12		Liberal Arts College	M. A.	
			Zoology	12				
			Chemistry	12				
			Physics	15				

			Human Physiology	4				
			Chem. II	15				
			Embryology	6				
			Total	80				
165	Regular high school	1941	Botany	28	Mathematics	Teachers College	B. S.	6
			Zoology	8				
			Physics	24				
			Physical Geog.	8				
			Human Physiology	4				
			Nature Study	4				
			Science	2				
			Total	78				
166	Regular high school	1941	Botany	12	Mathematics	Teachers College	B. S.	8
			Zoology	12				
			Chemistry	44				
			Physics	20				
			Physical Geog.	4				
			Nature Study	4				
			Human Physiology	8				
			Astronomy	4				
			Science	2				
167	Regular high school		Biology	16	Physical Education Social Studies	Liberal Arts College	B. S.	4
			Botany	10				
			Zoology	11				
			Human Physiology	17				
			Embryology	5				
			Total	59				

DATA OBTAINED FROM THE STATE HOUSE (continued)

168	Regular high school	1932	Chemistry	12	Mathematics	Fine Arts	A. B.	4
			Physics	18				
			Physical Geog.	5				
			Astronomy	6				
			Geology	21				
			Total	62				
169	Regular high school	H	Biology	24	Agriculture	Liberal Arts College	B. S. M. S.	
			Chemistry	20				
			Human Physiology	2				
			Hygiene	3				
			Total	49				
170	Regular high school	1939	Botany	16	Social Studies	Liberal Arts College	B. S. M. S.	10
			Chemistry	6				
			Physics	17				
			Human Physiology	4				
			Geology	15				
			Total	58				
171	Regular high school	1939	Chemistry	9	Mathematics	Teachers College	A. B.	
			Chemistry	15				
			Physics	15				
			Physical Geog.	5				
			Human Physiology	8				
			?	3				
			Total	55				
172	Regular high school	1934	Chemistry	24		Teachers College Liberal Arts College	A. B.	5
			Physics	42				
			Geology	3				
			Total	69				

DATA OBTAINED FROM THE STATE HOUSE (continued)

173	Regular	1928	Biology	36	Foreign	Liberal	A. B.	3
	high		Chemistry	22	Language	Arts		
	school		Geology	8		College		
			Total	66				
174	Blanket		Zoology	6	Mathematics	Liberal	A. B.	12
			Chemistry	51		Arts		
			Physics	20		College		
			Total	77		Normal	Dip.	
175	Regular	1927	Biology	9	Home	Normal	Dip.	2
	high		Chemistry	15	Economics	Liberal	A. B.	
	school		Geology	3		Arts		
			Total	27		College		
176	Permit	1938	Botany	12	Agriculture	Liberal	B. S.	
			Zoology	24		Arts		
			Chemistry	12		College		
			Physics	6				
			Total	54				
177	Voca-	1937	Botany	5	Agriculture	Liberal	B. S.	
	tional		Zoology	5		Arts		
	agriculture		Chemistry	15		College		
			Human Physiology	3				
			Bacteriology	8				
			Total	36				
178	Regular	1941	Biology	36		Teachers	B. S.	
	high		Physics	12		College		
	school		Physical Geog.	36				
			Astronomy	6				
			Total	90				

DATA OBTAINED FROM THE STATE HOUSE (continued)

179	Regular high school	1938	Botany	5	Agriculture	Liberal Arts College	B. S.	
			Zoology	14				
			Chemistry	5				
			Human Physiology	3				
			Bacteriology	5				
			Geology	5				
			Total	37				
180	Special high school	1941	Botany	5	Agriculture	Liberal Arts College	B. S.	
			Chemistry	5				
			Physical Geog.	8				
			Geology	5				
			Total	23				
181	Regular high school	1940	Chemistry	8	Physical Education	Liberal Arts College	B. S.	
			Human Physiology	20	Social Studies			
			Anatomy	11				
			Total	39				
182	Regular high school	1941	Botany	8	English	Liberal Arts College	B. S.	5
			Zoology	14	Mathematics			
			Chemistry	6				
			Geography	10				
			Anthropology	3				
			Anatomy	5				
			Nature Study	5				
			Total	51				
183	Regular high school	1932	Physics	30	English	Liberal Arts College	A. B.	5
			Geology	5	Foreign Language			
			Total	35	Mathematics			

DATA OBTAINED FROM THE STATE HOUSE (continued)

184	Voca- tional agriculture	1927	Biology Chemistry Total	36 8 44	Agriculture		B. S.	6
185	Voca- tional agriculture	1939	Biology Chemistry Physics		Agriculture		B. S.	
186	Supt. Regular high school	1939	Zoology Economic Geog. Human Physiology Geology			Liberal College	B. S.	5
187	High school prin.	1935	Biology Chemistry Physics Physical Geog. Economic Geog.		English		A. B.	5
188	Special high school	1935	Biology Botany Chemistry Physics		Agriculture		B. E.	5
189	Int.- Gram.	1938	Physical Geog. Geology			Liberal Arts College		
190	Regular high school	1938	Biology Zoology Chemistry Human Physiology		Social Studies		A. B.	

DATA OBTAINED FROM THE STATE HOUSE (continued)

191	Regular high school	1937	Botany Zoology Chemistry Human Physiology	English Physical Education	Liberal Arts College	A. B.	5
192	Special high school	1940				B. S.	
193	H. S. prin.	1940	Biology Botany Zoology Chemistry Physical Geog. Human Physiology	Agriculture	Technical College	B. S. A. M. S.	5
194	4 year Elem.	1941	Biology Physical Geog. Human Physiology Nat. Sci.		Liberal Arts College Normal		3
195	Voc.	1932	Zoology Chemistry Physics Geology		Liberal Arts College		15
196	Regular high school	1930	Botany Chemistry Physics Physical Geog. Human Physiology Astronomy			A. B.	20

DATA OBTAINED FROM THE STATE HOUSE (continued)

197	Supt.	1931	Botany Chemistry Physics	Agriculture	Technical College		5
198	Regular high school	1933	Zoology Physics Physical Geog. Human Physiology	English	Liberal Arts College	A. B.	4
199	Regular high school	1932	Zoology Chemistry Physics Physical Geog. Geology	Mathematics	Teachers College	A. B. A. M.	
200	Regular high school	1933	Physical Geog.		Liberal Arts College	A. B.	5
201	High school	1924			Liberal Arts College		25
202	Supt.	1940			Technical College	A. B. M. S.	5
203	Regular high school	1935			Liberal Arts College	A. M.	15
204	Special high school	1941	Biology Zoology Chemistry Physics	Agriculture	Teachers College	B. E.	4½

DATA OBTAINED FROM THE STATE HOUSE (continued)

205	El. 4 year	1933		English Physical Education	Teachers College	B. S.	6
206	Regular high school		Biology Botany Zoology Chemistry Human Physiology			A. B.	
207	Junior high school	1924	Physics Physical Geog.	English Mathematics	Liberal Arts College	A. B.	18
208	Blanket	1924			Normal	Diploma	12
209	Rural school	1925			Liberal Arts College	Diploma	5
210	Blanket	1924	Physics	English Foreign Language Mathematics	Liberal Arts College	A. B.	20
211	Special high school		Biology	Agriculture	Technical College	B. S.	
212	Blanket	1917			Liberal Arts College	B. S.	12

DATA OBTAINED FROM THE STATE HOUSE (continued)

213	Blanket	1924				A. B.	19
214	Rural school	1935			Normal		5
215	Regular high school	1930	Biology Chemistry Human Physiology	Agriculture	Technical College	B. S.	3
216	Special high school	1932		Art Music	Liberal Arts College	B. M.	4
217	Blanket	1924			Normal	Diploma	22
218	Regular high school	1924			Normal	Diploma	12
219	Supt.	1939		Mathematics	Liberal Arts College	A. B.	
220		1929	Nature Study		Normal		3
221	Regular high school	1941		English Mathematics		B. S.	
222	Blanket Life	1917			Liberal Arts College	A. B.	13

DATA OBTAINED FROM THE STATE HOUSE (continued)

223	H. S. cert.	1923	Physical Geog	Industrial Arts	Normal	B. S.	5
224	Regular high school		Biology Physical Geog. Human Physiology	English		P. H. B.	4
225	El. prin. rural	1931			Normal	Life 2 yr.	5
226	Regular high school	1927	Biology Botany Chemistry Physics Human Physiology	English	Normal	A. B.	5
227	Regular high school	1938	Biology Botany Physical Geog. Human Physiology Hygiene	Mathematics		A. B.	11
228	Regular high school	1939		Commercial Subjects English		B. S.	
229	Vocational agriculture	1938	Biology Chemistry	Agriculture	Teachers College		2
230	Regular high school	1939	Biology	English Physical Education	Liberal Arts College	A. B.	5

DATA OBTAINED FROM THE STATE HOUSE (continued)

231	Special high school				Teachers College	B. S.	5
232	Regular high school	1940	Biology Physics	Mathematics	Liberal Arts College	A. B.	
233	Regular high school	1937					
234	Special high school	1940	Biology Chemistry Physics Hygiene	Home Economics	Teachers College	B. S.	
235	Regular high school	1935	Biology Chemistry Physics Physical Geog. Total	Mathematics		A. B.	
236	Voc.-H. Ec.	1940	Biology Chemistry Physics Human Physiology Hygiene	Home Economics		B. S.	
237	Regular high school	1939		English Foreign Language		A. B.	

DATA OBTAINED FROM THE STATE HOUSE (continued)

238	Regular high school	1926	Biology Chemistry Physics Human Physiology	Mathematics	Normal	A. B.	
239	Voc. chem.	1939	Chemistry Physics	Mathematics		A. B.	9
240	Blanket	1924	Botany Physical Geog. Gen. Science	Mathematics	Liberal Arts College Teachers College	A. B.	7
241	Regular high school	1922	Biology Botany Chemistry Physics Human Physiology Bacteriology Nature Study	Foreign Language Mathematics	Teachers College	A. M.	28
242	Regular high school	1928	Biology Botany Zoology Chemistry Physical Geog. Human Physiology	English	Teachers College	B. S.	21
243	Regular high school	1938	Biology Zoology Chemistry Human Physiology			A. B.	

DATA OBTAINED FROM THE STATE HOUSE (continued)

244	Regular high school	1937	Botany Zoology Chemistry Human Physiology	English	A. B.	5

DATA SHEET

I. Name of Teacher

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Last First Middle

II. Name of County Where Employed ____________________

III. License Held________________ Date Issued________________

IV. Science Courses Pursued

Name of Course	Number of Weeks	Hours per Week	Total Credits Term Hours	Total Credits Sem. Hours	Total Hours
A. Biology					
B. Botany					
C. Zoology					
D. Chemistry					
E. Physics					
F. Physical Geography					
G. Economic Geography					
H. Human Physiology					
I.					
J.					
K.					
L.					

V. Related and Unrelated Subject Groups (Check)

1. Art............___ 5. Home Economics ___ 9. Music.......___
2. Commercial Subj.___ 6. Industrial Arts___ 10. Physical Ed.___
3. English.........___ 7. Library Science___ 11. Social Stu..___
4. Foreign Lang....___ 8. Mathematics....___ 12.

VI. Training Degree or Diploma________________
Normal_____ Teachers College_____ Liberal Arts College________
Other Institution____________________

VII. Experience
Number of Years________________

VIII. Comments

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APPENDIX B

TOTAL TERM-SEMESTER HOUR EQUIVALENTS

Teacher	Term hours	Semester hours	Teacher	Term hours	Semester hours	Teacher	Term hours	Semester hours
1	96	64	43	89	59	85	134	89
2	56	37	44	81	54	86	92	61
3	88	59	45	120	80	87	89	59
4	76	51	46	53	35	88	30	20
5	68	45	47	38	25	89	42	38
6	90	60	48	108	72	90	94	63
7	48	32	49	55	37	91	72	48
8	55	37	50	65	43	92	57	38
9	66	44	51	39	26	93	40	27
10	48	32	52	87	58	94	60	40
11	80	53	53	108	72	95	28	19
12	32	21	54	120	80	96	56	37
13	81	54	55	90	60	97	24	16
14	44	29	56	21	14	98	54	36
15	54	36	57	93	62	99	49	33
16	40	27	58	58	39	100	30	20
17	44	29	59	83	55	101	60	40
18	46	31	60	39	26	102	75	50
19	68	45	61	30	20	103	86	57
20	64	43	62	100	67	104	80	53
21	72	48	63	42	38	105	42	38
22	64	45	64	103	69	106	68	45
23	69	46	65	84	56	107	88	59
24	75	50	66	84	56	108	54	36
25	129	86	67	94	63	109	40	27
26	63	42	68	26	17	110	67	45
27	61	41	69	74	49	111	49	33
28	85	57	70	49	33	112	59	39
29	66	44	71	18	12	113	48	32
30	62	41	72	33	22	114	94	63
31	95	63	73	148	99	115	38	25
32	150	100	74	78	52	116	66	44
33	59	39	75	94	63	117	54	36
34	62	41	76	76	51	118	60	40
35	65	43	77	67	45	119	103	69
36	48	32	78	54	36	120	72	48
37	42	38	79	54	36	121	95	63
38	72	48	80	41	27	122	62	41
39	105	70	81	36	24	123	69	46
40	74	49	82	63	43	124	48	32
41	101	67	83	89	59	125	24	16
42	57	98	84	52	35	126	26	17

TOTAL TERM-SEMESTER HOUR EQUIVALENTS (continued)

Teacher	Term hours	Semester hours	Teacher	Term hours	Semester hours	Teacher	Term hours	Semester hours
127	64	45	147	77	51	166	112	75
128	76	51	148	46	31	167	59	39
129	39	26	149	70	47	168	62	41
130	66	44	150	64	43	169	49	33
131	25	17	151	40	27	170	58	39
132	84	56	152	72	48	171	55	37
133	68	45	153	55	37	172	69	46
134	76	51	154	101	67	173	66	44
135	47	31	155	28	19	174	77	51
136	80	53	156	33	22	175	27	18
137	66	44	157	58	39	176	54	36
138	68	45	158	69	46	177	36	24
139	70	47	159	43	29	178	90	60
140	44	29	160	79	53	179	37	25
141	58	39	161	62	41	180	23	15
142	66	44	162	75	50	181	39	26
143	48	32	163	70	47	182	51	34
144	66	44	164	80	53	183	35	23
145	63	42	165	78	52	184	44	29
146	48	32						

MEASURES OF CENTRAL TENDENCY AND VARIABILITY
TERM-SEMESTER HOUR EQUIVALENTS

Tables	Measures							
	Means		Medians		Ranges		σ's	
	Term hours	Semester hours	Term hours	Semester hours	Term hours	Semester hours	Term hours	Semester hours
XI	10.9	7.2	9.09	6.06			50.4	33.6
XII	16.7	11.1	12.10	8.06			63.0	42.0
XIII	1.7	1.1	1.10	0.70			5.2	3.5
XIX	14.1	9.4	10.80	7.20			60.0	40.0
XXIII	65.8	43.9	65.40	43.60	105	70		
	59.3	39.5	59.60	39.70	102	68		
	76.9	51.3	77.50	51.70	108	72		