Abstract:
In a questionnaire study on the duplication of course content in general chemistry submitted to high school and college experts for their opinions regarding what should or should not be taught in a high school general chemistry course, several findings were revealed.

1. A majority of the experts indicated that they taught most of the topics listed in the questionnaire in their general chemistry course.

2. Fifty per cent or more of the experts were of the opinion that nearly three-fourths of the topics in the questionnaire should be taught in the high school general chemistry course.

3. The experts have questioned the value of repeating in college one-half of the topical content of chemistry as listed in the questionnaire.

4. College experts in their comments indicated that all of the topics in the questionnaire could be repeated in college general chemistry without creating disinterest or boredom by pursuing the topical content to a greater depth with added emphasis on mathematics and qualitative analysis.

THE STATUS OF DUPLICATION OF CONTENT IN HIGH SCHOOL AND COLLEGE GENERAL CHEMISTRY

by

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L.S.S.

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ABSTRACT

In a questionnaire study on the duplication of course content in general chemistry submitted to high school and college experts for their opinions regarding what should or should not be taught in a high school general chemistry course, several findings were revealed.

1. A majority of the experts indicated that they taught most of the topics listed in the questionnaire in their general chemistry course.

2. Fifty per cent or more of the experts were of the opinion that nearly three-fourths of the topics in the questionnaire should be taught in the high school general chemistry course.

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CHAPTER I

INTRODUCTION

Educators and laymen have pondered over the solution of college "dropouts" due to boredom and disappointment on the part of students who have repeated in college material which was covered adequately in the high school. It appeared to this writer that with science moving rapidly forward and with added emphasis on quality of instruction in the classroom, colleges cannot afford to waste time and effort duplicating that which was already covered satisfactorily in the high school. Several of the paragraphs that follow convey the viewpoints of various persons and groups with regard to the above statements.

Among several reasons listed on the front page of a brochure by Science Research Associates for college dropouts was, "Boredom and disappointment on the part of some who found that they were repeating in their freshman year work that they had already had in high school."[1]

Need for research on curriculum improvement was indicated by Killian,[2] chairman of the corporation, Massachusetts Institute of Technology, who indicated there was a great need (1) for giving more national attention to the quality and content of courses and curriculums in high schools and colleges, (2) for extensive organized national effort to bring together in each subject field leading scholars with groups of teachers to re-examine and modernize the content of courses, (3) for

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[1]Spencer, Lyle M., "The Reasons for College Dropouts," Guidance Newsletter, p. 1, March, 1957.

[2]Killian, James R., Jr., "Education for the Age of Science," Journal of the National Education Association, Vol. 49, p. 12, February, 1960.

preparing more modern textbooks, and (1) for making available better but less expensive laboratory equipment.

The concern of educators over the lack of opportunities for gifted students to work at the highest level of their abilities in high schools because of obsolete high school science courses was brought out in an editorial by Brinkman when he quoted the Dean of Columbia's Engineering School. He said:

> We believe, too, that the content of many science courses in high school is obsolete--they have stayed still for a generation or two while the frontiers of science have been rapidly moving forward. We are going to introduce these able young people, both boys and girls, to the growing edge of modern science.[3]

Waterman,[4] director of the National Science Foundation, pointed out that the emphasis on technology was likely to continue at an accelerated pace, and that it was characteristic of courses in the school to lag behind actual work in the field. But, that lag would present a real problem in seeing to it that trainees come into their profession fresh and prepared to progress with it.

A committee report on specific weaknesses and failures between high school and college was done by members of the faculties of Andover, Exeter, Lawrenceville, Harvard, Yale and Princeton. They found two special

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[3]Brinkman, William W., "College Science Courses for Gifted Secondary Pupils," an editorial in School and Society, Vol. 86, p. 422, November 22, 1958.

[4]Waterman, Alan T., "The Problem: Its Dimensions and What is Being Done," The Growing Shortage of Scientists and Engineers, in Proceedings of the Sixth Thomas Alva Edison Foundation Institute, p. 34.

kinds of weaknesses. The first was the wasting of time in covering the same material twice, once in high school and again in college, with the most striking evidence of this in the sciences. The other weakness involved "barren work," where a subject was dropped before it had done the student much good, or a teacher placed emphasis on the less valuable topics in a course. The committee noted the waste of time was the fault of both the high school and college, and the solution is a joint responsibility. This fault was thought to be typical throughout the country. The investigators from the six schools named emphasized that every hour wasted in school did double damage: time was lost, and more important was the loss of pupil interest and momentum. Most unfortunate, however, was the fact that this double damage was done most often to the abler student.[5]

This committee report and others have indicated what this writer as a high school and college teacher had experienced, and has served to strengthen a strong personal conviction that course content and offerings should be investigated and coordinated at these two levels.

Statement of the Problem

The chief purpose of this investigation was to determine the essential and non-essential content of general chemistry as given in the title to this study, "The Status of Duplication in Course Content Between High Schools and Colleges That Teach General Chemistry." The

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[5]A Committee Report, faculties of Andover, Exeter, Lawrenceville, Harvard, Princeton, and Yale, "General Education in School and College," p. 17.

main problem was then broken down into determining the answers to six questions. They are : (1) What are the topics in general chemistry that should be taught in high school? (2) Which of the topics taught in high school general chemistry should be repeated in a comparable course in college for further mastery and to obtain greater depth? (3) Which of the topics taught in high school general chemistry should or should not be repeated in a comparable course in college? (4) What is being done to avoid unnecessary duplication? (5) What are the present trends with regard to teaching high school general chemistry? (6) How might the findings of this study assist those involved in curriculum research?

Procedures

To answer the questions presented under the statement of the problem three procedures were used: (1) the literature was reviewed to determine the general trends in course offering in general chemistry; (2) the most frequently used high school and college chemistry textbooks, and high school syllabi were examined to determine what was offered at those levels, and to form the basis of items for a questionnaire; (3) a questionnaire on concepts from the content of chemistry offerings in high school and college was constructed and adminstered to experts to determine what was being taught, and the degree of emphasis to be placed on concepts at both levels.

Definition of Terms

A number of terms have been used in this report which are often subject to different interpretations. They are defined in this section to clarify their meaning.

Articulation. In this study articulation has been used to describe sequential coordination of content from grade to grade as revealed by the Joint Commission of Teachers of Science and Mathematics in its report which said:

> The science curriculums of American schools are too often non-developmental and repetitive. Science programs should aim at a soundly articulated growth in understanding and deepening of knowledge by students as they move from the lower grades through secondary school and into college.[6]

CBA. In this report CBA refers to the Chemical Bond Approach.[7]

Checklist. This term was used in the way in which it has been defined by Good:

> A checklist is a prepared list of items that may relate to a person, procedure, building, and so on, used for purposes of observation and/or evaluation, and on which one may show by a check mark or other simple method the presence, absence, or frequency of occurence of each item on the list.[8]

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[6]The Joint Commission on the Education of Teachers of Science and Mathematics, Improving Science and Mathematics Programs in American Schools, p. 6, 1960.

[7]Strong, Laurence E., and Wilson, M. Kent, "Chemical Bonds: A Central Theme for High School Chemistry," Journal of Chemical Education, Vol. 35, p. 56, February, 1958.

[8]Good, Carter V., Dictionary of Education, pp. 87-88.

CHEM. When seen in the abbreviated form, CHEM represents a contraction for Chemical Education Material Study.[9]

Concept. From Webster's dictionary [10] a concept is a thought, an opinion, or a mental image of a thing formed by generalization from particulars; a thought; an opinion.

Curriculum. For the purpose of this report, the following definition of Bossing was used:

> Western civilization has come to think of the school curriculum as, a collection of subject matter that the pupil is to study in some order of sequence toward some general goal, though such goal may be vague or poorly defined.[11]

Syllabus. Good's definition was used in which he defined a syllabus as "... a condensed outline or statement of the main points of a course of study or of books or other documents."

Topic. This investigation used Thorndike's[13] interpretation of a topic as being represented by a short phrase or sentence with reference to a subject used in an outline.

Questionnaire. Webster[14] designated a questionnaire as a set of questions for submission to a number of persons to get data for evaluating.

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[9] Seaborg, Glenn T., "The Chemical Education Material Study," in Chemical Education Material Study Newsletter, Vol. 1, p. 4, November, 1960.

[10] Webster's New Collegiate Dictionary, p. 171.

[11] Bossing, Nelson L., Principles of Secondary Education, p. 362.

[12] Good, op. cit., p. 544.

[13] Thorndike, E. L., and Barnhart, Clarence L., High School Dictionary, p. 994.

[14] Webster, op. cit., p. 693.

Limitations of the Study

There were two limitations to this study: (1) The content determination of syllabi and textbooks prepared for both high schools and colleges were limited as much as possible to the last 10 years for recency in areas, topics, practices, and trends, with older studies used only for comparison, and (2) 35 experts were used in determining the amount of emphasis given various topics in high school and college general chemistry.

The first step in the investigation was to determine from the literature the different approaches used in the selection of topics for course content in high school chemistry. The results of this review are presented in Chapter II.

CHAPTER II

BASIC TOPICS IN HIGH SCHOOL CHEMISTRY

The determination of the topics basic to high school chemistry is not a new problem. This is evidenced by the fact that the Committee on Chemical Education of the American Chemical Society in 1924 published a report on a "Standard Minimum Course in High School Chemistry" to meet the criticisms and suggestions of chemistry teachers at large.[15]

In determining the basic topics included in a general chemistry syllabus for high school, four sources were considered: (1) syllabi and new trends in subject matter revealed in the literature, (2) syllabi from state departments of education, (3) the table of contents of high school chemistry textbooks, and (4) a random geographical sampling of syllabi from local communities throughout the United States.

Topics Taken From Various Organizational Types of Syllabi Revealed in the Literature

An examination of the literature revealed seven very distinct types of organized approaches to the teaching of chemistry. They are the (1) traditional, (2) college preparatory, (3) major topics, (4) functional, (5) modern, (6) CHEM, and (7) CBA approaches. The literature was examined not for a study of the method used, but to find the topics stressed in the content of a course in chemistry for high school.

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[15]National Society for the Study of Education, A Program for Teaching Science, in Thirty-First Yearbook of the Society, part 1, p. 258, 1932.

The traditional approach. Most high school texts with few exceptions still use the traditional approach to chemistry; that is, typical content is descriptive in nature and reads like a classic. According to Summers, the topical headings in most instances read as follows:

1. Chemical and physical changes
2. Oxygen and its oxides
3. Water
4. Hydrogen
5. Simplified gas laws
6. Solutions
7. Theory and laws of the atom
8. Equations
9. Stoichiometric relationships[16]

Later in this chapter, a list of topics by Summers for a modern course in high school chemistry is also given and may be of interest to those who have taught chemistry by the old traditional approach.

College preparatory. Among several college preparatory outlines to be discussed, the New England Association of Chemistry Teachers reported one, "A Minimum Syllabus for a College Preparatory Course in Chemistry," in 1956 that was divided into three parts, namely, descriptive, general

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[16]Summers, Donald B., "Are High School Chemistry Texts Up-to-Date?" Journal of Chemical Education, Vol. 37, p. 236, May, 1960.

supplementary. The report stipulated further that every teacher must feel free to decide when and how each topic was to be studied. It also indicated that individual laboratory work should include preparation of gases, quantitative exercises, and ionic reactions, and that laboratory exercises should be a part of every course. No less than one double period was to be set aside for laboratory work and four single periods a week for classroom discussions and demonstrations. The course, as outlined, consisted of three parts:

1. Descriptive chemistry
    a. Chemistry of some nonmetals and their common compounds
    b. Composition of air
    c. Water
    d. Chemistry of sodium, aluminum, iron, and their compounds
    e. Industrial processes of Haber, Ostwald, and the contact process for sulfuric acid
2. General chemistry
    a. Physical properties of solids, liquids, and gases
    b. Chemical changes
    c. Solutions
    d. Structure of matter
    e. Nucleonics
3. Supplementary topics
    a. Organic chemistry
    b. Equilibrium

c. Molecular weights

d. Equivalent weights and normal solutions

e. Balancing equations by electron transfer

f. Metals

g. Nonmetals

h. Applied Chemistry[17]

The supplementary topics are designed for gifted students or, as designated, for teachers who have additional time or may wish to select certain materials for their courses. Some teachers of high school chemistry become disturbed at this point that the gifted are the only students who might go beyond descriptive and general chemistry under this particular college preparatory approach. One could suggest Gifford's article[18] relative to the importance of teaching students to "think" and pursue research projects of interest to the individual, rather than to be concerned about memorization of meaningless facts as well as the covering of all the material in the book.

Brandwein, Watson, and Blackwood presented three college preparatory courses in chemistry as they appeared in the western, midwestern and eastern section of the country. The common content materials covered in

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[17] New England Association of Chemistry Teachers, "A Minimum Syllabus for a College Preparatory Course in Chemistry," Journal of Chemical Education, Vol. 34, p. 307-308, June, 1957.

[18] Gifford, Dorothy W., "Trends in High School Chemistry," Journal of Chemical Education, Vol. 32, p. 490, September, 1955.

the western high schools follows:

1. History of chemistry
2. Oxygen
3. Hydrogen
4. Formulas and equations
5. Sodium
6. Sodium compounds
7. Chlorine
8. Problems (Avogadro's hypothesis)
9. Sulfur
10. Ionization
11. Reactions-reversible and nonreversible
12. Nitrogen
13. Halogens
14. Carbon
15. Calcium and its compounds
16. Metals
17. Important mineral substances
18. Activity of metals, electrochemical series
19. Compounds of carbon[19]

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[19]Brandwein, Paul F., Watson, Fletcher G., and Blackwood, Paul E., Teaching High School Science: A Book of Methods, p. 262.

The authors merely listed the topics without using the three areas as was done in the preceding topical outline. As is true of different lists, there were some variations and much is left for the reader to infer; for instance, it was found that compounds of carbon may or may not infer organic chemistry.

The western schools also listed history of chemistry as a separate topic, rather than having it integrated throughout the context of the course. Regardless of the manner in which history of chemistry is taught, a report by the Joint Commission on the Education of Teachers of Science and Mathematics[20] indicated little is being done to acquaint high school students with the philosophy, history, and methods of science.

High schools of the Midwest indicated additional areas that were similar which may be ascertained from the following list:

1. Oxygen
2. Hydrogen
3. Water
4. The structure of water
5. Formulas and equations
6. Chemical calculations
7. Acids, bases, and salts

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[20] A Report of the Joint Commission on the Education of Teachers of Science and Mathematics, Improving Science and Mathematics Programs in American Schools, p. 7.

8. The halogens
9. Sodium, potassium, and compounds
10. Sulfur
11. Nitrogen (the atmosphere)
12. Carbon and compounds
13. Fuels
14. Calcium and its compounds
15. Metals
16. Iron and steel
17. Copper, zinc, tin, and lead
18. Aluminum and magnesium
19. Mercury, silver, and other metals
20. Colloids
21. Organic chemistry
22. Textiles, dyes, and plastics
23. Foods, drugs, and cosmetics
24. Nuclear chemistry[21]

The high schools in the western and midwestern section of the United States differed in their choice of topics. The midwestern section began with oxygen, hydrogen, and water, sometimes called the historic-

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[21] Brandwein, Watson, and Blackwood, op. cit., p. 262.

systematic[22] type of chemistry course, while the West preferred not to treat water as a topic by itself. Both the west and midwest programs introduced metals but an extended treatment of related topics that followed was different, and although both listed halogens as a topic, the West introduced chlorine earlier, probably as a background for the problems on Avogadro's hypothesis that followed. Again, they were different inasmuch as ionization and reversible-nonreversible reactions were listed in the western outlines for high school chemistry, while only the Midwest listed fuels, colloids, organic chemistry, textiles, dyes, plastics, foods, drugs, cosmetics, and nuclear chemistry.

The preceding list of topics in chemistry, though similar to each other, appear to show still different organization from the topics in the high schools of the East.

1. Introduction
2. Solutions and water
3. Oxygen and hydrogen
4. Atomic structure
5. Chemical nomenclature, formulas, equations, and problems
6. Periodic table, metals, nonmetals, and inert elements
7. The halogens and their compounds
8. Sodium and calcium compounds

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[22] Ibid, p. 260.

9. Ionization
10. Sulfur and its compounds
11. Nitrogen and its compounds
12. Carbon and its oxides
13. Nuclear energy
14. Organic chemistry
15. Metallurgy
16. Principles of reaction[23]

Brandwein, Watson, and Blackwood selected the preceding topics from course outlines typical of the eastern section of the country in high school chemistry. Several topics were combined into related areas; for example, chemical nomenclature, formulas, equations, and problems were included under one heading. The same was true of the periodic table, metals, nonmetals, and inert elements. Formulas, equations, and the elements of the halogen family, oxygen, hydrogen, nitrogen, sulfur, calcium, potassium, and sodium and their compounds appeared as a common core of topics throughout the United States.

Major topics approach. Organization of the content by major topics has also undergone some changes with popularity lessening for the tight or non-flexible units. The organization seemed logical enough but created difficult situations with regard to learning and teaching for the pupil and beginning teacher respectively. Difficult concepts now appear

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[23] _Ibid_, p. 262.

interspersed throughout the content to prevent discouragement for the learner.[24]

Thurber and Collette presented the following outline of a chemistry course organized by major topics:

1. Early chemistry
2. Pioneers of chemistry
3. Physical and chemical changes; elements, compounds, and mixtures
4. Units of measurement; temperature and heat
5. Oxygen
6. Atoms and symbols
7. Hydrogen
8. Valence, formulas, equations
9. Water
10. Chemical calculations
11. Carbon and carbon dioxide
12. Carbon monoxide and fuels
13. Molecular motions and their effects
14. Combination by weight and volume
15. Ionization in solution

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[24] Jaffe, Bernard, "Trends in High School Chemistry," National Association of Secondary School Principals Bulletin, p. 72, January, 1953.

16. Acids, bases, and salts
17. Sulfur, hydrogen sulfide, and sulfides
18. Oxides and oxygen acids of sulfur
19. Chlorine and hydrogen chloride
20. The halogen family
21. Nitrogen and the atmosphere
22. Compounds of nitrogen
23. Sodium and its compounds
24. Typical metals and their compounds
25. Organic chemistry [25]

The materials in each block of related areas lend themselves very well to the problem-solving approach that provides for the development of important knowledge and skills if the teacher will allow ample time for applications of commonplace things and utilize facilities to the fullest extent.

A functional approach. Renner, lamenting about the obesity of the chemistry curriculum, implied there was a need for related areas to be studied together in order to show a whole picture with functional parts. The major areas given in his functional approach are:

1. "The Tools of Chemistry" -the characteristics of matter and energy
2. Atomic structure
3. Understanding the periodic chart

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[25] Thurber, Walter A., and Collette, Alfred T., Teaching Science in Today's Secondary Schools, p. 397.

4. The gaseous state of matter

5. Carbon and organic chemistry

6. The metals[26]

Renner also emphasized the value of presenting the periodic chart and its use while the idea of the structure of the atom is still vivid. He also felt that carbon should not be divorced from organic chemistry. The same assumption would likewise hold true for gases as well as metals.

The modern approach. Summers advocated the following as a distinctly modern approach to topics that should be in every syllabus:

1. The method of classification of matter according to Hildebrand and Powell

2. The mole concept —Avogadro's number of particles, 6.023×10^{23}

3. Bonding —correlate reactivity and crystal structure with experimental observation

4. Water and solubility — water recognized as a "bent" molecule and dipole

5. Acid-base theory——Bronsted-Lowry concept of proton-donor and acceptor

6. Equilibrium — greater emphasis given to "equilibrium position," to pH and the buffers

7. Atomic structure — Bohr energy levels used, but not "circular" orbits

8. Symbols and nomenclature — texts not up-to-date with revision of 1957, for example, Ar for A for Argon and Iron (II) in preference to ferrous

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[26]Renner, John W., "A High School Chemistry Curriculum," School Science and Mathematics, Vol. 42, pp. 263-264, May, 1960.

9. Atomic, molecular and ionic geometry - spatial arrangement of ions in ionic compounds, spatial structure, varying sizes of atoms and ions, and packing to help explain properties

10. Mathematical problem solving - stressing the "common sense" or "factor-label" method instead of the "proportion" method

11. Complex ions - used in explaining certain types of chemical reactions

12. Valence concepts - electrovalence, covalence, coordination number and oxidation-number

13. Electrochemistry - Faraday's laws are explained, use mole concept, predict simple oxidation-reduction and electrolytic reactions are explained[27]

The preceding 13 items are not new to high school chemistry, but the depth of treatment given each item or topic determines whether it is labeled modern or not; for example, the topic of equilibrium goes into a treatment of buffers that had been ignored much of the time in the past in high school chemistry.

A modern course should also contain recent information and ideas, such as is given under the atomic structure where Bohr's energy levels are to be used instead of the old circular orbits.

The CBA and CHEM study approaches that follow, while not labeled modern chemistry, are recent and still in the experimental stage.

The chemical bond approach. From a summer conference of college and high school teachers of chemistry at Reed College[28] in 1957, came a new

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[27]Summers, op. cit., pp. 263-264.

[28]Committee on College Teaching, "The Council at Work: Chemistry," in The Educational Record, Vol. 39, pp. 389-390, October, 1958.

proposal for teaching chemistry, the Chemical Bond Approach, that may completely revolutionize the conventional methods of the past. As a result of the interest at Reed, a follow-up conference was held at Wesleyan University during the summer of 1958. This group developed with its pilot studies and summer conferences what it considered by 1963 would be the desirable high school chemistry course. They proposed to teach the basic first year chemistry without memorization of hundreds of seemingly unrelated facts by placing emphasis on the making and breaking of the bonds between atoms. This approach to chemistry would correlate the idea that properties of a substance are also determined by breaking of the bonds between the atoms.

Presentation of this CBA material by Strong and Wilson[29] began with what the authors considered a traditional introduction followed by a brief presentation of stoichiometry. A strict analogy to the solar system of the Bohr atom is to be discarded. The various bondings were then presented: ionic or electrovalent in which bonding forces resulted from electrostatic attraction; covalent in which bonding forces arise; from the mutual attraction of two nuclei for a pair of electrons; and metallic bonds in which there arises bonding from the mutual attraction of many nuclei for many electrons. The various properties of matter are a reflection of these bond types. The ionic bonds in general are formed by reaction of covalent compounds with metals; thus metallic bonds are discussed along with the ionic bond and followed by a discussion of the first twenty elements and the periodic table. Acids and bases are then touched upon from the standpoint of the Lewis theory with emphasis

[29]Strong and Wilson, op. cit., p. 56.

upon the experimental aspects. A non-mathematical treatment of chemical equilibrium precedes an illustration of solvent systems other than water. Oxidation of ammonia to yield nitric acid introduces the concept of polyatomic ions and those substances whose atoms may be linked by both covalent bonds and by ionic bonds. Other examples, such as sulfuric acid may be included if time permits.

Because of its length, the proposed outline for a high school chemistry course based on chemical bonds as the central theme was placed in Appendix A.

The chemical education material study approach. According to Seaborg[30] CHEM study was an outgrowth of a study committee set up in 1959 by the American Chemical Society at Ohio State University. It was intended that the CHEM study be supplemental to, and in no sense competitive with, the Chemical Bond Approach.

Pimental, editor of the text for the CHEM study, listed the following chapter titles:

1. Chemistry: an experimental science
2. Introduction to atomic theory
3. Atoms combined in substances
4. Chemical reactions and phase changes
5. The gas phase: kinetic theory
6. Substances and solutions

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[30]Seaborg, op. cit., p.2

7. Chemistry and the periodic table
8. Geochemistry: the earth as a source of material
9. A general view of chemical reactions
10. Energy effects in chemical reactions
11. The rates of chemical reactions
12. Equilibrium in chemical reactions
13. Ionic solutions and reactions
14. Acids and bases
15. Oxidation-reduction
16. Chemical calculations
17. Believing in atoms
18. Periodicity of chemical properties and electronic structure
19. Molecules and their structures
20. Structure in solids and liquids
21. The chemistry of carbon
22. The halogens
23. The transition elements
24. The third row of the periodic table
25. The second column of the periodic table[31]

The editor of the CHEM study text went on to say that this course not only provides a basic understanding of science, but places emphasis on the experimental nature of chemistry upon which succeeding courses can

[31]Pimental, G. C., "Chemistry-An Experimental Science,", in Chemical Education Material Study Newsletter, Vol. 1, Number 1, p. 2, November, 1960.

be built.[32]

Other trends in syllabi content. Buehring[33] in a survey of 57 districts and 38 states reported five significant trends: (1) blending a basic understanding of principles with applications, (2) creation of special content of a functional nature for those not intending to go on to college, (3) securing facilities for teaching microchem techniques if funds were available, (4) preparation of own syllabi by chemistry teachers as well as (5) combining efforts on part of high school and college science instructors toward creating a minimum syllabus.

Colleges and universities have been arranging for (1) a summer program for academically talented students that will supplement, not duplicate the high school chemistry courses, and (2) the provision by some large high schools for a multitrack or "honors program" for these gifted students.[34]

Still other trends are toward: (1) giving support to a national curriculum to bring together scholars, scientists, and school people to do curriculum investigation, planning, experimentation and evaluation;[35]

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[32] Ibid, p. 2.

[33] Buehring, Leo E., "Senior High Schools," The Nations Schools, Vol. 65, pp. 77-89, February, 1960.

[34] National Education Association, Administration: Procedures and School Practices for the Academically Talented Student in Secondary Schools, pp. 70-71.

[35] Tyler, Ralph W., "Do We Need a National Curriculum," The Clearing House, Vol. 34, pp. 144-145, November, 1959.

(2) the fulfilling of local needs of students by including a unit such as ceramics that is pertinent to a certain locale;[36] and (3) the including of radioisotopes in classroom demonstrations.[37] All are trends that have received recent attention in the literature.

Contents of High School Chemistry Syllabi from State Departments

In order to determine state prescriptions of the contents of chemistry syllabi, a letter requesting this material was sent to each of the state departments of education in the fifty states. A copy of this letter, as well as the follow-up letter, is to be found in Appendix B. Replies were received from all of the states except Arkansas. Of those responding Alabama, Florida, Iowa, Minnesota, Missouri, Montana, Oregon, New York, North Dakota, Pennsylvania, and Texas had syllabi in either a tentative or completed form. Some stated they had plans for state development of science guides. The states that had such plans were Kentucky, Mississippi, Utah, New Hampshire, South Carolina, Vermont, Wisconsin, and Wyoming. Others indicated they had no course outlines or else they left the matter of course outlines to counties and/or cities as matters of local concern.

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[36] Orr, Robert J., "Teaching a Ceramics Unit in High School Chemistry," School Science and Mathematics, Vol. 54, pp. 461-462, January, 1954.

[37] Goldsmith, George J., "Demonstrations With Radioisotopes for the High School Chemistry Class," School Science and Mathematics, Vol. 55, p. 179, January, 1955.