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A Vocabulary Study of Scientific Terms in Four High School Chemistry Textbooks

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A VOCABULARY STUDY OF SCIENTIFIC TERMS IN FOUR HIGH SCHOOL CHEMISTRY TEXTBOOKS.

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This thesis, presented by Julian Norman Toftness in partial fulfillment of the requirements for the degree of Master of Science in Education, is hereby approved by the Committee on Instruction in charge of his work.

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CHAPTER I

INTRODUCTION

The Importance of Vocabulary Studies

A major portion of the difficulties of pupils in connection with their classwork results from inability to comprehend the subject matter of their textbooks. A student must understand the textbook vocabulary in order to attain any knowledge of the information contained in it. W. S. Gray states that "the correlation between scientific vocabulary and scientific achievement makes it imperative that both writers and teachers give increased attention to the problem of the vocabulary of science. The former should make an earnest effort to simplify the vocabularies of their books by reducing the number of scientific terms which they introduce, by confining the nontechnical words which occur in thousand-word levels in or above the seventh, and by including glossaries of scientific terms. The teacher's responsibility is that of developing meaningful concepts, for which words stand, by providing a background of concrete experience with real materials and phenomena in science. Both author and teacher need to know the essential words in each field that all students should

understand. Vocabulary lists by Lehman, Powers and Pressey are valuable sources of reference."[1]

Terman[2] maintains that vocabulary tests give a high correlation to general intelligence tests. This is indicative of the value of vocabulary. If vocabulary is this important, more research should be undertaken, particularly in the various content fields.

This study will not concern itself with a general scientific vocabulary study such as one might need for reading of the wonders of science in the newspaper, of popular magazines, or of popular scientific books, but it will rather restrict itself to technical terms found in some of our present-day secondary school chemistry textbooks. An attempt will be made to show a trend toward elimination of certain terms and the addition of new words and phrases.

In our present "Atomic" and "Plastic" age, chemistry has developed tremendously and as a consequence, new technical terms have been devised to label new elements, new concepts, and new processes. Today's high school chemistry class has assumed a new glamour for the student which is resulting in larger and larger classes. Newer

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1 National Society for the Study of Education, Forty-Seventh Yearbook, Part II, Reading in High School and College, p. 164.

2 L. M. Terman, Measurement of Intelligence, Houghton Mifflin Company, Boston, 1926, p. 230.

books are being written mainly to keep the information up to date. Some progress has been made by the addition of glossaries and vocabulary emphasis, but there is still room for great improvement. How this is to be attained cannot be specifically stated, unless perhaps by a restricted list of technical terms, by greater explanation of technical terms, by glossaries, by special vocabulary drills, and by more correlation with English classes in vocabulary study.

Seemingly, there is a trend towards vocabulary studies in content fields. Educators are becoming aware of the need and because of this, results will arrive naturally.

Previous Vocabulary Studies in Chemistry

As far as available library resources are concerned, there has been very little secondary school chemistry vocabulary study in the past decade.

Luella Cole,[3] whose technical vocabulary list included 520 terms, was a pioneer in this type of work.

A. B. Kitzmiller[4] did some work on specific

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3 Luella Cole, The Teacher's Handbook of Technical Vocabulary, Public School Publishing Company, Bloomington, Ill., 1940, p.6.

4 A.B. Kitzmiller, "Certain Vocabulary Problems in High School Chemistry", Science Education, XV (November 1930) p. 33-43.

vocabulary problems in high school chemistry. Kitzmiller demonstrated that students fail to master many of the terms of science. In fact, their loss in knowledge of technical terms in chemistry after a year has been found to be greater than their loss in any other of the objectives of the course. Kitzmiller's word list was primarily concerned with the vocabulary necessary for laboratory work.

Francis D. Curtis[5] completed a vocabulary study in the science content field about fifteen years ago, but he confined most of his work to the junior high school general science level. Recently, at Michigan, he has completed a similar work in the biological sciences. Perhaps his next field may be the physical sciences, chemistry and physics.

Need for Further Study

Previous researches, particularly by Curtis and Cole, indicate that the need for further study is urgent.

More recently, W. S. Gray,[6] serving as chairman of the Committee on Reading of the National Society for

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5 Francis D. Curtis, Investigations of Vocabulary in Textbooks of Science for Secondary Schools, Boston, Ginn and Company, 1935. p. 54.

6 National Society for the Study of Education, Forty-Seventh Yearbook, Part II, Reading in High School and College, p. 165.

the Study of Education, suggested that changing conceptions of the role of reading in general education and scientific studies of reading problems indicate that additional experimental endeavors by specialists in the field of reading were seriously needed.

Gray goes on to say that "there seems little doubt that part of the difficulty that students meet in science lies in the compactness of scientific writing. Because of the vast body of information to record in a limited space, authors crowd many facts into a few paragraphs. Often a single sentence is so burdened with facts that a student grasps only a few or acquires a confused notion of the whole. Some books are consistently 'heavy'. Others are uneven. Both make large demands on the reader. They require him either to read slowly and painstakingly throughout, which is uneconomical of time, or to distinguish the important facts and ideas from the unimportant, and this he cannot do. Nor can the teacher always do so. The author, who knows the whole broad field of science, can probably do the best screening of his own material until research has determined what concepts, facts, and principles are most important and where they can be taught most economically."[7]

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7 National Society for the Study of Education, Forty-Seventh Yearbook, Part II, Reading in High School and College, p. 165.

Words have a specific meaning, and in order to express ideas or concepts, vocabulary must be used. It is strange that such a basic matter as vocabulary, particularly scientific vocabulary, has not received more attention than it has. Definitely the need is there as any conscientious classroom teacher will verify. It is rather disheartening to go through his final review before the close of the school year and realize that in spite of all his efforts, the subject matter has not been understood as his efforts might justify. Most teachers realize the vocabulary burden and do their best to reduce it. Directed investigations conducted by the teachers, cooperating with the authors, undoubtedly would do much to lessen the vocabulary burden in scientific vocabularies.

According to Cole's[8] list, 520 new chemistry words demand a learning rate of 13.33 words per week during one school year. This load may seem heavy, but it is approximately one fourth of the actual number of special terms used in the average introductory text in chemistry.

The need is great for further study, and most educators are becoming increasingly cognizant of the problem.

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8 Luella Cole, op. cit., p. 63-70.

CHAPTER II

THE PROBLEM

Statement of the Problem

Curtis, in his investigations of vocabulary problems concerning science textbooks, declares that "the improvement of textbooks is a problem of major importance in the teaching of science. The opinion is frequently expressed by teachers and others that textbooks are too difficult. Mere reiteration of this opinion, however, serves no useful purpose, since it neither proves the truth of the statement nor offers constructive help in reducing the assumed difficulty. Authors of textbooks and teachers who use the textbooks with their classes need guidance in the form of answers to several questions. Among the most important of these questions are the following: (1) Are the vocabularies found in the textbooks of science actually too difficult for the pupils for whom the books are intended? (2) Is there some definite and readily determined level of vocabulary in present textbooks of science which marks a sharp increase in difficulty of comprehension by the pupils, and which, therefore, is the level at which simplification of vocabulary in such textbooks should begin? (3) Is the difficulty which

pupils encounter in reading textbooks of science attributable, to any considerable extent, to nonscientific, and hence nonessential, vocabulary? (4) Do present textbooks of science provide adequately for the mastery of essential vocabulary through definition and repetition? (5) What are important terms which should be mastered in the various courses in science?"[9]

William S. Gray says "vocabulary difficulties present a first real problem. A recent study reported by Curtis shows that of thirty textbooks in general science, biology, chemistry, and physics, there is not one that does not contain a vocabulary too difficult for the students for whom the books are written. Many of the words are scientific; others, particularly in physics, are mathematical terms; while 'too large a percentage' are nonscientific or nontechnical words which are not an essential part of the instructional materials. To complicate the situation, in only three of the texts studied are more than half of the scientific terms defined. Furthermore, scientific terms are frequently introduced considerably in advance of their definitions."[10]

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9 Francis D. Curtis, Investigations of Vocabulary in Textbooks of Science for Secondary Schools, Boston, Ginn and Company, 1938, p. 127.

10 William S. Gray, Reading in General Education, "American Council on Education", Washington D. C., 1940, p. 157-165.

Both Curtis and Gray emphasize the major importance of vocabulary study in content fields, Curtis concentrating his work in the science field. While Curtis focused most of his attention on the field of biology, this thesis concerns itself only with chemistry. The purpose of this study can be summarized as follows:

(1) To make a frequency count of the technical terms used in high school chemistry textbooks.

(2) To determine, whenever possible, the advisability of replacing or dropping certain technical terms which, by the frequency count, show low frequency.

(3) To compare the textbook word lists with those of Cole and Thorndike-Lorge to determine their level of difficulty.

Method of Procedure

The word list of Luella Cole[11] was used as the base in preparing this study. New words were added to this list as they appeared in the four different textbooks being checked. All words were listed alphabetically.

The chemistry books chosen for this study are listed on the following page and henceforth will be referred to by the Roman numeral preceding the title of the book.

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11 Luella Cole, op. cit., p. 63-70.

They are as follows:

I Carleton, Robert H. and Carpenter, Floyd F., Chemistry for the New Age, J. B. Lippincott Company, 1949.

II Rawlins, George M. and Struble, Alden H., Chemistry in Action, D. C. Heath and Company, 1948.

III Brownlee, Raymond B.; Fuller, Robert W.; Hancock, William J.; Sohon, Michael D.; Whitsit, Jesse E.; Elements of Chemistry, Allyn and Bacon, 1943.

IV McPherson, William; Henderson, William Edward; and Fowler, George Winegar; Chemistry at Work, Ginn and Company, 1942.

The following method was used in formulating the list. The chemical terms were tabulated on typing paper in alphabetical order, using a triple space to allow for the introduction of new words and also to allow plenty of space to place the tabulation marks. These typewritten pages were placed on large sheets of tagboard and firmly secured with scotch tape. Previously, the technical terms in the four textbooks used for this study were underlined with red pencil. As the technical terms were read, a tabulator checked a mark directly opposite the term. Each

tagboard was numbered with the Roman numeral corresponding to the book being scored to avoid any error.

As stated in the previous paragraph, the technical terms were underlined with red pencil, then a second check was made for errors and omissions and a third check was completed during the tabulation reading.

At the completion of the tabulation, each technical term was scored for frequency and the scores listed in Columns I, II, III, and IV of Appendix A. Columns I, II, III, and IV refer to the four chemistry textbooks mentioned previously in this chapter.

From the information provided in Appendix A, several tables were constructed. In Table I, the concepts occurring only once, two to five times, six to nine times, ten to nineteen times, and those occurring more than twenty times have been tabulated. The percentage for each of the above frequencies have been calculated and are given in Table II.

Terms used less than twenty times account for 34 per cent to 37.9 per cent, and terms used only once account for 4.8 per cent to 6.4 per cent of the total chemical concepts used in the four books. It is interesting to note that terms occurring two to five times account for approximately twenty-five per cent of the total technical terms. This would indicate that the chemistry teacher should em-

phasize these terms since their recurrence in the textbook will be seldom, but they occupy a fairly high percentage of the total concepts. Approximately seventy-five per cent of the concepts occur at least six times since terms appearing less than six times total nearly twenty-five per cent. These figures are illustrated by the tables below.

TABLE I

NUMBER AND FREQUENCY OF DIFFERENT CONCEPTS USED IN EACH OF THE FOUR CHEMISTRY TEXTBOOKS

Text-book	Frequency					Number of Different Concepts
	1	2-5	6-9	10-19	20 or more	
I	41	196	139	189	291	856
II	48	170	137	176	303	834
III	42	179	120	141	290	792
IV	49	171	123	157	261	761

TABLE II

THE PERCENTAGE FOR EACH FREQUENCY OF DIFFERENT CONCEPTS USED IN EACH OF THE FOUR ELEMENTARY CHEMISTRY BOOKS

Text-book	Frequency				
	1	2-5	6-9	10-19	20 or more
I	4.8	22.8	16.2	22.2	34.0
II	5.7	20.8	16.4	21.0	36.3
III	5.3	22.6	16.4	17.8	37.9
IV	6.4	22.4	16.2	20.6	35.6

It may become necessary at times to compare one textbook with another to decide which concepts are common to both. Table III furnishes this information for the four chemistry textbooks surveyed in this study.

TABLE III

NUMBER OF TERMS COMMON TO ANY TWO TEXTBOOKS

TEXTBOOK	I	II	III	IV
I	...	816	740	751
II	...	...	737	736
III	...	...	...	725

It will be noted that Books I and II have the greatest number of common concepts. These two books also have the latest copyright dates. This may indicate a tendency on the part of the authors to use similar concepts. Also the greatest divergence in common terms seems to be in Books I and IV which also have the newest and oldest copyright dates respectively. This may be a further indication of a growing movement toward more uniformity in concepts in content fields.

There may be errors in the tabulations shown in

the appendix, since the markings, counting, tabulating, transcribing, and typing involved a large number of words and a frequency of fair proportion.

Cole's[12] list served as a base, but several terms were added, particularly organic terms. She does not believe that organic chemistry should be taught in high school. However, the newer texts are including more and more organic material, so the reality of the problem forces one to include these terms. Atomic chemistry has brought new terms such as nuclear fission, atomic pile, and so on, so that the list has become considerably larger than hers.

The Thorndike-Lorge[13] list uses only the root of the word so that all the terms in Appendix A will not be found in that list.

Column G indicates that word's rating in the Thorndike-Lorge word list of thirty-thousand words. The Thorndike-Lorge rating indicates the frequency of that word per million words. As will be noted, not all technical terms are represented in the Thorndike-Lorge word list. For example, the word "absorption" has the number eight under Column G of Appendix A, indicating that Thorndike-Lorge found the word absorption to occur eight times in

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12 Luella Cole, op. cit., p. 63-70.

13 E. L. Thorndike and Irving Lorge, The Teacher's Word Book of Thirty-Thousand Words, Bureau of Publications, Teachers College, Columbia University, New York, 1944.

every million words. Thorndike-Lorge,[14] in their introduction to their thirty-thousand word compiliation, suggested that the average high school junior should master all words having a frequency of three or more per million. Scanning Column G of Appendix A, brings to light the fact that there are one hundred thirty-six words which would evidently be too difficult for the average student based on such a criteria.

In Column C, the term cc refers to a technical term for which Luella Cole has a frequency count in her list of chemical terms. The letter o refers to a term found in her supplementary list of organic terms for which she gave no frequency. The letter x refers to a new term or one which was felt should be included.

Delimitations of the Problem

The limitations of this study are briefly previewed in the following paragraphs.

Terms which had a doubtful relationship to scientific vocabulary were included because it was felt any further study could easily eliminate these if it were deemed advisable. Such a word as "stable" has some scientific meaning such as "stable compound", but the same sense is illustrated nonscientifically in "stable

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14 E. L. Thorndike and Irving Lorge, op. cit.

character", so perhaps it could have been eliminated.

Only those prefixes and suffixes which had some relationship with scientific vocabulary were used. Plurals were counted with the singular form of the term. Prefixes and suffixes included were: "-ate", "bi-", "di-", "ferri-", "ferro-", "hepta-", "hexa-", "hydro-", "hyper-", "hypo-", "-ic", "-ide", "-ite", "meta-", "mono-", "nitro-", "octa-", "ortho-", "-ous", "oxy-", "para-", "per-", "photo-", "poly-", "pyro-", "sesqui-", "super-", "tetra-", "thermo-", "thio-", "tri-".

Certain phrases were included as their combination designated a definite scientific concept. Phrases included were: "heat of fusion", "heat of vaporization", and "plaster of Paris".

Even though they have no Thorndike and Lorge rating, the following word combinations were included: absolute scale, absolute temperature, absolute zero, activity series, addition product, alpha rays, aqua fortis, aqua regia, atomic bomb, atomic fission, atomic pile, atomic weight, bead test, bell jar, bessemer converter, beta rays, blast furnace, blow pipe, boiling point, boric acid, Brownian movement, Bunsen burner, carbolic acid, carbon dioxide, carbon monoxide, carbon tetrachloride, cast iron, chain reaction, chamber process, chemical change,

chemical equivalent, chemical property, coal tar, contact process, corrosive sublimate, cubic centimeter, delivery tube, destructive distillation, directly proportional, dispersed medium, double replacement, electromotive force, evaporating dish, flash point, Florence flask, fractional distillation, freezing point, gamma rays, German silver, grain alcohol, gram molecular volume, gram molecular weight, heavy water, inversely proportional, kindling temperature, lamp black, lubricating oil, mass number, melting point, multiple proportions, nitric acid, normal salt, nuclear energy, nuclear fission, nuclear fusion, open hearth, periodic law, periodic table, permanent hardness, phlogiston theory, pig iron, pneumatic trough, rare earth, reducing agent, reversible reaction, ring compound, ring stand, sal ammoniac, specific density, specific gravity, specific heat, spontaneous combustion, straight chain compound, sulfa drug, temporary hardness, test tube, thistle tube, tracer chemistry, unsaturated compound, vapor pressure, watch glass, water gas, water glass, and wrought iron.

Abbreviations were usually left as abbreviations since in chemistry, abbreviations are a common practice. All the elements and compounds are abbreviated, so it was felt that common abbreviations should naturally follow.

For instance, trinitrotoluene is represented as T. N. T., its common abbreviation.

Names of scientists were omitted since the majority of them are discussed in most general science courses.

Word contractions were listed as the full term, e. g. "tube" for "test tube".

A combination of words whose meanings were unaffected by separation were usually placed in the list of individual words, e. g. "alkali metal" is listed as "alkali" and "metal".

CHAPTER III

Results of Study

There seems to be a trend toward the dropping of certain terms in chemistry, which were common in the textbooks twenty years ago. The following table indicates terms which had no frequency in this study although they were present in Cole's[15] list.

TABLE IV

TERMS NOT FOUND IN THIS STUDY ALTHOUGH PRESENT IN COLE'S LIST

acid salts	hood
adulterate	hornspoon
alundum	hyper-
aqua ammonia	manganic
brittle	manganous
cone	metathesis
decant	mortar and pestle
decrepitate	photo-
	weather

Such terms as brittle, decant, hood, hornspoon, and mortar and pestle would undoubtedly be found in laboratory manuals with which this study did not concern itself.

15 Luella Cole, op. cit., p. 63-70.

A word such as weather is today part of the general science vocabularies. Adulterate would be found in the biology vocabularies. The terms, acid salts and mortar and pestle, were broken up into their two component parts and listed as acid, salt, mortar, and pestle.

This list of terms which evidently could be dropped from our current high school chemistry texts could be expanded by the addition of those terms which occur only once. These terms are listed below in Table V.

TABLE V

TERMS FOUND ONLY IN ONE TEXTBOOK

addition product	flash point	osmosis
aeration	fluorination	pestle
anion	forceps	quinine
atomic fission	gauze	radioisotopes
butyric	getter	ring compound
chemotherapy	hepta-	sal ammoniac
combustible	inhibitor	sinter
deflagration	insulator	specific density
dessicate	mass number	straight chain compound
diatomic	normal salt	tetrachloride
evaporating dish	octa-	thermoplastic
thermosetting	tracer chemistry	

However, certain terms in Table V are new terms and appeared mainly in Book I which had a very recent copyright. Such terms as atomic fission, chemotherapy, flash point, fluorination, getter, inhibitor, mass number, radioisotopes, sinter, thermoplastic, thermosetting, and tracer chemistry are necessary tools of the present day teacher in explaining new developments in the sciences.

Table VI shows the addition of forty-six new terms contrasted to the loss of seventeen concepts in Table IV. The result is a net gain of twenty-nine more concepts. At such a rate, the field of elementary chemistry will become increasingly unwieldy as far as vocabulary burden is concerned. These additions do nothing to detract from the teacher's problem and the students' confusion. The unsettled world affairs have caused an increased activity in the field of chemistry resulting in the production of newer and deadlier weapons. Consequently, new discoveries are constantly being made, resulting in new concepts to describe them. So the problem has all the appearances of becoming worse before it gets better.

TABLE VI

NEW TERMS APPEARING IN RECENT YEARS

accelerator	freon
acrylic	getter
addition product	hydroneum
alkylation	hydroponics
alpha rays	inhibitor
americium	mass number
atabrine	micron
atomic bomb	neptunium
atomic fission	nuclear fission
atomic pile	nuclear fusion
buna	oxonium
chain reaction	ph
chemotherapy	plasticizer
copolymer	polonium
curium	positron
cyclotron	pyroxilin
DDT	sinter
detergent	thermoplastic
deuterium	thermosetting
endothermic	tracer chemistry
flocculent	U-235
francium	vinyl
exothermic	zeolite

There are certain terms which seemingly offer no problem as far as the necessity of teaching them is concerned. They occur twenty or more times in at least one textbook. They are listed in Table VII.

A term appearing at least twenty times in a textbook would mean that, on the average, it is being presented once every thirty pages. This recurrence should be often enough for the average student to become familiar with it, although there is no scientific proof that this is true.

Appendix A contains the entire list of terms used in this study. Those concepts which never occurred in any of the four textbooks examined were omitted from that list and were placed in Appendix B.

TABLE VII

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
absorb	20	32	26	
absorption	61	28	25	42
acetate	42	47	35	
acetic	67	53	36	23
acetylene	37	38	44	25
acid	1015	745	770	916
adsorption		23		
ag.	21		20	
al.	27	23		
alchemy				50
alcohol	94	163	84	134
alkali	27	34	66	43
allotropic			35	
alloy	154	94	151	129
alpha rays	50	39		
alum		22	22	
aluminum	207	173	198	154
ammonia	154	236	181	196
ammonium	79	111	98	132
amphoteric	23			

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
anaesthetic	21	25		
analysis	48	64	30	30
anhydride			23	28
anode	50	23	68	47
antimony	29	40	40	33
antiseptic		27		
apparatus		51	39	41
argon	22		24	28
arsenic	63	56	33	32
asbestos		20		
atmosphere	67	52	34	63
atom	698	469	568	348
atomic number	60	62	72	65
atomic weight	72	64	66	98
balance	59	40	38	43
barium	75	22	37	55
barometer			21	
base	241	153	84	152
battery	79			31
beaker		23		20

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
benzene	41	32	20	20
beryllium		29		
beta rays	28			
bicarbonate	60	40	49	
bismuth	34	30	25	
bivalent				29
blast furnace	33	20	27	
bleach	34	36	65	47
boiling point	71	32	30	53
bond			32	
borax	20		23	28
brass	23		22	
bromide	34	42	52	37
bromine	68	75	61	52
bronze			32	
BTU		28		
buna		21		
Bunsen burner			20	
butane	31	48		
by-product	21			39

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
c.		22		
cadmium	34		23	
calcium	243	224	253	256
calorie	51	35		46
capacity	80	40	70	20
carbide			26	22
carbohydrate		20		30
carbon	313	290	238	284
carbonate	125	100	145	147
carbon dioxide	167	201	192	214
carbonic			20	22
carbon monoxide	38	42	74	58
carbon tetrachloride		25		
cast iron			22	
catalyst	66	33	50	56
cathode	74	30	66	47
caustic			21	
cell	70	32	43	30
cellulose	65	57	53	50
cement		27	53	32

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
centigrade	171	215	143	150
centimeter		22		
charcoal	23	29	25	26
charge	138	136	82	70
chemical	577	414	305	254
chemical change		25	27	35
chemical property	38	36	41	
chemistry	230	270	90	337
chlorate	33	50	31	52
chloride	307	289	319	257
chlorine	228	209	287	242
chlorous	26	35	27	
chromate	20			
chromium	45	61	42	38
cl.	67	64	33	21
clay	31	38	43	30
coagulate			20	23
coal	67	91	107	162
cobalt			27	20
coefficient	20			

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
coke	20	32		
colloid	95	102	128	110
combination	161	124	162	166
combustion	53	72	59	100
component		32		
composition	174	101	116	199
compound	626	483	539	954
concentrated	162	131	110	75
condense	26	51	37	48
conductor	21	34		44
conservation	20			
constituent	20	29	32	52
copper	277	296	333	249
corrode	30			
corrosion	48		47	
crucible				20
crystal	88	79	128	105
crystalline	46	53	97	69
cu.	62	30	29	21
cubic centimeter	26	30	22	

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
current	80	53	82	83
cyanide		26	20	38
cylinder		29	25	57
decay	27		23	
decompose	76	75	94	91
degree	47	28	47	
density	70	30	97	54
deposit	65	68	90	52
dextrose	20		31	21
di-	38	42		
diffusion	24	32		
diluted	74	64	92	52
dioxide	90	90	121	89
dispersed	22	50		60
dispersed medium		24		
dissociation	63	27	58	
dissolve	184	163	182	181
distill	51	36	59	43
disulfide			28	
ductile			21	

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
dye		35		60
electrode	57	37	25	34
electrolysis	82	39	76	69
electrolyte	55	46	20	52
electron	333	300	387	240
element	663	465	461	797
emulsion	29		34	25
energy	205	126	128	84
equation	214	230	147	230
equilibrium	30	29	24	52
ester	34	23	23	
ethane	36	28		
ether	24	26		
ethyl	61	48	36	25
evaporation	74	61	52	59
evolve	32		24	
exert				20
expand		38		20
experiment	147	85	74	119
explode	70	90	67	96

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
extract		29		32
fats	40	45	29	46
fe.	35	26	41	
fermentation			24	
ferric	34	53	53	33
ferrous	32	35	45	30
fertilize	51	65	22	73
filter	74	42	31	34
fission	28			
flask		25		25
fluoride	26	45	26	
fluorine	81	59	36	33
formaldehyde		29	28	
formula	187	232	188	300
freezing point	30			24
fuel	29	21	35	40
fume			20	
fuse	24	25	35	
g.	185	125	110	193
galvanize	25			

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
gas	457	586	529	605
gasoline	78	40	53	54
gaseous	25	41	24	39
gel			22	
glucose		34	22	30
glycerine	57	55	20	20
glycerol	20	25		
gold	85	85	124	126
gram	118	230	195	95
graphite		31	57	28
gram molecular volume				32
gram molecular weight				28
h.	82	62	28	
halogen		31	53	26
helium	55	46	45	66
humidity	24			
hydrate	28			42
hydrocarbon	57	52	46	40
hydrochloric	123	82	98	116
hydrogen	579	603	794	803

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
hydrolysis	38	33	24	
hydroxide	229	180	246	208
hydroxyl	34	25		
ignite		29		
inert		25	36	
ingredient		25		
insecticide	27			
insoluble	53	34	79	100
iodide		30	30	24
iodine	77	88	58	44
ion	374	232	404	259
ionization	25	63	33	46
iron	398	334	419	293
isotopes	41	27	29	34
kiln			24	
kinetic		22		
laboratory	81	98	82	200
law	20	33	47	39
lead	180	169	168	181
liberate	44	40	47	34

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
lime	44	40	68	57
limestone	72	38	36	42
liquefy		23	25	44
liquid	249	299	192	356
liter	146	116	129	109
lithium	56	52	22	24
litmus	21	25	34	29
magnesium	203	137	111	84
malleable			30	
manganese	61	42	45	71
matter	25	32		29
melting point		24	40	43
mercuric	25	36	22	37
mercury	69	139	119	97
metal	728	366	806	533
metallic	24	57	89	30
metallurgy	22			
meter		20		
methane	53	41	46	30
methyl	21	64		

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
milliliter	69	98	64	62
millimeter			50	
millimicron		22		
mineral	214	91	64	111
mixture	239	218	193	196
mm.		52		
moisture	39	27	40	28
molar	55	28	31	27
mole	112	41	45	30
molecule	389	492	363	416
motion		30	26	20
na.	45	51	33	28
negative	79	54	99	48
neon	26		20	33
neutralize	66	80	63	38
neutron	86	44	44	43
nickel	56	41	59	57
nitrate	122	132	126	143
nitric acid	81	128	125	111
nitrite	21	20		

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
nitrogen	193	269	204	263
nonconductor		20		21
nonmetal	92	73	59	45
normal	89	63	42	25
nuclear fission	27			
nucleus	109	101	85	75
o.	66	64	34	58
octane	22			
oleic			20	
open hearth	20	35	28	30
ore	147	116	89	106
organic	80	81	65	53
oxalic			24	
oxidation	242	123	145	160
oxide	300	253	316	320
oxy-			27	
oxygen	527	452	490	760
ozone	27		29	36
paraffin		25	20	
particle	222	216	168	113

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
pb	21			
percentage	346	272	153	291
periodic table		23		
peroxide	24	21	36	42
petroleum	68	33	42	75
ph	77			
phenol	34	21		
phlogiston theory	32			20
phosphate	60	59	53	63
phosphorus	129	116	115	122
photograph	50	54	47	41
pig iron	20			
pigment	47			28
plastic	78	73	73	32
platinum	40	32	49	71
poisonous	70	59	37	63
polar		30		
polymerization	29	22		
positive	101	72	81	47
potassium	140	219	223	230

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
precipitate	122	68	70	88
pressure	156	298	178	192
properties	249	213	197	240
proportion		25	66	41
protein		26		
proton	58	81	60	65
purify	70	54	36	62
quartz	31		33	
radical	30	40	41	47
radioactive	57	27	59	
radium	22	54	61	71
ratio	42	25	23	32
rayon	40	42		
react	127	165	148	131
reactant	26			
reaction	649	450	311	286
reagent				24
reduce	162	116	100	119
refine	26			20
refrigeration		25		23

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
replacement	37	33	50	32
residue	38			
resin	38	52	42	
s.		22		
salt	229	277	236	457
saturated	67	40	31	35
silicate	38	28	38	52
silicon	54	31	40	73
silver	157	186	294	177
slake			26	
soda	44	51	53	49
sodium	461	416	471	464
solder			22	
solid	164	154	146	277
soluble	162	123	174	182
solute	49	26		
solution	694	295	530	454
solvent	63	64	46	44
specific gravity	45			
spectroscope	25			

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
spectrum		28	25	
stable	21	23	62	
starch	48	47	54	53
stearin		21		26
steel	168	103	138	95
STP	23			
structural	105	97	118	64
substance	205	385	330	221
substitution	22	23		28
sulfa	26			
sulfate	212	149	146	180
sulfide	98	110	188	118
sulfite	23	20		
sulfur	287	259	299	243
sulfuric	206	180	212	173
suspension		28		22
symbol		27	37	50
synthesis	56	89	48	38
tarnish	20			
temperature	341	350	331	304

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
test tube	75	49	37	44
thermometer		29		
tin	95	77	108	76
tri-	40	46	32	27
tubing	27	35	20	21
tungsten	29			29
U-235	22			
univalent				26
unstable			30	
uranium	37		26	23
vacuum	32			
valence	134	146	143	177
vapor	95	73	83	116
vaporize		27		
vinyl		26		
viscose	24			
vitamin	76	54	33	24
volatile	31	28	43	
volume	212	264	245	301
vulcanize	20	21		

TABLE VII (Continued)

TERMS APPEARING TWENTY OR MORE TIMES IN ONE BOOK

TERM	I	II	III	IV
x-ray	31	25		
zinc	196	173	236	188
zn.	46	27	28	26

CHAPTER IV

CONCLUSIONS

There seems to be a tendency among the authors in recent years toward a greater uniformity of concepts as presented in the textbooks examined. This was illustrated by Table III, especially when comparing the number of concepts common in Books I and II, which have the most recent copyright date.

There also seems a trend toward an increasingly greater vocabulary in high school chemistry textbooks. Cole's list of 520 chemistry terms published in 1940 has been increased in this study to eight hundred and ninety-six in spite of the fact that seventeen of her terms were not found in the books checked and were consequently dropped from Appendix A and placed in Appendix B. Table VI illustrates forty-six new concepts developed in the last few years. So instead of minimizing technical terms, the opposite is taking place, expansion of the list is developing, and in view of the accelerated research in the chemical field today, given impetus by war fear, no decrease seems in sight. Such being the case, the pupil vocabulary burden tends to becoming greater instead of less.

A third conclusion which can be arrived at is that the teacher must be aware of the problem and by

word substitution, study of the vocabulary used in chemistry, visual means, thorough explanation, and intensive glossary study, clarify the various concepts for the student. Authors must collaborate by unification of terms and minimization of concepts.

Finally, the most important conclusion that can be drawn is one substantiated by such authorities as Curtis, Kitzmiller, and Gray, namely, that the vocabulary burden for the average high school student in content fields is too great.

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6. Thorndike, E. L., and Lorge, Irving, The Teacher's Word Book of Thirty-Thousand Words, Bureau of Publications, Teachers College, Columbia University, New York, 1944.

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1. Kitzmiller, A. B., "Certain Vocabulary Problems in High School Chemistry", Science Education XV, November, 1930.

KEY TO APPENDIX A

cc--Concepts listed in Cole's compiliation.

o---Indicates organic terms listed in a supplement of Cole's chemistry terms. She gave no frequency count for them.

x---Refers to new terms added to Cole's list.

C---Indicates the frequency per million words. This frequency was derived from Thorndike-Lorge's rating of concepts.

The Roman numerals I, II, III, and IV refer to the four chemistry textbooks surveyed. Number I being the most recent and number IV the oldest.

APPENDIX A

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
abrasive	cc	8	6	4	3	
absolute scale	cc	2	1	1	3	
absolute temperature	x	7	18	9	0	
absolute zero	cc	11	1	2	8	
absorb	cc	20	32	26	15	
absorption	cc	61	28	25	42	8
accelerate	cc	7	9	4	2	
accelerator	x	3	2	3	0	1
acetate	o	42	47	35	11	
acetic	o	67	53	36	23	
acetone	o	13	15	9	2	
acetylene	o	37	38	44	25	1
acid	cc	1015	745	770	916	38
acrylic	x	8	10	6	0	
activity series	x	17	15	0	0	
addition product	x	2	0	0	0	
adsorption	x	10	23	16	18	
aeration	x	4	0	0	0	
affinity	cc	4	6	5	27	5
ag.	cc	21	14	20	8	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
al.	cc	27	23	14	6	
albumin	x	1	2	3	0	
alchemy	x	18	9	5	50	1
alcohol	o	94	163	84	134	15
aldehyde	o	15	16	6	10	
algebraic	cc	1	0	1	0	3
alkali	cc	27	34	66	43	3
alkaloid	o	3	2	1	1	1
alkylation	x	4	4	2	1	
allotropic	cc	7	12	35	13	
alloy	cc	154	94	151	129	4
alpha rays	x	50	39	11	8	
alum	cc	7	22	22	15	
aluminum	cc	207	173	198	154	6
amalgam	cc	15	5	9	2	2
americium	x	5	3	0	0	
amino	x	17	18	1	0	
ammonia	cc	154	236	181	196	5
ammonium	x	79	111	98	132	
amorphous	cc	1	11	17	8	1

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
amphoteric	x	23	19	8	4	
amyl	x	4	4	2	2	
anaesthetic	o	21	25	6	9	1
analysis	cc	48	64	30	30	14
anhydride	cc	16	9	23	28	
anhydrous	cc	9	4	2	6	
aniline	o	17	15	1	10	1
anion	cc	0	0	0	14	
anneal	x	9	6	15	5	1
anode	cc	50	23	68	47	
antifreeze	x	1	4	0	2	
antidote	x	1	3	0	0	2
antimony	cc	29	40	40	33	1
antiseptic	cc	11	27	7	7	2
apparatus	cc	19	51	39	41	18
aqua fortis	cc	3	1	1	0	
aqua regia	cc	6	5	4	8	
aqueous	cc	3	1	5	4	1
argon	cc	22	11	24	28	
aromatic	x	1	3	0	0	4

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
arsenate	cc	8	5	1	4	
arsene	cc	2	5	0	1	
arsenic	cc	63	56	33	32	3
arsenite	cc	4	1	0	0	
arsenious	cc	3	7	2	3	
as.	cc	6	8	4	1	
asbestos	cc	18	20	9	4	1
asphalt	x	11	0	1	3	5
aspirin	x	13	3	0	0	
association	cc	7	9	0	0	A
astatine	x	2	4	0	0	
atabrine	x	8	2	0	0	
-ate	cc	5	1	1	1	
atmosphere	cc	67	52	34	63	38
atom	cc	698	469	568	348	8
atomic bomb	x	17	7	0	1	
atomic fission	x	0	1	0	0	
atomic number	x	60	62	72	65	
atomic pile	x	16	8	0	0	
atomic weight	cc	72	64	66	98	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
attraction	cc	12	10	4	6	17
au.	x	9	4	6	3	
b.	cc	1	2	3	2	
ba.	cc	11	4	7	7	
bakelite	x	9	10	3	1	
balance	cc	59	40	38	43	A
barium	cc	75	22	37	55	
barometer	cc	4	12	21	14	2
base	cc	241	153	84	152	AA
battery	cc	79	17	16	31	19
bauxite	cc	9	12	1	7	
bead test	x	7	2	3	2	
beaker	cc	1	23	1	20	1
bell jar	cc	3	1	0	0	
benzene	o	41	32	20	20	1
benzoate	x	2	1	2	2	
benzol	o	0	1	3	2	
beryllium	x	18	29	13	14	
bessemer converter	cc	12	15	12	9	
beta rays	x	28	13	14	5	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
bi.	cc	14	6	4	1	
bi-	cc	9	11	3	4	
bicarbonate	cc	60	40	49	12	
binary	cc	3	8	1	8	
bismuth	cc	34	30	25	16	
bivalent	cc	10	1	0	29	
blast furnace	cc	33	20	27	10	
bleach	cc	34	36	65	47	9
blow pipe	cc	2	1	3	1	
boiling point	cc	71	32	30	53	
boneblack	o	4	2	8	10	
bond	x	13	9	32	2	A
borax	cc	20	12	23	28	2
boric acid	cc	2	6	9	7	1
boron	cc	8	19	5	17	
br.	cc	13	15	19	5	
brass	cc	23	10	22	16	32
bromide	cc	34	42	52	37	2
bromine	cc	68	75	61	52	
bronze	cc	6	12	32	13	19

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
Brownian movement	x	6	6	5	2	
BTU	x	6	28	0	2	
buna	x	7	21	1	1	
Bunsen burner	cc	5	16	20	9	
buoyant	cc	10	2	0	0	5
burette	x	1	13	2	0	
butane	x	31	48	18	2	
butyric	o	3	0	0	0	
by-product	cc	21	15	9	39	3
c	cc	17	22	14	10	
ca.	cc	17	9	5	4	
cadmium	cc	34	6	23	13	
calcite	x	6	8	0	0	2
calcium	cc	243	224	253	256	9
calculate	cc	4	10	12	19	
calorie	cc	51	35	15	46	4
capacity	cc	80	40	70	20	37
capillarity	cc	6	2	0	0	3
carbide	cc	11	16	26	22	
carbohydrate	o	17	20	8	30	4

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
carbolic acid	o	4	2	0	6	
carbon	cc	313	290	348	284	23
carbonate	cc	125	100	145	147	4
carbon dioxide	x	167	201	192	214	
carbonic	cc	9	17	20	22	10
carbonization	x	8	3	0	0	
carbon monoxide	x	38	42	74	58	
carbon tetrachloride	x	19	25	17	14	
carborundum	cc	8	6	8	4	
carboxyl	x	2	2	4	0	
casein	x	15	4	5	10	
cast iron	cc	15	18	22	14	
catalyser	cc	6	4	1	0	
catalysis	cc	7	10	5	4	
catalyst	x	66	33	50	56	
cathode	cc	74	30	66	47	
cation	cc	0	0	3	5	
caustic	cc	2	7	21	14	3
cc.	x	13	13	10	10	
cd.	cc	5	3	4	1	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
cell	x	70	32	43	30	A
cellophane	x	8	3	1	9	
celluloid	o	3	4	2	3	1
cellulose	o	65	57	53	50	2
cement	cc	8	27	53	32	17
centigrade	cc	171	215	143	150	1
centimeter	x	10	22	6	5	2
ceramic	x	3	5	6	1	
cesium	x	14	3	8	6	
chain reaction	x	18	3	0	0	
chalk	cc	13	9	6	8	13
chamber process	x	6	6	4	5	
char	cc	1	2	3	3	3
charcoal	o	23	29	25	26	11
charge	cc	138	136	82	70	AA
chemical	cc	577	414	305	254	26
chemical change	x	13	25	27	35	
chemical equivalent	x	8	9	6	10	
chemical property	x	38	36	41	3	
chemistry	x	230	270	90	337	11

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
chemotherapy	x	5	0	0	0	
chlorate	cc	33	50	31	52	
chloric	cc	8	2	6	15	
chloride	cc	307	289	319	257	2
chlorine	cc	228	209	287	242	3
chloroform	o	8	14	13	4	1
chlorous	cc	26	35	27	17	
chromate	cc	20	12	12	17	
chromic	cc	6	5	10	5	
chromium	cc	45	61	42	38	1
chromous	cc	2	5	2	0	
citrate	o	4	10	2	1	
citric	o	9	10	3	4	
cl.	cc	67	64	33	21	
clamp	cc	5	3	0	0	4
clay	cc	31	38	43	30	43
cm.	x	1	8	2	2	
co.	cc	4	1	3	1	
coagulate	cc	12	7	20	23	1
coal	x	67	91	107	162	AA

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
coal tar	o	3	8	1	5	
cobalt	cc	19	11	27	20	1
cobaltic	cc	2	2	1	2	
cobaltous	cc	2	1	4	3	
cocaine	o	10	2	0	2	1
coefficient	cc	20	12	4	11	1
cohesion	x	6	4	0	0	1
coil	x	10	2	3	4	13
coke	o	20	32	15	12	
colloid	cc	95	102	128	110	
collodion	o	2	2	1	4	
combination	x	161	124	162	166	40
combustible	cc	4	0	0	0	1
combustion	cc	53	72	59	100	9
component	x	8	32	6	3	3
composition	cc	174	101	116	199	19
compound	cc	626	483	539	954	22
concentrated	cc	162	131	110	75	19
concrete	cc	15	3	10	1	15
condense	cc	26	51	37	48	29

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
conduction	x	4	7	7	10	1
conductor	cc	21	34	15	44	16
conservation	cc	20	13	10	6	7
constituent	cc	20	29	32	52	8
contact process	x	5	6	7	6	
contaminate	cc	15	6	2	8	3
contract	cc	1	10	4	3	7
conversion	cc	8	6	4	5	6
copolymer	x	4	10	0	0	
copper	cc	277	296	333	249	46
cordite	x	3	3	0	0	
corrode	cc	30	16	15	12	1
corrosion	cc	48	13	47	12	
corrosive	cc	5	9	9	12	1
corrosive sublimate	cc	3	3	5	3	
corundum	cc	3	1	0	1	
covalence	x	11	9	7	19	
cr.	cc	6	6	6	7	
cracking	x	16	12	5	2	
critical	x	10	4	11	6	16

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
crucible	cc	5	18	7	20	2
crystal	cc	88	79	128	105	27
crystalline	cc	46	53	97	69	3
cu.	cc	62	30	29	21	
cubic centimeter	cc	26	30	22	19	8
cupric	cc	2	8	3	9	
cuprous	cc	2	14	2	8	
curium	x	4	3	0	0	
current	cc	80	53	82	83	A
cyanamide	o	6	12	8	12	
cyanide	o	10	26	20	38	1
cyanogen	o	1	0	4	2	
cyclotron	x	2	13	3	0	
cylinder	cc	18	29	25	57	16
DDT	x	14	11	0	0	
decay	cc	27	15	23	13	33
decompose	cc	76	75	94	91	6
deflagration	x	1	0	0	0	
degree	x	47	28	47	13	AA
dehydrate	cc	14	12	12	16	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
deliquescent	cc	4	8	3	10	
delivery tube	x	7	12	6	8	
denatured	o	7	8	10	12	1
density	cc	70	30	97	54	5
deodorize	cc	2	2	1	6	
deposit	cc	65	68	90	52	41
derivative	o	10	14	5	4	
desiccate	x	0	0	0	1	
destructive distillation	x	5	12	18	6	
detergent	x	4	3	10	3	
detonate	x	4	10	0	0	1
deuterium	x	14	11	13	4	
developer	x	6	10	10	4	
dextrose	o	20	17	31	21	
di-	cc	38	42	4	7	
dialysis	cc	6	9	3	3	
diamond	o	2	1	10	7	8
diastase	o	5	6	4	2	
diatomic	x	4	0	0	0	
dibasic	cc	7	6	4	9	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
dichromate	cc	7	2	2	9	
diffusion	cc	24	32	11	4	2
diluted	cc	74	64	92	52	3
dioxide	cc	90	90	121	89	4
directly proportional	cc	13	7	8	5	
disaccharide	x	2	1	0	0	
discharge	cc	6	3	7	7	30
disinfect	cc	4	19	13	9	1
dispersed	x	22	50	13	60	11
dispersed medium	x	9	24	4	14	
displacement	cc	8	5	14	14	3
dissociation	cc	63	27	58	17	1
dissolve	cc	184	163	182	181	29
distill	cc	51	36	59	43	5
disulfide	cc	14	16	28	12	
double replacement	x	13	12	10	10	
draft	cc	2	4	6	3	30
drier	x	10	2	4	3	2
ductile	cc	10	12	21	9	
dye	x	16	35	18	60	23

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
dynamic	x	7	7	4	7	2
dynamite	o	7	12	6	6	5
effervesce	cc	4	3	1	4	1
efflorescent	cc	6	5	6	3	1
elastic	cc	12	12	15	13	12
electrochemical	x	11	4	12	2	
electrode	cc	57	37	25	34	
electrolysis	cc	82	39	76	69	1
electrolyte	cc	55	46	20	52	1
electromotive force	x	4	6	10	17	1
electron	cc	333	300	387	240	1
electronic	x	1	3	0	0	
electroplating	x	9	4	5	14	
electrotyping	x	2	2	2	3	
electrovalent	x	13	11	17	19	
element	cc	663	465	461	797	A
emery	cc	2	1	2	4	3
emission	x	3	1	6	0	1
emulsion	cc	29	17	34	25	2
endothermic	x	6	3	6	0	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
energy	cc	205	126	128	84	41
enzyme	o	11	15	4	3	
equation	cc	214	230	147	230	4
equilibrium	cc	30	29	24	52	3
equivalent	cc	7	5	3	4	12
ester	o	34	23	23	14	1
ethane	o	36	28	17	8	
ether	o	24	26	9	8	4
ethyl	o	61	48	36	25	1
eudiometer	x	5	3	2	4	
evaporating dish	cc	2	0	0	0	
evaporation	cc	74	61	52	59	5
evolve	cc	32	15	24	19	5
exert	cc	15	8	10	20	11
exothermic	x	7	3	6	0	
expand	cc	17	38	13	20	15
experiment	cc	147	85	74	119	A
explode	cc	70	90	67	96	9
extract	cc	16	29	12	32	
f.	cc	10	7	3	6	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
fahrenheit	cc	16	17	7	5	2
fats	x	40	45	29	46	AA
fe.	cc	35	26	41	15	
feldspar	cc	9	11	13	9	2
ferment	cc	3	3	10	4	5
fermentation	x	11	16	24	16	3
ferri-	cc	12	15	11	12	
ferric	cc	34	53	53	33	
ferro-	cc	12	16	14	12	
ferrous	cc	32	35	45	30	
fertilize	x	51	65	22	73	6
filter	cc	74	42	31	34	8
filtrate	cc	4	13	7	6	
fission	x	28	2	10	8	
fixer	x	2	6	4	2	
flash point	x	2	0	0	0	
flask	cc	16	25	13	25	4
flocculent	x	3	1	0	1	
Florence flask	x	1	1	2	0	
flotation	x	11	8	1	1	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
fluorescence	x	6	7	2	2	
fluoride	cc	26	45	26	16	
fluorination	x	5	0	0	0	
fluorine	cc	81	59	36	33	
flux	cc	19	7	5	8	1
forceps	cc	2	0	0	0	1
formaldehyde	o	16	29	28	4	
formic	o	2	3	4	7	
formula	cc	187	232	188	300	11
fractional distillation	x	7	14	7	4	
francium	x	4	4	0	0	
freezing point	cc	30	8	7	24	
freon	x	5	2	0	0	
fructose	o	5	9	0	0	
fuel	o	29	21	35	40	
fume	cc	5	11	20	6	8
funnel	cc	2	1	0	6	5
fuse	cc	24	25	35	18	7
g.	x	185	125	110	193	
galvanize	cc	25	6	9	7	2

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
gamma rays	x	18	6	12	7	
gangue	x	14	11	0	0	
gas	cc	457	586	529	605	A
gaseous	cc	25	41	24	39	5
gasoline	o	78	40	53	54	15
gauze	cc	4	0	0	0	6
gel	x	7	14	22	5	
gelatin	x	15	9	22	11	7
germanium	x	1	1	0	0	
German silver	cc	4	4	2	3	
germicide	x	11	8	2	6	
getter	x	3	0	0	0	
glaze	cc	2	0	0	0	9
globule	cc	2	3	1	0	1
glucose	o	18	34	22	30	
glycerine	x	57	55	20	20	1
glycerol	o	20	25	10	7	
gold	cc	85	85	124	126	AA
graduate	cc	4	17	6	8	28
grain alcohol	o	0	0	2	3	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
graph	cc	10	5	10	8	3
graphite	o	12	31	57	28	4
gram	cc	118	230	195	95	1
gram molecular volume	x	15	10	17	32	
gram molecular weight	x	17	12	18	28	
guncotton	o	1	9.	2	3	
gunpowder	o	6	5	3	8	6
gypsum	cc	16	9	15	10	2
h.	cc	82	62	28	19	
halide	x	4	1	0	1	
halogen	cc	18	31	53	26	
heat of fusion	x	3	10	4	2	
heat of vaporization	x	7	10	5	3	
heavy water	x	6	4	3	5	
helium	x	55	46	45	66	1
hepta-	cc	2	0	0	0	
heptane	x	4	6	0	1	
hexa-	cc	6	7	1	1	
hg.	cc	8	13	13	7	
homogeneous	x	5	5	2	3	1

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
homologous	x	10	1	3	2	
hormone	x	6	0	0	2	
humidity	cc	24	14	7	3	3
hydrate	cc	28	17	18	42	
hydride	x	10	2	0	1	
hydriodic	cc	12	13	8	9	
hydro-	cc	6	2	0	2	
hydrobromic	cc	14	6	4	4	
hydrocarbon	c	57	52	46	40	
hydrochloric	cc	123	82	98	116	1
hydrofluoric	cc	12	8	5	10	
hydrogen	cc	579	603	794	803	16
hydrogenation	x	18	8	13	14	
hydrolysis	cc	38	33	24	12	
hydrometer	x	14	2	5	3	
hydroneum	x	0	4	0	1	
hydroponics	x	1	2	0	2	
hydrosulfuric	cc	6	4	3	7	
hydroxide	cc	229	180	246	208	
hydroxyl	cc	34	25	14	19	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
hygroscopic	cc	1	0	2	1	
hypo-	cc	14	18	16	13	
i.	cc	10	14	18	15	
-ic	cc	1	7	5	5	
-ide	cc	3	4	2	4	
ignite	cc	13	29	14	15	2
immiscible	x	3	1	1	0	
impregnate	x	0	8	1	0	2
incandescent	cc	8	1	11	1	2
indicator	x	11	10	12	11	2
inert	cc	9	25	36	14	5
infer	x	16	10	2	4	
inflammable	cc	10	14	8	2	3
ingredient	x	16	25	18	13	11
inhibitor	x	0	1	0	0	1
injurious	cc	5	6	4	2	6
inorganic	cc	7	19	4	6	1
insecticide	x	27	12	5	13	
insoluble	cc	53	34	79	100	2
insulator	cc	3	0	0	0	1

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
inversely proportional	cc	6	7	10	5	
inversion	x	4	1	0	0	1
invisible	cc	0	1	0	1	
iodide	cc	16	30	30	24	
iodine	cc	77	88	58	44	2
iodoform	o	2	1	3	2	
ion	cc	374	232	404	259	1
ionization	cc	25	63	33	46	
iron	cc	398	334	419	293	AA
isomer	x	16	12	7	12	
isoprene	x	7	6	1	4	
isotopes	x	41	27	29	34	
-ite	cc	2	1	1	1	
k.	cc	10	13	9	6	
kaolin	x	6	2	6	4	
kerosene	o	17	14	17	14	7
ketone	x	9	8	5	10	
kiln	x	9	15	24	17	2
kilogram	cc	5	8	2	11	1
kindling temperature	cc	11	13	7	16	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
kinetic	cc	6	22	8	10	
krypton	x	11	7	5	10	
laboratory	cc	81	98	82	200	16
lachrymators	x	3	4	0	0	
lacquer	x	5	10	4	13	3
lactic	o	7	4	10	9	
lactose	o	9	8	8	7	
lake	x	3	7	2	3	
lamp black	o	1	1	4	2	
law	x	20	33	47	39	
leach	cc	6	2	0	0	1
lead	cc	180	169	168	181	AA
levulose	o	3	2	5	6	
li.	cc	9	7	3	5	
liberate	cc	44	40	47	34	9
lignite	x	3	5	0	0	1
lime	cc	44	40	68	57	27
limestone	cc	72	38	36	42	
limewater	cc	18	8	11	6	
liquefaction	cc	6	2	4	3	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
liquefy	cc	10	23	25	44	
liquid	cc	249	299	192	356	31
liter	cc	146	116	129	109	1
litharge	x	2	3	1	2	
lithium	cc	56	52	22	24	
litmus	cc	21	25	34	29	
lubricant	x	11	11	11	7	2
lubricating oil	o	1	0	2	0	
luminous	cc	4	1	0	0	8
lye	cc	13	16	9	3	1
magnesium	cc	203	137	111	84	3
malleable	cc	14	8	30	10	1
maltose	o	6	9	4	6	
manganese	cc	61	42	45	71	1
mass number	x	0	6	0	0	
matter	x	25	32	17	29	
melting point	x	12	24	40	43	
meniscus	x	3	3	0	0	
mercuric	cc	25	36	22	37	
mercurochrome	x	1	2	0	3	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
mercurous	cc	3	7	7	5	
mercury	cc	69	139	119	97	21
merthiolate	x	6	3	0	3	
meta-	cc	7	2	0	4	
metal	cc	728	366	806	533	A
metallic	cc	24	57	89	30	10
metallurgy	cc	22	19	14	17	1
metaphen	x	6	3	0	2	
meter	x	7	20	11	9	12
methane	o	53	41	46	30	
methyl	x	21	64	13	13	
mg.	cc	12	14	7	9	1
mica	cc	7	4	8	6	4
micron	x	6	5	0	3	
milliliter	x	69	98	64	62	
millimeter	cc	17	14	50	13	1
millimicron	x	14	22	4	6	
mineral	cc	214	91	64	111	38
miscible	x	3	1	4	1	
mixture	cc	239	218	193	196	39

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
mm.	x	9	52	8	6	1
mn.	cc	6	11	8	7	
mo.	x	2	2	3	1	
moisture	cc	39	27	40	28	21
molar	x	55	28	31	27	1
mole	x	112	41	45	30	14
molecule	cc	389	492	363	416	3
molybdenum	x	16	5	10	8	
mono-	cc	1	3	6	1	
monobasic	cc	2	0	0	6	
monosaccharide	x	3	3	0	0	
monoxide	cc	1	3	0	0	1
mordant	x	8	8	5	11	
morphine	o	2	7	1	1	
mortar	cc	7	4	8	10	8
motion	cc	15	30	26	20	A
multiple proportions	cc	3	6	12	4	
n.	cc	12	15	9	8	
na.	cc	45	51	33	28	
naphthalene	o	13	10	3	6	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
nascent	x	4	5	2	9	
ne.	x	1	2	4	4	
negative	cc	79	54	99	48	10
neon	x	26	14	20	33	
neoprene	x	3	9	4	1	
neptunium	x	9	9	0	0	
neutralize	cc	66	80	63	38	4
neutron	x	86	44	44	43	
ni.	cc	6	6	9	7	
nickel	cc	56	41	59	57	11
nicotine	o	2	6	2	1	1
nitrate	cc	122	132	126	143	2
nitration	x	5	2	0	0	
nitric acid	cc	81	128	125	111	
nitride	cc	11	6	2	2	
nitrite	cc	21	20	6	8	
nitro-	cc	10	12	4	7	
nitrobenzol	o	2	4	1	0	
nitrocellulose	o	5	7	18	10	
nitrogen	cc	193	269	204	263	12

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
nitroglycerine	o	3	9	15	7	
nitrous	x	15	11	21	15	1
nonconductor	cc	10	20	15	21	
nonelectrolyte	x	6	10	9	8	
nonmetal	x	92	73	59	45	
nonpolar	x	7	14	6	5	
normal	x	89	63	42	25	41
normal salt	cc	2	0	0	0	
novoccaine	x	2	1	0	0	
nuclear energy	x	5	2	4	6	
nuclear fission	x	27	2	0	0	
nuclear fusion	x	10	4	0	0	
nucleus	x	109	101	85	75	6
nylon	x	17	19	8	11	
o.	cc	66	64	34	58	
octa-	cc	3	0	0	0	
octane	x	22	18	8	4	
oleic	o	4	13	20	12	
olein	o	7	9	11	19	
opaque	cc	3	8	10	6	3

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
open hearth	cc	20	35	28	30	
ore	cc	147	116	89	106	18
organic	cc	80	81	65	53	8
ortho-	cc	9	3	1	1	
osmium	x	4	8	3	2	
osmosis	cc	0	2	0	0	2
-ous	cc	1	7	5	2	
oxalate	o	10	12	14	8	
oxalic	o	13	18	24	16	
oxidation	cc	242	123	145	160	2
oxide	cc	300	253	316	320	4
oxonium	x	0	1	1	0	
oxy-	cc	12	8	27	18	
oxy-acetylene	o	4	2	5	10	
oxygen	cc	527	452	490	760	25
ozone	cc	27	10	29	36	
p.	cc	4	10	6	8	
palladium	x	2	1	4	2	
palmitin	o	6	11	7	19	
para-	cc	3	4	0	0	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
paraffin	o	13	25	20	6	3
particle	cc	222	216	168	113	17
pb.	cc	21	19	10	9	
penicillin	x	10	9	0	0	
penta-	cc	7	1	1	0	
pentane	x	5	11	3	1	
pentoxide	cc	9	10	6	5	
per-	cc	5	6	8	5	A
percentage	cc	346	272	153	291	13
periodic law	cc	13	10	11	19	
periodic table	x	10	23	12	8	
permanent hardness	x	4	7	5	3	
permanganate	cc	9	7	4	10	
peroxide	cc	24	21	36	42	
pestle	cc	2	0	0	0	2
petroleum	o	68	33	42	75	8
pewter	cc	4	0	2	3	3
ph	x	77	0	6	0	
phenol	o	34	21	9	4	
phenolthalein	x	5	4	0	0	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
phlogiston theory	x	32	8	10	20	
phosphate	cc	60	59	53	63	4
phosphene	cc	3	4	1	1	
phosphorescent	cc	2	0	1	2	
phosphoric	cc	14	14	9	12	5
phosphors	x	5	10	3	3	
phosphorus	cc	129	116	115	122	1
photograph	x	50	54	47	41	35
pickling	x	5	5	8	4	13
picric	o	10	5	2	1	
pig iron	cc	20	17	18	16	
pigment	x	47	17	18	28	4
pipette	cc	2	5	0	0	
plaster of Paris	cc	12	7	15	8	
plastic	cc	78	73	73	32	3
plasticizer	x	2	0	0	0	
platinum	cc	40	32	49	71	4
plutonium	x	18	12	0	10	
pneumatic trough	x	2	4	0	0	
poisonous	cc	70	59	37	63	42

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
polar	x	8	30	15	7	8
poling	x	3	2	4	3	
pollute	cc	5	5	6	10	4
polonium	x	6	2	7	3	
poly-	cc	2	4	4	0	
polymerization	x	29	22	12	16	
polysaccharide	x	2	1	0	0	
porcelain	cc	4	11	13	8	8
positive	cc	101	72	81	47	15
positron	x	13	7	9	7	
potash	cc	2	10	5	5	3
potassium	cc	140	219	223	230	3
potential	x	7	6	3	8	8
precipitate	cc	122	68	70	88	7
preservative	x	8	24	6	8	2
pressure	cc	156	298	178	192	48
principle	x	6	8	11	10	A
propane	x	15	10	6	6	
properties	cc	249	213	197	240	A
proportion	cc	10	25	66	41	A

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
protein	x	15	26	12	16	6
proton	x	58	81	60	65	
prussic	o	0	0	1	2	
pt.	cc	2	4	3	2	
puddling	cc	4	5	5	9	3
pumice	cc	2	2	2	1	1
purify	cc	70	54	36	62	
pyrex	x	1	2	1	1	
pyro-	cc	2	1	0	0	
pyroxilin	x	12	6	5	2	
quartz	cc	31	10	33	13	14
quicklime	cc	9	4	16	11	
quinine	o	12	0	0	0	3
ra.	cc	2	2	3	5	
radiation	cc	18	6	8	7	3
radical	cc	30	40	41	47	16
radioactive	cc	57	27	59	18	
radioisotopes	x	7	0	0	0	
radium	cc	22	54	61	71	2
radon	x	4	7	3	3	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
rare earth	x	9	2	1	3	
ratio	cc	42	25	23	32	11
rayon	x	40	42	12	19	1
rb.	x	2	2	2	2	
react	cc	127	165	148	131	5
reactant	x	26	6	4	3	
reaction	x	649	450	311	286	21
reagent	cc	17	10	15	24	
reduce	cc	162	116	100	119	A
reducing agent	x	10	10	19	7	
refine	cc	26	16	14	20	7
refrigeration	cc	19	25	12	23	2
replacement	cc	37	33	50	32	1
residue	cc	38	11	8	15	2
resin	o	38	52	42	19	3
respiration	cc	9	8	6	4	4
retard	cc	3	5	6	10	5
retort	cc	6	12	8	19	15
reversible reaction	cc	11	17	10	19	
ring compound	x	8	0	0	0	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
ring stand	x	3	4	6	8	
roasting	x	18	12	14	9	31
rosin	x	1	0	2	2	1
rubidium	x	9	3	2	6	
s.	cc	19	22	13	15	
saccharin	x	1	1	2	3	
sal ammoniac	cc	1	0	0	0	
salicylic	o	10	4	2	3	
saline	cc	2	0	1	0	1
salt	cc	229	277	236	457	AA
saponification	o	6	5	3	6	
saturated	cc	67	40	31	35	3
saturation	cc	12	16	15	14	1
sb.	cc	10	9	3	4	
se.	x	2	2	3	1	
sediment	cc	1	1	0	0	3
selenium	x	16	5	17	11	
sesqui-	cc	4	0	2	3	
shellac	o	2	2	0	1	
si.	cc	4	3	4	5	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
silica	cc	4	8	8	16	2
silicate	cc	38	28	38	52	
silicon	cc	54	31	40	73	2
silver	cc	157	186	294	177	AA
sinter	x	1	0	0	0	
slag	cc	16	17	15	9	2
slake	cc	13	8	26	13	2
smelter	cc	15	14	13	16	
sn.	cc	16	11	14	19	
soda	cc	44	51	53	49	12
sodium	cc	461	416	471	464	3
sol.	x	2	12	4	0	1
solder	cc	9	11	22	11	2
solid	cc	164	154	146	277	42
solidify	cc	12	3	2	10	1
soluble	cc	162	123	174	182	4
solute	cc	49	26	16	19	
solution	cc	694	295	530	454	31
solvent	cc	63	64	46	44	3
specific density	cc	4	0	0	0	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
specific gravity	cc	45	19	10	15	
specific heat	cc	3	10	1	0	
spectroscope	cc	25	11	15	17	2
spectrum	x	9	28	25	11	6
spontaneous combustion	cc	6	2	9	6	
sr.	cc	4	2	2	4	
stable	cc	21	23	62	18	39
stannic	cc	2	6	6	4	
stannous	cc	4	5	4	4	
starch	x	48	47	54	53	10
stearic	o	6	10	8	10	
stearin	o	12	21	14	26	
steel	cc	168	103	138	95	A
sterilize	cc	9	3	0	0	3
stopcock	cc	0	2	0	1	
stopper	x	6	7	7	4	2
STP	x	23	12	6	4	
straight chain compound	x	4	0	0	0	
strontium	cc	13	4	8	11	
structural	x	105	97	118	64	4

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
strychnine	o	10	7	2	1	
sublimation	x	19	3	7	4	1
sublime	cc	2	6	3	10	8
subscript	x	6	6	5	3	
substance	cc	205	385	330	221	A
substitution	cc	22	23	18	28	4
sucrose	o	13	19	7	15	
sulfa	x	26	3	0	0	
sulfa drug	x	4	7	0	0	
sulfate	cc	212	149	146	180	3
sulfide	cc	98	110	188	118	2
sulfite	cc	23	20	18	10	
sulfur	cc	287	259	299	243	21
sulfuric	cc	206	180	212	173	6
sulfurous	x	4	14	12	16	2
super-	cc	3	13	3	0	1
supersaturated	cc	6	7	6	13	
suspension	cc	11	28	16	22	7
symbol	x	16	27	37	50	17
synthesis	cc	56	89	48	38	1

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
talc	cc	2	7	3	4	1
tannate	o	10	7	3	2	
tannic	o	2	3	0	1	
tannin	o	2	2	0	2	
tarnish	cc	20	11	14	17	2
tartaric	o	14	12	10	7	
tartrate	o	11	9	8	10	
tellurium	x	11	6	12	4	
temper	cc	12	7	14	7	39
temperature	cc	341	350	331	304	A
temporary hardness	x	1	10	8	4	
tenacious	cc	10	6	3	6	2
terminal	cc	12	1	5	0	6
ternary	x	4	8	0	4	
test tube	cc	75	49	37	44	
tetra-	cc	13	10	7	6	
tetrachloride	cc	4	0	0	0	
thermite	cc	13	4	7	4	
thermo-	cc	13	6	7	4	
thermometer	cc	5	29	9	10	12

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
thermoplastic	x	6	0	0	0	
thermosetting	x	4	0	0	0	
thio-	cc	6	4	1	2	
thistle tube	x	1	8	2	0	
thorium	x	5	8	0	3	
tin	cc	95	77	108	76	36
tin foil	cc	1	0	0	2	
tincture	o	12	11	3	9	2
titanium	x	14	8	2	7	
titration	x	16	13	7	15	
TNT	x	7	10	2	5	
toluene	x	16	7	3	7	
tracer chemistry	x	8	0	0	0	
translucent	cc	11	2	7	2	3
transmutation	x	12	4	10	14	
transparent	cc	2	1	6	4	10
tri-	cc	40	46	32	27	
trichloride	cc	2	4	3	2	
tritium	x	6	3	2	1	
trivalent	cc	2	4	2	10	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
tubing	cc	27	35	20	21	1
tungsten	cc	29	16	18	29	1
turpentine	o	8	5	6	8	4
U.	cc	3	3	2	1	
U-235	x	22	14	2	0	
ultraviolet	x	6	6	13	7	2
univalent	cc	12	14	13	26	
unsaturated compound	x	10	6	14	3	
unstable	cc	17	14	30	16	2
uranium	x	37	11	26	23	
urea	x	16	17	7	12	
vacuum	cc	32	16	0	12	5
valence	cc	134	146	143	177	3
vanadium	x	19	3	9	12	
vapor	cc	95	73	83	116	27
vaporize	cc	10	27	16	19	
vapor pressure	x	2	6	2	5	
varnish	o	1	3	4	2	
vaseline	o	3	2	1	5	
ventilation	cc	3	2	4	7	5

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
vesicants	x	1	4	0	0	
vinyl	x	11	26	8	0	
viscous	cc	9	12	16	7	
viscose	x	24	11	11	3	
vitamin	x	76	54	33	24	1
vitriol	cc	2	10	10	15	1
volatile	cc	31	28	43	16	3
volume	cc	221	264	245	301	A
vulcanize	cc	20	21	10	6	
w.	cc	3	3	6	2	
watch glass	cc	1	1	0	0	
water gas	x	2	9	16	10	
water glass	cc	1	1	4	5	
weld	cc	10	9	9	19	5
wood alcohol	o	1	2	5	7	
wrought iron	cc	7	8	10	14	
xenon	x	8	5	3	9	
x-ray	x	31	25	18	13	2
yeast	o	5	7	4	6	
zeolite	x	15	13	3	11	

APPENDIX A (Continued)

THE FREQUENCY OF CHEMISTRY CONCEPTS ACCORDING TO TEXTBOOKS, AND THORNDIKE-LORGE'S RATINGS OF CONCEPTS

CONCEPTS	C	I	II	III	IV	G
zinc	cc	196	173	236	188	10
zn.	cc	46	27	28	26	

APPENDIX B

TERMS WHICH HAD NO FREQUENCY IN THE FOUR TEXTBOOKS

acid salts
adulterate
alizarin
alundum
aqua ammonia
ash
brittle
caffeine
cone
decant
decrepitate
desiccate
formate
gum arabic
hood
hornspoon
hydrocyanic
hyper-
manganic
manganous
metathesis
mortar and pestle
olmitic
photo-
prussiate
ptomaine
toluol
weather
xylol