HEALTH SUBJECT MATTER IN THE NATURAL SCIENCES

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INTRODUCTION

Teaching children the knowledge and skill necessary to maintain themselves in good physical health is generally accepted as one of the chief objectives of education. A complete program of health education as administered in public schools includes three types of activities:

1. Health Inspection.
2. Physical Education.
3. Health Instruction, either by special periods devoted to health instruction or by correlation with other subjects.

This study is limited to a consideration of the third phase of the program, health instruction, and is further limited to a study of the possibilities of health instruction through correlation with courses of four natural sciences, (1) general science, (2) biology, (3) chemistry, and (4) physics, of the secondary school level.

Anyone familiar with the present high school curricula realizes that the content of natural science courses has large areas of subject matter that definitely relate to health instruction. For example, we know that principles of sanitation are taught in general science and biology; that tests for detecting adulterations in food may be taught in chemistry, and that the anatomy of the eye is taught in connection with the study of the lens in physics. To repeat, the problem stated briefly is: (1) to determine quantitatively the percentage of health content in the subject matter of general science, biology, chemistry, and physics as taught in secondary schools, and (2) to determine the nature and scope of the health content in the above natural sciences.

Obviously, in order to determine how much health content is found in the natural sciences it is first necessary to determine upon the definition of health subject matter. Fortunately Dr. Ruth Strang,[1] in 1926, made a study of the health content of the subject matter in

[1] Strang, Ruth, Subject Matter in Health Education, Bureau of Publications, Teachers' College, Columbia University, New York City, 1926.

fourteen textbooks and eighteen courses of study for health instruction. She carefully analyzed the content of these textbooks and courses of study and distributed all subject matter under twenty-six headings. The contents of Strang's list, supplemented by material in three textbooks on health and hygiene, were accepted as guides in defining health subject-matter.

The next step of the study was to determine the best measures of what is actually taught in the natural science classes. For reasons sufficiently obvious to need no discussion in a paper of this length, textbooks, courses of study, and final or college entrance examinations were accepted as the best objective measures of what is taught in high school courses of natural science.

Methods Used in the Study

The first analysis in this investigation was of the contents of twenty textbooks on natural science, five each for general science, biology, chemistry, and physics. These textbooks were those most frequently mentioned by prominent high school teachers and college instructors who were asked to name the five leading textbooks in their fields of specialization. In each of these textbooks a record was made of the number of printed lines devoted to subject matter that was also covered in the content of regular health courses.

The total number of lines of health subject matter in each textbook was divided by the lines per page to figure the total number of pages of health subject matter. Special adaptions were made for cuts, tables, and diagrams; for pages whose lines were not uniform; for blank or partly blank pages; and for questions, summaries, or exercises. Hence, the pages of health subject matter for each textbook reported were complete full pages.

The number of page equivalents devoted to health subject-matter subtracted from the total number of pages of instructional matter leaves the number of pages of non-health subject matter. The percentage of health content is computed upon the basis of the total number of pages of instructional matter rather than upon the number of pages of the complete textbook.

The second analysis was of forty recent and representative courses of study, five state and five city courses each for general science, biology, chemistry, and physics. All topics in the natural science courses of study that were likewise found in courses of study for classes in regular health courses were accepted as health subject matter.

The third analysis was of the thirteen sets of College Entrance Examination Board questions and the twenty sets of New York State

Regents' Examination questions on biology, chemistry, and physics for the years 1916-1926. A record was made of all questions or portions of questions that could be answered with a knowledge of health subject matter. Since each question and portion of question in these examinations was given an arbitrary value in points, to be awarded for the correct response, it was possible to secure a definite ratio between health subject matter and the total subject matter. In borderline cases where the subject matter necessary for the correct response applied equally to health and non-health subjects, one-half of the credits allowed for the correct response was assigned to the health count.

In carrying out the fourth part of this study, a checking list containing the two hundred seventy-six statements which Strang[2] had found to occur five or more times in her investigation was submitted to two hundred teachers, fifty each of general science, biology, chemistry, and physics. These teachers checked those statements which they presented to the class in the subject matter of the natural science which they taught, and indicated roughly the amount of class time given to each statement.

Findings

Table I displays the results of five different analyses of the subject matter taught in biology. In each analysis the percentage of subject matter of biology that is also offered in courses for health instruction is given. Thirty-seven per cent of the subject matter of five biology textbooks was definitely about health. Forty-three per cent of the subject matter outlined in five state courses of study and 32 per cent of the subject matter of five city courses of study was likewise about health. The information required to correctly answer thirteen college entrance examinations in biology is 33 per cent health subject matter and to answer twenty New York State Regents' examinations is 32 per cent health subject matter.

When the five above measures were averaged it was found that 36 per cent of the subject matter of biology is also included in the courses for health instruction. Similar studies were made for general science, chemistry, and physics with the exception that examination questions were not available for general science. It appears that the College Entrance and New York Regents' Board did not feel that general science was sufficiently well organized to receive credit for admission to college, hence, no examinations were given in this subject.

[2] *Op. cit.*

TABLE I

HEALTH CONTENT IN HIGH SCHOOL BIOLOGY

Amount and Extent of Biological Subject Matter Devoted to Health Content, as determined in Five Biology Textbooks.

SECTION 1—TEXTBOOKS

Percentages and Pages of Health Content in Five Biology Textbooks.

Textbook and Author	Pages for all subject matter	Pages for health subject matter	Per cent of pages for health
Biology and Human Life (Benjamin Gruenberg)	480.45	201.83	42.01
New Essentials of Biology (George W. Hunter)	412.05	139.23	33.79
Biology for Beginners (Truman J. Moon)	516.05	180.59	34.99
Biology and Human Welfare (Peabody and Hunt)	477.11	201.65	42.23
New Biology (Smallwood, Reveley and Bailey)	603.71	197.54	32.72
Total for five textbooks	2,489.37	920.87	36.99

SECTION 2—STATE COURSES OF STUDY

Percentages and Topics of Health Content in Five State Courses of Study for Biology.

State Issuing Course	Topics for all subject matter	Topics for health subject matter	Per cent of topics for health
Minnesota	635	302	47.56
New York	801	318	39.70
Vermont	162	60	37.04
Virginia	248	74	29.84
Wyoming	1,051	486	46.24
Total for five State courses	2,897	1,240	42.80

SECTION 3—CITY COURSES OF STUDY

Percentages and Topics of Health Content in Five City Courses of Study for Biology.

City Issuing Course	Topics for all subject matter	Topics for health subject matter	Per cent of topics for health
Austin, Texas	362	93	25.69
Bayonne, N. J.	174	94	54.02
Denver, Colo.	716	167	23.32
Muncie, Ind.	363	180	46.83
St. Louis, Mo.	178	44	24.72
Total for five city courses	1,793	578	32.23

SECTIONS 4 AND 5—EXAMINATION QUESTIONS

Percentages and questions upon health content in thirteen college entrance and twenty New York State Regents Examinations in Biology.

Examinations	Questions upon all subject matter	Questions upon health subject matter	Per cent of questions upon health
College Entrance	195	64.8	33.23
New York State Regents	300	95.8	31.93

A summary of the results of the analysis of the subject matter in general science, chemistry, and physics appears in Table II. It was found that the percentage of subject matter offered in these courses that was also taught in health courses was for general science 33 per cent, chemistry 11 per cent, and physics 3 per cent.

Stated in terms of school weeks this means that a student taking a thirty-six weeks' course in high school science receives the equivalent of thirteen weeks instruction in health subject matter if he takes biology; eleven weeks if he takes general science, three weeks if he takes chemistry; and one week if he takes physics.

TABLE II

SUMMARY OF ALL ANALYSES OF THE HEALTH CONTENT IN THE SUBJECT MATTER OF NATURAL SCIENCES

Showing the percentage of total subject matter devoted to health content in each analysis for each natural science.

	Percentage of Total Subject Matter Devoted to Health in Each Science			
	General Science	Biology	Chemistry	Physics
Page analysis of five popular textbooks	30.78	36.99	9.16	3.05
Topical analysis of five state courses of study	34.49	42.80	16.65	2.76
Topical analysis of five city courses of study	34.91	32.23	14.45	6.13
Credit point analysis of 13 college entrance examinations	.....	33.23	5.79	2.82
Credit point analysis of 20 New York State Regents' examinations	.....	31.93	7.77	1.03
Average	33.36	35.44	10.76	3.16

THE HEALTH SUBJECT MATTER THAT SCIENCE TEACHERS UTILIZE

The number of health statements checked upon the check list of two hundred seventy health topics submitted to teachers indicated that science teachers fully utilize the health content of the subject matter of the natural science courses. Many teachers offer additional health content which does not appear in the text books or courses of study.

Twenty per cent of the health statements are checked by three-fourths of the general science teachers. Fifty-five per cent of the statements are checked by more than one-half of the teachers. Statements concerning *disease* were most often checked, indicating that general science teachers hold this phase of health instruction to be of predominating importance.

Forty-seven per cent of the health statements are checked by three-fourths of the biology teachers. Eighty-two per cent of the biology teachers check three-fourths of the statements. There is a tendency

for biology teachers to supplement the textbooks in developing *structure and care of the teeth* and *elimination of body waste.*

Chemistry teachers show little agreement upon the health subject matter taught in chemistry. Statements concerning foods, however, were most frequently checked.

Physics teachers check few health statements, but there is a tendency to agree upon the statements that concern *eyes—structure and care, and air—ventilation and breathing. Structure and care of the ear,* practically ignored by physics textbooks, is taught from supplementary sources by a large number of physics teachers.

General Science

The type of health subject matter most fully treated in general science is: *foods—nutrition and digestion; disease—cause and prevention; cleanliness—personal and general; air—ventilation and breathing;* and *eyes—structure and defects.*

Sleep, rest and fatigue, and elimination of body waste, which are treated but slightly in general science, deserve more complete consideration.

Exercise and posture are not treated as fully in general science as in the pure health courses. This is no doubt desirable because exercise and posture are essentially matters of habits and skills which can be more adequately developed in the classes of physical training than in science courses.

Health education is commonly offered as one of the principal objectives of general science. This study shows that the health objective is well supported by the subject matter content of the general science curriculum.

General science occurs first in the sequential order of the natural science courses of high school level and therefore reaches many students who withdraw from school before they take other science courses. With respect to numbers of students enrolled, general science is by far the most important science course. For these reasons general science should be given the preference of the health subject matter to be offered, and subsequent science courses should then be adjusted to prevent unnecessary and uninteresting overlapping.

Biology

The type of health instruction receiving greatest emphasis in biology is: *foods—digestion and nutrition; disease—cause and prevention; heart and circulatory system; mental hygiene and psychology; posture, exercise; care of teeth;* and *air—breathing and ventilation.*

The chief criticism of the health content of biology is the nature of its overlapping with the health content of general science. Figures are not available to show the number of students who take both general science and biology but the number is undoubtedly large. Overlapping that presents previously studied facts with different and new emphasis is consistent with good teaching practice. Overlapping that is a mere repetition of subject matter without a change of emphasis is, however, very likely to prove uninteresting and tiresome. Numerous examples of the latter type of overlapping between biology and general science were found, most particularly in the subject matter upon *food* and *disease*.

In the most desirable overlapping observed, general science in the ninth year emphasized the nature of the subject matter, showing the relationship of the subject matter to the individual and to the environment; the course in biology, following in the tenth year, presents essentially the same subject matter, but is continually given new relationships by the emphasis upon the actual functioning of the human body.

Chemistry

The type of health subject matter most fully presented in chemistry is: *foods—nutrition and digestion* (which was consistently more than 50 per cent of the health content of chemistry), *cleanliness—personal and general, safety—personal and property,* and *clothing—hygiene and care.*

The variation in the amount of health subject matter in chemistry was largely due to the extent of treatment of a few special health classifications (particularly those named above) rather than to the inclusion of a wider range of subject matter by the courses devoting greater percentages to health content.

There appears to be a tendency on the part of those chemistry courses devoting liberal content to *foods* to repeat subject matter that has been well presented to students who have taken either general science or biology. It would seem that the subject matter in chemistry upon *foods* should not be a mere review of the elementary principles of a balanced diet or the preservation and care of foods in the home, which are treated in some detail in both general science and biology. Chemistry can make a unique contribution to the study of *foods* by taking advantage of the student's previous training and directly proceeding to teach the chemical composition of foods, the chemical changes involved in digestion, and the industrial chemistry concerned

in food production. Writers of chemistry courses can study with profit the content upon foods in courses of instruction that usually precede chemistry.

Physics

The health content of physics was very largely confined to the following types of subject matter: *air—breathing and ventilation; eyes—structure, defects and care;* and *food—nutrition and digestion.*

It is the opinion of the writer that the possibilities of teaching health in physics are not fully realized in present high school instruction. For example, while the physiology of the eye is reviewed to good advantage in connection with the physics teaching of the lens and light, the physiology of the ear is scarcely mentioned in physics subject matter as it might well be in connection with the study of sound.

In some physics textbooks, thirty to forty pages are devoted to the subject of sound. The origin of and the medium for transferring sound are studied in detail, the course of the vibrations is considered up to the human end-organs, but there is no word regarding the manner in which the sensation of sound is perceived by the human brain.

The writer observed the instruction of one physics class where the teacher introduced interesting supplementary work in connection with sound. Starting with the lungs and vocal cords, showing how human sounds are produced, and following the sound through the physical medium to the organs of the ear that receive the sound waves, she ended with a study of the nerves that carry the sensation of sound to the brain. The human organs involved in this cycle of producing and receiving sounds were studied and discussed. No doubt there are many other physics teachers who thus supplement the available physics subject matter with applications to health.

Application of the Findings

1. The findings of this study should direct the attention of natural science teachers to the health subject matter that is incumbent upon them to teach, because of the nature of the health content of the natural sciences.

2. The natural science teachers are herewith presented data revealing the nature and scope of the health content of the natural sciences from which they may evaluate their teaching, and perhaps readjust points of emphasis.

3. Accurate knowledge of the health content of each of the natural sciences should prevent deadening and wasteful overlapping. Undesirable overlapping between general science and biology, especially in the subject matter concerning *foods* and *disease* exists to a considerable degree. In many instances, the subject matter in chemistry of *foods* is a mere repetition of the treatment in general science and biology, and is no doubt unnecessary and uninteresting to students who have studied either.

4. When overlapping occurs between general science and subsequent natural sciences, general science should be given preference of health subject matter and other courses adjusted to prevent unnecessary overlapping.

5. The findings of this study direct the health teachers' attention to the contributions to health education that can reasonably be expected from natural science courses. Such knowledge can enable the teachers to take advantage of correlating them with their own instruction rather than merely repeating health subject matter previously taught in natural sciences.

6. The interrelations of the health instructor and science instruction are so intricate that teacher training institutions might with profit require students preparing to become natural science teachers to take some courses in health education. Such a procedure would enable the future natural science teachers to make more profitable health adaptation and interpretation from the science subject matter they will teach. On the other hand, college courses in natural science for future health teachers would enable them to appreciate better the scientific basis of the health subject matter they will teach.

7. From the findings of this study, the curriculum builders can better recognize the possibilites of health instruction in the formation of courses of study for natural science. In the making of health courses of study, recognition can be given to the health subject matter of the natural sciences.

8. The high school administration can learn from this study the health instruction that should be yielded from the natural science courses of the curriculum, and hold science teachers responsible for the health subject matter of each course.

9. The high school administration can profit to advantage in using the findings of this study in working out the health instruction received by individual students. Dr. Thomas Wood in a lecture before one of his health classes at Teachers College, Columbia University, made the following statement:

"It is incumbent upon the administrative officer responsible for the educational outcomes of the curriculum to bring together the contributions that all subjects may make to the important objective of health education. Any subject that, taught effectively, can contribute to health education should be recognized as a part of the health program, and its relationship and integration in the unified and rational program definitely provided for."

10. In conclusion, the writer is convinced that the problem of health education is sufficiently great to challenge the best efforts of every contributing department. It is not a question of the natural sciences taking over the sole responsibility of teaching health. It is the problem of the natural science department to make the most of the potential applications to health that lie in the inherent nature of the subject matter of its courses. Health education is only consummated with the changes of behavior of the individual. With the science department assisting in providing a basis for intelligent healthful living, through scientific facts that aid in interpreting proper health principles, it is paving the way for health and physical habits and ideals of living without which all factual knowledge of health is futile.