BIBLIOGRAPHY OF SCIENCE TEACHING

COMPiled BY A COMMITTEE OF THE AMERICAN FEDERATION OF TEACHERS OF THE MATHEMATICAL AND THE NATURAL SCIENCES
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BIBLIOGRAPHY OF SCIENCE TEACHING.

INTRODUCTION.

The following bibliography of science teaching was prepared by a committee of the American Federation of Teachers of the Mathematical and the Natural Sciences, and edited by Professor Richard Elwood Dodge, Teachers College, Columbia University. The following specialists collaborated in selecting and annotating the titles for the several lists: Biology—Professor Otis W. Caldwell, School of Education, University of Chicago, Chicago, Illinois; Chemistry—New England Association of Chemistry Teachers, and Professor John F. Woodhull, Teachers College, Columbia University, New York City; Geography—Professor Ray H. Whitbeck, University of Wisconsin, Madison, Wisconsin; Mathematics—Professor J. W. A. Young, University of Chicago, Chicago, Illinois, and Professor David Eugene Smith, Teachers College, Columbia University, New York City; Nature study—Professor Maurice A. Bigelow, Teachers College, Columbia University, New York City; Physics—New York Physics Club, and Professor John F. Woodhull, Teachers College, Columbia University, New York City. The necessary limitation in the number of items in each field has doubtless led to the omission of many works of value. It will be found, however, that the titles have been carefully selected, and that items here included are really serious contributions to the field.
BIOLOGY.

(a) Articles Relating to the Teaching of Biology as a Whole.


BIBLIOGRAPHY OF SCIENCE TEACHING.


38. Seawell, B. L. Symposium on The teaching of biology and nature study in normal schools. School science and mathematics, 8:369-79, May 1908.


40. Trauzeau, E. N. Biology a single science. School science and mathematics, 8:775-77, December 1908.

41. True, Albert C., and others. United States department of agriculture. On different aspects of Agricultural education.

42. Walter, H. W. The nature and amount of biological work that can profitably be attempted in secondary schools. School review, 8:171-76, March 1900.


(b) Articles on General Science with Special Bearing upon Biological Subjects.

1. Barnes, Charles B. Sciences in the high school. School review, 8:643-58, November 1898.


BIBLIOGRAPHY OF SCIENCE TEACHING.

(c) Botany.


22. ________, Shall the preparation of a herbarium and the identification of species form a part of the required work in botany in our secondary schools? School science and mathematics, 2:89-94, 149-53, April and May 1902.
BIBLIOGRAPHY OF SCIENCE TEACHING.


(d) Zoology.


2. Brown, Marion B. The history of zoology teaching in the secondary schools of the United States. School science and mathematics, 3:201-4, 256-64, October and November 1902.


Bibliography: p. 343-46.


CHEMISTRY.


16. Long, John H. Some points in the early history and present condition of the teaching of chemistry in the medical schools of the United States. Science, 14:369-72, September 6, 1901.
23. Morgan, William Conger. The relation of the technical world to school chemistry. School science and mathematics, 8:645-56, November 1908. The best reason for introducing experiments from the industrial world is to illustrate the general principles of chemistry. The whole article shows admirably how high school chemistry may be enriched.
BIBLIOGRAPHY OF SCIENCE TEACHING.


Begin chemistry at the age of ten with talks on bread making, etc. Physics should precede chemistry outlined to college graduation.
The best order for the student is the necessary order of discovery: conjecture—imagination—logic, and reasoning—test by observation and experiment.
BIBLIOGRAPHY OF SCIENCE TEACHING.

68. Williams, Rufus P. Teaching of chemistry in schools, 1876-1901. Science, 14:100-4, July 19, 1901.


Paper read before American association for advancement of science, December 31, 1909.

GEOGRAPHY.

   Enumerates some of the benefits of field work and discusses the difficulties.

   Also in Journal of geography, 4:286-300, November 1905.

   Considers methods and devices. A helpful article by one well trained in pedagogy and psychology.

   Analyzes the aims and functions of elementary geography and examines the utilitarian and cultural value of the study.

   Takes the ground that high school geography needs humanizing.

   The shorter of the two recent books which trace the more manifest influences of geography upon the history of our country. Written in an easy and somewhat popular style. Should be read by every teacher of American history and geography. Inexpensive.


   Also in Journal of geography, 4:23-37, January 1905.

   Discusses the scope and method of the subject. Demands laboratory work.

    Urges the study of home surroundings and industries, causal relations, the use of maps, globes and pictures. Sufficiently detailed and definite to be really helpful.

    Also in Journal of geography, 8:1-9, September 1909.
    An analysis of the objection to the type of geography generally taught and a recommendation for the future. The most important report on this subject since that of the Geographical conference of the committee of ten in 1883.

    A helpful article with diagrams and cuts showing plans and equipment of such laboratories in Chicago.

Outlines in moderate detail the course of study covered in two terms of fourteen weeks each in the normal school. Distinctly a course for prospective teachers.


A collection of over twenty-five essays, published in various periodicals since 1889. Some of the topics are: An inductive study of the content of geography (1905).—The progress of geography in the schools (1892).—The teaching of geography (1892).—The extension of physical geography in elementary teaching (1892).—Geography in the grammar and primary schools (1892).—Physical geography in the high school: The need of geography in the university (1895).—Physical geography as a university study (1894).—Methods and models in geographical teaching (1899).—Field work in physical geography (1892). There is in America no other such valuable collection of geographical essays on the teaching side of the subject.


"I would urge on every teacher the importance of not only leading pupils to observe accessible facts, but of leading them quickly and readily to perceive the meaning of the facts observed."


Also in The geographical journal, 21:41-31, October 1903.

Presents a device for showing graphically the interrelation among groups of ontographic and physiographic facts.


Contains a rather full list of recommended maps, periodicals, school texts, teachers' books and reference books both for teachers and pupils. Publishers' names are given in each instance.


A summary of nineteen replies to a questionnaire sent to a score or more of geographers and teachers of geography in various parts of the country. These replies constitute a most valuable collection of opinions on the question of what ought to be the character of the secondary school geography work. Should be read by every geography teacher in the secondary school. The replies indicate a marked change in sentiment in recent years.


Outline of the round table discussion at the meeting of the Association of American geographers in Baltimore, December 1908. The first formulation of the platform of the movement for humanized geography in the secondary schools.


A clear presentation of the principles which underlie a good course in elementary geography. Emphasizes the greater importance of life geography as compared with physical geography in the elementary school.


A report upon the conditions of geography teaching in our normal schools. Facts gathered by a questionnaire and from printed catalogues.


A valuable collection of definitions, opinions and quotations from various American and European sources.


Includes the course in the normal school and also that in the practice school. Detailed and logical and prepared by a man who has had long experience in an excellent school.


Discusses the changes within twenty years in both the subject matter and the method of secondary school geography. Gives suggestions for a course in introductory earth science, discusses laboratory work and advocates regional geography or rational commercial geography.
BIBLIOGRAPHY OF SCIENCE TEACHING.

   A scholarly discussion of the fundamental difference in method, in subject matter and in character of textbooks needed by elementary, secondary and mature pupils.

   Useful in teaching the contour map.

   One of our most thorough and scholarly papers on the subject. Deals with: An historical review of geographical textbooks—An historical review of the methods of teaching geography—The present status of geography in Europe—Geography in high schools in the United States—Geography in our normal schools—Geography in our technical schools—Geography in American colleges and universities—Geography in the elementary schools. Contains a bibliography of ninety-five titles.

   Also in School science and mathematics, 6:506-77, October 1905.
   Outlines the field of commercial geography. States the character of the work which should be undertaken in secondary schools. Discusses illustrative material and the teacher's preparation.

   Also in Elementary school teacher, 4:271-82, January 1905.
   Discusses the gradual decrease in the control over man exerted by his physical surroundings as he advances in civilization. One of the few available papers on this important phase of modern geography.

   The psychology and the advantages of memory map work, with specific application to the continents reduced to their lowest terms.

   Urges observational field studies near home and the making of maps.

32. Hubbard, George D. College geography. Educational review, 35:381-400, April 1908.
   Discusses the nature of the science, the utility of its subject matter, and courses of construction.

   Defends the cultural value of the study and believes that its value in this respect entitles it to more time than it receives in the high school course.

   Also in Journal of geography, 4:49-47, February 1905.
   Gives reasons why out-of-door work is desirable and discusses existing conditions in secondary school geography.

   Gives list of important governmental publications and of commercial and trade journals, with price and place of publication of the latter.

   A book dealing with the general principles of geography teaching and with many special problems. Gives special emphasis to the course of study, what to teach on North America, Commercial geography, Mathematical geography, and includes an extensive list of reference books in two chapters, entitled Sources of Information and A list of a thousand books.

   Favors laboratory work and gives some details of exercise on isotherms, isolines, winds, rainfall, etc.
   A little book of helpful suggestions for young teachers.

   Chiefly for the third and fourth grades. Contains the subject matter of a large number of "type lessons."

   Outlines a complete course of study from the third through the eighth grade. The plan lays stress on the gradual movement from the home outward, on the strong concentration upon North America and Europe and upon type studies. Contains a graded bibliography.

   Holds that satisfactory work in the field can be done only when the students map the area studied. Urges the study of models, maps, and photographs. Discusses method of teaching college physiography.

   Emphasizes the need of a large proportion of outdoor work.

   Invaluable reference volume for all teachers. Latest edition is the most complete bibliography of the kind in English.

   A plea for elementary observational studies as a part of nature study.

   Chaps. 7-12 deal especially with the teaching of geography. They treat of the emphasis of essentials, Pictures, models and the globe, Maps and their uses, The course of study, Observation and field work, and The teacher's preparation. Contains a bibliography.

   Maintains that economic geography is not a part of geography, but a part of economics and can be adequately handled only by an economist.

   Also in Journal of geography, 8:4-5, November 1909.
   A plea for elementary observational studies in geography. Discusses the teaching of geography and especially facts of location.

   Describes the geography teaching of the various types of schools in Germany. Gives outlines of courses. Part II deals with university geography in Germany.

   Makes a plea for concrete regional studies and illustrates with a detailed plan for treatment of the Atlantic coastal plain.

   A strong and clarifying discussion by an experienced teacher well trained in geography. Discusses the aims and scope of geography in clear cut. Gives several chapters of practical suggestions for improving the teaching of geography. Contains a bibliography of forty titles of books and papers on the teaching side of the subject, and one hundred and fifty titles on the subject matter side. It is perhaps the best single book for the average teacher.
A discussion of those phases of geography which in the writer's opinion deserve emphasis.
Believes that some features of the older geography should be retained.

Discusses the relative amount of emphasis to be put upon the physical and commercial phases of the study. Urges map study.

Discusses modeling, map drawing, the use of outline maps, diagrams, pictures, museum specimens, the taking of field trips, etc.

Also in Journal of geography, 6:104-7, October 1907.
A plea for the humanising of our high school course in geography.

A reply to Professor Davis' paper read at the Minneapolis meeting of the Society for the scientific study of education. Maintains that a discussion of some of the processes of manufacture and other industries does belong to elementary geography.


MATHEMATICS.

Also in American mathematical society bulletin, 10:74-77, November 1903.

Also on Geometry.

Discusses carefully various definitions of "mathematics."

A discussion of the history and teaching of arithmetic, algebra and geometry, based on historical and psychological considerations. Contains a bibliography.


Discusses the extent to which strict logic should dominate the early instruction in mathematics.

A condensation of Cantor's Geschiclite der elementar-mathematik. Covers particularly the history of arithmetic, algebra, geometry and trigonometry, but touches also upon the higher branches.

A full historical discussion accompanied by many suggestions for twentieth century instruction.

A series of "dialog-exercises" developing certain fundamental notions of the subjects named.


A course of lectures at the University of Göttingen, 1904-05. Discusses the position of mathematics in the various kinds of German schools, also historically contains much of interest to Americans. A strong and modern book.

Treats various mathematical recreations and paradoxes not as mere curiosities but from the pedagogic standpoint as introductory to the relevant mathematical topics, ranging from counting to analytic geometry.

Discusses the various branches of mathematics from the elements of arithmetic to analytic geometry, mechanics, and the elements of calculus, first from the standpoint of subject matter, then from that of the classroom.

An informal discussion of topics of elementary and secondary mathematics that is full of life and suggestions for making the subject interesting.

16. Loomis, Eliakim H. Original investigation, or how to attack an exercise in geometry. Boston, Ginn and company, 1901. vi, 63 p. 16°.
Discusses various types of proofs with a view to their use in finding other proofs.

Relates chiefly to questions of primary arithmetic.

A detailed presentation of specific ways in which cross-section paper can be systematically used as a uniting element in mathematics.

Also in Science, 17:401-16, March 13, 1903; School review, 11:231-38, June 1903.
Discusses the fundamental notions of mathematics and the problems of instruction. Suggests various lines of action looking toward improvement in the teaching of mathematics.
20. BIBLIOGRAPHY OF SCIENCE TEACHING.


25. Perry, John, ed. Discussion on the teaching of mathematics which took place on September 14th, at a joint meeting of two sections: Section A.—Mathematics and—physics. Section L.—Education. to which is now added the Report of the British association committee drawn up by the chairman. Prof. Forsyth. [2d ed.] London, Macmillan and company, limited, 1902, vi, 123 p. 8°.


33. and McMurry, F. M. Mathematics in the elementary school. Teachers college record, 4:70, March 1903.

Detailed outline of a course in arithmetic in the various grades.
BIBLIOGRAPHY OF SCIENCE TEACHING.


35. Story, W. E. The unification of mathematics in the school curriculum. School review, 11:822-55, December 1903. Calls for the treatment of elementary mathematics as one subject, in a connected, consequent, and progressive way, as an art as well as a science.


40. ———. The teaching of mathematics in the higher schools of Prussia. New York, Longmans, Green and company, 1900. xiv, 141 p. 16°. Treats the organization of these schools in general, the teaching of mathematics in detail, and the suggestions this work offers to Americans.

NATURE STUDY.


4. Burkett, O. W., Stevens, F. L., and Hill, D. H. Agriculture for beginners. Boston, Ginn and company, 1903. xii, 267 p. Illus. 12°. Most of the many books on elementary agriculture are distinctly adapted to secondary schools, but this book has much material in line with nature study.


BIBLIOGRAPHY OF SCIENCE TEACHING.

   A very helpful series of lessons adapted to primary schools in widely separated localities.

   Intended for Canadian schools, but very suggestive for teachers elsewhere.

    An excellent introduction to principles of gardening and the plant side of agriculture.

    Also in Nature study review, 3: 228-35, November 1907.

    About 50 cents per dozen. Illus.
    A valuable series of leaflets dealing with nature study and agriculture. Published monthly.

    A manual useful for teachers unfamiliar with gardening.

    A manual useful for teachers unfamiliar with gardening.

    One of the two best known books on nature study. A brief discussion of principles in the first chapters is followed by many chapters dealing with biological materials in an interesting and suggestive style.

    The first part deals with general principles, the second part with subject matter, chiefly biological.
    A very practical book for teachers in training and others who have had no training in nature study materials and methods.

    An extensive series of leaflets on agriculture by professors of the University of Illinois, full of useful suggestions.

    Several books with similar titles were published by this author, all of which are out of line with the present interpretation of nature study, but are useful for reference in preparing outlines and lesson plans.

    A collection of lesson plans chiefly on plants and animals, but some on physical nature study.

    Suggestions regarding materials, chiefly biological, profitable for nature lessons, especially in the eastern part of North America.

    See chapter 3 on Nature study.


    A discussion of principles, outlines of course, list of books, and suggestive lesson plans. The discussion of principles and methods of teaching is the most valuable part of the book.

    A suggestive series of lessons for primary grades.
   A discussion of principles, methods, and materials. Most of this work is out of line with the most approved nature study to-day and resembles high school biology.


28. Nature study review. Pub. at Urbana, Ill., by American nature study society. $1.00 per year, 9 nos.


30. Purdue university leaflets. Lafayette, Ind. A valuable series, but not complete for distribution.


BIBLIOGRAPHY OF SCIENCE TEACHING.

PHYSICS.

   "I challenge you to name any truly great man who was merely a specialist—un-sided pursuits are apt to make us very narrow minded." "Overspecialized science is apt to degenerate into a mere hobby where all conceptions of true proportions and harmony are lost."
4. Bailey, L. H. The teaching of science. In State science teachers' association. Proceedings, 12th annual meeting, 1907. Albany, University of the state of New York, 1908. p. 110-15. (Education department. Bulletin, no. 431, September 15, 1908.) Distinguish between the teaching function and the research function. We are teachers. It is our business to open the minds of the young to the facts of science.
16. Franklin, William S. The study of science by young people. In New York state science teachers' association. Proceedings, 12th annual meeting, 1907. Albany, University of the state of New York, 1908. p. 65-94. (Education department. Bulletin no. 431, September 15, 1908.) "My experience is, most emphatically, that a student may measure a thing and know nothing at all about it, and I believe that the present high school courses in elementary physics in which quantitative laboratory work is so strongly emphasized are altogether bad—I believe that physical sciences should be taught in the secondary schools with reference primarily to their practical applications—I can not endure a so-called knowledge of elementary science which does not relate to some actual physical condition or thing—either you must create an actual world of the unusual phenomena of nature by purchasing an elaborate and expensive equipment of scientific apparatus, or you must make use of the boy's everyday world of actual conditions and things."
Popular and accurate.
"For colleges to specify certain classes of subjects regardless of the real interest of the secondary schools and their pupils is a species of impertinence which only tradition justifies. In general the high school graduate who has a training worth while while in the conduct of life is also well fitted to enter college for further training. The average American boy quits the high school in disgust because he can not interpret its work in terms of life."


42. ———. The specialist blight on American education. Popular science monthly, 73:340-44, October 1908. “Men in the professions have seemingly gone mad upon the question of specialization. Many a green tree of scholarship, many a fair, broad field of general culture has been overgrown into a naked waste of narrow pedantry.”

43. New York physics club. Recommendations concerning examinations in physics. School science and mathematics, 8:388, May 1908. Also in a pamphlet published by the club, which contains a proposed syllabus. p. 12, April 1908.


54. Snedden, David Samuel. Educational tendencies in America. Educational review, 39:13-31, January 1910. “All education seems to inherit a fundamental tendency toward the abstract, the relatively unreal, the bookish. The teaching of science has done something to correct this, but even here there seems to be a persistent disposition to wander out of the sunlight.”


56. ———. What knowledge (of physics) is of most worth? School science and mathematics, 6:87-90, November 1906.

   An easy method to keep in touch with modern periodical literature.


   "A record of no small portion of the scientific achievements of the nineteenth century."


71. Wilson, George. The life of the Hon. Henry Cavendish, inc. abstracts of his more important scientific papers and a critical inquiry into the claims of all the alleged discoverers of the composition of water. London, printed for the Cavendish society, 1851. xiv, 478 p.

   Also in School science and mathematics, 6:226-26, April 1903.

73. ——— How the public will solve our problems of science teaching. School science and mathematics, 9:267-80, March 1909.


   Also in School review, 15:123-33, February 1907.

76. ——— The significance of the requirements in physics of the college entrance examination board. School science and mathematics, 10:34-42, January 1910.

   Contains various aims and methods suggested in the preface of nearly every elementary textbook.