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32. Swift, Robert N., A study of the effects of tidal current on suspended matter at the mouth of the Delaware Bay (Masters thesis, Millersville State College, 1970).

33. Thomas, Charle W., The effects of temperature, salinity and exercise on blood lactic acid concentration in the white shrimp (Masters thesis, Northeastern State College, Natchitoches, La., 1969).

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PREFACE

The marine environment is a vast and complicated place. Its study embraces all of the sciences and its effects are often felt many hundreds of miles from their source. This environment includes some of the most prolific species known to man as well as some soon to become extinct unless conservation measures are quickly instituted. Some marine species have a vast potential as a human food source. The key to man's eventual survival may lie here.

Educators have long been aware of the world's oceans potential. In recent years, probably because of the impetus provided by world food and ocean pollution problems, they have felt a need to provide marine science instruction at the precollege level. Forward looking educators have realized the need for a marine scientifically literate public. These futuristic pedagogues also were aware that educating people to the point of scientific literacy required many years, not just a crash course.

Increasingly, teachers at all levels are being asked, by both school administrators and the public, to offer marine science instruction. Most are not well prepared to accomplish this task. However, precollege teachers are a resourceful lot. They are highly skilled in putting to work materials and information generated by others. One problem they are continually plagued with, though, is insufficient time. While there may be vast amounts of information available, locating it is often prohibited by lack of time.

Prior to designing an appropriate marine science program, regardless of the grade level, one must have a good bibliography from which to draw. The bibliography normally forms the basic building block of any good science program. Obviously, a bibliographical work is of paramount importance to those with a limited background in the sciences and/or the marine sciences.

The aim of this publication is to help precollege teachers and others interested in the marine sciences. Many marine science curriculum guides are included amongst these listings. This bibliography should in no way be interpreted as being complete. The citations were drawn from Education Index, Current Journals in Education, Masters Theses in Education, Reader's Guide to Periodical Literature, Resources in Education (ERIC) and the citations included in the various articles. Some of the citations may be used directly by precollege students while others require abstraction prior to use.

Any mistakes in spelling, titles, inclusive page numbers, year of publication, journal volume number, etc. are solely the responsibility of the author.

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Richard M. Schlenker

CHAPTER I

Introduction

Perhaps the most difficult task faced by any researcher is that of information acquisition. A skillful researcher is able to visualize the whole, break it into its component parts and then synthesize a new whole. He uses a thesaurus to obtain key words or descriptors, then uses the key words in searching various abstracting services. When suitable references are located, their literature cited sections are consulted for useful inclusions. A searching strategy of this type has a pyramiding effect and most often yields fruitful results. This was the scheme used in obtaining the information cited in this work.

Annotation often saves the user many hours of work. The remainder of this publication is divided into two sections. The first section includes those articles which are annotated while the second includes those which are not.

Each section includes several chapters. Each chapter enjoys a key word name. However, the user should approach this scheme with a degree of caution. The inclusion of a citation under a certain heading is somewhat arbitrary, especially since in some cases several different types of information are presented. For example, one might encounter a curriculum guide which deals with both marine science and marine science career education material. In cases such as this, an attempt has been made to list the citation in the chapter whose title describes the citation's major emphasis.

Where possible in the annotated section, citations include a grade level or a range of grade levels of applicability. These are suggested

levels or ranges which, in most cases, were assigned by the author. Imaginative teachers, however, should be able to adapt most of these entries to any level of their choosing.

Some of the citations in both sections, especially those from Science, use sophisticated scientific vocabularies. These articles will generally require abstraction by the teacher prior to use. Articles of this description might be used to challenge some of the ablest students.

Citations listed in Resources In Education (ERIC) have a unique ED number. Libraries subscribing to ERIC normally hold indexes, descriptor usage reports, thesaurus, and microfiche copies of the majority of references cited. Hard copies of these references may be procured from the following address:

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A few documents listed by ERIC are not available from ERIC. Wherever the source is other than ERIC, that information is included. In a few instances, these documents are available from the National Technical Information Center in both hard copy and microfiche. Pricing information as well

as procurement are available from:

National Technical Information Center
Operations Division
5285 Port Royal Road
Springfield, Virginia 22151

The periodical inclusions are normally available in college, university and public libraries. They may also be found in many good high school libraries. Necessary periodical articles, when not available locally, may be obtained via interlibrary loan. This service is available through most libraries. When there is a charge it is nominal.

Unpublished masters theses may normally be obtained through interlibrary loan. These are normally obtained on a no cost basis for a minimum time period.

Section 1

This is the annotated section. Following each citation, the reader will find a brief annotation. Grade levels or grade level ranges are provided in some cases. These data are provided just above the upper right hand corner of each inclusion. The citations in each chapter are listed alphabetically by the author's last name. In cases where the article was written by a staff author, the journal name is included as the author rather than staff author.

CHAPTER II

Career Education

Close attention to these articles will provide the reader with a well rounded view of marine science career education, both past and present. The reader's attention is drawn to the fact that many of these articles are dated. The dated articles do, however, provide an historical overview.

Several descriptions of college courses are included in this section. The user will no doubt find many useful techniques within these courses which may be used at the precollege level. The rationale for inclusion in this section, however, is that they show the young student what types of things he/she might be doing if post-high school marine science education is pursued. The outlines of college curricula, aside from whetting the young appetite, show quite well the sequence of events leading to the most sophisticated levels of marine science education.

1. American Childhood, Glimpses of Industry. American Childhood, 22(9): 17; May 1937.

   The article discusses the cod fishing industry on the Gaspe Peninsula. Information describing the homes of the fishermen, their boats, nets, and other equipment is included.

2. American Society for Oceanography, The Oceans and You. U.S. Office of Education, ERIC ED 064 088, 1971.

   An oceanographic information kit is described. The kit contains booklets describing oceanography, ocean industries, oceanographic agencies, bibliographies which are grade leveled, etc. Kit is available from ASO Information Kit, 1730 M Street, N.W., Suite 412, Washington, D. C. 20036.

3. Anderson, B. Robert, With cooperation and care, students get back to nature. College and University Business, 53(2): 39-41; Aug 1972.

   Describes the New Jersey consortium which enables land-locked colleges to give their ecology and oceanography students the ocean as a laboratory.

4. Ball, Edward, Marine Lab. A taxonomy of marine technicians and technologists and the implications for training them. U. S. Office of Education, ERIC ED 062 509, 1971.

   The article describes a three phase study to (1) ascertain education, training, and classification characteristics of marine science technicians; (2) suggest implications to oceanographers, educators, and labor administrators; (3) develop a scheme for classifying the people. Available from National Technical Information Service.

5. Banerjee, Tapan, Syllabus for an associate degree program in applied marine biology and oceanography. U. S. Office of Education, ERIC ED 046 750, 1970.

Describes a marine science technician program at Southern Maine Vocational Technical Institute. The document includes pictures of activities, sample tests and experiments.

6. Benson, Richard C., The marine technician--past, present and future. U. S. Office of Education, ERIC ED 092 739, 1973.

The article discusses the origin of the marine science technician, community needs and community action to meet those needs. Includes and describes factors necessary for a successful marine science technician program, e.g. hands-on training. The document is available from the National Technical Information Center.

7. Boolootian, Richard A., and Thomas, June, the realm of the marine biologist. American Biology Teacher, 28 (1): 13-18; Jan 1966.

Presents a definition of the marine environment, as well as the chores of a marine scientist.

8. Bright, Donald B., The "wild goose" chase. Oceans, 6 (5): 50-53; Sept-Oct 1973.

Describes a five day station oceanographic cruise off the coast of southern California. The cruise was designed to provide practical experience for college students enrolled in marine science courses.

9. Brown, Helen Jean, Marine algae of commerce. School Science and Mathematics, 35: 803-809; Nov 1935.

Describes many commercial uses of marine algae. Some of these are fertilizer, iodine, potash, food, agar, algin, etc. Gives the student a feeling for marine related industries.

10. Brown, Martin D., The future of the oceanographic technician. American Biology Teacher, 33 (9): 528-531; Dec 1971.

The article discusses marine science technician programs and their future. Lists of some of the current programs are provided. The program at Southern Maine Vocational Technical Institute is listed as b ng the first in the U. S.

11. Buck, Dale R., Marine technology: diversity and flexibility. New Directions for Community Colleges, 1 (4): 53-8; Winter 1973.

The marine technology field indicates that training for a specific field must reflect the diversity of that field. The training must be flexible enough to accomodate the changing job market.

12. Calhoun, Olivia H., Agri-business, natural resources, marine science; grade 7. Cluster V. U. S. Office of Education, ERIC ED 089 008, 1972.

Lists career opportunities available in several areas--marine science is one of these areas.

13. Canadian Vocational Journal, Training caribbean trawlermen for the future. Canadian Vocational Journal, 11 (2): 10-15; May 1975.

Using two multi-purpose fishing boats, the Caribbean Fishery Development Institute has begun training 45 persons in an 11 month course covering all aspects of the marine environment.

14. Carlander, Kenneth D., What does a fishery biologist do. American Biology Teacher, 20 (5): 200-202; Oct 1958.

Describes the day to day life of the fishery biologist. Also describes the education required in order to be in this profession and discusses organizations which hire these types of people.

15. Carver, Alfred, Modern teaching methods and the merchant navy. U. S. Office of Education, ERIC ED 023 961, 1967.

Discusses methods of training English sailors. It includes 8 mm films, programed texts, etc. Also includes an appraisal of these methods of education. Available from National Institute of Adult Education, 35 Queen Anne Street, London W 1, England.

16. Carver, Charles E., The role of engineering in the geophysical sciences. Journal of Engineering Education, 50 (5): 408-410; Feb 1960.

The article discusses priority areas of marine investigation which were to be investigated during the 1960-1970 period.

17. Chan, Gordon S., The education and training of marine technician. U. S. Office of Education, ERIC ED 025 238, 1968.

The article discusses the need for marine technicians in California. Defines marine technician, discusses their jobs, training and classification.

18. Charlier, Roger H., Growth of oceanographic education in the United States. Limnology and Oceanography, 11 (4): 636-640; 1966.

The article discusses the growth of college oceanography in the U. S. from 1928 to 1966. First oceanography course in the U. S. was in 1928 at the University of Washington. Also provided is information describing the growth of graduate programs, types of programs, program locations and government interest in oceanography.

19. Charlier, Roger H., Manpower and oceanographic education in the United States. Rocks and Minerals, 44 (8): 563-569; 1969.

The growth of oceanography 1928-1969. Suggests that at this point the need for oceanographic personnel outdistances the supply. Points out that of 3,000 precollege teachers surveyed, 11% had persued a course of study in oceanography. Of these, 11% had less than 15 credit hours (earth science teachers).

20. Chester, R. and Riley, J. P., Oceanography. Education in Chemistry, 10 (4): 126-127; July 1973.

The article describes the scope of chemical oceanography and the various ways in which chemical oceanographers become qualified. Most of the subjects involved in studying chemical oceanography are listed.

21. Clifton, H. Edward, Tektite 1, man-in-the-sea-project. Science, 168 (3932): 659-663; May 1970.

The article discusses a project in which four men spent 60 days, 15 meters beneath the sea. Included in the article are descriptions of their habitat and the research they carried out.

22. Clingman, Otis, Biological diver under antarctic ice. The Science Teacher, 33 (9): 23-27; Dec 1966.

Divers working in an antarctic research program work under the ice. Their work methods are presented here.

23. College Management, A model in cooperation. College Management, 5 (12): 11; Dec 1970.

Eight New York area universities found the New York Ocean Science Laboratory. The essential purpose of the laboratory is to aid graduate students. In the summer of 1970, the laboratory held a seminar for high school teachers.

24. Congress of the United States, National sea grant college program. Joint hearing before the subcommittee on oceans and atmosphere of the committee on commerce and the subcommittee on education of the committee on labor and public welfare, United States Senate, ninety-third congress, fifth session on S 1262 and H. R. 5452. U. S. Office of Education, ERIC ED 096 105, 1973.

Lists National Sea Grant program goals as well as existing National Sea Grant programs.

25. Congress of the United States, Hearings before the ad hoc committee on maritime education and training of the committee on merchant marine and fisheries, ninety-third congress; second session on officer requirements, and session on maritime education regarding safety at sea. Serial no. 93-44. U. S. Office of Education, ERIC ED 107 845, 1974.

The article lists supply and demand predictions through 1984 for merchant marine officers. Also included is a seaman's employment analysis.

26. Daniels, R. W., et.al, Automated operator instruction in team tactics. U. S. Office of Education, ERIC ED 061 705, 1971.

An experiment was conducted to ascertain whether team training tactics in the Navy, using tactics trainers, were sufficient or did a new trainer need to be developed.

27. Deblij, Harm Jan, The sea fishing industry of South Africa. The Journal of Geography, 57: 135-142; Mar 1958.

The article includes a description of the industry, physical factors which effect it as well as a discussion of fishing methods.

28. Department of Commerce, U. S. Government, A list of institutions offering degrees in oceanography. U. S. Office of Education, ERIC ED 068 364, 1972.

Listed are 52 institutions in 23 states. Also lists institutions offering degrees in specialized areas.

29. Department of Labor, U. S. Government, Employment outlook, environmental scientists, geologists, geophysicists, meteorologists, oceanographers. U. S. Office of Education, ERIC ED 045 400, 1970.

Describes the type of work, type of training required, potential earnings and working conditions in each of the areas listed.

Grades 4-12

30. Difford, W. C., Going down in the trieste bathyscope. Instructor, 73 (1): 34-35; Sept 1963.

The article describes the work of the bathyscope and the people who work on the vessel.

Grades K-12

31. Difford, W. C., Research vessel atlantis from woods hole. Instructor, 73 (2): 24-25; Oct 1963.

The work of the research vessel is described.

Grades K-12

32. Difford, W. C., The instrumentation center. Instructor, 73 (5): 24-25; Jan 1964.

Describes some of the jobs of oceanographers.

Grades 4-12

33. Difford, W. C., Ocean highways for shipping. Instructor, 73 (6): 68-69; Feb 1969.

Presents some information concerning the daily lives, work and travel of merchant seamen as well as information concerning the use of the oceans for shipping.

Grades 4-12

34. Difford, W. C., The fip ship. Instructor, 73 (9): 90-91; May 1964.

The work of a unique research vessel is presented.

Grades 4-12

35. Difford, W. C., Wanted! More fresh water. Instructor, 73 (8): 112-113; Apr 1964.

Presents the idea of desalting sea water to satisfy fresh water needs.

Grades 4-12

36. Difford, W. C., Scientists, and sailors, too, who is an oceanographer? Instructor, 73 (10): 76-77; June 1964.

Provides a good definition of oceanography.

Grades K-8

37. Difford, W. C., Operation deep dip. Instructor, 74 (4): 40-41; Dec 1964.

The article describes the exploration of the ocean depths carried on by the navy.

38. Difford, W. C., Baby subs that study the sea. Instructor, 74 (5): 88-89; Jan 1965.

Deep diving submersibles are used for studying the ocean depths.

Grades K-8

39. Difford, W. C., Living under the sea. Instructor, 74 (6): 78-79; Feb 1965.

The article discusses living and working under the sea and some of its problems, e.g. bends, helium inhalation, etc.

Grades K-8

40. Difford, W. C., Project mohole. Instructor, 74 (8): 72-73; Apr 1965.

Presents a description of project moho. The goal of this project was to drill through the earth's crust and into the mantle.

Grades K-8

41. Difford, W. C., Research buoys. Instructor, 74 (9): 68-69; May 1965.

Describes a method by which oceanographic researchers gather research information.

Grades K-12

42. Difford, W. C., The scuba oceanologist. Instructor, 74 (10): 86-87; June 1965.

The article describes the jobs of this type of person.

43. Evans, Givil O., and Panshin, Daniel A., Harnessing the ocean potential. Extension Service Review, 41 (8): 8-9, 14-15; Aug 1970.

A description of extension services provided to Oregon commercial fisheries with the assistance of Oregon State University Sea Grant.

44. Farning, Maxwell, Career education: the marine science occupation cluster. U. S. Office of Education, ERIC ED 080 662, 1973.

Presents a discussion of career opportunities in harbor and ship construction, merchant marine activities, longshoring, fishing and fish farming, petroleum exploration and marine research.

45. Federal Council for Science & Technology, University curricula in the marine sciences and related fields, academic years 1973-4, 1974-5. U. S. Office of Education, ERIC ED 082 970, 1973.

This is a guide for students and counselors. It lists 138 institutions offering 25 or more credit hours in marine sciences. Courses and degrees offered are also listed.

46. Fisher, W. K., The hopkins marine station of Stanford University. The Scientific Monthly, 29: 298-303; Oct 1929.

Early years in the station's history are presented. The author includes the types of research and researchers there during the early years.

47. Fowler, Howard G., Marine propulsion technology program meets the demand. School Shop, 34 (2): 70-1; Oct 1974.

The marine technology program cluster at Florida Keys Community College is described. Technicians in this program are trained to repair marine engines and selected marine accessories.

48. Frey, Henry R., Graduate training program in ocean engineering. Final report. U. S. Office of Education, ERIC ED 094 039, 1971.

Described are the activities conducted during the first three years of New York University's ocean engineering program.

49. Frosch, Robert A., University curricula in the marine sciences. U. S. Office of Education, ERIC ED 016 627, 1967.

Lists marine programs at American colleges and universities. Also included are additional sources of career education information.

50. Geotimes, Junior college geology. Geotimes, 17 (8): 23; Aug 1972.

The article summarizes data from a questionnaire which was sent to 1240 junior colleges. The questionnaire requested information concerning earth science courses and earth science instructors.

51. Gillie, Angelo C., and Pratt, Arden L., Marine technology programs: Where they are and where they are going. U. S. Office of Education, ERIC ED 062 111, 1971.

This is a summary of a conference on the training of marine science technicians in junior colleges. Information is provided concerning successful curricula, manpower, predictions and institutions with marine technicians programs. Available from American Association of Junior Colleges, 1 Dupont Circle, N. W., Washington, D. C. 20036.

52. Gordon, Bernard L., Marine careers. U. S. Office of Education, ERIC ED 055 793, 1970.

This is a collection of five papers designed to help students, teachers and guidance counselors. Governmental and private positions in the marine sciences are discussed. The article also includes a bibliography of marine careers. Paperbacks available from the Government Printing Office.

53. Gorsline, Donn S., Marine geology. Geotimes, 17 (1): 20-21; Jan 1972.

The article discusses the major research projects in marine geology which were conducted during 1971. The author also suggests that career opportunities in that field were poor during 1971.

Grades 4-12

54. Grade Teacher, The—fishing industry. The Grade Teacher, 62 (10): 42-43; June 1945.

This is a series of pictures with excellent captions which describe the fishing industry and the life of a Glouchester, Mass. fisherman.

55. Hansen, Donald V., Oceanography for the 1970's. The Science Teacher, 38 (1): 19-26; Jan 1971.

The article presents information concerning who is carrying on ocean research and what types of research they are doing. Also discussed are the goals of science education. The author calls for a scientifically literate population.

56. Healey, James E., Opportunities and occupations in the American merchant marine. Occupations, 17 (6): 16-23; Mar 1939.

The article describes jobs, merchant marine entrance requirements, modes of entrance, types of training, methods of advancement, future trends, unions, etc.

57. Heinkel, Otto A., and Tepedino, Francis J., An assessment of the marine industry and marine technology programs in community colleges in San Diego county. Final project report. U. S. Office of Education, ERIC ED 081 420, 1972.

This is a needs assessment survey to measure the gap between marine technology education and the related market. Discusses the results of inadequate technical training.

58. Heinzel, Joseph R., and May, R. V., A study of the rating structure requirements for the aviation 3M data analysis. U. S. Office of Education, ERIC ED 054 312, 1969.

This is a study to determine the optimum means of identifying naval personnel qualified to perform analysis tasks. Also discusses education required in order to perform these tasks.

59. Herbich, John B., Industries' interest in ocean engineering education programs. U. S. Office of Education, ERIC ED 100 615, 1971.

The results of a questionnaire are presented. Results show that industry feels undergraduates should concentrate on basic sciences and humanities. Courses of study for graduate students are suggested.

60. Hersey, J. B., Marine geophysics 1944 to 1966. The Science Teacher, 34 (9): 15-20; Sept 1967.

The article provides some historical information concerning marine geophysical investigations. Some discussion is provided concerning the history of instruments such as the magnetic compass.

61. Hill, Barry L., Marine option program. First biennial report. U. S. Office of Education, ERIC ED 093 665, 1973.

This is a description of the marine studies program at the University of Hawaii from March 1, 1972 through August 31, 1973.

62. Hill, Phillip G., Directory of facilities. Development activities in the marine environment of the coastal plains region. U. S. Office of Education, ERIC ED 054 930, 1971.

A directory of marine facilities in North Carolina, South Carolina and Georgia both on and offshore.

63. Hogg, Thomas C., Man in the marine environment. U. S. Office of Education, ERIC ED 056 884, 1971.

This is a marine program which was offered at Oregon State University between July 1970 and June 1971. The major program components were seminars, personal research, guest speakers, etc.

64. Hood, Ernie, Lummis seek spirit of the salmon. Manpower, 3 (9): 2-7; Sept 1971.

The northwest indians turn to aquaculture as a source of jobs and steady income.

65. Hope, Ronald, Living well after fifty: a seafarer prepares to retire. Adult Education (London), 45 (5): 293-6; Jan 1973.

The author suggests that the mid-forties might be a good time for a pre-pre-retirement course.

66. Jennings, Feenan D., The challenge of inner space. The Science Teacher, 28: 6-12; Apr 1961.

The article discusses some of the marine science activities conducted by the National Academy of Sciences. Information is also included which describes some of the elements involved in the study of physical oceanography, marine chemistry, marine biology, and marine geology.

67. Jensen, Belva L., Technicians fight river inlet pollution. Technical Education Reporter, 1 (2): 15-20; July/Aug 1974.

The author presents a description of the development of an estuarian resource technician program, its curriculum, student recruitment, placement, etc.

68. Knight, William J., The union way to better seamanship. Panorama, 47: 2-9; Spring 1971.

Provides a description of an educational program for merchant seamen. Through this program, students can obtain a high school diploma by passing a special form of equivalency exam.

69. Lau, Alan W., et al, An analysis of the navy vocational interest inventory as a predictor of career motivation. U. S. Office of Education, ERIC ED 054 318, 1969.

Results show that occupational keys were more effective than area scales in predicting reenlistment.

70. Lau, Alan W., Area scales of the navy vocational interest inventory as predictors of school performance and rating assignment. U. S. Office of Education, ERIC ED 054 319, 1969.

The area scales are described as well as a test conducted to validate the scales.

71. Linnenbon, Victor J., Our ocean planet. The Science Teacher, 34 (5): 25-26; May 1967.

This is a discussion of how the physicist and the engineer view the ocean. Information describing historical oceanography as well as water cycles is also included.

72. Louisiana State University, Marine research interest in Louisiana universities. U. S. Office of Education, ERIC ED 113 202, 1975.

The author identifies the location of marine research interests and abilities in Louisiana's research community. Also provided are a list of 79 marine activity categories.

73. MacLean, D. S., Give them an earful where they work. Training in Business and Industry, 8 (1): 26-29; Jan 1971.

A description of how systems analysis evolved an effective shipboard training package for the navy.

74. McLeod, Ferrara, Ensign, Fathom one: marine science training center. Fathom two: lodging for commuting students. Investigations of the requirements for two types of specialized community colleges. U. S. Office of Education, ERIC ED 049 549, 1970.

This is a discussion of all physical needs required in putting together a marine science institution on a community college basis.

75. McKinnerney, Beryl and Clark, Donald L., Marine occupations in the Texas coastal zone. U. S. Office of Education, ERIC ED 080 798, 1973.

This publication was designed as a guide for guidance counselors and curriculum developers; several occupational areas are listed.

76. Malec, Vernon and Lansville, Anthony, Interm quantitative manpower projections for proposed hydrographic survey ship system (AGS) candidate configurations (navyships subproject S46-27012, task 14408). U. S. Office of Education, ERIC ED 054 311, 1969.

Manpower needs for survey ship systems are discussed.

77. Mangelsdorf, Frederick E., et al, Proceedings of the New England conference on ocean science education, Woods Hole, Mass. May 1966. U. S. Office of Education ERIC ED 028 943, 1966.

Various aspects of marine science education and marine science teacher education are discussed.

78. Manpower Administration, U. S. Government, Fish cutter (fish) 3-89.04--technical report on standardization of the general aptitude test battery. U. S. Office of Education, ERIC ED 065 610, 1963.

A discussion of a series of 12 tests, occupation norms for the test, etc.

79. Manpower Administration, U. S. Government, Shrimp picker (can & preserve) 8-04. 10-technical report on standardization of general aptitude test battery. U. S. Office of Education, ERIC ED 065 611, 1963.

The article is about a series of 12 tests and occupational norms for the test.

80. Marshall, Nelson, Oceanography, the new frontier for the twenty-first century. The Science Teacher, 40 (8): 16-19; Nov 1973.

This article describes what oceanography used to be, discrete subjects, and how it has evolved into an integrated science. The author also makes mention of the Law of the Seas Conference and who will control the seas in the future.

81. Mazzone, Walter F., Steps in man's return to the sea. The Science Teacher, 33 (8): 21-23; Nov 1966.

A discussion of the Navy's project Sealab II and some problems it has encountered. Some information on the diving which has been done by Sealab.

82. Mecca, Christyna E., Directory of personnel in research, technology, education, administration and management. Development activities in the marine environment of the coastal plains region. U. S. Office of Education, ERIC ED 054 931, 1970.

The directory concentrates on technical fields. It lists local, state, county and federal agency personnel.

83. Mitchell, Leonard, and Goodman, Joel, Marine technician training and employment: a current overview and assessment. Summary. U. S. Office of Education, ERIC ED 113 179, 1974.

This document was designed as a guide for future program management. It includes current jobs, training programs and sample curricula.

84. Monahan, Edward C. et al, Oceanography field practicum spring half-term, 1972. U. S. Office of Education, ERIC ED 094 955, 1972.

A course at the University of Michigan. The author describes student projects, papers, etc.

85. Morgan, William, Farming the sea. Agricultural Education Magazine, 43 (11): 272-273; May 1971.

The article describes a vocational education program in Florida designed to teach cultivation, harvesting, marketing and conservation practices related to production of crabs, oysters, shrimp, scallops and fun fishes.

86. Mosaic, The Academic fleet. Mosaic, 6 (4): 30-33; Jul/Aug 1975.

A description of a fleet of ships which provide laboratory space and equipment for scientists studying the sea.

87. Napoli, James J., Marine programs at the University of Rhode Island. U. S. Office of Education, ERIC ED 094 940, 1972.

A description of the University of Rhode Island's switch to a total marine program in all departments.

88. National Council on Marine Resources and Engineering Development, University Curricula in the marine sciences and related fields, academic years 1969-1970 and 1970-1971. U. S. Office of Education, ERIC ED 041 745, 1969.

This is a list of institutions, academic degrees and marine curricula.

89. National Council on Marine Resources and Engineering Development, Marine science affairs--selecting priority programs. U. S. Office of Education, ERIC ED 045 440, 1970.

The article describes 1969 federal ocean program and policies, priorities and goals; budget figures for fiscal 69-71 is included.

90. National Society for Professional Engineers, Skills conversion project: chapter 10, ocean engineering and oceanography. Final report. U. S. Office of Education, ERIC ED 070 884, 1972.

An assessment of the ability to use displaced aerospace personnel in ocean engineering.

91. Naval Oceanographic Office, University curricula in the marine sciences and related fields, academic years 1971-72 and 1972-73. U. S. Office of Education, ERIC ED 063 861, 1971.

A list of 134 institutions with marine science programs. The document includes admission requirements, geographic locations, and financial assistance information.

92. Neal, Victor T., Oceanography for teachers, a unique summer program. The Science Teacher, 35 (2): 38; Feb 1968.

The author describes a summer program started in 1968. Prior to this, there were no oceanographic institutions offering summer teacher programs. The article includes information concerning the availability of low cost materials for use by precollege teachers.

93. Nealey, Stanley M., The relative importance of job factors: a new measurement approach. U. S. Office of Education, ERIC ED 045 721, 1970.

A study of various job factors as they relate to retention in the Navy (a sample of 91 sailors on a destroyer was used).

94. Norton, Bill, Exciting fish story evolves on coast. The Open Door, 6 (1): 6-7; Winter 1970.

Marine technology students at Cape Fear Technology Institute investigate the habits of fish near Wrightsville Beach, North Carolina.

95. Occupations, The deep-sea pilot. Occupations, 16 (6): 560-561; Mar 1938.

The job of a harbor pilot is described.

96. Operations Research Inc., Evaluation of NJROTC influence on Navy accessions. U. S. Office of Education, ERIC ED 082 029, 1973.

A study of membership in NJROTC and its relationship to future enlistment in the Navy; no relationship was found.

97. Pesson, L. L., Coastal fishermen of Louisiana: their characteristics, attitudes, practices, and responsiveness to change. U. S. Office of Education, ERIC ED 092 740, 1973.

A study to identify problems and opprotunities for an organization with the capability of delivering effective extension education programs to appropriate audiences. Available from National Technical Information Service.

98. Pond, Samuel E., The marine biological laboratory. School Science and Mathematics, 39: 665-669; Oct 1939.

A description of the Marine Biological Laboratory at Woods Hole, Mass. in 1939. The article provides some history of the laboratory as well as some locations of laboratories in other countries.

99. Puerto Rico State Department of Agriculture, Training of fishermen for the tuna industry. U. S. Office of Education, ERIC ED 084 376, 1969.

This is a discussion of the failure of a program to train Puerto Ricans to replace foreign crews on tuna boats.

100. Rakestraw, Norris W., Hermann Wattenberg: a pioneer in a new field of exploration. Journal of Chemical Education,33 (5): 217-222; May 1956.

The life and accomplishments of one of the first marine chemists.

101. Rakestraw, Norris W., Analytical chemistry in oceanography. Journal of Chemical Education, 35 (3): 119-122; Mar 1958.

A description of the role of analytical chemistry in oceanography.

102. Rakestraw, Norris W., Training in chemical oceanography. Journal of Chemical Education, 35 (3): 123-124; Mar 1958.

A discussion of the courses a future chemical oceanographer should take.

103. Rosenthal, Neal H., A career in the biological sciences. U. S. Office of Education, ERIC ED 108 934, 1973.

Among others, this article describes the tasks of one employed in the biological areas of marine science.

104. Sainsbury, John C., A vocational technical institute developmental program for commercial fisheries. Final Report. U. S. Office of Education, ERIC ED 068 087, 1972.

A description of the development of a two year program in commercial fisheries. The program was designed to reduce the traditional training period fishermen, educate and train future fishing fleet captains.

105. Schnell, Mary Elizabeth, Occupational orientation secondary level. Part 2. Curriculum bulletin no. 73CBM2. U. S. Office of Education, ERIC ED 094 239, 1973.

This document includes five occupational clusters, one of which is in the marine sciences. This writing could be of great use to teachers in developing career education and career awareness lessons.

106. School Science and Mathematics, Lack of legal status holds back sea miners. School Science and Mathematics, 67 (595): 722; Nov 1967.

A discussion of problems facing sea floor mining.

107. Schriner, Karl Leonard, A study of enlisted training and education in applied oceanography. U. S. Office of Education, ERIC ED 094 944, 1972.

A discussion of current training programs in the Navy and their shortcomings; suggests new courses and ratings for the Navy.

108. Schurman, Donald, Marine and fisheries training in P.E.I. Canadian Vocational Journal, 10 (1): 2-5; May 1974.

A description of the facilities, curriculum, etc. at Prince Edward Island Marine and Fisheries Training Center at Summerside.

109. Small, Lawrence F., Teaching and research in biological oceanography. American Biology Teacher, 28 (1): 19-22; Jan 1966.

This is a discussion of marine programs in 1966, where they were, how large they were and the program levels.

110. Smithsonian Institution, Marine research fiscal year 1968, a catalog of unclassified marine research activities sponsored during FY 1968 by federal and non-federal organizations. U. S. Office of Education, ERIC ED 038 314, 1968.

A list of 2589 projects, categorized by subject; education projects are included.

111. Smithsonian Institution, The smithsonian oceanographic sorting center. The Science Teacher, 36 (3): 29-31; Mar 1969.

A description of the center's mission as well as the types of people who work there.

112. Sprintzer, Allan D., Trade union sponsored occupational training in the U. S. maritime industry: the upgrading and retraining program of the national maritime union. Final Report. U. S. Office of Education, ERIC ED 056 277, 1971.

A description of the union's increased interest in formal training after 1960.

113. Stallo, Carlo J., A career in oceanography. The Science Teacher, 38 (7): 52-54; Oct 1971.

A discussion of oceanographic careers, possible sources of financial assistance for education, job sources and lists of publications about oceanography.

114. Teel, Ward, et al, The need to establish a marine science technology program at shorline community college. U. S. Office of Education, ERIC ED 011 781, 1966.

The author presents the results of a study and the need for marine technology programs; information concerning programs already in existence is included.

115. Tiller, Richard E., Polished professional aids for coastal waters. Junior College Journal, 42 (8): 18-19; May 1972.

Describes the training of the Estuarine Research Aid, at Charles County Community College (Maryland). The program emphasizes the practical development of skills through field work.

116. Tolonen, Paul, Feasibility of establishment of associate degree program in marine technology at Clatsop Community College. U.S. Office of Education, ERIC ED 014 527, 1965.

The article describes the work involved in program development. The first year of the program is described.

117. Torpey, William G., Educational principles in seamanship training. Nations Schools, 38: 20-22; July 1946.

A description of methods used to train merchant seamen for WW II. This is a learn by doing method which uses frequent recall as a method of reinforcement.

118. United States Coast Guard, Training program for cooperative student trainees in professional career options; GS-trainee-21 to trainee GS7. U. S. Office of Education, ERIC ED 051 489, 1971.

A financial aid program for university students. The program is conducted at 61 universities. In order to take part, the student must be in a BS program in one of the designated fields and be eligible for work study funds.

119. United States Office of Education, Seafood merchandising, a guide for training programs. U. S. Office of Education, ERIC ED 013 303, 1964.

The article describes an educational program and a program training guide.

120. Visick, Hal H., Manpower for marine sciences. Higher Education, 18 (7): 7-10; May 1962.

The author indicates that there is a great need for ocean scientists. He also discusses the problems encountered in attempting to find these types of people.

121. Waterman, Larry Wayne, Officer education and training in oceanography for ASW and other naval operations. U. S. Office of Education, ERIC ED 094 935, 1972.

Presents a discussion of the types of oceanography needed in graduate programs for anti-submarine warfare officers in the Navy.

122. Whitehorn, Norma C., Marine resources capabilities in Texas. U. S. Office of Education, ERIC ED 072 959, 1973.

A listing of 105 names from 11 state and 12 federal agencies. All of these individuals have been identified as possessing expertise in marine related activities.

123. Williams, John A., and Venezian, Giulio, Ocean engineering at the University of Hawaii. Engineering Education, 60 (3): 242-244; Nov 1969.

A description of a program leading to an MS degree in ocean engineering. The program was established in 1969 and at this point, there are but three of its kind in the U. S.

124. Wilson, David A., Personnel implications of new technological developments: undersea technologies. U. S. Office of Education, ERIC ED 054 313, 1969.

A discussion of projected personnel needs for the next 20 years, especially in the Navy. Projections are made in the light of new underwater experimental techniques.

125. Wise, Charles D., Dear student: are you interested in oceanography? American Biology Teacher, 21 (8): 341-346; Dec 1969.

A discussion of marine science career education, schools of oceanography. The article describes what a marine scientist does, who hires him, etc.

126. Wood, Walter, Orientation to the oceans. American Education, 8 (5): 17-22; June 1972.

A marine science technician program at Cape Fear Technical Institute, Wilmington, North Carolina is discussed. The article includes a description of how the institute was originally founded, some of its equipment, hands-on experience gained by students, etc.

CHAPTER III

Methods

This chapter contains those citations which are in some way related to teaching methods. The chapter is further subdivided into several categories and, as before, there is some correspondence between categories. In some cases an article might easily have been listed in the chapter titled, Science. The converse, of course, is also true. At this point, I should also point out that any well designed scientific experiment or investigation contains a host of methods. Any one of these methods might be put to great use in the precollege classroom by an imaginative teacher.

Aquaria

1. American Biology Teacher, Rhode Island plans oceanarium. American Biology Teacher, 22 (9): 543; Dec 1960.

   A discussion of the building of an oceanarium in 1961 at Saunderstown, Rhode Island.

2. American Biology Teacher, Aquaria. American Biology Teacher, 29 (7): 540; Oct 1967.

   The author describes the use of marine aquaria at an inland school.

3. Bennett, Lloyd M., Marine aquaria--their value in teaching science in the elementary school. School Science and Mathematics, 72 (1): 57-71; Jan 1972.

   Provided is a list of sources of aquarium materials, specimens, salt water for maintaining aquaria, obtaining and using live specimens, etc. The author also discusses the value of using aquaria in the classroom.

4. Beyers, Robert J., The metabolism of twelve aquatic laboratory microsystems. Ecological Monographs, 33: 281-306; 1963.

   A presentation of some excellent laboratory methods using aquaria as a vehicle. These methods could be easily adapted to high school use.

5. Breckelman, John, The Aquarium as a teaching device. American Biology Teacher, 3 (4): 133-135; Jan 1941.

A discussion of the building, stocking, maintaining organisms, animal feeding habits, respiration, etc.

6. Gallagher, John L., An economical cooling system for aquaria. American Biology Teacher, 29 (7): 535-536; Oct 1967.

A discussion of this system; system diagrams are provided.

7. Givler, J. P., The seven seas in every laboratory. American Biology Teacher, 4 (3): 85-86; Dec 1941.

A method of using large test tubes as small aquaria.

8. Kane, Michael M., An algae-outside purification system for marine aquaria. American Biology Teacher, 36 (6): 344-345; 1974.

The system is described in detail. A number of pictures of the purification system are also provided.

9. Masters, Charles O., Requirements for the culturing of sea animals. American Biology Teacher, 29 (7): 537-540; Oct 1967.

A discussion of aquaria problems and marine animal behavior in the light of organic content in the aquaria.

10. Miller, John W. and Mazur, Jane E., Gallon-jar marine aquaria. American Biology Teacher, 36: 40-41; Jan 1974.

The author discusses the use of filters, buffer systems, establishing nitrifying bacteria populations which convert ammonia to nitrite.

11. Moutvic, J. C., Pickle jar oceanography. The Science Teacher, 40: 43; Nov 1973.

A method of using used pickle jars to build marine aquaria.

12. Postiglione, Ralph, Dancing mothballs and fish buoyancy. American Biology Teacher, 37 (1): 49; 1975.

Presents an interesting method of studying the way in which fish are able to change depths via use of aquaria.

13. Pope, Phillip H., Maintaining a salt water aquarium. American Biology Teacher, 11 (3): 84-85; Mar 1949.

This is a discussion of experiences gained over a winter using a marine aquarium.

14. Raimist, Roger J., Laboratory experiences in marine biology for upper elementary and secondary school grades teachers edition. U. S. Office of Education, ERIC ED 039 123, 1967.

Information about marine aquaria, e.g. oxygen consumption, salinity tolerance, population densities, etc.

15. Stegner, Robert, Marine aquaria. American Biology Teacher, 25 (2): 128-129; Feb 1963.

The author discusses methods of collecting specimens and using marine aquaria.

16. Welsh, John H., Marine aquaria. School Science and Mathematics, 37: 899-901; Nov 1937.

A description of aquarium maintenance tips.

17. Woods, Joan, Down to the seashore. American Biology Teacher, 15(1): 8-11; Jan 1953.

The author provides an excellent description of how to make an aquarium, stock it, etc. Other useful laboratory and field methods are also included in the article.

18. Wright, Kirk E., Preserving radula patterns of limpets. American Biology Teacher, 37 (5): 300; May 1975.

Algae growth occurs on the sides of marine aquaria. The author describes a method of studying the radula patterns of limpets by using this algae growth.

Bibliographies

This section includes two types of bibliographies: those listing marine science and marine science related films and those listing texts and marine science articles. Some of the article bibliographies cite films as well as other useful materials.

Articles

1. American Society for Oceanography, The oceans and you. U. S. Office of Education, ERIC ED 064 088, 1971.

   A reading list of 300 entries, grouped as elementary, secondary and adult. Also lists information sources and provides career information. Available in kit form from American Society for Oceanography, 1730 M St. N.W., Suite 412, Washington, D. C. 20036.

2. Cohen, Maxwell, 1960-69 cumulative index of articles related to oceanography and limnology education in The Science Teacher. U. S. Office of Education, ERIC ED 040 072, 1970.

   A bibliography of articles from The Science Teacher.

3. Eric Information Analysis Center, Science education information analysis center newsletter. U. S. Office of Education, ERIC ED 030 916, 1968.

   This is a directory of outdoor education programs in the United States.

4. Hemenway, Leone, Please pass the plankton. Wilson Library Bulletin, 49 (2): 165-173; Oct 1974.

   A review of 72 books on oceanography. A brief annotation is listed for each entry. Grade levels are also included. The books range from grade 1 through 9.

5. Hopman, Anne B., Helping children learn science, a selection of articles reprinted from Science and Children. U. S. Office of Education, ERIC ED 017 468, 1966.

   Some of the articles included in this collection are related to the marine environment. The collection is available from the National Science Teachers Association, Washington, D. C.

6. Instructor, Space and oceanography. Instructor, 79 (5): 68; Jan 1970.

   A few good oceanographic references are included.

7. Luedtke, John R., Directory of marine and marine related information resources at the University of Wisconsin. Part I, references and referral resources. U. S. Office of Education, ERIC ED 061 044, 1970.

   The majority of these resources are available on interlibrary loan.

8. Luedtke, John R., Directory of marine and marine related information resources at the University of Wisconsin. Part II, library and film resources. U. S. Office of Education, ERIC ED 061 045, 1970.

   The majority of these resources are available on interlibrary loan.

9. Matthews, William H., Sources of earth science information. U. S. Office of Education, ERIC ED 014 426, 1964.

   A listing of U. S. and Canadian sources of information. Some marine science information sources are included. Available from Educational Book Division, Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632.

10. Matthews, William H., Selected references for earth science courses. U. S. Office of Education, ERIC ED 019 219, 1964.

    A list of text books, teachers guides, and field activities, some of which are in the marine sciences.

11. Minemier, Betty, The ocean world of Jacques Cousteau. Instructor, 84 (7): 125; Mar 1975.

    A review of many of Cousteau's books.

12. Morgan, Myra J., A bibliography of elementary and secondary marine science curriculum projects and education materials. U. S. Office of Education, ERIC ED 089 995, 1974.

    A review of marine science curriculum projects and other educational resource materials. Items are listed in terms of their value to elementary and secondary teachers. Available from National Technical Information Service.

13. Oregon State University, Department of Oceanography, Reading in marine science, a partially annotated bibliography for young readers, nonprofessionals and teachers. U. S. Office of Education, ERIC ED 046 743, 1968.

    300 entries are grouped in the following categories: general references, historical and exploration, biological oceanography, geological oceanography, and physical oceanography.

14. Porter, R. R., Earth-space science teaching tips from TST, a compilation of articles from seven years of The Science Teacher 1960-66. U. S. Office of Education, ERIC ED 020 103, 1967.

Includes many activities and other teacher information. Available from NEA, Publications Sales Division, 1201 16th Street, N. W., Washington, D. C. 20036.

15. Qutub, Musa, Environmental reference series, earth and environmental studies, part II. U. S. Office of Education, ERIC ED 072 970, 1973.

A list of books and articles, some of which are in the marine science area. This list is not annotated.

16. Schlenker, Richard M., Precollege marine science education 1973 through 1976. U. S. Office of Education, ERIC ED (in press).

A review of 67 articles related to precollege marine science instruction. Several curriculum guides are included.

17. Schlenker, Richard M., Marine science education materials and their usefulness. U. S. Office of Education, ERIC ED (in press).

A catalog of 289 documents. The documents are categorized according to subject matter content, grade level of usefulness. Acquisition sources as well as brief annotations are included.

18. Schweitzer, James P., Directory of marine science education. U. S. Office of Education, ERIC ED 093 615, 1973.

A national listing of marine science teachers in precollege education. Lists instructors by name, gives name of the school in which they teach, sizes of marine science classes, etc.

19. Schweitzer, James P., A bibliography of popular books on the marine environment and wetlands ecology. U. S. Office of Education, ERIC ED 067 230, 1973.

A listing of 100 books which were judged to contain teaching and background materials useful in K-12 marine science and wetlands programs.

20. Vetter, Richard C., Oceanography information sources 70. U. S. Office of Education, ERIC ED 055 797,

A listing of information sources for kits, laboratory programs, newsletters, periodicals, bibliographies, career education information, industries involved in oceanography, etc.

Films

1. Canadian National Committee, Water films, 2nd edition, 1965-1974. U. S. Office of Education, ERIC ED 067 224, 1970.

   A listing of 455 entries. The document includes the title source and an annotation for each entry.

2. Chapman, Frank L., Marine science film catalog. U. S. Office of Education, ERIC ED 052 049, 1971.

   A listing of 48 films and filmstrips. Each entry includes the type, producer, recommended grade level, running time and a summary of content.

3. Chapman, Frank L., Marine science film catalog, movies, filmstrips and slides. U. S. Office of Education, ERIC ED 019 252, 1967.

   An annotated list of 16 mm films and 35 mm film strips and slides. Title, producer, topic and grade level are included. Available from Carteret County Public Schools, Beaufort, North Carolina.

4. Carter, Ledford C., Films: oceans. Journal of Geography, 61: 419-20; Dec 1962.

   A list of 12 films, sources, running time, year of publication. Seven of the entries are annotated.

5. Cuzon du Rest, R. P., Films on oceanography. U. S. Office of Education, ERIC ED 045 433, 1969.

   A list of films in the areas of general oceanography: marine biology, chemistry, engineering geology, and physics. Includes information on content, running time, type of audience for which it was intended and sources.

6. Educational Product Report, Thorne marine environmental series. Educational Product Report, 41 (5): 5-7; Feb 1972.

   Describes a series of color film loops concerned with marine organisms.

7. National Audiovisual Center, U. S. government films 1969. A catalog of motion pictures and filmstrips for sale by the national audiovisual center. U. S. Office of Education, ERIC ED 033 612, 1969.

An annotated list of 3,000 films which document operations by federal agencies, some in marine biology. Available from National Audiovisual Center, Washington, D. C. 20409.

8. Ring, Paul, Marine related films available from the University of Maine Film Rental Library. U. S. Office of Education, ERIC ED 095 023, 1974.

Each entry contains a brief annotation, as well as grade levels and running times.

9. Serena Press,Guide to films (16 mm) about ecology, adaption and pollution. U. S. Office of Education ERIC ED 055 , 1971.

Some of the inclusions are in the marine area. Available from Serena Press,70 Kennedy Street, Alexandria, Virginia 22305.

10. World Future Society, Films on the future: a selective listing. U. S. Office of Education, ERIC ED 074 009, 1973.

Some marine films are included in this list. Each entry includes a brief annotation, year of release, rental fee, length, rental source, film number and whether the film is black and white or color.

Curriculum Guides

1. Andersen, Ruth, Life on the tidal mudflats; elkhorn slough. U. S. Office of Education, ERIC ED 073 946, 1972.

Life in an estuarian environment is studied using audiovisual materials. Available from Monterey County Office of Education, Instructional Media Division, P. O. Box 851, Salinas, California 93901.

2. Awkerman, Gary L., Sea changes, topics in marine earth sciences. U. S. Office of Education, ERIC ED 086 556, 1973.

Designed to be used as a standard science curricula. Covers continental drift, shoreline changes, sea level changes, beaches, nearshore currants and man-made structures and estuaries.

3. Awkerman, Gary L., Animals of the sea: coelenterates, protozoa and sponges. U. S. Office of Education, ERIC ED 086 552, 1974.

Includes units covering coelentrates, protozoa and sponges. Designed to be used with a standard curricula.

4. Awkerman, Gary L., Aspects of marine ecology. U. S. Office of Education, ERIC ED 086 553, 1974.

Designed for use in a standard curriculum. The study guide covers food webs and chains, describes functions of producers and consumers and discusses pollution, etc.

5. Awkerman, Gary L., Estuaries. U. S. Office of Education, ERIC ED 086 554, 1974.

Defines an estuary, describes five types of estuaries, estuarian environments, fluctuations, etc. The guide is designed for use in a standard science curriculum.

6. Askerman, Gary L., Marine biological field techniques. U. S. Office of Education, ERIC ED 086 555, 1974.

A guide to various field techniques, the document is designed for inclusion in a standard curriculum.

7. Beakley, John C., et al, The source book of marine sciences. U. S. Office of Education, ERIC ED 046 715, 1970.

A collection of 45 marine science activities for the high school.

8. Beakley, John C., et al, The source book of marine sciences. U. S. Office of Education, ERIC ED 054 118, 1970.

A marine science curriculum which includes background information for the teacher. The major topics covered are aquaria, nature of tides, beach analysis, salinity, analysis of populations and a study of a variety of creatures.

9. Bethlehem Area Schools, Diggers to divers, geology K-6; elementary science unit no. 2. U. S. Office of Education, ERIC ED 033 036, 1968.

A discovery approach to child centered learning for grades 4 and 5. Petrology is the major emphasis in grade 4 and oceanography is the major emphasis in grade 5.

10. Bolles, William H., Earth and space science. A guide for secondary teachers. U. S. Office of Education, ERIC ED 094 956, 1973.

The guide includes a unit on the oceans. Basic science information is provided for the user.

11. Brevard County School Board, Man's impact on the environment: the barrier beach as an ecosystem. U. S. Office of Education, ERIC ED 106 076, 1974.

Deals with biotic factors of the barrier reef ecosystem as well as natural factors. The publication includes a section on activities.

12. Brevard County School Board, Man's impact on the environment: the estuary as an ecosystem. U. S. Office of Education, ERIC ED 106 077, 1974.

The guide focuses on the estuary as an ecosystem.

13. Castellani, Marylynn L., Guide to marine ecological research, a curriculum for secondary students. U. S. Office of Education, ERIC ED 106 089, 1974.

The topics covered include a study of plankton populations, the San Francisco Watershed, biological sampling of a mud flat, etc.

14. Chapman, Frank L., Eighth grade unit, sea--restless giant. U. S. Office of Education, ERIC ED 020 053, 1968.

A unit guide which deals with tides, waves, currents, ocean floors, beaches, etc.

15. Chapman, Frank L., The sea and its boundaries. U. S. Office of Education, ERIC ED 046 735, 1970.

Designed as a three week unit in marine science at grade 8; topics covered are tides, waves and beaches.

16. Contra Costa County Department of Education, Marine ecology research resource units. grades 7-9. U. S. Office of Education, ERIC ED 106 088, 1974.

This is an ecological unit designed to involve secondary students in the study of the marine biome.

17. Dade County Public Schools, Authorized course in instruction for the quinmester program. Science; recreation and the sea; oceanography; marine ecology of South Florida, and invertebrate marine biology. U. S. Office of Education, ERIC ED 067 175, 1971.

Describes a program of instruction in Miami, Florida and Dade County Florida schools.

18. Dubach, Harold W., and Taber, Robert W., Questions about the oceans. U. S. Office of Education, ERIC ED 033 858, 1968.

100 questions typical of those asked by students at the 17th annual science fair in 1966. The questions include all areas of oceanography.

19. Falmouth Public Schools, High school oceanography. U. S. Office of Education, ERIC ED 043 501, 1970.

A series of papers designed to aid high school teachers in organizing a course in oceanography. The collection covers the following areas: introduction to oceanography, geology of the ocean, the continental shelves, physical properties of the sea water, waves, ocean circulation, air-sea interaction, sea ice, etc.

20. Forbes, Lynn, An oceanographic field course for the eighth grade. U. S. Office of Education, ERIC ED 042 622, 1969.

A course designed to supplement an 8th grade science program. Manual includes suggested teaching plans, bibliographies, lesson plans, field and laboratory procedures, etc.

21. Georgia State Department of Education, Field study manual to freshwater and estuarine habitats. U. S. Office of Education, ERIC ED 056 914, 1971.

This program is designed to give the student experiences collecting data. Included are methods of sampling and quantification.

22. Godfrey, Paul L., and Hon, Will, Dune detective, using ecological studies to reconstruct events which shaped a barrier island. U. S. Office of Education, ERIC ED 061 060, 1970.

Students in grades 11 and 12 are exposed to research methods through a variety of field experiences.

23. Heitzmann, William Ray, Two if by sea: America's maritime heritage and the social studies teacher. U. S. Office of Education, ERIC ED 109 039, 1974.

Provides a rationale for making and/or teaching a study of the sea. The document includes units on fishing, naval technology, etc. Also included is an annotated bibliography of materials, sources, and references.

24. Hon, Will, The regional marine science project of the Carteret County, North Carolina, Public Schools. U. S. Office of Education, ERIC ED 055 833, 1969.

Presents experiments in the use of field ecology as an approach to understanding the coastal environment.

25. Kraft, Tom, Can education and this nation survive? American oceanography. U. S. Office of Education, ERIC ED 050 990, 1970.

Covers nine marine science programs for students of various levels.

26. Lamie, Richard G., A formal course in oceanography at the secondary level through independent study; summary report and final report. U. S. Office of Education, ERIC ED 016 619, 1967.

A program which was conducted in Valhalla Union Free School District, New York. The document includes lecture materials, bibliographies, etc.

27. Linsky, Ronald B., and Schnitger, Ronald L., Marine sciences student syllabus. U. S. Office of Education, ERIC ED 028 097, 1968.

This is a manual which was developed for students participating in the Orange County, California marine science floating laboratory program. It includes background information as well as techniques for studying the key properties of the ocean.

28. Linsky, Ronald B., and Schnitger, Ronald L., Marine science student syllabus, third edition. U. S. Office of Education, ERIC ED 039 146, 1969.

A manual or guide for those participating in Orange County, California's marine science program.

29. Linsky, Ronald B., and Schnitger, Ronald L., Teacher's Guide. U. S. Office of Education, ERIC ED 046 684, 1969.

This is a teacher's guide to be used in conjunction with the previous citation. It provides a bibliography of marine related Scientific American articles published between 1948 and 1969. Also included are film bibliographies, sources of materials, etc.

30. Marine Science Project, Beaufort, North Carolina, Major coastal communities of North Carolina. U. S. Office of Education, ERIC ED 020 829, 1968.

Provides identifications for five types of natural habitats in terms of plants, animals, adaptions and special features.

31. Mary, Charlotta B., Adventures in ecological reading, language arts (experimental). U. S. Office of Education, ERIC ED 086 529, 1972.

This is a collection of reading activities, discussion activities, and experiments for students interested in ecology.

32. Montgomery County Public Schools, Rockville, Md., Development of a pilot career cluster curriculum for all students in a college preparatory oriented high school. Final Report, Part I: curriculum development. U. S. Office of Education, ERIC ED 084 377, 1973.

A career education program which uses mini-courses and internships.

33. Morgan, David W., A handbook of estuarian life. American Biology Teacher, 34 (9): 538-9; Dec. 1972.

A discussion of a teacher's manual on saltwater studies. Included is information concerning salt water aquaria, laboratory and field activities, etc.

34. National Park Service, Elementary teachers resource manual, lightship chesapeake 1973-4. U. S. Office of Education, ERIC ED 086 501, 1974.

A guide written to help teachers prepare students for a tour of Lightship Chesapeake. Contains activities concerned with weather maps, humidity, food webs, air speed, and direction, water analysis, etc.

Grade 5

35. Northern New Jersey Conservation Foundation, Education for survival: ecology in science and social studies. Curriculum guide for grade V. U. S. Office of Education, ERIC ED 066 359, 1972.

Grade five students evaluate their attitudes regarding man and his environment. Units on oceanography are present in outline form. Available from Northern New Jersey Conservation Foundation, 300 Mendham Road, Morristown, New Jersey 07960.

36. Rabinowitz, Alan, et al, Oceanography: an environmental approach to marine science. U. S. Office of Education, ERIC ED 045 430, 1970.

The teachers guide provides materials for a full year course. This is an environmental approach which emphasizes the interdisciplinary nature of the ocean sciences.

Grades K-12

37. Raimist, Roger J., Marine science sourcebook, first edition. U. S. Office of Education, ERIC ED 037 340, 1970.

This manual was prepared for a teacher workshop in marine science education. Provided are methods of collecting marine specimens, methods of preparing shell collections as well as an annotated bibliography.

Grades K-3

38. Richeson, Karren, and Knacky, Janey, Interdisciplinary outdoor education, sea and shore. U. S. Office of Education, ERIC ED 061 034, 1972.

Provides a description of 24 classroom activities, most of which involve observing and discussing various kinds of life found at the seashore. Instructor background information is provided with each activity.

Grades 9-12

39. Taber, Robert W., et al, An oceanographic curriculum for high schools. U. S. Office of Education, ERIC ED 033 853, 1968.

This is a collection of 18 one-hour lectures on oceanography. The topics include oceanographic surveying and research, geology of the oceans, tides and currents, chemistry of sea water, etc.

Grade 10

40. Taylor, Beth, The field approach to coastal ecology, fall unit. U. S. Office of Education, ERIC ED 061 061, 1970.

The coastal environments are used to demonstrate the basic principles of ecology. Emphasis is placed upon salt marshes. Laboratory exercises are included.

Grades 9-12

41. Whitaker, David M., Marine field study on the high school level. American Biology Teacher, 37 (4): 240-1; Apr 1975.

This is a hands-on program in which students sample the environment both in the intertidal zone and the offshore areas. The program is designed for advanced high school students, i.e. students with an elementary or beginning high school science background.

Grades K-8

42. Vaiuso, Frank, The sea, an interdisciplinary approach to marine science for elementary school children. U. S. Office of Education, ERIC ED 045 375, 1970.

The guide suggests objectives, materials, procedures, evaluation, and follow-up activities. The lessons consider food chains, physical characteristics, water pollution, political issues, etc.

43. Yeater, L. W., A field experience--a why, a how. U. S. Office of Education, ERIC ED 020 830, 1967.

This guide offers the teacher a direct means of providing a directed discovery, field-oriented approach to the study of oceanology.

1. American Biology Teacher, Fresh seafood. American Biology Teacher, 27 (1): 29; Jan 1965.

   A discussion of a method of prolonging the life of fresh fish at temperatures above freezing.

2. American Biology Teacher, Salt marshes. American Biology Teacher, 30: 197; Mar 1968.

   A discussion of the setting up of a live salt marsh on a university farm.

Grade 5

3. Anson, Elva M., Putting the tide zones and marine biology together. Instructor, 82 (9): 85-6; May 1973.

   After studying the marine environment in the classroom, the students take a weekend trip to the coast.

4. Anthony, Vaughn, Use of population dynamics in marine fisheries studies. American Biology Teacher, 29 (6): 448-52; Sept 1967.

   Presents a method of studying fish populations.

Grade 1

5. Ballard, Katherine, A study of the sea. Instructor, 70 (8): 46; Apr 1961.

   The author presents a method of teaching first graders about the sea.

6. Barnes, W. J. P., et al, Corophium volutator--an intertidal crustacean useful for teaching in schools and universities. Journal of Biological Education, 3: 283-98; 1969.

   The article describes collection procedures, procedures necessary in maintaining the organism, observations of behavior. Included are experiments in the areas of substrate selection, light reactions, population analysis, and movements in and out of water.

Grade 5

7. Bennett, Lloyd M., Marine life: for fifth grade. Science Education, 48 (5): 404-18; Dec 1964.

   This is a nine day unit. Scientific background information is provided for teachers along with activities and tests.

Grade 7

8. Bennett, Lloyd M., A marine ecology unit for seventh grade. American Biology Teacher, 28 (1): 43-50; Jan 1966.

The article provides an overview of a unit of instruction. The author points out that students and teachers can handle this material with enthusiasm.

Grades 4-6

9. Bennett, Lloyd M., Marine biology project of Texas Woman's University. School Science and Mathematics, 67 (595): 723-738; Nov 1967.

This is a description of a marine science program developed for grades 4-6.

10. Boer, Helen Bush, Utilization of a marine environment in the teaching of biology. American Biology Teacher, 17 (5): 171-3; May 1973.

A discussion of the need and possibility of teaching a complete biology course within the confines of marine science. The author also suggests how other subjects can be related to the sea.

11. Boubjerg, Richard V., and Glynn, Peter W., A class exercise on a marine microcosm. Ecology, 41: 229-32; 1960.

A description of a class activity in which community structure, and community dynamics such as standing crop, etc. are measured.

12. Boyd, Ellsworth, Dive-in for dropouts. Oceans, 6 (5): 54-5; Sept-Oct 1973.

The author describes a 6 month program for school dropouts. The program teaches many skills related to the marine environment.

13. Boyer, Robert E., and Butts, David P., Capturing excitement: oceanography. Science and Children, 8 (6): 14-7; Mar 1971.

A description of four activities. Each activity is designed to help children answer questions about the ocean floor, continental drift, etc.

Grades K-12

14. Bridgeman, Richard H., Tides and times. The Science Teacher, 19: 195-6; Sept 1952.

An interesting method of presenting information concerning tides, to students who live some distance from the sea.

15. Bryan, R. C., Campus ecology. Science Activities, 11 (3): 29-31; July-Aug 1974.

A method of using those things found on campus or around a school, in science instruction.

16. Bryan, Arthur H., The halophiles: recent studies in marine bacteriology. American Biology Teacher, 24 (7): 499-503; Nov 1962.

The article includes collection methods, data analysis, etc.

17. Campbell, J. A., Eco-Chem. Journal of Chemical Education, 52 (3): 171; Mar 1975.

An interesting method by which students may learn many facts about barnacles.

18. Charlier, Roger H., and Charlier, Patricia S., A general oceanography course and "sea-camp" for teachers and beginners. Science Education, 53 (2): 105-6; Mar 1969.

A program for both teachers and students is described.

Grades K-8

19. Clark, Kay, Seals. The Grade Teacher, 63 (5): 42-3; Jan 1946.

Students study portions of the life cycle of the sea, how sealing is conducted in the arctic as well as some history concerning the sealing industry.

Grades K-6

20. Cole, Mildred, Sea gulls. The Grade Teacher, 70 (10): 17; June 1953.

This is a brief teaching unit which considers gulls.

21. Day, Robert S., Investigation of the reaction of high school students to a curriculum oriented towards oceanography. U. S. Office of Education, ERIC ED 057 407, 1971.

An evaluation of a school program in which the curriculum was made more relevant to the students everyday surroundings. The program embraced all academic departments.

22. Eike, Robert A., Woods hole diary. American Biology Teacher, 18 (5): 196-8; May 1956.

A description of a summer program at Woods Hole, Mass. for pre-college students.

Grades K-12

23. Emerson, Cora, The fisheries. The Grade Teacher, 54: 16-7; May 1937.

A unit of instruction about the fishing industry. The unit includes some information about what types of jobs exist in the fishing industry.

24. Ermish, Gloria, Life in the sea. Instructor, 76 (3): 138-9; Nov 1966.

The author describes a program which was conducted at Berwick, Pa.

25. Evangelos, Nicholas J., Enrichment activities in environmental education. U. S. Office of Education, ERIC ED 086 490, 1973.

A collection of activity units written for elementary teachers. Some of the marine oriented units are useful in locales other than Massachusetts. Available from Merrimack Education Center, Chelmsford, Mass.

Grades 9-12

26. Farraday, Clayton L., Precollege oceanography: short course in marine science for high school. American Biology Teacher, 37 (8): 475-7; Nov 1975.

A description of three-day courses in oceanography for high school students. The courses are offered at Wallops Island, Va.

Grade 8

27. Forbes, Lynn, Thomson, Gerald B., and Soderberg, Jon., Oceanography: a vehicle for integrating science concepts. The Science Teacher, 36 (3): 40-2; Mar 1969.

This article discusses a grade 8 four week summer course in the marine sciences which has been conducted in the past.

28. Gee, Maureen, Kits in motion. Science and Children, 12 (4): 31; Feb 1975.

A program description in which a group of traveling instructors provide marine science instruction to students removed from seashore areas.

29. Gordon, Bernard L., An ocean science program for pre-college students. American Biology Teacher, 30: 106-8; Feb 1968.

A discussion of some functioning U. S. precollege marine science programs. One program in particular by the American Littoral Society is discussed.

30. Graham, Joseph J., Ocean currents. American Biology Teacher, 29 (6): 453-458; Sept 1967.

The author suggests a collection of methods used in studying ocean currents.

31. Gregson, A., Biological assessment of river quality. School Science Review, 55 (191): 295-8; Dec 1973.

Various methods of ascertaining water quality.

Grades 4-6

32. Griff, Bernard, What makes the tides. Instructor, 80 (4): 33; Dec 1970.

The author presents a verse used to kick off a unit on tides used by gifted children. He also discusses other methods which he uses.

Grades K-12

33. Haan, Aubrey, Oceanography in general education. The Journal of Geography, 50 (7): 294-301; Oct 1951.

This is a discussion of the importances of precollege marine sciences and the need to offer this type of instruction in the public schools. The author suggests classroom as well as field trip activities.

Grades K-6

34. Hoagey, Catherine, At the seashore. Instructor, 72 (10): 24; June 1963.

A discussion of songs about the sea.

Grades 9-12

35. Hollenbeck, Irene, A unit on marine biology. American Biology Teacher, 16 (1): 5-7; Jan 1954.

A discussion of how a course is conducted in terms of methods, field trips, etc. The author also includes a discussion of the needs and desires of the students.

36. Hon, Will, Rowboat oceanography. The Science Teacher, 38 (1): 127-30; Jan 1971.

A summary of the marine science activities in Beaufort County, North Carolina schools. Included are excellent descriptions of methods such as transects and quadrats.

37. Hope, Ronald, In cabined ships at sea; fifty years of the seafarers education service. U. S. Office of Education, ERIC ED 044 605, 1969.

A description of 50 years of these types of services. The publication provides information concerning activities, courses offered, distribution of materials, correspondence with tutors, films, completion certificates, etc.

Grades K-8

38. Instructor, The ocean and today's world. Instructor, 79 (5): 59-63; Jan 1970.

Methods of teaching oceanography to elementary school students.

Grades K-12

39. Janke, Delmar L., and Pella, Milton O., Earth science concepts list for grades K-12 curriculum construction and evaluation. Journal of Research in Science Teaching, 9(3): 223-230; 1972.

A list of 52 earth science concepts are presented in order of their ranking by a panel of earth scientists. These individuals were asked to judge the importance of this list for inclusion in the public curriculum.

40. Kellog-Smith, Ogden, Biological oceanography, junior grade. BioScience, 18 (10): 975-6; 1968.

A discussion of a program which takes in several levels as well as some research conducted by the school. The program took place in Arnold, Maryland.

Grade 6

41. Kogawa, Yoshinasa, The living seaside. Instructor, 65 (10): 86; June 1956.

The author describes teaching art and science at the seashore.

Grades 9-12

42. Krupowicz, Joseph R., Studying the ocean frontier. The Science Teacher, 36 (3): 39-40; Mar 1969.

A program at Middletown, Rhode Island high school for the non-college bound student. Included are sources of information, field trip locations, etc.

43. Kuhn, David J., Experiments with display patterns in the siamese fighting fish. American Biology Teacher, 32 (2): 102-4; Feb 1970.

The author describes the use of this fish as a method of studying fish behavior.

44. Levenson, Dorothy, The clearwater sails against pollution. Teacher, 92 (7): 66-7; Mar 1975.

This program is designed to educate students about their environment. Students with a good background will be able to help fight pollution.

45. Lindstrom, Esther, The aquart room. Arts and Activities, 30-1, Dec 1975.

A teacher describes how she converted her classroom into a marine environment.

46. Linsky, Ronald B., Marine biology--a summer enrichment course. The Science Teacher, 34 (6): 40-1; Sept 1967.

This program was conducted at Fountain Valley, California. Included were lectures, field trips, etc. The author presents the program philosophy and describes some of the equipment used.

Grades K-6

47. Linsky, Ronald B., Oceans and ecological understanding. Childhood Education, 47 (4): 191-4; Jan 1971.

Teachers and students learn a reverence for life in a hands-on approach to the study of oceanography and marine ecology.

48. Linsky, Ronald B., Educational strategies for an environmental ethic. The Science Teacher, 38 (1): 16-8; Jan 1971.

A discussion of the needs in marine science education in Orange County, California. Also discussed is a hands-on marine program at that location.

Grades 9-12

49. MacCurdy, Jack F., Teaching marine biology at the secondary level. American Biology Teacher, 17 (8): 251-3; Dec 1955.

This is a four unit program in the marine sciences. The program lasts six weeks. At the publishing date, the course had been in operation five weeks. The study involves collecting specimens, building aquaria, painting marine pictures, and giving oral reports.

Grades K-6

50. MacDermand, Ethel, A springtime study of water life. Instructor, 71 (8): 44; Apr 1962.

A unit of instruction designed to cover several academic areas.

51. MacLean, Donald, and Gessel, John R., The ocean and today's world. Instructor, 79 (5): 59-64; Jan 1970.

A descriptive article which includes many suggestions for marine related activities.

Grades K-6

52. McDonald, Helena, A fishing unit. The Grade Teacher, 70 (10): 18-19; June 1953.

This is a unit of instruction about marine fishes. The unit was developed and has been taught in coastal North Carolina.

53. McDougal, Christina, UN and the Sea. UNITAR News Vol. 6 no. 1. U. S. Office of Education, ERIC ED 104 662, 1975.

The article presents sample activities in ocean pollution as well as activities in oceanography and navigation. Available from UNITAR, 801 United Nations Plaza, New York, New York 10017.

Grades K-12

54. McFadden, D. L., Teaching in the tidepools. Oceans, 6 (5): 44-9; Sept-Oct 1973.

The article describes several marine science programs, all on the west coast of the U. S. These programs cover the grade span from K-12.

55. Murphy, James E., Sex, symmetry and sea urchins. Science Activities, 9 (3): 21-3; Apr 1973.

This is a discussion of ways to study fertilization by using the sea urchin. The study can be conducted in the classroom.

56. Murphy, James E., Seaweeds are much more than weeds. Science Activities, 11 (3): 11-3; Jul-Aug 1974.

The article discusses industrial uses of seaweed as well as classroom activities revolving around these weeds.

Grades 9-12

57. Moutoic, J. C., Oceanography in the high school curriculum. The Science Teacher, 34 (5): 55-57; May 1967.

The author describes activities which should be included in any oceanography program which is conducted within 100 miles of a lake or ocean.

58. Naval Training Command, A navigation compendium. Revised edition. U. S. Office of Education, ERIC ED 096 098, 1972.

The publication deals with the basic terms, instruments, sources of information, currents, tides, physical laws, trigonometric functions and other essentials of ocean navigation.

59. Nesbitt, William A., and Karls, Andrea B., Control of the sea. Intercom, 78: 26-30; June 1975.

The author presents background information and also activities which examine the conflicts over control of the oceans.

Grades 9-12

60. Osner, Richard F., A summer marine biology seminar for U. S. fifth air force high school students. American Biology Teacher, 26 (1): 40-2; Jan 1964.

Discusses a program, field trips, etc. for a summer program. Students were required to have a 3.0 average in order to get into the program.

61. Panush, Naomi, Anchored ship explores new fields. American Vocational Journal 45 (4): 64-7; Apr 1970.

The Explorer serves as a classroom for disadvantaged youth studying for careers as oceanographic aids.

62. Passow, Michael, Literature as a scientific hors d'oeuvre. Journal of College Science Teaching, 4 (3): 189-90; Jan 1975.

A course titled, "Literature of the Oceans: is designed to stimulate student interest in the oceans and aquaint him/her with sources of information for future use.

63. Pletcher, T. F., Inquiry into life processes using live lampreys in the laboratory or classroom. American Biology Teacher, 30(9):734-8, Nov 1968.

Useful in marine science instruction as well as other sciences.

Grades 9-12

64. Raimist, Roger John, A secondary school marine science curriculum. American Biology Teacher, 30: 189-92; Mar 1968.

The author suggests the composition of a 10 unit marine science course. He also mentions the difficulties in finding a marine course for precollege use.

65. Rillo, Thomas J., Exploring oil pollution. Science Activities, 11 (2): 52-7; May-June 1974.

A discussion of oil pollution followed by 22 classroom activities dealing with oil pollution. Each activity is grade leveled.

66. Silverstein, Harold, Siegel, Lou, 45 minutes from broadway--an action approach to marine biology. American Biology Teacher, 37 (7): 422-25; Oct 1975.

A description of a full year program which is conducted at John Dewey High School in Brooklyn, New York.

Grades K-8

67. Skliar, Norman, Marine biology in the elementary school. American Biology Teacher, 29 (3): 226-8; Mar 1967.

This is a detailed description of a program conducted at Great Neck, New York.

Grade 8

68. Soderberg, Jon and Thomason, Gerald A., A summer course in oceanography for eighth grade students. American Biology Teacher, 21 (3): 151-4; Mar 1969.

In a summer program at Falmouth, Ma., students studied plankton, identified organisms, studied fish distribution, potential productivity, conducted a clam survey, etc.

69. Springer, John U., Science school--a community summer school for children. The Science Teacher, 39 (4): 39-40; Apr 1972.

A summer school marine science program conducted in Woods Hole, Ma. As part of the program, the resources of the Biological Institution at Woods Hole were used.

70. The Grade Teacher, Seals and their homes. The Grade Teacher, 68 (5): 42-3; Jan 1951.

The history of the sealing industry and the life of seals are discussed. The author also suggests several classroom activities dealing with seals.

Grades K-12

71. The Science Teacher, Sea grant curriculum on the marine environment. The Science Teacher, 42 (2): 50-1; Feb 1975.

A description of a K-12 program which embraces all of the subject areas.

Grade 3

72. Vance, Erma, A seashore project inshore. American Biology Teacher, 15 (6): 145-8; Oct 1953.

This is a third grade marine science project which ties in all of the academic areas.

Grades K-9

73. Watrous, John, Animals of the Arctic. The Grade Teacher, 63 (5): 40-1; Jan 1946.

A discussion of some student centered activities dealing with whales.

74. Webb, Helen S., All wet-Palm Beach County's marine science program. Contemporary Education, 44: 346-8; May 1973.

The county wide marine science program in Palm Beach County, Florida.

75. Weissmann, Richard J., Marshland classroom. Conservationist, 26 (6): 8; June-July 1972.

A description of a marine study area of saltmarshes and wetlands in Oceanside, Long Island, New York. Tours are conducted here which inform participants about marshland ecology and intertidal ecology.

Grade 5

76. Wilson, Audrey L., The secrets of oceanlife were revealed when we submerged! Instructor, 70 (5): 39; Jan 1961.

Students study sea shells, rocks, plant life, fishes and the marine industry.

77. Wright, Bradford L., Exciting pools. Physics Teacher, 13 (5): 275-8; May 1975.

The author advocates the creation of swimming pool oscillations as a general investigation of mechanical oscillations.

Data Acquisition Sources

1. American Biology Teacher,The seashore. American Biology Teacher, 31 (4): 243; Apr 1969.

The article describes a periodical by that name, available from Hydro Products, P. O. Box 2528, San Diego, California 92112.

2. Caless, Thomas W., Plan for implementing an information system for marine sciences. U. S. Office of Education, ERIC ED 036 300, 1968.

The author discusses the need for such a system. In 1968 there were 25,000 marine science citations and there was a 20% increase per annum in citations.

3. National Oceanic and Atmospheric Administration, User's guide to OASIS, oceanic and atmospheric scientific information system. Key to oceanic and atmospheric sources no. 1. U. S. Office of Education, ERIC ED 095 932, 1975.

An information retrieval service that furnishes ready reference to the technical literature and research efforts concerning the environmental sciences and marine coastal resources.

4. Schuyler, Sonya, User's guide for NODC's data processing system. U. S. Office of Education, ERIC ED 067 135, 1969.

The guide was designed to aid users of the National Oceanographic Data Center to make use of the information the center receives.

5. Systems Development Corportaion, National data program for the marine environment technical development plan. Final report, volume one. U. S. Office of Education, ERIC ED 039 885, 1969.

Discusses marine data management.

6. Systems Development Corportaion, National Data Program for the marine environment. Final report, volume two. U. S. Office of Education, ERIC ED 039 886, 1969.

A recommendation for a national data program for the marine environment.

Equipment

1. Caprio, Mario W., and Jones, George V., A water sampler. American Biology Teacher, 29 (7): 541-3; Oct 1967.

A description of the construction of an inexpensive water sampler. The sampler could be made at home.

2. Lissant, Ellen Kern, Construction of an algae culture chamber. American Biology Teacher, 31 (1): 27-8; Jan 1969.

Describes a method of constructing a chamber. The chamber is designed to grow marine tropical algae.

3. Pletcher, T. F., Plankton nets from plastic bottles. American Biology Teacher, 30: 186-8; Mar 1968.

This is a description of net construction using plastic bottles and bolting cloth. Different types of tows are suggested by the author.

4. Science, Physical oceanography: big science, new technology. Science, 185 (4147): 246; July 1974.

The uses of many different pieces of new equipment are discussed.

Field Trips and Activities

1. Baird, Gerald, Oceanography in a swimming pool. Science and Children, 11 (7): 7-10; Apr 1974.

   An elementary school ocean science study in which the children take a trip to a local swimming pool. At the pool they study wave phenomenon, etc.

2. Brown, Walter H., Aquatic biology field trips. American Biology Teacher, 20 (3): 91-4; Mar 1958.

   A discussion of where water field trips may be taken. Described specifically is a trip to the Caribbean area.

3. Chan, Gordon L., Effects of visitors on a marine environment. American Biology Teacher, 34 (6): 319-21; Sept 1972.

   The author presents a description of the effects of school children and other visitors upon the marine environment.

4. Cleveland, Lois Jane, Family life salmon style. Instructor, 83 (3): 112; Nov 1973. Grade 1

   A first grade class makes a study of the pacific salmon. As part of the study the class takes a trip to a west coast fish hatchery.

5. Cockran, Tom, Oregon students help prepare impact statements. American Biology Teacher, 35: 518-20; Dec 1973.

   Students catalog an area which is to be filled in by a runway extension. The students write environmental impact statements and submit them to the project engineer.

6. Cole, Richard C., Science interpretive program--spermaceti cove interpretive center. U. S. Office of Education, ERIC ED 020 898, 1967.

   A field based program for grades 5 and 6 conducted by the Middletown, New Jersey school system.

7. Dobbs, Mary Carolyn, Send us a museum. Instructor, 83 (9): 58; May 1974.

   The activities of a special education class learning about the seashore.

8. Donnelly, Dennis P., The atmosphere and the ocean: a field study course. American Journal of Physics, 41 (5): 664-9; May 1973.

A discussion of a college course which is heavily field based. The field activities are adaptable to precollege use.

9. Eyster, Carol J., Oceanology. The Science Teacher, 42 (5): 52-3; May 1975.

This is a heavily field based 6 week summer course conducted in California. The course also includes paper writing and journal use.

10. Flora, Charles and Swift, Al, Rapport and the cyclopean eye. Science Education, 48 (5): 396-404; Dec 1964.

The author discusses the use of educational television and seashore field trips.

11. Fower, H. Seymour, Song, Yong Kyoo, and Choi, Kichul, Tidelands biology research in a Korean high school. American Biology Teacher, 32 (2): 93-5; Feb 1970.

A discussion of a program in which students investigated coastal fish species.

12. Guy, Diane, Cape Hatteras national seashore field project. The Science Teacher, 42 (6): 28; June 1975.

The author describes a field trip to the Cape, what can be studied there and why this is a good field trip area.

13. Hodgins, H. Ronald, On an oceanographic expedition off Cape Hatteras. Instructor, 79 (5): 67; Jan 1970.

A discussion of marine science for the public schools.

14. Mathis, Philip M., The effect of sulfur dioxide on lichens: a field activity. American Biology Teacher, 36 (7): 418-9; 1974.

A method which works well close to and away from the sea. Especially useful near large cities.

15. Moulton, James M., An experiment in the behavior of intertidal animals. American Biology Teacher, 30: 105; Feb 1968.

The author describes a method by which the behavior of intertidal organisms may be studied. Paint spots are placed upon the organism's shell after which movements are charted.

16. Naquin, Nancy, Marine and wetland study. The Science Teacher, 42 (2): 41; 1975.

Students study the local intertidal area as well as taking a trip to an offshore island.

17. Nutting, William B., Zottoli, Robert, and Gustafson, Alton H., Tidepool transect. American Biology Teacher, 33 (5): 282-5; May 1971.

Some techniques used in teaching marine biology at the seashore.

18. Peck, Donald, and Gary, Henry, A day of oceanography. Science and Children, 8 (6): 11-3; Mar 1971.

A description of field oriented marine science activities.

19. Picker, Lester, How about using scuba? Science Activities, 12 (5): 23-5; Sept-Oct 1975.

The author suggests that ecology clubs utilize skin or scuba diving techniques to do ecological research.

20. Pope, Philip H., Bringing marine animals to an inland laboratory. American Biology Teacher, 2 (7): 175-8; Apr 1940.

A discussion of a collecting trip to gather and bring back marine species: the tools used and a discussion of methods of transport are included.

21. Reed, Judith, Operation lightship. Children Today, 2: 7-10; May 1973.

Elementary school children take a trip to a converted Coast Guard Lightship. On the way they take water samples which are then analyzed in the ship's laboratory.

22. Rutherford, Robert, San Francisco Bay studied. American Biology Teacher, 36 (2): 110; 1974.

Public school children take ecological trips on an oceanographic vessel. During the trip they engage in hands-in-the-water investigations, studying the ecology of San Francisco Bay.

23. Schubel, J. R. Aboard the ridgely warfield. The Science Teacher, 36 (3): 36-8; Mar 1969.

Twenty-five high school earth science teachers take a day-long training session on John Hopkins University's research vessel.

24. Sherman, Kenneth, Zooplankton, a rich fauna for high school research. American Biology Teacher, 24 (7): 487-495; Nov 1962.

An outline of a project to determine the seasonal abundance of various zooplankton constitutients. The author includes descriptions of the field methods which were used.

25. Tignor, Donald M., The collection of vertical migrating planktonic animals. American Biology Teacher, 24 (3): 208-9; Mar 1962.

A project in which students sample planktonic species from different depths at different times of the day.

26. Watting, Carol and Hallard, Raymond E., The sea beside us. Teaching the Exceptional Child, 7 (1): 26-8; Fall 1974.

Children with learning problems take a trip to the shore. They use picture keys to identify organisms, etc.

27. Webster, Steven, Commencement on a coral reef. Oceans, 6 (5): 40-3; Sept-Oct 1973.

An environmental science program in which 16 students and three biology teachers from Northfield, Mass. spent two weeks examining the ecology of a Caribbean reef.

28. Wood, John H., and Bayly, Maxine M., Field trip studies on Cape Hatteras. The Science Teacher, 42 (4): 23-5; Apr 1975.

A description of a field trip to Cape Hatteras. What is to be gained by taking a field trip to this area.

General Section

1. Adams, Velma A., Education for survival. School Management, 14 (12): 10-3; Dec 1970.

A discussion of present and proposed programs in marine science education.

2. Awkerman, Teller, P. F., and Laurie, Dan, Priorities in ocean science study. Science Education, 58 (4): 449-56; 1974.

The results of a questionnaire sent to practicing marine scientists. Respondents rank ordered areas of marine science in terms of their importance in pre-college marine science instruction.

3. Bennett, Lloyd M., Determining the feasibility of presenting a marine biology unit in ecology to average seventh graders. School Science and Mathematics, 64 (563): 306-11; Apr 1964.

Bennett presents the results of a research project which indicated it was feasible to present such a unit to this type of group.

4. Charlier, Patricia S., and Charlier, Roger H., A case of oceanography at the inland school. Science Education, 55 (1): 15-20; Jan-Mar 1971.

A discussion of the need for marine science education, especially for teachers.

5. Cherkis, Norman E., A glossary of world bathymetric terms and their English language equivalents. U. S. Office of Education, ERIC ED 047 944, 1970.

A two part list in 27 languages. The list was compiled by the users of bathymetric charts which are printed in languages other than English.

6. Clark, Roger, Marine & small engines; glossary of key words. Vocational reading power project. U. S. Office of Education, ERIC ED 086 851, 1972.

A vocabulary designed to assist students in vocabulary mastery of terms necessary for particular vocational education courses. Two definitions are provided for each term.

7. Foster, Oma Ruth, Maryland environmental education survey. Part one: the Chesapeake Bay as an integral part of the environmental education program. U. S. Office of Education, ERIC ED 107 475, 1975.

The results of a questionnaire sent to people in the Chesapeake Bay watershed area. Identifies the level of programs in that area as well as the need to develop a Chesapeake Bay curriculum.

8. Gordon, Bernard L., Precollege studies in oceanography. American Biology Teacher, 32 (6): 366-7; Sept 1970.

A discussion of the current state of the art in marine science education. The author also discusses the locations of pre-college marine science programs currently in progress and additionally who is funding said programs.

9. Hedgpeth, Joel W., Aspects of research in marine biology. American Biology Teacher, 24 (1): 7-13; Jan 1962.

A discussion of ways in which high school and college teachers can stimulate interest in marine science. The author also discusses the use of the field trip as a teaching method. He seeks to discourage its use as a one shot affair suggesting that one field trip is not enough.

10. Hoover, Linn, Geotimes news of the earth sciences. U. S. Office of Education, ERIC ED 019 247, 1968.

Compares curricula in France, Germany, England and the United States. Available as Geotimes 13 (3) from: American Geological Institute, 1444 N Street N.W., Washington, D. C. 20005.

11. Howard, Alice Sturtevant, The greatest traveling library in the world. Journal of Adult Education, 4: 401-3; Oct 1932.

A description of the American Merchant Marine Library Association, its founding in 1921, the first gift from the American Library Association and the beginning of Service to the U.S.C.G. in 1926.

12. Lyman, John, Marine. Geotimes, 18 (1): 26; Jan 1973.

A brief treatment of some current marine science events.

13. Porter, Mildred C.B., Behavior of the average visitor in the Peabody Museum of Natural History, Yale University. U. S. Office of Education, ERIC ED 044 920, 1938.

The author describes the activities of the visitors to the Peabody Museum.

14. Raimist, Roger J., An elective course at the secondary level. American Biology Teacher, 28 (1): 50-3; Jan 1966.

A discussion of and justification for a course such as this. Also mentioned are the goals of science education as they have existed over a period of time.

15. Riddle, Jan, Jacques Cousteau's living sea: a museum of the mind and the senses. Oceans, 6 (5): 34-5; Sept-Oct 1973.

A description of the major exhibits in Cousteau's Living Sea Museum. The museum is located aboard the Queen Mary located in Long Beach, Calif.

16. Riddle, Jan, The living sea love of Jean-Michel Cousteau. Oceans, 6 (5): 38-9; Sept-Oct 1973.

A discussion of the role of Jean-Michel Cousteau as designer of the living sea museum.

17. Schweitzer, James P., Marine science education in America: its status in precollege programs. The Science Teacher, 40 (8): 24-6; Mar 1973.

The results of a questionnaire circulated in 1971 showed that there were at least 800 K-12 classroom teachers in the United States offering some sort of marine science instruction.

18. Wilhm, Jerry L., Simulation of sampling of benthic macro-invertebrates. American Biology Teacher, 29 (6): 471-4; Sept 1967.

A description of a statistical tool to accomplish this task.

Laboratories and Laboratory Methods

1. Bruce, David S., and Linden, Donald G., Use of the marine vertebrate, the flounder, in the physiology teaching laboratory. American Biology Teacher, 35 (8): 465-9; Nov 1973.

A description of two experiments using marine vertebrates as specimens. The experiments discussed are: (1) the effect of excess potassium upon the EKG, and (2) the effect of temperature on the heart rate.

2. Bryan, Arthur H., Recent studies in marine bacteriology. Science Education, 50 (1): 76-81; Feb 1966.

Provides some excellent laboratory techniques.

3. Driscoll, Andrew L., A model marine science laboratory, North Kitsap Marine Environmental Center. U. S. Office of Education, ERIC ED 080 345, 1972.

A marine science laboratory is developed for teaching and research. Sample activities are also included.

4. Engle, David W., X-radiography of marine animals. American Biology Teacher, 22 (9): 547-8; Dec 1960.

The author presents a method of preserving marine animals in the laboratory without destroying the specimen.

5. Florida State University, Laboratory exercises in oceanography for high schools. U. S. Office of Education, ERIC ED 018 399, 1967.

Describes laboratory exercises in oceanography developed for use in high schools by teachers enrolled in the 1967 NSF summer institute in oceanography at Florida State University.

6. Fox, William T., Computer-oriented laboratory exercises for geology and oceanography. Journal of Geological Education, 17 (4): 125-34; Oct 1969.

The author describes the use of computers to predict tides.

7. Hagan, Janice Maaks, Studying fish. Instructor, 79 (8): 46; April 1970.

Fish dissection in the elementary school.

8. Hummer, Paul, Fish ponds--sources of organisms for the laboratory. Science Education, 41 (5): 55-7; May 1974.

Fish ponds are a good source of organisms; collecting methods are the same as those used for marine collections.

9. Parkhurst, Joseph L., Inexpensive exhibits for biology teachers. American Biology Teacher, 18 (5): 193-5; May 1956.

A method of exhibiting the starfish in a museum setup.

10. Raimist, Roger John, Mounting of zooplankton. American Biology Teacher, 29 (6): 468-70; Sept 1967.

A laboratory technique for accomplishing this task.

11. Raimist, Roger J., Laboratory experiences in marine biology, student edition. U. S. Office of Education, ERIC ED 039 145, 1967.

Instructions for laboratory exercises using marine organisms. The exercises deal with measurement of oxygen consumption in fishes, population density, fertilization in the sea urchin, salinity tolerance, and food webs of shore organisms.

12. Renwick, George, Algae mounts simplified. The Science Teacher, 33 (7): 65; Oct 1956.

A method of mounting marine algae using file cards and transparent food wrapping.

13. Sherman, Kenneth, A high school oceanography laboratory. American Biology Teacher, 23 (1): 29-35; Jan 1961.

A marine science laboratory conducted at Randolf, Mass. High School. This article describes data collection, projects, equipment, etc.

14. Sherman, Kenneth, Coastal zooplankton. American Biology Teacher, 29 (6): 460-4; Sept 1967.

Methods of making plankton counts, charts, etc.

15. Sindermann, Carl J., Blood types in fish. American Biology Teacher. 29 (6): 439-41; Sept 1967.

A discussion of methods of blood typing fishes.

16. Warsh, K. L., Demonstrations in physics from oceanography and meteorology. Physics Teacher, 7 (6): 327-9; Sept 1969.

Described are several useful laboratory demonstrations. These demonstrations could be the base of a discovery learning unit.

17. Welch, Walter R., Sedentary bottom animals. American Biology Teacher, 29 (6): 465-7; Sept 1967.

Methods of teaching students how filter feeders feed and how much they eat.

Grade 7

18. Whitney, L. Jack, Osmoregulatory behavior in shore crabs. The Science Teacher, 36 (6): 58-9; Sept 1969.

A laboratory experiment in which students studied the crab's choice of salinities.

19. Woolever, John T., Marine laboratory for high school biology. The Science Teacher, 30: 12-3; Dec 1963.

A marine biology laboratory was originally started by the science club. Student interest blossomed and a one year course in marine sciences was developed. Students build their own equipment, maintain organisms and conduct indepth studies.

Keys

1. Contra Costa County Department of Education. Handbook of techniques and guides for the study of the San Francisco Bay delta-estuary complex part 4. Key to coastal marine fishes of California. U. S. Office of Education, ERIC ED 086 482, 1971.

A guide to identifying fishes which inhabit the bay area.

2. Helrich, Jane, Handbook of techniques and guides for the study of the San Francisco Bay delta-estuary complex part 2. Key to the phytoplankton phyla and genera. U. S. Office of Education, ERIC ED 086 483, 1971.

A guide for identification of the phytoplankton phyla and genera of the bay area.

3. Shettler, James, Handbook of techniques and guides for the study of the San Francisco Bay delta-estuary complex part 3. Key to the invertebrates. U. S. Office of Education, ERIC ED 086 484, 1971.

A guide for identification of the invertebrates of the bay area.

4. Sikora, Bob, Handbook of techniques and guides for the study of the San Francisco Bay delta-estuary complex part 5. Key to common fishes of San Francisco Bay. U. S. Office of Education, ERIC ED 086 487, 1973.

A key to identifying common fish of the bay.

5. Valentine, David W., Family key to the fish commonly taken on board the Orange County schools' marine science floating laboratory. U. S. Office of Education, ERIC ED 051 988, 1969.

A key designed by junior and senior high school students. Diagrams and drawings show diagnostic characteristics.

6. Williams, H. R., Keys to common genera of marine plants taken aboard the Orange County floating marine laboratory. U. S. Office of Education, ERIC ED 051 989, 1970.

A key designed by junior and senior high school students. Diagrams and drawings show diagnostic characteristics.

Texts

1. Bureau of Naval Personnel, Aircrew survival equipmentman 1 and C NAVPERS 10360-D. Rate training manual. U. S. Office of Education, ERIC ED 082 013, 1971.

A guide for study by Navy men preparing for advancement.

2. Bureau of Naval Personnel, Aviation boatswain's Mate H 1 and C NAVPERS 10303-B. U. S. Office of Education, ERIC ED 082 021, 1971.

A guide for advancement of naval enlisted personnel.

3. Bureau of Naval Personnel, Equipment operator 3 and 2 NAVTRA 10640-G. Rate training manual. U. S. Office of Education, ERIC ED 082 028, 1973.

A guide for preparation of naval enlisted personnel for advancement.

4. Bureau of Naval Personnel, Gunner's mate G1 and C NAVTRA 101186-C. Rate training manual. U. S. Office of Education, ERIC ED 082 010, 1972.

A guide for preparation of naval enlisted personnel for advancement.

5. Bureau of Naval Personnel, Instrumentman 1 and C NAVTRA 101194-C. Rate training manual. ERIC ED 082 050, 1973.

A guide for preparation of naval enlisted personnel for advancement.

6. Bureau of Naval Personnel, Ship serviceman's handbook NAVPERS 101292-A. Rate training manual. U. S. Office of Education, ERIC ED 082 009, 1971.

Provides basic information describing the various ships service specialties in the Navy. They are laundryman, tailor and barber.

7. Bureau of Naval Personnel, Small arms marksmanship manual, NAVPERS 93863. U. S. Office of Education, ERIC ED 082 013, 1971.

Covers basic marksmanship as it applies to the Navy.

8. Bureau of Naval Personnel, the 3 11/50 gun NAVPERS 10110. U. S. Office of Education, ERIC ED 082 011, 1965.

Provides naval enlisted men with a self study, on the job training source, for shipboard use.

9. Carter, Samuel, Kingdom of the tides. U. S. Office of Education, ERIC ED 022 611, 1966.

A discussion of all aspects of tides. Available from Hawthorn Books Inc., 70 Fifth Avenue, New York, New York 10011.

10. Contra Costa County Department of Education, Handbook of techniques and guides for the study of the San Francisco Bay delta-estuary complex part I. Monitoring techniques for the measurement of physiochemical and biological parameters. U. S. Office of Education, ERIC ED 086 482, 1971.

A guide to help teachers and students gather data about the bay area.

11. Key, Robert E., A science teacher's handbook to Guam. U. S. Office of Education, ERIC ED 030 564, 1968.

A description of the environment of Guam including the marine environment. Also provides sources of materials. Available from Guam Science Teachers Association, P. O. B. 2872 Agana, Guam 96910

12. Morgan, David W., A handbook of estuarian life. American Biology Teacher, 34 (9): 538-9; Dec 1972.

Discusses a guide developed by Delaware Department of Public Instruction, for Chesapeake Bay. Available from the department in Dover, Delaware 19901

13. Naval Education and Training Command, Aviation boatswain's mate E 1 and C. Rate training manual. U. S. Office of Education, ERIC ED 109 344, 1974.

A guide for preparation of naval enlisted personnel for advancement.

14. Naval Education and Training Command, Engineering aid 1 and C. Rate training manual. U. S. Office of Education, ERIC ED 105 121, 1971.

A guide for preparation of naval enlisted personnel for advancement.

15. Naval Education and Training Command, Machinists mate 1 and C. Rate training manual. U. S. Office of Education, ERIC ED 106 658, 1974.

A guide for preparation of naval enlisted personnel for advancement.

Grade 2

16. Scarff, Judith M., A tour of mudflat town. U. S. Office of Education, ERIC ED 055 834, 1970.

The text serves as a supplementary second grade reading text. It describes waves, animals, algae, salinity, etc.

CHAPTER IV

Marine Conference Reports

A review of these reports provides an overview of the contemporary feelings of the time concerning the marine environment. These reports suggest the direction which marine science investigation will take in the future. They also suggest, sometimes implicitly, the direction which marine science education should take. In some cases, the state of the art in precollege marine science education was a subject of discussion.

In the final analysis, these reports may provide impetus for including

one topic over another in a course of marine science instruction.

1. Abel, Robert B., Education in marine science and technology--historical and current issues. U. S. Office of Education, ERIC ED 056 859, 1967.

   The report provides information presented at the American Association for the Advancement of Science.

2. American Biology Teacher, Marine environment symposium. American Biology Teacher, 27 (2): 117; Feb 1965.

   A report of the activities of a symposium held at Fullerton, California.

3. American Biology Teacher, Marine microrganisms. American Biology Teacher, 27 (2): 117; Feb 1965.

   A description of the activities of a conference held on the subject.

4. Brainard, Robert W., Science policy bulletin number 4. U. S. Office of Education, ERIC ED 020 145, 1968.

   Bibliographic and other information concerning science and public policy. Includes marine information. These bulletins are published bimonthly by Battelle Memorial Institute, Columbus, Ohio.

5. Commission on Marine Science, Engineering and Resources. Marine resources and legal-political arrangements for their development; volume 3, panel reports of the commission on marine science, engineering and resources. U. S. Office of Education, ERIC ED 045 439, 1969.

   The report recommends programs in all areas of marine sciences as well as discussing problems. This is a guide to U. S. marine policy. This guide is used for the advancement of the Marine Resources and Engineering Development Act of 1966.

6. Commission on Marine Sciences, Engineering and resources, industry and technology: keys to oceanic development, volume 2, panel reports of the commission on marine science, engineering and resources. U. S. Office of Education, ERIC ED 056 854, 1969.

   An assessment of the present national marine effort. The report recommends the consolidation of some of the national marine effort.

7. Commission on Marine Sciences, Engineering and Resources. Science and the environment panel reports of the commission on marine science, engineering and resources. U. S. Office of Education, ERIC ED 045 452, 1969.

Recommendations for an overall national marine program as well as reviewing the status of marine science education.

8. Congress of the United States, Effects of man's activities on the marine environment: committee on commerce, United States Senate, ninety-fourth congress, first session. Committee print. U. S. Office of Education, ERIC ED 116 934, 1975.

A discussion of national and international pollution and activities for control and abatement.

9. Council on Environmental Quality, Ocean dumping, a national policy. A report to the president prepared by the council on environmental quality. U. S. Office of Education, ERIC ED 055 891, 1970.

Lists locations, quantities, composition trends, pollution and international aspects of ocean dumping.

10. Cummings, Maynard W., University of California sea grant college program, annual report 1972-1973. September 1, 1972 to August 31, 1973. U. S. Office of Education, ERIC ED 111 646, 1974.

A summary of sea grant activities for the inclusive period.

11. Cummings, Maynard W., University of California sea grant college program, annual report 1973-1974. September 1, 1973 to August 31, 1974. U. S. Office of Education, ERIC ED 111 647, 1974.

A list of program activities for the inclusive period.

12. Higher Education, International conference on oceanography. Higher Education, 17 (1): 17-8; Sept 1960.

Describes a UNESCO sponsored international conference on oceanography.

13. International Field Studies Inc., International field studies 1973 report to the Bahamian government. U. S. Office of Education, ERIC ED 086 510, 1973.

A description of an international field studies program on Andros Island, Bahamas.

14. Knauss, John A., Marine science and the 1974 law of the sea conference. Science, 184 (4144): 1335-41; June 1974.

Reviews the present status of the law of the sea negotiations.

15. Linsky, Ronald B., Proceedings of the marine sciences in education conference. U. S. Office of Education, ERIC ED 028 098, 1968.

A discussion of the conference. The article includes information on teaching methods, curriculum, etc. conducted by the Orange County Board of Education, Santa Ana, California.

16. President's Science Advisory Committee, Effective use of the sea report of the panel on oceanography of the president's science advisory committee. U. S. Office of Education, ERIC ED 046 720, 1966.

A discussion of the marine activities of the nation and how they contribute to the national well being.

17. Subarsky, Zachariah, Seminar on marine biology. American Biology Teacher, 28 (1): 39-42; Jan 1966.

A discussion of a seminar held in Mombasa, Kenya and an oceanographic cruise. The author also includes a discussion of Smithsonian Institution's sorting center in Washington, D. C.

18. The Office of the President, The federal ocean program. U. S. Office of Education, ERIC ED 072 962, 1973.

A review of the nation's efforts to comprehend, conserve and use the sea.

19. UNESCO, Intergovernmental oceanographic commission seventh session. Summary report. U. S. Office of Education, ERIC ED 085 210, 1972.

A discussion of marine pollution, education, legal problems, data management, etc. The article makes proposals for international cooperation.

20. Weaver, Charles R., Proceedings of the conference on the changing identity of graduate earth science education. U. S. Office of Education, ERIC ED 014 627, 1965.

A discussion of the topic identified in the title; oceanographic information is included.

CHAPTER V

Marine Science

The citations in this chapter are divided into several categories. Generally, they are those listings which were found to be weighted more heavily on the side of science than on the side of methods.

The majority of the articles included here can be understood by those having the most limited of science backgrounds. However, this information is sufficient to provide the majority of teachers with all the necessary prelesson expertise. Many of these articles will serve well as the basis for instructional unit development.

Biological Literature

Fauna

A. Barnacles

High School

1. American Biology Teacher, Teeth and barnacles. American Biology Teacher, 31 (4): 260; Apr 1969.

Describes the use of the adhesive made by barnacles in filling teeth.

High School

2. Chemical and Engineering News, Organometallic polymers targeted at barnacles. Chemical and Engineering News, 53 (1): 18-9; Jan 1975.

Navy scientists suggest a group of compounds which show promise for keeping barnacles off ship hulls.

High School

3. Parkhurst, Joseph L., Barnacles in fact and fiction. American Biology Teacher, 22 (7): 433-4; Oct 1960.

Many aspects of barnacles, including the origin of the name, how the plates fit together, etc., are discussed by the author.

Grades K-8

4. Williams, Isabel, A barnacle really settles down. American Childhood, 36 (7): 60; Mar 1951.

A discussion of how barnacles feed, swim, settle, kick food into their mouths, population densities, species, places where they settle, etc.

B. Birds

Grades K-8

1. Bishop, B. F., The spotted sandpiper. American Childhood, 33 (5): 57-8; Jan 1948.

A discussion of the many aspects of the life cycle of the sandpiper.

Grades K-8

2. Chaffee, Allen, Fundy, the feathered auto-gyro. American Childhood, 35 (9): 56-7; May 1950.

A discussion of the puffins on Machias Seal Island which is in the Bay of Fundy. The male takes turns keeping the eggs warm for 36 days. The puffins nest on the ground, also have webbed feet, etc.

Grades K-8

3. Dean, Emma Nora, Beautiful sea gulls. American Childhood, 34 (1): 57; Sept 1948.

A discussion of how gulls eat garbage, nest in swamps and are gregarious.

Grades 4-12

4. Geller, Avrum, Penguins. American Biology Teacher, 28 (7): 550; Sept 1966.

A discussion of the penguin in story style.

Grades K-12

5. The Grade Teacher, The life of a sea gull--a study in elementary science. The Grade Teacher, 65 (10): 42-3; June 1948.

Several pictures of gulls, gulls' eggs and nesting on an island off Rockland, Maine.

6. Wyndham, Lee, Antarctic visitors. Instructor, 59 (8): 29; June 1950.

A descriptive story of the penguin's life.

C. Crabs

1. Bates, Helen Oliphant, Father crab goes house hunting, The Grade Teacher, 72 (10): 49; June 1955.

Describes the crab's search for a larger shell as well as the way he travels.

High School

2. Bryan, Arthur H., Conservation of the edible crabs of our coastal and inland salt waterways. American Biology Teacher, 25 (1): 36-9; Jan 1963.

The author discusses the need for conservation methods. He describes the edible and inedible species and how most people don't know the difference.

Grades K-8

3. Chaffee, Allen, Party at the seashore. American Childhood, 33 (5): 56; Jan 1948.

Discusses the hermit crab, where he lives, how he feeds, and who the preditors are.

Grades K-8

4. Dean, Emma Nora, About crabs. American Childhood, 30 (9): 51-2; May 1945.

Discusses the blue, hermit, spider and horseshoe crabs. She also includes information about the hermit's use of shells as a home, a sponge or anemone for protection and how he pulls the female around with his claw.

Grades K-6

5. Graham, Lillians, and Wackenbarth, Old habits of crabs. American Childhood, 30 (2): 53-4; Oct 1944.

Discusses the fiddler crab and another species of Florida land crab which migrates to the sea at breeding time to shed sexual products.

Grades K-8

6. Williams, Isabel, The traveling sea weed. American Childhood, 39 (1): 55; Sept 1953.

Discusses the spider crab, how he covers himself with sea weed which reflects the area in which he is feeding. The sea weed hooks to his spiney shell.

D. Eels and Fishes

Grades K-6

1. Beckhart, Lucille H., Some fish sing. American Childhood, 31 (5): 56; Jan 1946.

A discussion of the noises fish make and how some accomplish this task.

2. Beckhart, Lucille H., Queer hitch-hikers. American Childhood, 33 (5): 58; Jan 1948.

This fish spends its entire life either inside or riding on the cutside of a whale.

3. Boyar, Harold C., Swimming behavior of fishes. American Biology Teacher, 29 (6): 442-4; Sept 1967.

A discussion of fish swimming behavior, including a consideration of length vs. speed.

4. Bryan, Arthur H., Prehistoric sea monsters and the modern lamprey eel. Science Education, 50 (1): 81-2; Feb 1966.

Presents information about the eel in a geographically historic context.

5. Chaffee, Allen, Salmo the salmon. American Childhood, 38 (5): 62; Jan 1953.

A discussion of the salmon, how it lays its eggs, how embryonic fish feed, what salmon eat, and how they change color as they grow.

6. Cox, R. T., Electric fish. American Journal of Physics, 11 (1): 13-22; Feb 1943.

Some aspects in the life cycle and habitats of the electric fish are discussed.

Grades K-8

7. Dean, Emma Nora, Flying fish. American Childhood, 37 (4): 59-60; Dec 1951.

Flying fish often jump out of the water when being chased by predators.

8. Feiro, Arthur D., The counter current mechanism in biology. American Biology Teacher, 30: 130-7; Feb 1968.

An excellent treatment of fish breathing.

Grades K-8

9. Graham, and Wackerbarth, Noisey fish. American Childhood, 27 (7): 49; Mar 1942.

Fish make noises by grating their teeth together, grunting, using gill covers as sounding boards, using air bladders, etc.

Grades K-6

10. Hunt, Elsie Denean, Sammy salmon. Instructor, 62 (7): 45; Mar 1953.

Describes a salmon's return from the sea to spawn.

Grades 7-12

11. Kraft, Thomas L., and Miloy, Leatha, Let's talk about you and sharks, American Oceanography special oceanography newsletter. U. S. Office of Education, ERIC ED 052 048, 1971.

Major emphasis is upon the habits and stinging effects of sharks.

Grades 4-12

12. Olgin, Howard, Fishes that crawl on land and climb trees. American Childhood, 36 (9): 62; May 1951.

Some species of fish climb trees.

13. Phillips, Mary Geisler, The funny little stickleback. The Grade Teacher, 76 (8): 25; Apr 1959.

Some of the stickleback's behavior as well as its mating behavior are discussed.

14. Rostlund, Erhard, The evidence for the use of fish as fertilizer in aboriginal North America. The Journal of Geography, 46: 222-8; May 1957.

A discussion of fish uses in various areas.

15. Schaefer, Milner B., Fisheries productivity, School Science and Mathematics, 69 (607): 141-9; Feb 1969.

Provides information about fisheries future, food webs and trends in the fishing industry.

16. School Science and Mathematics, Trained fish. School Science and Mathematics, 49 (426): 8; Jan 1949.

The author describes a method by which fish were trained to detect industrial pollution.

High School

17. Watson, John E., Age and growth of fishes. American Biology Teacher, 29 (6) 435-8;

A discussion of the problems inherent in determining the age of fish.

E. General

1. American Biology Teacher, Marine sounds, American Biology Teacher, 28 (1): 38; Jan 1966.

A junior high school student records marine sounds.

Grades K-6

2. Attell, Adee, Trouble under the sea. The Grade Teacher, 74 (9): 25; May 1957.

Some information about salmon, shrimp, seahorses, etc. in story form.

High School

3. Bang, Frederick B., Immune reactions among marine and other invertebrates, BioScience, 23 (10): 854-9; Oct 1973.

Defense mechanisms and immune reactions found in invertebrates are considered. The author also discusses biological problems that need investigation.

Grades K-8

4. Dean, Emma Nora, Coral and its cousins. American Childhood, 26 (5): 46; Jan 1941.

A discussion of corals, where they are found and the fact that they form reefs.

Grades K-8

5. Difford, W. C., Giants of the sea. Instructor, 74 (1): 144-5; Sept 1964.

The author describes physically the conger eel, whale shark, sea turtle, meducae jellyfish, manta ray, sperm whale, and squid.

6. Fox, Robert P., Life in a New England salt marsh. American Biology Teacher, 28 (5): 369-72; May 1966.

The salt marsh is discussed as an ecosystem. The harm caused by their destruction is also discussed.

Grades K-6

7. Jahoda, William J., Our teacher, the sea. Instructor, 72 (10): 22-3; June 1963.

A photographic series of children investigating the seashore.

Grades K-6

8. Mason, Dorothy Dill, The world in a pool. Instructor, 59 (8): 28; June 1950.

A nontechnical description of the lives of some intertidal animals.

9. Mosaic, All that unplowed sea. Mosaic, 6 (3): 22-7; May/June 1975.

Hunting and gathering at sea may fast be approaching its productive limits.

High School

10. Parkhurst, Joseph L., Corners of the shore. American Biology Teacher, 20 (4): 122-4; Apr 1958.

A discussion of the sea beach at low tide and after a storm. The author also presents information about the strand line.

Grades K-6

11. Sloan, Maywill Dudley, Alfred was hungry. American Childhood, 33 (1): 52-3; Sept 1947.

A story about a hungry octopus. Other marine organisms are also mentioned.

12. Stickney, Alden P., Physiology of marine organisms and adaption to their environment. American Biology Teacher, 29 (6): 445-7; Sept 1967.

The effects of salinity upon the organism are discussed. Phascolosoma gouldii is suggested as a good organism for use in investigation of this parameter.

Grades 7-12

13. Wells, M. M. The coral reefs of the gulf coast. School Science and Mathematics, 30: 124-31; Feb 1930.

Describes the coral reef environment, including the animals that live there.

F. Plankton

High School

1. Bryan, Arthur H., The red tide. American Biology Teacher, 25 (1): 53-4; Jan 1963.

A discussion of red tides, the water conditions which are necessary and the dinoflagellates which cause the tide.

High School

2. Conger, Paul S., Lesson of the diatoms. American Biology Teacher, 18 (6): 187-93; Oct 1956.

The life cycles of marine diatoms are considered.

High School

3. Grimm, Kenneth G., and Ellis, Benson, Spotlight on diatoms. American Biology Teacher, 25 (1): 9-17; Jan 1963.

Discusses structure, uses, economic deposits, paleontology, ecology, locomotion, reproduction, etc.

4. Stephan, E. C., Discolored water. The Science Teacher, 29: 6-11; Nov 1962.

A discussion of plankton, its distribution, how blooms cause the water to look discolored, what organisms cause discoloration, and how some species are toxic to man.

G. Sea Anemones and Cucumbers

Grades K-8

1. Dean, Emma Nora, Sea and garden anemones. American Childhood, 36 (7): 58-60; Mar 1951.

How the anemone feeds (stings prey) and how food is rejected if it is not the proper food.

Grades 4-12

2. Geller, Avrum, Sea cucumbers. American Biology Teacher, 28 (7): 550-1; Sept 1951.

A description of the sea cucumber and its life in story style.

Grades K-6

3. Johnstone, Emma Jean, Sally the sea anemone. Instructor, 66 (6): 44; Feb 1957.

The sea anemone and its relatives are discussed.

H. Sea Horse

Grades K-8

1. Bernharat, Virgie, Father sea horse. American Childhood, 31 (4): 56-7; Dec 1945.

A discussion of the life cycle of the sea horses, what they feed on, how they feed and how they reproduce (father harbors the eggs in his pocket.)

Grades K-8

2. Chenault, Jennie, Some fish resemble horses. American Childhood, 38 (3): 60-1; Nov 1952.

There are about 50 species of sea horses ranging from 2-12 inches in length. They carry their babies in the father's pocket, etc.

Grades K-4

3. Foltz, Fr. ces, A sea horse story. Instructor, 64: 46; Feb 1955.

The life of the sea horse at sea, in story form.

Grades K-6

4. Van Dusen, Bernice, Gift of the sea. The Grade Teacher, 21 (10): 18; June 1954.

The male sea horse carries the eggs in his pocket until they hatch. Baby sea horses hatch as minatures of the adult.

Grades K-6

5. Waterbury, D. R., The little horse in the sea. The Grade Teacher, 77 (8): 68; Apr 1960.

A plain language description of the life of a sea horse.

I. Sea Urchins, Sand Dollars and Star Fish

1. Bryan, Arthur H., Aristotles lantern. American Biology Teacher, 17 (7): 230-1; Nov 1955.

A discussion of the structure of Aristotle's Lantern.

Grades 7-12

2. Davis, Millard C., Hands at the edge of the sea. American Biology Teacher, 25 (1): 51-2; Jan 1963.

The author describes the actions of starfish.

Grades K-8

3. Dean, Emma Nora, Sea urchins. American Childhood, 30 (5): 55; Jan 1945.

A description of the green and giant sea urchins, where they live, what they live on, and how they feed.

High School

4. Duran, John C., Sea urchin development: an investigative exercise. American Biology Teacher, 33 (9): 539-41; Dec 1971.

An injection of KCl causes urchins to extrude sexual products. Following this, egg development may be plotted.

High School

5. Parkhurst, Joseph, Nature notes. American Biology Teacher, 29 (1): 56-7; Jan 1957.

A physical description of sand dollars.

Grades K-8

6. Stubenvoll, Charlotte B., Starfish. Instructor, 68: 48; June 1959.

The stars life in the sea.

Grades 7-12

7. Wright, Robert W., Fertilization and embryology of sand dollars. American Biology Teacher, 31 (3): 184-5; Mar 1969.

Describes collection, maintenance, and methods of obtaining gametes.

J. Seals and Sea Otters

Grades 4-12

1. Allen, Nellie B., Uncle Sam's fur farm. The Grade Teacher, 53 (5): 46-7 Jan 1936.

A description of seal life, products from seals and the seal industry.

Grades 7-12

2. American Biology Teacher, California sea otter census. American Biology Teacher, 28 (7): 535; Sept 1966.

Many aspects of the otter's life cycle are discussed.

Grades K-8

3. Chaffee, Allen, Lophus, the sea lion (zalophus). American Childhood, 33 (9): 56-7; June 1948.

Many aspects in the life of a small seal are discussed. Information is included which describes predators and how seals warn each other.

Grades K-6

4. Clark, Kay, Baby seal learns to swim. The Grade Teacher, 63 (5): 22-3; Jan 1946.

A story form of a seal rookery, how seals learn to swim and some of the events in the early life of the seal.

High School

5. Jacobson, David, Operation quick find. Science Activities, 7 (3): 13-15; Apr 1972.

The use of a trained sea lion to locate and attach a retrieval device to submerged instruments and equipment.

Grades K-6

6. Kuenstler, I. Dyer, Tubby the baby seaelephant. American Childhood, 32 (1): 55; Sept 1946.

A discussion of many of the habits of seals.

High School

7. Mackenzie, W. D., Seals and their adaptions. South Australian Science Teachers Journal, 734: 18-24; Dec 1973.

Seals are discussed in terms of their classification, ecological influences, their pelage, moult, thermoregulations, respiratory and vascular systems, predation, and mortality.

Grades K-6

8. Messick, Margaret K., How Boffo grew up. American Childhood, 30 (3): 56; Nov 1944.

A seal's life from birth until it is fairly well grown; the events of his life.

Grades K-6

9. Reardon, Margaret, Blubber, the baby seal. Instructor, 67 (7): 43; Mar 1958.

A description of the first few days in the life of an Alaskan seal.

10. Sauro, Regina, The seal who did not like water. The Grade Teacher, 73 (5): 14; Jan 1956.

A description of the conditions under which seals live.

K. Shellfish

Grades 7-12

1. American Biology Teacher, Teredos. American Biology Teacher, 28 (1): 38; Jan 1966.

Teredo causes a tremendous amount of economic damage. An American zoologist is investigating a marine flatworm which eats teredo eggs.

2. Bennett, Peter, Spirals in nature. American Biology Teacher, 28 (7): 533-5; Sept 1966.

A discussion of spiral shell construction.

3. Gould, John A., Maine discovers the mussel. Down East, 22 (3): 48-51; Oct 1975.

A description of mussel aquiculture in Maine.

4. Practical Home Economics, Fish and shellfish. Practical Home Economics, 29 (2): 77; Feb 1951.

The author discusses various fish and shellfish species, their nutritive value, how to store them and prepare them.

5. O'Donnell, Mary M., Oysters, pearls of nutrition. American Biology Teacher, 3 (3): 84-7; Dec 1941.

A presentation of some historical information concerning the use of oysters as food. The article also discusses information concerning how oysters feed, spawn and age.

Flora

Grades 4-8

1. Hadley, Paul, Sea wrack. The Grade Teacher, 68 (10): 36-7; June 1951.

A description of some of the aspects of intertidal life.

2. Johnson, Duncan S., and Skutch, Alexander H., Littoral vegetation on a headland of Mt. Desert Island, Maine I. Submersible or strictly littoral vegetation. Ecology, 9:188-215; 1928.

A description of the vegetation mentioned above by genus species.

3. Johnson, Duncan S., and Spenser, Alexander H., Littoral vegetation on a headland of Mt. Desert Island, Maine II. Tide pools and the environment and classification of submersible plant communities. Ecology, 9: 307-38; 1928.

Describes the algae in tide pools of this area. Also includes an excellent bibliography.

4. Lynch, D. L. and Fenwick, M. G., Factors affecting the growth of two green algae. American Biology Teacher, 36 (8): 494-5; 1974.

The use of different media to study the growth of two different algae.

5. Malatesta, Anne, Back to the green kingdom. American Biology Teacher, 17 (3): 105-8; Mar 1958.

A discussion of the feeding of an algae population on sewage.

6. Marcus, Bernard A., A method for demonstrating algae blooms in artificial reservoirs. American Biology Teacher, 36 (9): 558-60; 1974.

Use of gallon jars and sea sediment to study algae blooms.

Food

Grades 7-12

1. American Biology Teacher, Menhaden. American Biology Teacher, 28 (1): 38; Jan 1956.

The economic value of this species is discussed, including its use in oils, drying agents, paints, varnish, animal feeds, etc.

Grades 4-6

2. Carver, Marie B., Sea food and its relation to conservation and child labor laws. Instructor, 62 (7): 48; Mar 1953.

The author describes fishing methods, laws, some aspects of bivalve life cycles, etc.

Grades K-8

3. Difford, W. C., The sea can feed us. Instructor, 74 (7): 122-3; Mar 1965.

A description of many sea organisms that are used for food.

High School

4. Dow, Robert L., The use of biological, environmental and economic data to preduct supply and to manage a selected marine resource. American Biology Teacher, 28 (1): 26-30; Jan 1966.

The article provides excellent temperature vs. catch information.

5. Practical Home Economics, The sacred cod goes to school. Practical Home Economics, 33 (5): 21; Jan 1955.

A discussion of how fish are used in school lunch programs in Massachusetts.

6. Practical Home Economics, Abundance from the sea. Practical Home Economics, 33 (7): 18-20; Mar 1955.

A discussion of the use of fish as food and the types that are available to the American public.

High School

7. Schaefer, Milner B., Fisheries productivity. School Science and Mathematics, 69 (607): 141-9; Feb 1969.

The author discusses fisheries productivity and the ocean as a source of food.

Grades 7-12

8. Stopyra, Ted V., Sea pasture. American Biology Teacher, 28 (1): 31-8; Jan 1966.

This is an excellent source of food for an expanding population. The author discusses the marine species which can be used for human food.

Physical Marine Sciences

A. Chemistry of the Sea

High School

1. Burwell, Calvin B., Desalting and nuclear energy. Physics Teacher, 9 (1): 67-74; Jan 1971.

Burwell includes methods of desalting sea water by membrane separation, distillation, and crystallization.

High School

2. Cavetli, John E., Concerning two oceans. Journal of Chemical Education, 24: 406-12; June 1947.

Contains information about the content of the sea.

3. Chave, Keith E., Chemical reactions and the composition of sea water. Journal of Chemical Education, 48 (3): 148-50; Mar 1971.

The author provides a great deal of information useful in advanced high school chemistry.

4. Chemical and Engineering News, Effects of pollutants on marine life probed. Chemical and Engineering News, 51 (51): 17-8; Dec 1973.

Research activities are being conducted to determine the longterm effects on natural marine ecosystems by heavy metals, synthetics and petroleum hydrocarbons.

Grades K-8

5. Commagere, Ruth, Salt in the sea. The Grade Teacher, 72 (2): 79; Oct 1954.

A plain language discussion of the sea's salinity.

High School

6. Corles, James T., Determination of calcium in sea water. Journal of Chemical Education, 42 (8): 421-23; Aug 1965.

A method which could be used in a high school laboratory.

High School

7. Goldberg, Edward G., The process of regulating the composition of sea water. Journal of Chemical Education, 35 (3): 116-9; Mar 1958.

The author discusses methods by which this task may be accomplished.

High School

8. Kester, Dana, Chemical processes in the ocean. Journal of Chemical Education, 49 (1): 11-4; Jan 1972.

A few aspects of the composition and physical chemistry of sea water as well as processes affecting the oxygen content of the oceans.

9. Klugh, Bfooker A., Factors controlling the biota of tide pools. Ecology, 5: 192-6; 1924.

A discussion of salinity, sunlight, temperature, etc.

10. Levenspiel, Octave, and de Nevers, Noel, the osmotic pump. Science, 183 (4121): 157-60; Jan 1974.

The principles used in an osmotic pump are used to extract fresh water from the oceans.

11. Lloyd, Stewart J., The world's greatest mine. Journal of Chemical Education, 24: 273-6; June 1947.

A description of the composition of seawater.

12. Lyman, John, Marine geochemistry. The Science Teacher, 34 (5): 27-30; May 1967.

The author describes the marine geochemical cycle between the earth and the atmosphere.

High School

13. Lyman, John, and Abel, Robert B., Chemical aspects of physical oceanography. Journal of Chemical Education, 35 (3): 113-5; Mar 1958.

A technical description of marine chemistry and composition of the sea.

High School

14. Morton, Stephen D., and Lee, Fred G., Calcium carbonate equilibria in the oceans ion pair formation. Journal of Chemical Education, 45 (6): 513-5; Aug 1968.

A description of one of the sea's chemical processes.

15. Peter, Walter G., New York Bight: a case study, part I. BioScience, 20 (10): 617-9; May 1970.

A summary of chemical analysis, pelagic studies, and benthic studies which bear on pollution in the New York Bight.

16. Stephenson, T. A., Zoond, A., Eyre, Joyce, The liberation and utilization of oxygen by the population of rock pools. Journal of Experimental Biology, 11: 162-72; 1934.

An investiagtion of three tide pools. The author discusses temperature, oxygen, hydrogen ion concentration, etc.

17. Young, Gale, Dry land and desalted water. Todays Education, 59 (5): 28-30; May 1970.

A discussion of the uses of desalted sea water, etc.

B. Currents

1. Church, P. E., Labrador current does not reach the United States coast. The Journal of Geography, 34 (9): 375-6; Dec 1935.

A discussion of evidence which indicates that the Labrador current doesn't reach the coast of Maine.

Grades K-8

2. Difford, W. C., Ocean currents. Instructor, 74 (2): 58-9; Oct 1964.

A plain language discussion of ocean currents and counter currents.

Grades K-12

3. Hermanni, Edwing, and Ritchie, Harolds, Movements of water. The Grade Teacher, 57: 51; Jan 1940.

A brief description of ocean currents. It includes simple line drawings of currents.

Grades K-8

4. Nava[illegible] John G., The oceans of the world. Instructor, 73 (1): 36-7; Sept 1963

Describes ocean currents and provides some suggestions concerning classroom activities.

Grades 7-12

5. Schuessler, Raymond, The civilizing current. The Science Teacher, 36 (6): 49; Sept 1969.

A discussion of the magnitude of the Gulf Stream.

High School

6. Shalowitz, A. L. Our changing coastline. The Journal of Geography, 39 (1): 1-10; Jan 1940.

Disappearing inlets as well as new inlets are discussed.

High School

7. Von Engeln, O. D. Wangeroog. The Journal of Geography, 32 (5): 220-222; May 1933.

A description of a marine flood which separated 3 large German islands into 29 small ones on January 16, 1362.

C. General

High School

1. Barton, Thomas Frank, Is there an antarctic ocean? The Journal of Geography, 53: 14-7; Jan 1954.

Reasons why there is no antarctic ocean are presented.

High School

2. Clarke, Georg L., Light ... limiting factor for aquatic animals and plants. American Biology ...cher, 1 (7): 150-4; Apr 1939.

Provides light a... ion/meter of light data for several areas.

Grades 4-12

3. Difford, W. C., The floor of the Atlantic Ocean. Instructor, 73 (3): 18-9; Nov 1963.

Describes the Atlantic Ocean floor.

Grades K-12

4. Difford, W. C., The floor of the Pacific Ocean. Instructor, 73 (4): 80-1; Dec 1963.

The history of the Pacific Ocean floor and its physical geography.

Grades 4-12

5. Difford, W. C., Matthew Fontaine Maury. Instructor, 73 (7): 46-7; Mar 1964.

A brief history of the foundation of oceanography in the United States.

6. Earney, Fillmore C. F., Ocean space and seabed mining. The Journal of Geography, 74 (6): 539-47; Dec 1975.

The author discusses various aspects of ocean floor mining including the legal aspects.

7. Environmental Science and Technology, Applying physics to clean energy needs. Environmental Science and Technology, 9 (2): 104-5; Feb 1975.

Solar and ocean thermal energy sources offer an environmentally clean fuel which will be able to be used by the year 2000.

8. Garstrang, Michael, Fueling of the air-sea system. School Science and Mathematics, 67 (295): 707-16; Nov 1967.

The sun's energy input to the ocean is discussed.

9. Geotimes, ERTS & EROS. Geotimes, 17 (3): 20-3; Mar 1972.

Investigations have been proposed which would be conducted with the Earth Resources Technology Satellite.

10. Harnwell, G. P., Submarine physics. American Journal of Physics, 16 (3): 127-39; Mar 1948.

The article includes information on the properties of sea water as well as the travel of sound in sea water.

11. Heitzman, William Ray, America's forgotten maritime heritage: a bicentennial treasure. Social Education, 39 (6): 400-6; Oct 1975.

An examination of the contributions of maritime enterprises to the development of America.

High School

12. Hull, E. W. Seabrook, the atom and the ocean, understanding the atom series. U. S. Office of Education, ERIC ED 042 651, 1968.

The role of atomic physics in ocean exploration. The author suggests an analysis of plankton to measure man-made radiation.

High School

13. IGY Committee, National Academy of Sciences, Earth probe analysis. The Science Teacher, 25 (8): 434-7; Dec 1958.

A discussion of the accomplishments by nations participating in the IGY.

14. Knauss, John A., Marine science and the 1974 law of the sea conference. Science, 184 (4144): 1335-41; June 1974.

The topic of discussion is what the law of the sea conference will mean to coastal nations.

Grades K-8

15. Munch, Theodore W., Earth science and oceanography. Instructor, 74 (1): 65; Jan 1965.

The author presents several physical aspects of the oceans as they relate to Earth Science.

16. Naval Undersea Center, NUC symposium on environmental preservation, 20-21 May 1970. U. S. Office of Education, ERIC ED 088 691, 1971.

A discussion of surface oil slicks and other aspects of the marine environment.

17. Osborn, Gerald, Our water supply. School Science and Mathematics, 67 (589): 200-3; Feb 1967.

Desalted seawater is an excellent source of fresh water.

18. Paterson, Arthur E., Marine pollution and the law of the sea. Bulletin of the Atomic Scientists, 31 (10): 48-50; Dec 1975.

Despite a rising tide of contamination, effective controls of marine pollution appear dubious because of conflicting national and economic interests.

19. Peter, Walter G., New York Bight: a case study, part II. BioScience, 20 (11): 669-71; Jan 1970.

Legislation previously passed to prevent pollution of the New York Bight, has not been implemented.

20. Raimist, Roger J., The oceans--an economic and geographic future of man. American Biology Teacher, 28 (1): 23-5; June 1966.

The economic reasons why the oceans are important to man's future are presented. Two of these are food and minerals.

21. Revelle, Roger, Weather, sea and ice studies in the IGY. The Science Teacher, 24 (6): 260-3; October 1957.

The goals of the IGY as well as some of the work that was accomplished are presented.

22. Rudman, Albert, The role of geophysics in new global techtonics. The Science Teacher, 36 (7): 21-6; Oct 1969.

A summary of the developments which led to the concept of the new global techtonics which attempts to explain ocean ridges, trenches and island arcs.

High School

23. Shipek, Carl J., Microrelief on the sea floor. The Science Teacher, 28: 6-13; Oct 1961.

A discussion of sea floor relief, some history of its study, methods used in its study and how it varies with water content, depth, etc.

High School

24. Thompson, Thomas G., A short history of oceanography with emphasis on the role played by chemistry. Journal of Chemical Education, 35 (3): 108-12; Mar 1958.

Excellent background information for use in advanced high school chemistry courses.

25. Wallace, Bruce, Commentary: radioactive wastes and damage to marine communities. BioScience, 24 (3): 164-7; Mar 1974.

This is a discussion of the effects of radioactive wastes on marine communities with reference to the fitness of populations and the need for studies looking for evidence of ecological change.

26. Wilson, R. D. et al., Natural marine oil seepage. Science, 184 (4139): 857-65; May 1974.

A discussion of environmental pollution problems caused by direct discharge of submarine seeps of marine oil.

D. Sand

Grades K-12

1. Hodges, Elisabeth F., Sand and sea. The Grade Teacher, 71 (10): 24-5; June 1954.

How and where sand is made, where it is found and the reasons why there are different kinds.

2. Miller, Julius Sumner, Concerning the sand at the seashore. School Science and Mathematics, 56 (492): 321; Apr 1956.

The author discusses sand, wet, dry and submerged, as well as the forces which hold it together.

E. Tides

1. Anderson, Robert G., An investigation of tides: are they related to the moon? The Science Teacher, 34 (5): 21-3; Apr 1968.

A discussion of tide generating forces, and methods of studying the tides for an entire year.

Grades K-12

2. Branley, Franklyn M., Part II: the earth-moon system. Science and Children, 9 (4): 24-8; Dec 1971.

A plain language discussion of tides, moon months, etc.

3. Bratton, Sam T., The tides: Teaching the essential facts. The Journal of Geography, 30 (7): 291-3; Oct 1931.

A good and simple description of tide generating forces.

Grades K-8

4. Difford, W. C., The tides. Instructor, 74 (3): 104-5; Nov 1964.

A discussion of tides and their effects, tidal bores and the prediction of tides.

High School

5. Hicks, Steacy C., Ocean tides. The Science Teacher, 32 (9): 11-14; Dec 1965.

A presentation of the causes of tides, variations in the tides, and predictions of tides.

6. Sandon, Frank, Tides of the British Seas. Physical Education, 10 (4): 262-6; June 1975.

An examination of the gravitational effects and the way that local conditions interact with these effects to produce tides.

7. Seligmann P., and Steinberg, M., Simple hydrodynamic treatment of ocean tides, American Journal of Physics, 43 (12): 1106-3; Dec 1975.

A nonmathematical, hydrodynamic explanation of tide action.

Grades 7-12

8. Whitney, Paul C., Some elementary facts about the tides. The Journal of Geography, 34 (3): 102-8; Mar 1935.

A discussion of the types of tides and tide generating forces.

F. Waves

1. Keith, H. D., Simplified theory of ship waves. American Journal of Physics, 25: 466-74; Oct 1957.

A discussion of wave theory.

High School

2. Mendoza, Eric, Storm location at sea--an illustration of group velocity. American Journal of Physics, 22: 208-11; Apr 1954.

Observation of the wavelength of an arriving wave train as a function of time determines the distance away from the storm center.

3. Pilkey, Orrin H., Let the lighthouse fall in. The High School Journal, 58 (6): 1-10; Oct 1974.

The author discusses shoreline changes caused by wave action.

G. Weather

1. Hamming, Edward, Conversations with earth, a human approach to the earth sciences. Science and Children, 7 (2): 37-42; Oct 1969.

A discussion of man's effects on the hydrosphere and the hydrosphere's effect on man and how these relationships effect the weather.

High School

2. Kopec, Richard J., Global climate change and the impact of a maximum sea level on coastal settlement. The Journal of Geography, 70: 541-9; Dec

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Section 2

The citations listed in this section are not annotated. The section is divided into categories in the same manner as was Section 1. There is, however, one difference in this section. The section is divided into categories only, not individual chapters and chapter categories Each entry is listed alphabetically by authors. In cases where the article was written by a journal staff author, the article is listed using the journal name in place of the author's name.

This section includes entries from one additional source not used in Section 1. The additional source, Master's Theses in Education, is an excellent source of information for those desiring to develop their own marine science programs.

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