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AUTHOR Dobert, Raymond
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ABSTRACT

This document, prepared by The Biotechnology Information Center at the National Agricultural Library, contains sources of information that can provide a starting point for teachers, university faculty, extension agents, and other education leaders who have an interest in biotechnology education and training. Sections include a bibliography of the current literature in the field of biotechnology education and training, a guide to selected print and electronic resources, an author index, and a subject index. The citations included in the bibliography were drawn from the Agricola and ERIC databases. (JRH)

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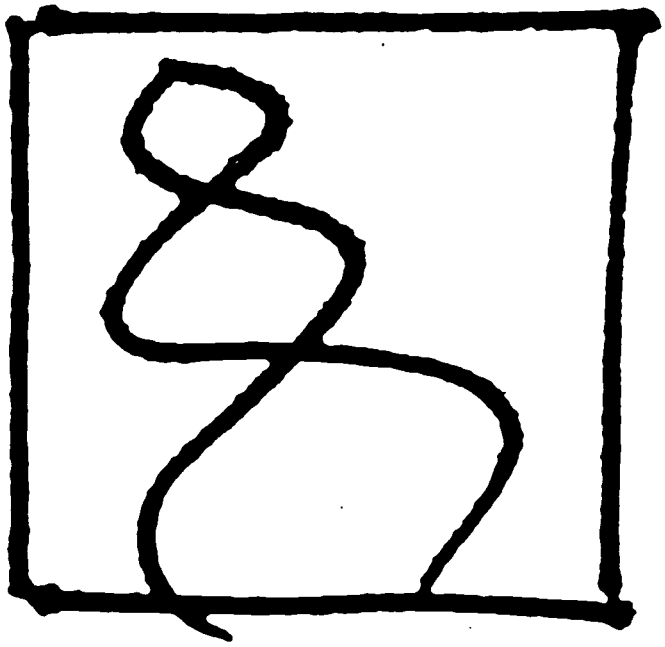
Biotechnology: Education and Training

SRB 96-08

Special Reference Briefs Series



Biotechnology: Education and Training

Special Reference Briefs Series no. SRB 96-08
(updates SRB 92-05)

Compiled By:
Raymond Dobert
Biotechnology Information Center
National Agricultural Library
Agricultural Research Service
U.S. Department of Agriculture

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BIOTECHNOLOGY: EDUCATION AND TRAINING

For many Americans, the promise or threat of biotechnology remains in the realm of science-fiction. As biofoods and other products developed using the tools of modern biotechnology begin entering the marketplace in large numbers, the questions about biotechnology will move out of the labs and meeting rooms into the produce aisle, giving consumers the power to make choices about biotechnology-derived foods. While actual knowledge of what biotechnology or genetic engineering is remains extremely low, consumers will need objective information and educational opportunities to help them form individual opinions about the "biotech" products available.

New food and agriculture products derived using the tools of biotechnology are the result of a great deal of research and development. The expansion of biotechnology as an industry will lead to the development of new jobs which require new skills. Thus, training a skilled workforce will be important for the future of biotechnology in the food and agricultural sectors.

To facilitate these processes, The Biotechnology Information Center at the National Agricultural Library has prepared this Special Reference Brief (SRB) in Biotechnology Education and Training. The sources of information found in this guide should provide a good starting point for teachers, university faculty, extension agents, and other education leaders who have an interest in biotechnology education and training.

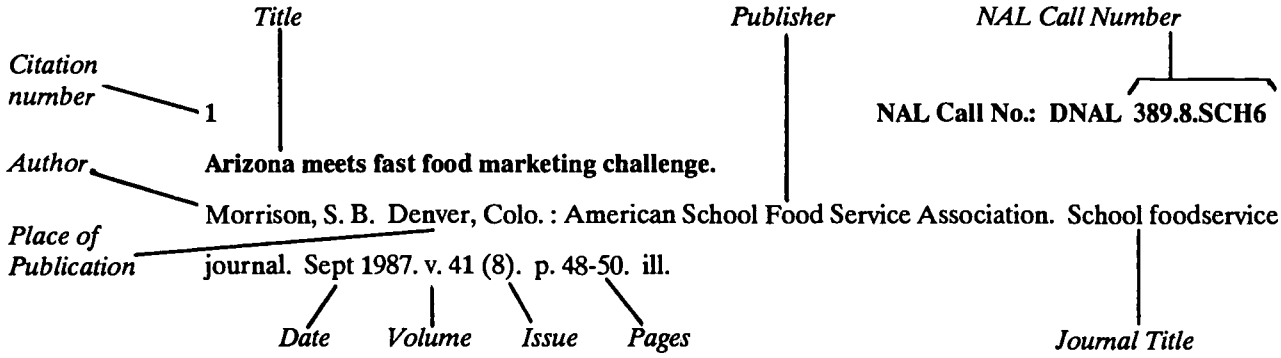
The publication has several main sections, a bibliography of the current literature in the field of biotechnology education and training; a guide to selected print and electronic resources; a author index and a subject index. The citations included in the bibliography were drawn from the Agricola and ERIC databases. For most citations an NAL call number has been included, those items not in the NAL collection have "N/A" for not available in the call number field.

INDEX

SAMPLE CITATIONS

Citations in this bibliography are from the National Agricultural Library's AGRICOLA database. An explanation of sample journal, book, and audiovisual citations appears below.

Journal Article:



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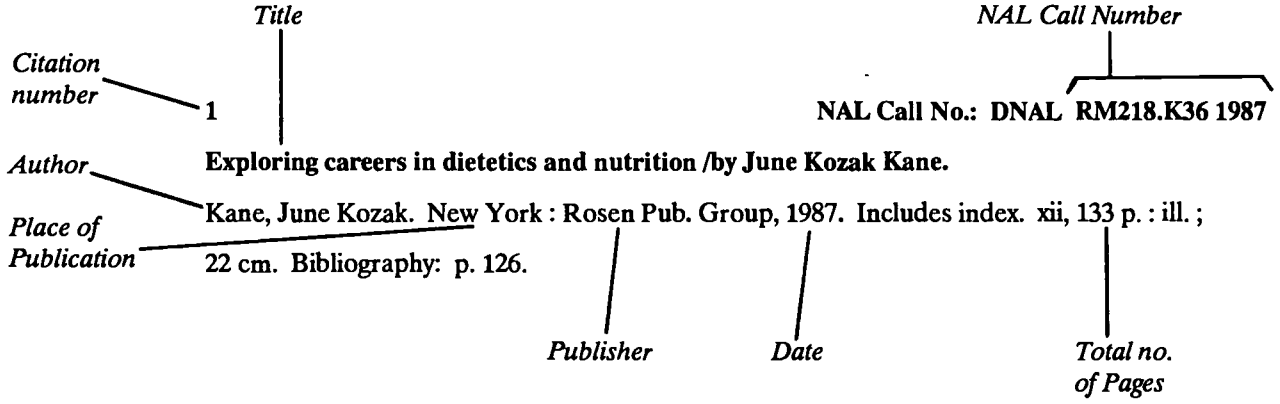

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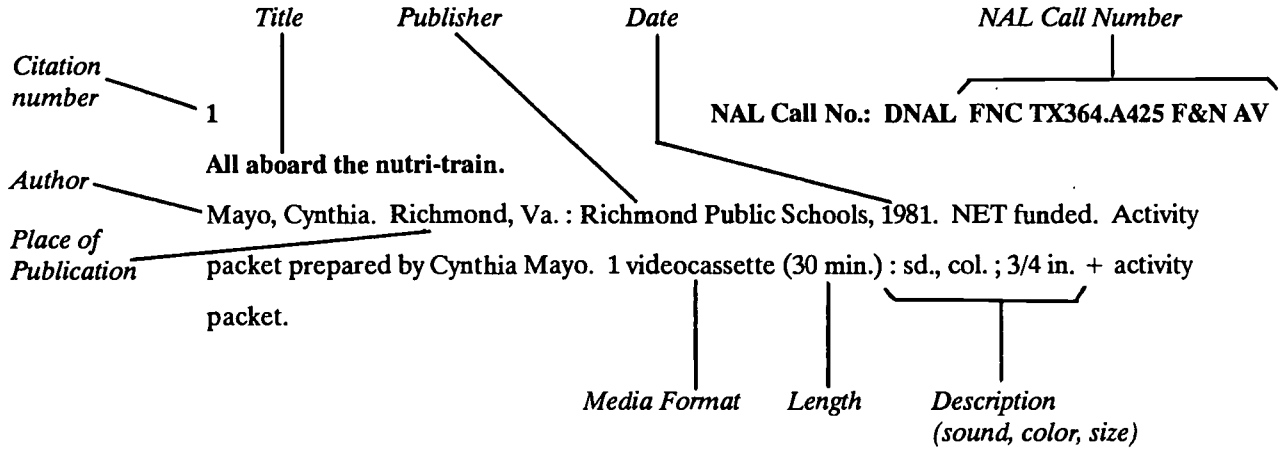

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Dr. Smith Faculty Ag School
Canadian Journal of Soil Science 1988 v 68(1): 17-27
De Jong, R. Comparison of two soil-water models under semi-arid growing conditions
Ver: AGRICOLA Remarks: Not available at AU or in region.
NAL Call Number: 56.8 C162 Auth: Charles Johnson CCL Maxcost $15.00
Ariel IP = 111.222.333.444.555 or Fax to 123-456-7890

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Biotechnology: Education and Training

1 NAL Call No.: 275.8-AG8
Agricultural education: First twenty-five years of the third millennium.
Powers, L.; Walson, F. *Agric-Educ-Mag* v.63(12): p.9-11. (1991 June)
Includes references.
Descriptors: agricultural-education; biotechnology-; teacher-training; curriculum-; program-development; educational-planning; educational-resources; leadership-; public-schools; usa-; teacher-in-service

2 NAL Call No.: HD1773.A5U8
Agriculture and education--partners in progress.
Bentley, O. G. *Ushering in the twenty first century : emphasis on the rural South / editor, Thomas T. Williams. Tuskegee, Ala. : Tuskegee University* p.31-35 (1987)
Papers presented at the 44th Professional Agricultural Workers Conference, December 7-9, 1986, at Tuskegee University, Tuskegee, Alabama.
Descriptors: agricultural-education; agricultural-colleges; small-farms; biotechnology-; usda-; extension-activities; usa-

3 NAL Call No.: 275.8-AG8
Agriscience and technology: the answer to program revitalization.
Luft, V. D.; Peterson, D. *Agric-Educ-Mag* v.61(8): p.13-14. ill. (1989 Feb.)
Descriptors: agricultural-education; vocational-training; biotechnology-; technology-transfers; educational-planning; north-dakota

4 NAL Call No.: 275.8-AG8
Agriscience: good for students or just a charade.
Gliem, J. A. *Agric-Educ-Mag* v.64(4): p.11-12, 23. (1991 Oct.)
Includes references.
Descriptors: agricultural-education; curriculum-; biotechnology-; physics-; mathematics-

5 NAL Call No.: N/A
Algae, electronics and ginger beer: explorations in biotechnology at the governor's school.
Wells, J.; And Others *TIES: Technology, Innovation, and Entrepreneurship for Students* v.4(4): p.27-32 (1992 Mar.-1992 Apr.)
TIES Magazine, Philadelphia, PA
Descriptors: Biology; Microbiology; Problem Solving; Science Education; Science Projects; Secondary Education; Student Projects; Summer Science Programs; Technology; Algae; Technology Education

Abstract: Describes a variety of projects that were used in a summer program for gifted high school students to help teach biotechnical concepts and applications. Presents six projects utilizing algae as tool for solving problems. Also presents five production-oriented projects with hydroponics and fermentation as research and development themes.

6 NAL Call No.: N/A
All about amber.
Lundberg, D. *Science Teacher* v.60(3): p.20-23 (1993 Mar.)
Descriptors: Biology; Dinosaurs; DNA; Entomology; Genetic Engineering; Geology; High Schools; Minerals; Paleontology; Science Education; Scientific Concepts; Scientific Literacy; Amber

Abstract: Describes amber and its hardened form called copal. Explains how amber is formed and where it comes from. Discusses possibilities of obtaining DNA from insects caught in amber.

7 NAL Call No.: Z7994.L3A5
Alternatives to and reduction of animal use in biomedical research, education and testing.
Frazier, J. M.; Goldberg, A. M. *ATLA,-Altern-lab-anim. Nottingham : Fund for the Replacement of Animals in Medical Experiments.* v.18 p.65-74 (1990 Nov.)
Includes references.
Descriptors: animal-testing-alternatives; toxicity-

Special Reference Brief

Abstract: Biomedical endeavors can be divided into three major categories: research, education, and testing. Within the context of each of these categories, activities involving whole animals have made major contributions and will continue to do so in the future. However, with technological developments in the areas of biotechnology and computers, new methods are already reducing the use of whole animals in certain areas. This article discusses the general issues of alternatives and then focuses on the development of new approaches to toxicity testing.

8 **NAL Call No.: QH442.G452**
AMA tells physicians to boost agriculture biotechnology.
Genet-Eng-Lett. Washington, D.C. : Gershon W. Fishbein. Mar 24, 1991. v. 11 (6) p. 1.
Descriptors: consumer-education; food-safety; genetic-engineering; food-biotechnology; usa-; american-medical-association

9 **NAL Call No.: 1.9-P69P**
Appropriate education for plant pathologists planning to work in developing countries.
Thurston, H. D. *Plant-Dis* v.72(9): p.741. (1988 Sept.)
Descriptors: plant-pathology; education-; biotechnology-; technology-transfers; ecosystems-; tropics-; small-farms; farming-systems; cultural-environment; developing-countries

10 **NAL Call No.: N/A**
Beginning plant biotechnology laboratories using fast plants.
Williams, M. (Wisconsin Fast Plants, Madison, WI , 1990)
74p.
Descriptors: Agricultural Education; Biology; Environmental Education; Environmental Influences; Higher Education; Laboratory Experiments; Photosynthesis; Plant Growth; Plants (Botany); Science Activities; Science Education; Science Experiments; Secondary Education; Worksheets; Fast Plants; Germination; Life Cycles; Seeds

11 **NAL Call No.: QD415 A1B53**
Biochemical education in leisure.
Tayyab, S. *Biochemical Education* v.22(1): p.21-23 (1994 Jan.)
Descriptors: Biochemistry; Educational Games; Higher Education; Molecular Biology; Science Education; Science Instruction; Teaching Methods

Abstract: Presents two alternative teaching approaches to ensure that students become active participants of learning in the biochemistry classroom. Diagrams and rules are provided for using educational playing cards and creating a biochemical comic book.

12 **NAL Call No.: QD415 A1B53**
Biochemistry is a difficult subject for both student and teacher.
Wood, E. J. *Biochemical Education* v.18(4): p.170-172 (1990 Oct.)
Descriptors: Biochemistry; Higher Education; Instructional Improvement; Molecular Biology; Science Education; Science Instruction; Science Teachers; Scientific Concepts; Teaching Methods

Abstract: Offers suggestions to aid the biochemistry and molecular biology teacher in enhancing student understanding of a subject that borrows from many other areas of study as well as its own.

13 **NAL Call No.: QH634.5.C37-1992**
Biosynthesis and the integration of cell metabolism.
Cartledge, T. G.; Jenkins, R. O.; Leach, C. K.; Weston, G. D.; Open Universiteit (Heerlen, N. Oxford ; Boston : Butterworth-Heinemann, 1992. x, 252 p. : ill., Includes index.
Descriptors: Biosynthesis-Study-and-teaching; Cell-metabolism-Study-and-teaching

14 NAL Call No.: N/A
Biotechniques.
Armour, S.; Fall, R. *Science Teacher* v.59(8): p.46-49 (1992 Nov.)
Descriptors: Biological Sciences; Biotechnology; Enzymes; Science Activities; Science and Society; Science Education; Science Experiments; Science Instruction; Secondary Education; Secondary School Science; Secondary School Teachers; Teaching Methods; Detergents

Abstract: Biotechnology has arrived in the supermarket in the form of genetically engineered enzymes. Presents an activity in which students explore the presence of protease enzymes in laundry detergents.

15 NAL Call No.: TX341.J6
Biotechnology and food safety: dietetic professionals' views on bovine somatotropin.
Dobbins, M. J.; Gates, G.; Hughes, K.; Holdt, C.; Spain, J.; Slusher, B. *J-nutr-educ* v.26(2): p.69-73. (1994 Mar.-1994 Apr.)
Includes references.
Descriptors: food-safety; somatotropin-; biotechnology-; dietary-surveys; pesticides-; consumer-attitudes; men-; women-

Abstract: Some consumer advocates oppose the use of bovine somatotropin (BST), a hormone that can be produced through biotechnology, to increase milk production. The purpose of this study was to assess dietetic professionals' awareness of and attitudes about biotechnology and BST. A questionnaire was mailed to 1192 members of the Missouri Dietetic Association; 517 surveys were returned. Respondents agreed that, when used correctly, additives and pesticides enhance food quality and food production; however, most respondents indicated that they did not know if BST should be approved or if the approval of BST would make milk unsafe to drink. Most respondents indicated that they would tell clients that they did not know whether they should recommend or discourage the purchase of milk from cows treated with BST. Most felt that biotechnology should be controlled and that milk from BST-treated cows should be labeled. Almost all respondents indicated that they would like more information about biotechnology and food. The results of this study indicate that dietetic professionals need more education on biotechnology and BST in order to respond to consumer concerns.

16 NAL Call No.: 500-M663
Biotechnology and its future: implications for school and careers.
Frey, J.; Cronn, J. *J-Minn-Acad-Sci* v.53(1): p.40-42. (1987 Fall)
Paper presented at "Biotechnology and Our Future: a Conference on the Revolution in Biology," April 29-30, 1987.
Descriptors: biotechnology-; universities-; students-; education-; career-development; minnesota-; university-of-minnesota

17 NAL Call No.: S544.3.N7S3
Biotechnology and local economic development: biotechnology transfer extension program.
St-Lawrence-Cty-Agric-News. Canton, N.Y. : Agricultural Division, St. Lawrence County Cooperative Extension Association. v.73(8): p.12-13 (1989 Aug.)
Descriptors: biotechnology-; cooperative-extension-service; diffusion-of-information; new-york

18 NAL Call No.: N/A
Biotechnology and the food industry.
Henderson, J.; And Others *Journal of Biological Education* v.25(2): p.95-102 (1991 Summer)
Descriptors: Bacteria; Bakery Industry; Biology; Enzymes; Food; Genetic Engineering; Higher Education; Industry; Resource Materials; Science Activities; Science Education; Secondary Education; Teaching Methods; Technological Advancement; Technology; Biotechnology; Dairy Industry

Abstract: Traditional and novel uses of enzymes and microbes in the baking, brewing, and dairy industries are described. Cheese, yogurt, baking,

brewing, vinegar, soy sauce, single-cell proteins, enzymes, food modification, vanilla, citric acid, monosodium glutamate, xanthan gum, aspartame, and cochineal are discussed. Industrial links with firms involved in food biotechnology are considered and suggestions are made for suitable teaching approaches.

19 **NAL Call No.: 500-AM322A**
Biotechnology and the small farm.
DuPuis, E. M.; Geisler, C. *BioScience-Am-Inst-Biol-Sci* v.38(6): p.406-411. ill. (1988 June)
Includes references.
Descriptors: dairy-cows; growth-promoters; genetic-engineering; biotechnology-; green-revolution; technology-transfers; rural-economy; rural- sociology; education-; institutional-administration; small-farms; bovine-growth-hormone

20 **NAL Call No.: QR41.2.C7-1989**
Biotechnology--applied microbiology textbook. Biotechnologie--Lehrbuch der angewandten Mikrobiologie. 3., neu bearb. Aufl. Biotechnologie--Lehrbuch der angewandten Mikrobiologie.
Crueger, W.; Crueger, A. Munchen : Oldenbourg, 1989. xvi, 342 p. : ill., Includes bibliographical references.
Descriptors: Microbiology-Study-and-teaching; Biotechnology-Study-and-teaching

21 **NAL Call No.: N/A**
Biotechnology--biotechnical systems.
Ruggles, S. *TIES Magazine* p.20-21,45 (1990 Sept.-1990 Oct.)
Descriptors: Curriculum Development; Decision Making; Elementary School Science; Elementary Secondary Education; Environmental Education; Problem Solving; Science Activities; Science and Society; Science Education; Secondary School Science; Technology; Biotechnology

Abstract: The perspective of biotechnology and its development in the K-12 technology education curriculum are described. The content curriculum development and implications for activities are discussed. The difference between a curriculum focused on the activities of industry compared to one that addresses technology as it pervades all human endeavors is described.

22 **NAL Call No.: N/A**
Biotechnology career education: educational technology imperative for the 21st century.
Tomal, D. R. *Technology Teacher* v.52(1): p.7-9 (1992 Sept.-1992 Oct.)
Descriptors: Career Education; Emerging Occupations; Genetic Engineering; Occupational Information; Quality of Life; Biotechnology; Technology Education

Abstract: Biotechnology, the study and application of engineering and science to improve the quality of life, can be an integral part of technology education. Numerous project ideas exist to expose students to the career possibilities of this field.

23 **NAL Call No.: Videocassette--no.1773**
Biotechnology : careers for the 21st century.
Pfizer Inc. Central Research Division. Reston, Va. : Distributed by National Association of Biology Teachers, c1992. 1 videocassette (14 min.) : sd., col. with b&w sequences.
Descriptors: Biotechnology-Vocational-guidance

24 **NAL Call No.: 389.8-F7398**
BIOTECHNOLOGY: Consumer concerns about risks and values.
Busch, L. *Food-Technol* v.45(4): p.96, 98, 100-101. (1991 Apr.)
Includes references.
Descriptors: biotechnology-; consumer-protection; food-technology; health-hazards; consumer-education; food-beliefs; food-processing; nutritive-value; standards-

Abstract: Many scientists would argue that the new food technologies now under development promise

many benefits with few consequential risks associated with problems of food spoilage or adulteration, such as Salmonella poisoning, and note that we now have the safest, most secure food supply in the world.

25 **NAL Call No.: N/A**
Biotechnology: economic and behavioral considerations.
McGhan, W. F.; Beardsley, R. S. *American Journal of Pharmaceutical Education* v.54(1): p.71-72 (1990 Spring)
Descriptors: Administration; Biomedicine; Cost Effectiveness; Ethics; Health Education; Health Occupations; Higher Education; Needs Assessment; Pharmaceutical Education; Technological Advancement; Biotechnology

Abstract: The paper reviews factors related to effects of biotechnology on the discipline of pharmacy administration including needs assessment, diffusion of technology, cost benefit analysis, marketing, cost containment, patient education and compliance, ethics, and health professions training.

26 **NAL Call No.: TP248.2.B546**
Biotechnology education. (Pergamon Press, Oxford, UK ; Elmsford, NY, USA, 1989)
Title from cover.
Descriptors: Biotechnology-Study-and-teaching-Periodicals

27 **NAL Call No.: aS21.D27S64**
Biotechnology: education.
Airozo, D.; Warmbrodt, R. D. *Spec-Ref-Briefs-Natl-Agric-Libr-U-S. Beltsville, Md. : The Library.* p.29 (1992 Feb.)
(92-05) Bibliography.
Descriptors: biotechnology-; education-; textbooks-; training-; secondary-education; universities-; agriculture-; medicine-; microbiology-; mycology-; pharmacology-; plant-breeding; veterinary-science; bibliographies-

28 **NAL Call No.: TP248.22.B54-1992**
Biotechnology education inventory : representative activities nationwide.
Association of Biotechnology Companies (U.S.). Education Committee. Washington, DC : The Association, 105 p., "Winter 1993."
Descriptors: Biotechnology-Study-and-teaching-United-States

29 **NAL Call No.: TP248.65.F66Z55--1994**
Biotechnology & food : leader and participant guide. Biotechnology and food, leader and participant guide.
Zinnen, T. M.; Voichick, J.; Biotechnology and Food Videoconference (1994)]. [Madison, Wis.] : University of Wisconsin--Extension, Cooperative Extension, [1994] 73 p. : ill., Cover title.
Descriptors: Food-Biotechnology; Food-Study-and-teaching

30 **NAL Call No.: 275.28-J82**
Biotechnology: implications for Extension.
Hoban, T. J. *J-Ext. Madison, Wis. : Extension Journal.* v.27p.20-21 (1989 Fall)
Includes references.
Descriptors: biotechnology-; cooperative-extension-service; information-dissemination; educational-programs; roles-

31 **NAL Call No.: N/A**
Biotechnology in agriculture. Teacher edition.
Peterson, D. R.; Rehberger, T. (Mid-America Vocational Curriculum Consortium, Stillwater, Okla., U.S. Oklahoma, 1991)
318p.
Descriptors: Agricultural Education; Agricultural Engineering; Agricultural Production; Animal Husbandry; Biology; Botany; Classroom Techniques; Course Content; Educational Resources; Field Crops; Genetic Engineering; Learning Activities; Learning Modules; Lesson Plans; Postsecondary Education; Secondary Education; Teaching Methods; Technological Advancement; Units of Study; Zoology; Biotechnology

Special Reference Brief

Abstract: This curriculum guide is designed to help teachers to present a course that emphasizes the interrelationship of science and technology and the impact of this technology on agriculture and agricultural products. The guide contains six units that each contain some or all of the following basic components of a unit of instruction: objective sheet, suggested activities for the teacher, answers to assignment sheets, written test and answers, unit evaluation form, teacher supplements, transparency masters, information sheets, assignment sheets, student supplements, job sheets, and laboratory sheets.

32 **NAL Call No.: QH1 A43**
Biotechnology in the high school biology curriculum: the future is here.
Zeller, M. F. *American Biology Teacher* v.56(8): p.460-64 (1994 Nov.-1994 Dec.)
Descriptors: Biology; Biotechnology; High Schools; Science Curriculum; Science Education; Science Instruction; Surveys; Measurement Instruments

Abstract: Describes the development and use of a survey instrument designed to make available information regarding the perceptions that teachers have as to the appropriate content areas in biotechnology for a high school biology curriculum and the instructional methods that would best convey this information.

33 **NAL Call No.: QH1 A43**
Biotechnology in the high school classroom.
Ahmed, M. *American Biology Teacher* v.58(3): p.178-80 (1996 Mar.)
Descriptors: Biology; Biotechnology; DNA; Genetics; Science Curriculum; Science Instruction; Scientific Concepts; Scientific Methodology; Secondary Education

Abstract: Describes a project that introduces students to the field of biotechnology and provides them with an understanding of the basic principles and techniques as well as an opportunity to participate in experimental methodology. Presents specific science projects that deal with polymorphism in the lipase gene and the genetic engineering of a lipase gene.

34 **NAL Call No.: 275.28-J82**
Biotechnology is in our future.
Reiners, N. M.; Roth, D. *J-Ext. Madison, Wis. : Extension Journal.* v.27 p.19-20 (1989 Fall)
Includes references.
Descriptors: biotechnology-; risks-; safety-; information-sources; cooperative-extension-service; educational-programs

35 **NAL Call No.: QH1 A43**
Biotechnology outlines for classroom use.
Paolella, M. J. *American Biology Teacher* v.53(2): p.98-101 (1991 Feb.)
Descriptors: Biology; Biotechnology; Course Descriptions; Definitions; Enzymes; Genetic Engineering; Genetics; Higher Education; High Schools; Lesson Plans; Science Activities; Science Curriculum; Science Education; Science Experiments; Science History; Science Instruction; Secondary School Science

Abstract: Presents a course outline for the study of biotechnology at the high school or college level. The outline includes definitions, a history, and the vocabulary of biotechnology. Presents a science experiment to analyze the effects of restriction enzymes on DNA.

36 **NAL Call No.: TP248.14.B573**
Biotechnology : science, education, and commercialization : an international symposium, University of Florida, Gainesville, Florida, December 3-6, 1989.
Vasil, I. K.; University of Florida. Biotechnology Institute for Technology Transfer. New York : Elsevier, c1990. viii, 309 p. : ill., Includes bibliographical references.
Descriptors: Biotechnology-Congresses

37 NAL Call No.: Videocassette--no.1871
Biotechnology : the choice for your future.
Biotechnology Industry Organization. Washington, D.C. : The Organization, [1992?] 1 videocassette (9 min., 18 sec.) : sd., col. 1 resource guide + 1 brochure..
Descriptors: Biotechnology-Vocational-guidance

Abstract: Describes various career opportunities available in the field of biotechnology.

38 NAL Call No.: Q183 U6J68
Breaking the genetic code in a letter by Max Delbruck.
Fox, M. *Journal of College Science Teaching* v.15(5): p.324-25 (1996 Mar.-1996 Apr.)
Descriptors: Biology; Coding; DNA; Genetics; Heredity; Higher Education; Science Activities; Science History; Science Instruction

Abstract: Describes a classroom exercise that uses a letter from Max Delbruck to George Beadle to stimulate interest in the mechanics of a nonoverlapping comma-free code. Enables students to participate in the rich history of molecular biology and illustrates to them that scientists and science can be fun.

39 NAL Call No.: S605.5.A43
Can agricultural colleges meet the needs of sustainable agriculture.
Lacy, W. B. *Am-J-altern-agric. Greenbelt, MD : Henry A. Wallace Institute for Alternative Agriculture.* v.8(1): p.40-45 (1993)
Includes references.
Descriptors: agricultural-colleges; sustainability-; agricultural-education; extension-; biotechnology-

Abstract: As concern about the long-term viability of our food and fiber system has grown, many agricultural research administrators, prominent scientists and policymakers have focused increasing attention on the important research and educational needs in sustainable agriculture. Colleges of agriculture should be important in meeting the challenges of sustainable agriculture; a central question is whether they are adequate for the task. This paper highlights several individual and institutional constraints that limit the ability of these colleges to address the needs: 1) assumptions and biases regarding the relationship between humans and nature, and the concept of progress, 2) the demographic characteristics, education, and experience of research scientists, 3) the specialized departmental organization of research institutions; 4) imbalances among analyses on the molecular, cell, organism and ecosystem levels; 5) emphasis on farm level analysis and technology development; 6) new agricultural biotechnologies that may overemphasize short-term, narrow technical considerations and proprietary products; 7) compartmentalization of education by discipline, and the limited informal and field experiences for students; 8) the background and education of current Extension Service agents, 9) the emphasis on economic effects in research impact assessments, to the neglect of environmental effects and social consequences for farmers, rural communities and society at large; 10) limited capability for comprehensive public policy analysis. Despite these limitations, new research agendas and college programs are effectively addressing many needs of sustainable agriculture systems. To be more successful, these efforts must be broad-based and sensitive to a wide range of issues, and must include all participants in the system.

40 NAL Call No.: S544.N6
Careers in biotechnology.
Webber, G. D. *North-Cent-reg-ext-publ. East Lansing, Mich. : Cooperative Extension Service.* v.483p.6 (1994 Mar.)
In the subseries: Biotechnology Information Series. Iowa State University, Office of Biotechnology
Descriptors: biotechnology-; career-choice; careers-; career-education

41 NAL Call No.: 275.8-AG8
Changing the curriculum: Will it ever end.
King, D. R. *Agric-Educ-Mag* v.63(11): p.18-19. (1991 May)
Descriptors: agricultural-education; secondary-education; curriculum-; biotechnology-;

environmental-education; international-trade

42 NAL Call No.: N/A
Cloning--maximize your mediums.
Cook, R. C. *Science Teacher* v.60(8): p.42-45 (1993 Nov.)
Descriptors: Biology; Biotechnology; High Schools; Plant Propagation; Plants (Botany); Science Activities; Science Education; Science Experiments; Science Instruction; Science Materials; Scientific Concepts; Teaching Methods; Cloning

Abstract: Describes an easy and inexpensive method of preparing experimental growth media that high school students can use for plant cloning investigations.

43 NAL Call No.: 10-OU8
Communication between scientists and consumers.
Harlander, S. K. *Outlook-Agric. Oxon : C.A.B. International.* v.20(2): p.73-77 (1991 June)
Includes references.
Descriptors: agricultural-production; biotechnology-; food-production; food-supply; food-safety; macroeconomics-; communication-; consumer- education; scientists-

44 NAL Call No.: N/A
Computer graphics and metaphorical elaboration for learning science concepts.
ChanLin, L.-J.; Chan, K.-C. (1996 Feb.)
14p.; Paper presented at the Annual Meeting of the Association for Educational Communication and Technology (Indianapolis, IN, February 12-16, 1996).
Descriptors: Animation; Biotechnology; College Students; Computer Graphics; Concept Formation; Educational Media; Foreign Countries; Higher Education; Instructional Effectiveness; Instructional Material Evaluation; Learning Motivation; Learning Processes; Metaphors; Multimedia Instruction; Student Attitudes; Verbal Stimuli; Visual Aids; Visual Stimuli; Design Research; Instructional Materials Motivation Scale; Mental Imagery; Metaphorical Thought; Semantic Features; Visual Displays; Visual Imagery

Abstract: This study explores the instructional impact of using computer multimedia to integrate metaphorical verbal information into graphical representations of biotechnology concepts. The combination of text and graphics into a single metaphor makes concepts dual-coded, and therefore more comprehensible and memorable for the student. Visual stimuli help the learner establish semantic connections between the abstract and the concrete, and it is hoped that metaphoric stimuli can facilitate analogical links between the unfamiliar and the familiar. In this study, six versions of instructional materials were developed: non-graphics without metaphors (control group), static graphics without metaphors, animated graphics without metaphors, non-graphics with metaphors, static graphics with metaphors, and animated graphics with metaphors. Participating college students (n=120) were randomly assigned into the six groups and studied the materials independently. A criterion-referenced test was used to assess students' learning performance, while the Instructional Material Motivation Survey (IMMS) was used to gather attitudinal responses. Interviews and observations yielded information about how students employed graphics and metaphors for mental elaboration. Quantitative results suggested that animated graphics plus metaphorical treatment enhanced motivation the most, although metaphorical treatment seemed to be received positively regardless of what accompanied it. Furthermore, the results of the interviews and observations shed light on, among other things, how students process and interpret graphical displays and how the pace of animated presentations influences learning. As a sample of the metaphorical technique, an appendix offers a series of sequential drawings and accompanying verbal information that depict strands of genetic materials as "screwed zippers."

45 NAL Call No.: HT401.S68
Concern about eating genetically engineered food.
Israel, G. D.; Hoban; T.J. *South-Rural-Sociol-J-South-Rural-Sociol-Assoc-South-Assoc-Agric-Sci* v.9(1): p.23-43. (1992)
Includes references.
Descriptors: meat-; milk-products; food-safety; risk-; consumer-attitudes; food-production; genetic-engineering; food-technology; consumer-information; beliefs-; moral-values; academic-achievement; women-; consumer-surveys; household-income; regional-surveys; florida-; north- carolina; educational-attainment

Abstract: Concern about eating genetically engineered food is explored for a sample of residents from Florida and North Carolina. Previous research on consumers' food safety concerns and perceived risk associated with food production suggests that concern about genetically engineered food is influenced by three factors. Concern is influenced by how well informed consumers are about food technology, their capacity to understand that information, and the compatibility of genetic engineering with consumers' moral beliefs. Utilizing logistic regression, women and persons who viewed genetic engineering to be morally wrong were found to have greater concern about eating genetically engineered foods. Awareness and educational attainment also decreased concern among North Carolina residents. For the Florida sample, awareness had no effect on concern, and education decreased concern for only one of two types of food. Although addressing concerns based on moral beliefs may be problematic, efforts to better inform consumers, especially women, might reduce their concern.

46 NAL Call No.: QH1 A43
Considering plants.
Flannery, M. C. *American Biology Teacher* v.53(5): p.306-09 (1991 May)
Descriptors: Biology; College Science; Discovery Processes; Ecology; Genetics; Higher Education; Plant Growth; Plants (Botany); Research; Resource Materials; Science Education; Secondary Education; Secondary School Science; Weeds; Molecular Biology

Abstract: Examples from research that incorporate plants to illustrate biological principles are presented. Topics include dried pea shape, homeotic genes, gene transcription in plants that are touched or wounded, production of grasslands, seaweed defenses, migrating plants, camouflage, and family rivalry. (KR)

47 NAL Call No.: TX341.F662
The Consultative Group on International Agriculture Research--goals, accomplishments, and current activities.
Plucknett, D. L.; Horne, M. E. *Food-Rev-Int* v.6(1): p.67-89. (1990)
Literature review.
Descriptors: agricultural-research; international-organizations; research-institutes; objectives-; biological-techniques; physical-properties; social-sciences; training-; biotechnology-; literature-reviews; developing-countries

48 NAL Call No.: 49-J82
Consumer concerns about modern technology in agriculture: considerations for undergraduate and graduate teaching.
Weber, G. M.; Hoban, T. J.; Kendall, P. A.; Bull, L. S. *J-anim-sci* v.73(9): p.2727-2732. (1995 Sept.)
Presented at a symposium titled "Animal Agriculture's Image: Issue of Concern to Society" at the ASAS 85th Annu. Mtg., Spokane, WA.
Descriptors: agricultural-education; biotechnology-; universities-; public-opinion; consumer-attitudes

Abstract: A number of events over the last several decades have sensitized society to the possible negative impacts of technology. The majority of our population is one or more generations removed from direct experience on farms and ranches. Thus, few individuals are aware of the dramatic changes that have occurred in agriculture. Since the establishment of the land-grant university system,

agriculture in the United States has changed from a system employing 10 million farmers and farm workers each feeding five people to a system in which 2.1 million farmers feed more than 100 people each and support exports of more than $35 billion annually. There are perceptions, as well as survey data, indicating society is concerned about the use and impacts of technology in the food and agriculture system. Survey data indicate 87% of people disagreed that "economic growth is more important than environmental protection." In addition, the survey data indicate society is concerned about how technology is used and who decides which applications are to be pursued. More than 8 out of 10 people (85%) surveyed believed "citizens deserve a greater role in decisions about science and technology." There seems to be concern regarding the use of technology and resultant impacts on the environment, food safety, animal well-being, and the size and numbers of farms in the United States. Education, both formal and informal, is the key to helping the public make informed decisions regarding the role of science and technology in the food and agriculture system. The colleges of agriculture need to carefully evaluate their research, teaching, and extension portfolios to "rediscover" their mission. The "new" mission must be viewed by. adapt teaching programs to meet the changing expectations of society and of the food and agriculture system as we enter a new era for agriculture and a new century.

49 **NAL Call No.: 389.8-F7398**
Consumer concerns and educational strategies: focus on biotechnology.
Bruhn, C. M. *Food-Technol* v.46(3): p.80, 95, 97. (1992 Mar.)
This record corrects IND 92001478 which was entered incorrectly under call number 389.8 AM34.
Descriptors: biotechnology-; food-safety; consumer-attitudes; consumer-protection; consumer-education; environmental-protection; california-

Abstract: Abstract: Surveys and workshops emphasize that education is the key to public understanding and proper evaluation of biotechnology.

50 **NAL Call No.: -FNC 389.8-AM34**
Consumer concerns and educational strategies: focus on biotechnology.
Bruhn, C. M. *J-Am-Diet-Assoc* v.92(4): p.80, 95, 97. (1992 Apr.)
Includes references.
Descriptors: biotechnology-; food-safety; consumer-attitudes; consumer-protection; consumer-education; environmental-protection; california-

Abstract: Surveys and workshops emphasize that education is the key to public understanding and proper evaluation of biotechnology.

51 **NAL Call No.: 100-C12CAG**
Cooperative extension at 75: people investigating in California's future.
Beall, G. A. *Calif-Agric* v.43(3): p.4-11. (1989 May-1989 June)
Descriptors: cooperative-extension-service; information-services; research-projects; biotechnology-; educational-programs; policy-; natural-resources; farming-systems; integrated-pest-management; california-; land-grant-colleges

52 **NAL Call No.: Q183 U6J68**
Cooperative learning in introductory cell and molecular biology.
Posner, H. B.; Markstein, J. A. *Journal of College Science Teaching* v.23(4): p.231-33 (1994 Feb.)
Descriptors: Asian Americans; Blacks; College Science; Cooperative Learning; Cytology; Higher Education; Hispanic Americans; Molecular Biology; Science Education; Science Instruction; Teaching Methods; Minority Education

Abstract: Discusses a pilot study conducted to determine whether cooperative learning had a beneficial effect on the academic performance of minority students and subsequent enrollments in the elective courses in biochemistry and molecular biology. Minority students average GPA increased from 2.13 (n=39) to 2.96 (n=17). Enrollment in

aforementioned courses increased from one minority student to eight.

53 NAL Call No.: 166.2-N47
Cooperatives in changing environment focus on marketing, equity, research.
Gill, K. *Farmer-Coop-U-S-Dep-Agric-Agric-Coop-Serv* v.53(2): p.20-21. ill. (1985 May)
Descriptors: cooperatives-; structural-change; agribusiness-; integration-; biotechnology-; agricultural-research; market-competition; communication- skills; educational-programs; usa-

54 NAL Call No.: N/A
A course in immobilized enzyme and cell technology.
Lee, W. E. I. *Chemical Engineering Education* v.25(2): p.82-86 (1991 Spring)
Descriptors: Chemical Engineering; Course Content; Course Descriptions; Curriculum Development; Cytology; Elective Courses; Engineering Education; Higher Education; Instructional Materials; Undergraduate Students; Biotechnology

Abstract: Describes an undergraduate course in chemical engineering that details the technology of immobilized enzymes and cells. Includes the course rationale and purpose; the course outline when offered as an engineering elective in the biotechnology area; and discussion of appropriate text, selected real-world applications, and laboratory presentations. (42 references) (JJK)

55 NAL Call No.: TX537.C74--1994
Creating informed citizens for tomorrow's food safety decisions : teacher's manual : middle/junior high school food safety curriculum.
Wilken, K.; Colorado State University. Cooperative Extension Service. [Fort Collins, CO] : Colorado State University, Cooperative Extension, [1994] 1 v. (various pagings) : ill. 1 booklet., Title on booklet: Final report.
Descriptors: Food-Microbiology-Study-and-teaching; Food-Contamination-Study-and-teaching; Food-adulteration-and-inspection-Study-and-teaching; Radiation-preservation-of-food-Study-and-teaching; curricula-; teaching-materials

56 NAL Call No.: L11 E38
Designing an authentic assessment.
Schnitzer, S. *Educational Leadership* v.50(7): p.32-35 (1993 Apr.)
Descriptors: Biology; Cooperative Learning; Decision Making; High Schools; Models; Science Tests; Thinking Skills; Aurora Public Schools CO; Authentic Assessment

Abstract: Describes the development of an authentic assessment model identifying 14 complex thinking processes. Two teachers designed a task allowing high school students to demonstrate their biotechnological knowledge and simultaneously deploy a complex thinking process (decision making). This model required students to synthesize and integrate what they had learned and justify the resulting decision to others.

57 NAL Call No.: 80-Ac82
The development of courses for plant tissue culture education.
Cassells, A. C. *Acta-hortic* (350): p.255-263. (1993 Nov.)
Paper presented at the "First International Symposium on Education and Training in Horticulture," July 13-17, 1992, Auchincruive, United Kingdom.
Descriptors: educational-courses; training-; agricultural-education; northern-ireland; developing-countries; plant-tissue-culture

58 NAL Call No.: QH1 A43
Economic matrices for electrophoresis of dyes or dna: examples of culinary biotechnology.
Santiago-Blay, J. A.; Battaion, S. *American Biology Teacher* v.57(1): p.40-41 (1995 Jan.)
Descriptors: Biotechnology; DNA; Science Education; Science Experiments; Secondary Education; Electrophoresis

Abstract: Describes an inexpensive replacement for the gel matrix, agarose, to aid teachers in reducing the cost of supplies needed to perform gel electrophoresis experiments.

59 NAL Call No.: S530.J6
Educating the next generation of plant breeders: challenges of integrating plant biotechnology.
Lee, M.; Brinkman, M. J.; Veldboom, L. R.; Su, G. Q.; Freymark, P. J.; Lee, D. *J-Agron-Educ* v.19(2): p.219-222. (1990 Fall)
Includes references.
Descriptors: agricultural-education; plant-breeding; integrated-systems; biotechnology-

60 NAL Call No.: HD9999.B443E8515
Education and information: the Japanese experience.
Mori, Y. *Industrial biotechnology in Europe : issues for public policy / edited by Duncan Davies* p.58-64. (1986 Winter)
Descriptors: biotechnology-; technical-progress; information-retrieval; research-; educational-programs; national-expenditure; japan-

61 NAL Call No.: TP248.2.R56
Education for biotechnology.
Rinard, B. F. B. F. 43p. (Center for Occupational Research and Development, Waco, Tex., 1986) map
Descriptors: Biotechnology-Study-and-teaching; Biotechnology-Curricula

62 NAL Call No.: QK725.C37
Educational services for plant tissue culture.
Bottino, P. J. *Cell culture and somatic cell genetics of plants* v.1 p.13-17 (1984)
edited by Indra K. Vasil. Orlando, Fla. : Academic Press. Includes references.
Descriptors: plants-; tissue-culture; education-

63 NAL Call No.: N/A
The emerging significance of biotechnology for the study of international relations.
Wiegele, T. C. *International Studies Notes* v.15(3): p.98-103,97 (1990 Fall)
Descriptors: Agriculture; Court Litigation; Developed Nations; Developing Nations; Ecology; Futures (of Society); Higher Education; International Law; International Relations; International Studies; International Trade; Policy Formation; Political Issues; Political Science; Research and Development; Science and Society; Theory Practice Relationship; Biological Warfare; Biotechnology; International Systems

Abstract: Considers biotechnology's influence on international relations, focusing on agriculture, environmental issues, law, commerce, and biological warfare. Claims that, because biotechnology cuts across international boundaries and affects pubic and private interests, it necessitates the rethinking of international systems theory. Urges international relations scholars to examine the political implications of the current scientific, intellectual revolution.

64 NAL Call No.: QD1.A45
Encouraging research, development, and commercialization in agricultural biotechnology.
Young, A. L.; Jones, D. D.; Staton, J. C. *ACS-symp-ser* (551): p.497-508. (1994)
In the series analytic: Natural and engineered pest management agents / edited by P.A. Hedin, J.J. Menn, and R.M. Hollingworth.
Descriptors: biotechnology-; agriculture-; usda-; technology-transfer; regulations-; property-protection; patents-; consumer-education

Abstract: The applications of biotechnology to agriculture are growing at a significant rate throughout the world. With the application of any new technology, there often arise concerns about possible economic and societal effects. In the case of agricultural biotechnology, these concerns

Biotechnology: Education and Training

65 NAL Call No.: HD1755.H86
Enhancing public participation in rural development.
Farrell, K. R. *Human resources development in rural America : myth or reality* p.108-112 (1986) editor, Thomas T. Williams. Tuskegee, Ala. : Tuskegee University, Human Resources Development Center
Descriptors: rural-development; government-; public-investment; participation-; agricultural-policy; decentralization-; technical-progress; biotechnology-; research-; educational-institutions; usa-

66 NAL Call No.: N/A
Establishing a taxonometric structure for the study of biotechnology in secondary school technology education.
Wells, J. G. *Journal of Technology Education* v.6(1): (1994 Fall)
Descriptors: Biotechnology; Classification; Curriculum Development; Secondary Education; Technology Education

Abstract: A Delphi panel of 19 experts identified 8 main knowledge areas of biotechnology: bioprocessing, foundations, genetic engineering, agriculture, biochemistry, medicine, environment, and bioethics. Round 2 elicited 84 subdivisions and round 3 adjusted the ratings. The resulting classification suggests a different context and focus for technology education students than for pure science, medicine, and so forth

67 NAL Call No.: BJ59.B87--1993
Ethics : the next generation or, moral education in the technoscientific enterprise.
Burkhardt, J. 1.; Texas A & M University. Center for Biotechnology Policy and Ethics. College Station, Tex. : Center for Biotechnology Policy and Ethics, Texas A & M University, [1993] 21 p., "December 1993."
Descriptors: Technology-Moral-and-ethical-aspects

68 NAL Call No.: HD9999.B443E85--1993
Europe at work : labour and training in the biotechnology small firm sector : a report for the COMETT II programme.
Hayward, S. S.; Griffin, M. M. 1.; UK Interest Group on Education in Biotechnology. [Nottingham] : UK Interest Group for Education in Biotechnology, c1993. xiii, 104 p. : ill., maps, On cover: The Biochemical Society, BEMET, Nottingham Trent University, European Federation of Biotechnology.
Descriptors: Biotechnology-industries-Europe-Statistics

69 NAL Call No.: TP248.195.E85E97--1994
European compendium of higher education courses in biotechnology : a guide to courses in biotechnology across Western Europe for undergraduate and postgraduate students.
Griffin, M.; Biotechnology in Europe Manpower, E. a. T. P. London : UK Interest Group for Education in Biotechnology ; Nottingham NG : Produced and distributed by BEMET, [1994?] 104 p. : At head of title: BEMET (Biotechnology in Europe Manpower, Education and Training).
Descriptors: Biotechnology-Study-and-teaching-Higher-Europe

70 NAL Call No.: HD9000.1.J6
Farmer acceptance of biotechnology and marketing strategies: implications for agribusiness from surveys in western Canada.
Klein, K. K.; Hobbs, J. E.; Kerr, W. A. *J-int-food-agribus-mark* v.6(1): p.71-88. (1994)
Includes references.
Descriptors: biotechnology-; farmers'-attitudes; growth-promoters; constraints-; agribusiness-; innovation-adoption; farm-surveys; information-services; extension-agents; market-planning; canada-; socio-economic-constraints

71 NAL Call No.: TP248.185.U48-1991
FDA biotechnology inspection guide : reference materials and training aids.

United States. Food and Drug Administration. [Rockville, Md.?] : U.S. Dept. of Health and Human Services, Public Health Service, Food and Drug Administration, [1991] 48 p. : ill., "November 1991."
Descriptors: Biotechnology-United-States-Evaluation-Handbooks,-manuals,-etc

72 **NAL Call No.: 275.8-AG8**
Food for thought.
Kotrlik, J. W.; Parton, G.; Borne, C. *Agric-Educ-Mag* v.59(3): p.9-10. ill. (1986 Sept.)
Descriptors: agricultural-education; vocational-training; technology-; innovations-; biotechnology-

73 **NAL Call No.: QH1 A43**
Genetic engineering--a lesson on bioethics for the classroom.
Armstrong, K.; Weber, K. *American Biology Teacher* v.53(5): p.294-97 (1991 May)
Descriptors: Academic Achievement; Bioethics; Biology; Cognitive Development; Controversial Issues (Course Content); Critical Thinking; Debate; Decision Making; Ethics; Genetic Engineering; Genetics; Pretests Posttests; Questionnaires; Science Activities; Science Curriculum; Science Education; Secondary Education; Secondary School Science; Student Attitudes; Teaching Methods

Abstract: A unit designed to cover the topic of genetic engineering and its ethical considerations is presented. Students are expected to learn the material while using a debate format. A list of objectives for the unit, the debate format, and the results from an opinion questionnaire are described.

74 **NAL Call No.: QH1 A43**
Genetic transformation of bacteria.
Moss, R. *American Biology Teacher* v.53(3): p.179-80 (1991 Mar.)
Descriptors: Bacteria; College Science; DNA; Genetic Engineering; Genetics; Heredity; Higher Education; Laboratory Procedures; Microbiology; Science Activities; Science Education; Secondary Education; Secondary School Science; Teaching Methods

Abstract: An activity in which students transform an ampicillin-sensitive strain of E. coli with a plasmid containing a gene for ampicillin resistance is described. The procedure for the preparation of competent cells and the transformation of competent E. coli is provided.

75 **NAL Call No.: QH1 A43**
Getting DNA into a cell: a survey of transformation methods.
Karcher, S. J. *American Biology Teacher* v.56(1): p.14-20 (1994 Jan.)
Descriptors: Biotechnology; Genetic Engineering; Genetics; High Schools; Learning Activities; Science Education; Science Instruction; Scientific Concepts; Secondary School Science; Bioengineering

76 **NAL Call No.: SB950.2 A1J58**
Grassroots strategies for confronting biotechnology.
Hassanein, N. *Journal of Pesticide Reform* v.13(3): p.12-14 (1993 Fall)
Descriptors: Activism; Biotechnology; Community Action; Community Education; Environmental Education; Genetic Engineering; Moral Values; Action Plans; Environmental Health; Environmental Issues

Abstract: Describes strategies used by the Biotechnology Working Group during their efforts to influence state and local policy concerning biotechnology issues. Strategies address methods for framing the issue, educating self and others, recruiting allies, and developing citizen pressure.

77 **NAL Call No.: S1.A375**
High tech in agriculture [Plant and animal biotechnological research, genetic manipulation of microorganisms, Canadian higher education].
Le Roux, E. J. *Agrologist* v.13(2): p.6-7. ill. (1984 Spring)
Descriptors: Canada-

78 NAL Call No.: BJ52.5.J68
Impact of education on the attitudes of college students toward biotechnology.
Sterling, L. G.; Halbrendt, C. K.; Kitto, S. L. *J-Agric-Environ-Ethics* v.6(1): p.75-88. (1993)
Includes references.
Descriptors: agricultural-education; biotechnology-; college-students; usa-

79 NAL Call No.: 41.8-AM3
Implications of biotechnology, risk assessment, and communications for the safety of foods of animal origin.
Acuff, G. R.; Albanese, R. A.; Batt, C. A.; Berndt, D. L.; Byers, F. M.; Dale, B. E.; Denton, J. H.; Fuchs, R. L.; Gastel, B.; Heidelbaugh, N. D. *J-Am-Vet-Med-Assoc* v.199(12): p.1714-1721. (1991 Dec.)
Includes references.
Descriptors: food-safety; biotechnology-; risk-; consumer-education

80 NAL Call No.: QH583.I53
Infrastructure and activities of cells.
Open Universiteit (Heerlen, N. Oxford : Butterworth-Heinemann, 1991. x, 266 p. : ill., "Published on behalf of: Open universiteit and Thames Polytechnic."
Descriptors: Cells-Study-and-teaching; Cells-Morphology-Study-and-teaching; Cells-Motility-Study-and-teaching; Cell-interaction-Study-and-teaching; Cell-physiology-Study-and-teaching

81 NAL Call No.: S530 A4
Inservice education needs of teachers of pilot agriscience courses in Mississippi.
Newman, M. E.; Johnson, D. M. *Journal of Agricultural Education* v.35(1): p.54-60 (1994)
Descriptors: Agricultural Education; Educational Needs; High Schools; Inservice Teacher Education; Pilot Projects; Agricultural Sciences; Mississippi

Abstract: Most of the 31 (of 39) teachers of pilot agriscience courses surveyed considered themselves competent and thought the units were important. Most pressing inservice needs were in the areas of biotechnology, computers, and mechanical/physical technology. Teachers perceived a lack of instructional materials for these and other less traditional areas, such as aquaculture, entomology, and environmental sciences.

82 NAL Call No.: N/A
Integrating a biotechnology program into the postsecondary curriculum.
Tomal, D. R. *Journal of Technology Studies* v.19(1): p.33-39 (1993 Winter-1994 Spring)
Descriptors: Biotechnology; Curriculum Development; Educational Benefits; Educational Technology; Fused Curriculum; Postsecondary Education; Tables (Data)

Abstract: Integrating a program of biotechnology into the curriculum can help increase student enrollment, stimulate interest, and add educational value and diversity to a school. The program can be a stand-alone program, an independent research study, or a module to be included as part of existing technical courses.

83 NAL Call No.: N/A
Introducing applications of biotechnology to high school students.
Wise, D. L.; And Others *Chemical Engineering Education* v.24(3): p.158-62 (1990 Summer)
Descriptors: Biochemistry; Biological Sciences; Biomedicine; Chemistry; Course Descriptions; High Schools; Science and Society; Science Education; Secondary Education; Secondary School Science; Technological Advancement; Technology; Biotechnology

Abstract: The need to give high school students a more pragmatic grasp and understanding of technology, in addition to guidance concerning their career paths, is discussed. Described are the design, initiation, methods, topics and evaluation of this exploratory program. Recommendations for future implementation of similar programs are provided.

Special Reference Brief

84 NAL Call No.: HD101.S6
Introducing foods produced using biotechnology: the case of bovine somatotropin.
McGuirk, A. M.; Preston, W. P.; Jones, G. M. *South-J-Agric-Econ-South-Agric-Econ-Assoc* v.24(1): p.209-223. (1992 July)
Includes references.
Descriptors: somatotropin-; milk-consumption; demand-; consumer-attitudes; household-surveys; biotechnology-; demography-; case-studies; virginia-

Abstract: A mailed questionnaire was used to assess consumer concerns and potential consumption response attributable to the introduction of bovine somatotropin (bST). Responses from 605 households in Virginia are described and analyzed. Logit models were estimated to identify which issues shape consumers' decisions to alter milk purchases contingent on the introduction of bST and to determine whether socioeconomic characteristics explain consumers' attitudes toward these issues. Estimates based on survey responses point toward sizable reductions in fluid milk purchases if bST is introduced. Large retail price reductions are predicted to be insufficient to offset these estimated decreases. Consumer education and marketing strategies are discussed.

85 NAL Call No.: TP248.22.I57--1990
An Introduction to biotechnology. Biotechnology education.
Biotechnology Education Project. St. Louis, Mo. : Mathematics and Science Education Center, [1990-1992?] 3 v. : ill., Cover title: Biotechnology education. [v. 1.] The nature of change : unit for sixth grade students -- [v. 2.] a junior high unit -- [v. 3.] unit for secondary students.
Descriptors: Biotechnology-Study-and-teaching

86 NAL Call No.: QH1 A43
An introduction to dna fingerprinting.
Hepfer, C. E.; And Others *American Biology Teacher* v.55(4): p.216-21 (1993 Apr.)
Descriptors: Biotechnology; College Science; DNA; Genetics; Higher Education; High Schools; Learning Activities; Science Activities; Science Education; Science Experiments; Science Instruction; Scientific Concepts; Secondary School Science; Teaching Methods; DNA Fingerprinting

87 NAL Call No.: QH1 A43
Isolation and characterization of plasmid from E.coli.
Schmidt, K.; Davis, L. C. *American Biology Teacher* v.56(7): p.424-28 (1994 Oct.)
Descriptors: Bacteria; Biology; Biotechnology; Genetics; High Schools; Science Activities; Science Education; Escherichia Coli; Plasmids

88 NAL Call No.: SB319.2.F6F56
A laboratory exercise for teaching tissue culture technique using Cyperus alternifolius as a source of explants.
Mohamed Yasseen, Y.; Davenport, T. L.; Splittstoesser, W. E.; Litz, R. E. *Proc-annu-meet-Fla-State-Hort-Soc. [S.l.]* v.105 p.215-217 (1993 May)
Meeting held November 3-5, 1992, Tampa, Florida.
Descriptors: cyperus-alternifolius; tissue-culture; teaching-; organogenesis-; explants-; totipotency-

89 NAL Call No.: SB1.H6
A laboratory exercise to demonstrate adventitious shoot formation using stem internodes of parrot-feather.
Kane, M. E.; McConnell, D. B.; Sheehan, T. J.; Dehgan, B. *Hortscience* v.23(2): p.408. ill. (1988 Apr.)
Includes references.
Descriptors: teaching-materials; laboratory-methods; tissue-culture; shoots-; growth-; myriophyllum-aquaticum; stems-; internodes-

90 NAL Call No.: 281.28-R88
Land-grant university-industry relationships in biotechnology: a comparison with the non-land-

grant research universities.
Curry, J.; Kenney, M. *Rural-Sociol* v.55(1): p.44-57. (1990 Spring)
Includes references.
Descriptors: biotechnology-; agricultural-colleges; industry-; research-institutes; universities-; college-programs; educational-resources; funds-; usa-

Abstract: The results of a 1986 survey of 185 biotechnology faculty in the land-grant colleges of agriculture are presented. Comparisons are made to a previous survey of biotechnology faculty in nonagricultural research universities. The survey investigates issues raised by industrial involvement in university biotechnology research and the impact of the new biosciences on the agricultural colleges. It was found that college of agriculture biotechnologists have more recently received their highest degrees, show more industrial involvement, and are more positive about the possible benefits of that involvement than their nonagricultural university counterparts. Industrial funding proved to be a significant exogenous variable affecting the activities and attitudes of agricultural college biotechnology faculty. Those with higher levels of industrial funding appear to have lower university productivity.

91 **NAL Call No.: 280.8-J822**
Low-input/sustainable agricultural research and education: challenges to the agricultural economics profession.
Madden, P. *Am-J-Agric-Econ* v.70(5): p.1167-1172. (1988 Dec.)
Includes references.
Descriptors: farm-inputs; alternative-farming; sustained-yield-management; research-; educational-programs; agricultural-economics; biotechnology-; biological-control; farm-management; trends-; usa-

92 **NAL Call No.: HD9999.B443E8552--1992**
Manpower and training needs for biotechnology in north and south Europe in the '90s : the report of a meeting organised by the COMETT II UETP BEMET held at the Technological Park of Galicia, Spain on 18-19 September 1992.
Griffin, M. M. 1.; Hayward, S. S.; Curtis, J.; UK Interest Group on Education in Biotechnology. Nottingham : UK Interest Group for Education in Biotechnology, [1992?] 65 p. : ill., At head of title: BEMET (Biotechnology in Europe Manpower, Education and Training).
Descriptors: Biotechnology-industries-Employees-Training-of-Europe

93 **NAL Call No.: QK745.P55**
Multiplication of Cyperus alternifolius from Axillary Buds in vitro: Instructive Laboratory Exercises.
Mohamed Yasseen, Y.; Splittstoesser, W. E. *Q-PGRSA* v.20(2): p.83-89. (1992 Apr.-1992 June)
Includes references.
Descriptors: cyperus-alternifolius; buds-; tissue-culture; organogenesis-; laboratory-methods; teaching-methods

94 **NAL Call No.: Videocassette--no.1980**
National Biotechnology Summit : town meeting : toward a scientifically educated America : how can America prepare for the biotechnology revolution. Town meeting.
BioConferences International, I. Bethesda, MD : BioConferences International, c1993. 1 videocassette (ca. 87 min.) : sd., col.. "S03.".
Descriptors: Biotechnology-Study-and-teaching-Congresses/ Biotechnology-Forecasting-Congresses

Abstract: Six speakers discuss the role of education in biotechnology. Topics covered include how to communicate with the public about biotechnology, the education programs offered by the North Carolina Biotechnology Center, and the future of medical research and agricultural biotechnology.

95 **NAL Call No.: 41.8-V641**
New horizons for veterinary medicine: Can the educators respond.
Soulsby, E. J. L. *Vet-Rec* v.119(13): p.327-334. (1986 Sept.)
Includes references.

Descriptors: veterinary-education; veterinary-medicine; teachers-; veterinary-schools; animal-welfare; genetic-engineering; united-kingdom

96 **NAL Call No.: S544.N6**
A new technological revolution: How will agriculture adjust.
Phillips, M. J.; Sundquist, W. B. *North-Cent-Reg-Ext-Publ-Mich-State-Univ-Coop-Ext-Serv* (266): p.6-10. (1987 June)
In the series analytic: Policy choices for a changing agriculture / edited by A.L. Frederick and D.R. Henderson.
Descriptors: biotechnology-; agricultural-development; innovation-adoption; educational-programs; usa-

97 **NAL Call No.: QH1 A43**
Nucleic acids as information molecules.
McInerney, J. D. *American Biology Teacher* v.58(1): p.44-45 (1996 Jan.)
Descriptors: Biochemistry; Biology; DNA; Genetics; Higher Education; Molecular Biology; Nucleic Acids; RNA; Science Activities; Scientific Concepts

Abstract: Presents an activity that aims at enabling students to recognize that DNA and RNA are information molecules whose function is to store, copy, and make available the information in biological systems, without feeling overwhelmed by the specialized vocabulary and the minutia of the central dogma.

98 **NAL Call No.: TX341.B75**
Nutrition education through consumer magazines. 2.
McNutt, K. *B-N-F-Nutr-Bull-Br-Nutr-Found* v.18(68): p.125-129. (1993 May)
Includes references.
Descriptors: nutrition-education; nutrition-information; periodicals-; consumer-education; consumer-behavior; health-education; trends-; animal- welfare; food-industry; food-biotechnology; men-; women-; usa-; women's-health

Abstract: The purpose of this two-part series regarding North American consumer magazine coverage on nutrition and food-related health articles is to help UK readers understand some of the reasons why some consumers do and other consumers don't believe advertising claims for food products and advice from health professionals. Part 1 was a retrospective summary of how, in 1992, journalists presented the latest biomedical research, food labelling issues and advances in food technology. Part 2 now takes a more prospective approach to the business and health education value of keeping in tune with consumers by knowing what magazines are telling their readers.

99 **NAL Call No.: QH1.S5**
Off-the-shelf bugs hungrily gobble our nastiest pollutants.
Snyder, J. D. *Smithsonian* v.24(1): p.67-70,72,74,76 (1993 Apr.)
Descriptors: Bacteria; Environmental Education; Genetic Engineering; Microbiology; Poisons; Public Education; Solid Wastes; Waste Disposal; Environmental Problems; Environmental Protection; Oil Spills; Pollutants

Abstract: Describes the historical development of the use of microbes to solve environmental problems such as oil spill clean-up and animal waste disposal.

100 **NAL Call No.: BIC Working Tool**
The Ohio Science Workbook: Biotechnology.
Reames, S. E. C. (Ohio Academy of Science, Columbus., Ohio, 1993)
241p. National Science Foundation, Washington, D.C.
Descriptors: Biochemistry; Biology; Biotechnology; Cytology; DNA; Environmental Education; Enzymes; Genetic Engineering; Genetics; High Schools; Laboratory Manuals; Laboratory Procedures; Physiology; Plants (Botany); Science Activities; Science Experiments; Science Projects; Secondary School Science; Hands on Science; Protein

Abstract: Because of the daily impact of biotechnology, it is important that students have some knowledge and experience with biotechnology in order to enable them to deal with the issues that arise as a result of its implementation. The purpose of this workbook is to assist in the efforts to expose students to the concepts of biotechnology through hands-on project activities. The projects in this book represent ideas that may be used as a starting point for a student project.

101 **NAL Call No.: TP248.2.B772--1994**
Opportunities in biotechnology careers.
Brown, S. S.; Hall, J. Lincolnwood, Ill. : VGM Career Horizons, 1994. xii, 148 p., Includes bibliographical references. What is biotechnology? -- Current developments in biotechnology -- Biotechnology career profiles -- Nonscientific careers in biotechnology -- Employment opportunities in biotechnology -- Educational preparation -- Attributes of a successful biotechnologist -- Strategies for finding the right job.
Descriptors: Biotechnology-Vocational-guidance

102 **NAL Call No.: 56.8-SO39**
Pedotechnology--soil genetic engineering: how and why soil scientists should be involved.
Fanning, D. S. *Soil-Surv-Horiz* v.31(2): p.29-32. (1990 Summer)
A written version of a seminar presented to the University of Maryland, and environs, Pedology, Soil Mineralogy, Soil Chemistry Research Group on February 17, 1989.
Descriptors: soil-science; soil-formation; pedology-; soil-types-anthropogenic; soil-parent-materials; time-; climate-; soil-biology; relief-; agricultural-education; training-; soil-pedogenic-effects

103 **NAL Call No.: S494.5 B563T36 1991**
Plant biotech lab manual.
Tant, C. (Biotech Publishing, Angleton, TX, 1993) 92p.; Illustrated by Tammy K. Crask.
Descriptors: Biotechnology; Botany; Higher Education; Plants (Botany); Science Activities; Science Experiments; Science Instruction; Secondary Education

104 **NAL Call No.: S530.J6**
A plant biotechnology course for distance delivery.
Ferguson, N. H.; Adams, P. E.; Franklin, R. E. *J-Nat-Resour-Life-Sci-Educ* v.21(2): p.133-136. (1992 Fall)
Includes references.
Descriptors: agricultural-education; biotechnology-; video-cameras; audiovisual-aids; continuing-education; south-carolina

105 **NAL Call No.: QK710.P63**
Plant molecular biology and biotechnology at UNESCO.
Vasil, I. K. *Plant-mol-biol-report* v.13(3): p.227-231. (1995 Sept.)
Descriptors: plant-breeding; molecular-biology; biotechnology-; educational-programs; educational-institutions; united-nations-educational,-scientific-and-cultural-organization; biotechnology-action-council

106 **NAL Call No.: 80-Ac82**
Plant tissue culture education at Krakow Agricultural University.
Bach, A. *Acta-hortic* (350): p.313-316. (1993 Nov.)
Paper presented at the "First International Symposium on Education and Training in Horticulture," July 13-17, 1992, Auchincruive, United Kingdom.
Descriptors: agricultural-education; training-; plant-tissue-culture

107 **NAL Call No.: N/A**
Plasmid instability in batch cultures of recombinant bacteria. A laboratory experiment.
Bentley, W. E.; Kompala, D. S. *Chemical Engineering Education* v.24(3): p.168-72 (1990 Summer)
Descriptors: Bacteria; Biological Sciences; College

Science; Cooperative Learning; Higher Education; Laboratory Procedures; Monera; Problem Solving; Science Activities; Science Education; Technology; Biotechnology

Abstract: Described is a laboratory experiment designed to expose students to problem-solving methods individually and as a group. Included are background information, a list of materials, laboratory procedures, analysis methods, and probable results.

108 **NAL Call No.: LB2300.C5**
Political activists working to change land-grant colleges.
Jaschik, S. *Chron-High-Educ* v.37(27): p.A1, A24. (1991 Mar.)
Descriptors: agricultural-education; research-support; educational-reform; curriculum-; usda-; guidelines-; biotechnology-; environmental-education; usa-; 1990-farm-bill; farmers-for-alternative-agricultural-research; center-for-rural-affairs; academic-freedom

109 **NAL Call No.: QH1 A43**
Polymerase chain reaction for educational settings.
Garrison, S. J.; dePamphillis, C. *American Biology Teacher* v.56(8): p.476-81 (1994 Nov.-1994 Dec.)
Descriptors: Biology; Biotechnology; Chemical Reactions; Chemistry; Higher Education; High Schools; Science Activities; Science Education; Polymerase Chain Reaction (PCR)

110 **NAL Call No.: QD415 A1B53**
Practical molecular biology for students: an integrated approach to teaching basic techniques.
Hames, B. D.; And Others *Biochemical Education* v.18(3): p.141-44 (1990 July)
Journal availability: see SE 547 528.
Descriptors: Bacteria; Biochemistry; College Science; DNA; Enzymes; Higher Education; Laboratory Equipment; Laboratory Procedures; Molecular Structure; Nucleic Acids; Safety; Science Activities; Science Education; Teaching Methods

Abstract: An activity that introduces students to the correct handling of bacterial recombinants, antibiotic sensitivity testing, insertional inactivation, plasmid DNA isolation, restriction endonuclease digestion, agarose gel electrophoresis, Southern blotting, hybridization, and autoradiography is presented. A list of needed materials, procedures, safety precautions, results, and discussion are included.

111 **NAL Call No.: S530 A4**
Priorities for research in agricultural education.
Silva-Guerrero, L.; Sutphin, H. D. *Journal of Agricultural Education* v.31(3): p.2-13 (1990 Fall)
Descriptors: Agricultural Education; Cost Effectiveness; Curriculum Research; Educational Research; Research Needs; Vocational Education

Abstract: Twenty agricultural education experts identified research topics and categories, which were then rated by 34 research experts (92 percent) and 49 department heads (79 percent). Highest ratings went to biotechnology, high technology, and agribusiness; agricultural education curriculum; and long-term impact and cost effectiveness of agricultural education.

112 **NAL Call No.: N/A**
Profiles of the national industry skills standards projects.
Rahn, M. L. C. p.31 (1994 June)
National Center for Research in Vocational Education, Berkeley, CA., Office of Vocational and Adult Education (ED), Washington, DC.
Descriptors: Behavioral Objectives; Competence; Competency Based Education; Federal Programs; Job Skills; Occupational Information; Postsecondary Education; Program Development; Skill Development; Standards; National Industry Skills Standards Projects

Abstract: In an effort to develop a more uniform and comprehensive system of national skill

standards, the U.S. Departments of Education and Labor have awarded grants to 22 technical committees, composed of representatives from business, labor, and education, in a variety of industries and occupations. These projects will begin proposing national standards and certification for competencies. This report consists of a profile of each of these 22 projects based on their response to the following sets of questions: (1) What is the definition of industry for your project? What criteria did you use to define the boundaries of your industry? What approach are you using to organize your industry in order to set standards?; (2) What definition of a standard are you using for your project? What is an example of such a standard?; and (3) How will performance against the standards be assessed? Each of the 22 profiles consists of one-page answers to these questions; the address, telephone number, contact, and date project began are also included. The 22 projects are in the following occupational areas: advanced manufacturing; agriscience and biotechnology; heating, air conditioning, and refrigeration occupations; automotive, auto body, and truck technicians; bioscience industry; computer-aided drafting and design; chemical process industries; electrical construction; electronics (both Labor and Education funded projects); food marketing industry; hazardous materials management technician; health science and technology; heavy highway and utility construction and environmental remediation; hospitality and tourism; human services; industrial launderers; metalworking; photonics technician; printing; retail trade; and welding occupations.

113 **NAL Call No.: QH1 A43**
Projector center. What is biotechnology?
Belzer, B.; Case, C. L. *American Biology Teacher* v.52(6): p.376-78 (1990 Sept.)
Descriptors: Biology; College Science; Food; Higher Education; Science and Society; Science Education; Science History; Secondary Education; Secondary School Science; Teaching Methods; Technological Advancement; Technology; Biotechnology

Abstract: Presented is a menu designed to illustrate some classical examples of fermentation. This may be used to discuss biotechnology from a technological perspective. Other examples of biotechnology used in the foods industry are described.

114 **NAL Call No.: QH1 A43**
Protein electrophoresis in the biology classroom using "safe" gels.
Atkins, T. *American Biology Teacher* v.53(8): p.490-95 (1991 Nov.-1991 Dec.)
Descriptors: Biology; Science Education; Science Instruction; Science Materials; Secondary Education; Electrophoresis; Laboratory Techniques; Molecular Biology; Proteins

115 **NAL Call No.: Q1.S37**
Public acceptance of biotechnology depends on how well scientists communicate the facts.
Hoban, T. *Scientist* v.6(18): p.12. (1992 Sept.)
Descriptors: biotechnology-; public-opinion; communication-skills; science-education

116 **NAL Call No.: 389.8-F7398**
PUBLIC COMMUNICATIONS: Genetically improved food crops.
Ingenthron, G. D. *Food-Technol* v.45(4): p.110, 112, 114, 117. (1991 Apr.)
Includes references.
Descriptors: biotechnology-; genetic-engineering; food-biotechnology; consumer-education; food-safety; regulations-; communication-; attitudes-

Abstract: This article will address subjects related to public communications on genetically engineered food crops. It will discuss various findings of related public opinion polls on food and give some critics' positions on biotechnology. Concluding the article are recommendations for a broad approach for communicating on biotechnology-related issues.

Special Reference Brief

117 **NAL Call No.: 80-Ac82**
Rapid-cycling Brassicas as a tool for plant biotechnology education.
Millam, S.; Lyon, J.; Hall, J.; Davidson, D. *Acta-hortic* (350): p.279-284. (1993 Nov.)
Paper presented at the "First International Symposium on Education and Training in Horticulture," July 13-17, 1992, Auchincruive, United Kingdom.
Descriptors: brassica-; biotechnology-; educational-resources; plant-tissue-culture

118 **NAL Call No.: QH1 A43**
Rapid transformation of a color mutant of yeast.
Montelone, B. A.; And Others *American Biology Teacher* v.57(3): p.171-73 (1995 Mar.)
Descriptors: Biology; DNA; Genetic Engineering; High Schools; Science Experiments; Science Instruction; Secondary School Science

119 **NAL Call No.: N/A**
Reclaiming the future: what every educator needs to know.
Hicks, D. *Australian Journal of Environmental Education* v.9 p.71-84 (1993 Sept.)
Descriptors: Biotechnology; Educational Trends; Elementary Secondary Education; Environmental Education; Futures (of Society); Student Interests; Environmental Education Curriculum; Environmental Issues; World Views

Abstract: Proposes that a futures dimension be included in the environmental education curriculum. Presents eight points to justify its inclusion and eight potential future trends that could be explored. Other methods of envisioning the future and moving forward are discussed.

120 **NAL Call No.: QH1 A43**
Recombinant DNA for teachers.
Duvall, J. G. I. *American Biology Teacher* v.54(5): p.284-85 (1992 May)
Descriptors: Biological Sciences; Biology; DNA; Genetic Engineering; Higher Education; Science and Society; Science Education; Science Instruction; Secondary Education; Teacher Workshops; Biotechnology

Abstract: A science teacher describes his experience at a workshop to learn to teach the Cold Spring Harbor DNA Science Laboratory Protocols. These protocols lead students through processes for taking E. coli cells and transforming them into a new antibiotic resistant strain. The workshop featured discussions of the role of DNA recombinant technology in society.

121 **NAL Call No.: S441.R38**
Reform and innovation of science and education : planning for the 1990 Farm Bill : Committee on Agriculture, Nutrition, and Forestry, United States Senate.
United States. Congress. Senate. Committee on Agriculture, N. a. F. Washington : U.S. G.P.O., 1989. vi, 256 p. : ill., At head of title: 101st Congress, 1st session. Committee print.
Descriptors: Agriculture-and-state-United-States; Agricultural-biotechnology-United-States; Agriculture-Research-United-States; Sustainable-agriculture-United-States

122 **NAL Call No.: N/A**
Reforms in science education, K-12.
School of Education Review v.5, spec iss. (1993 Spring)
San Francisco State Univ., Calif. School of Education. 134p.
Descriptors: Biotechnology; Classroom Research; Concept Formation; Educational Change; Elementary School Science; Elementary Secondary Education; Science Curriculum; Science Education; Science Teachers; Scientific Concepts; Secondary School Science; Student Evaluation; Teacher Education; Technology; Authentic Assessment; Project 2061 (AAAS); Scope Sequence and Coordination

Abstract: As powerful as the compelling reasons for reform in science education are, there is also uncertainty about where this reform may lead. This special issue focuses on reform in K-12 science

education. The 23 articles in this book are placed in the following sections: (1) In this issue, (2) Project 2061, (3) The Scope, Sequence and Coordination (SS&C) Project, (4) Teacher Preparation, (5) Science Assessment, (6) Technology in Science Education, (7) Earth Science Education, and (8) Biotechnology Education. (PR)

123 **NAL Call No.: SB1.H6**
Research and extension's role in the future of dry bean production in the United States.
Coyne, D. P. *HortScience* v.24(4): p.542-546. (1989 Aug.)
Includes references.
Descriptors: phaseolus-; production-possibilities; breeding-aims; disease-resistance; cultivars-; genetic-engineering; extension-education; usa-

124 **NAL Call No.: TP248.6.C6-1985**
Research and training programme in biomolecular engineering : (April 1982-March 1986) : progress report 1984.
Commission of the European Communities. Division Genetics and Biotechnology. Brussels, Luxembourg : Office for Official Publicatons of the European Communities, 1985. 2 v. : ill., English, French and German. Vol. 1: Research -- vol. 2: Training.
Descriptors: Genetic-engineering-Research-European-Economic-Community-countries; Biochemical-engineering-Research-European-Economic- Community-countries; Plant-genetics-Research-European-Economic-Community-countries; Agriculture-Research-European-Economic- Community-countries; Plant-genetics

125 **NAL Call No.: S494.5.B563W57-1988**
The role of Extension in the transfer of biotechnology : final report.
Wolek, F. W. 1. Villanova, PA : Villanova University, [1988] 1 v. (various pagings) : ill., "September 30, 1988."
Descriptors: United-States-Extension-Service; Agricultural-biotechnology-United-States

126 **NAL Call No.: TX945.S344**
Role of food biotechnology in child nutrition programs.
Unklesbay, N.; Unklesbay, K. *Sch-foodserv-res-rev* v.18(2): p.72-79. (1994)
Includes references.
Descriptors: school-food-service; food-biotechnology; nutrition-programs; child-nutrition; food-safety

Abstract: Rapid developments in food biotechnology will soon impact child nutrition programs (CNP). Food biotechnology is defined as the application of new technologies of genetic modification of bacteria, plants, and animals to improve specific characteristics of these organisms. This paper describes the field for professionals in CNPs. Our recent history of genetics and the global food situation are used to justify food biotechnology. Specific examples of food biotechnological developments that will be of concern are given for plant production, animal agriculture, microorganism production, and food processing operations. Many applications are discussed that will improve the flavor and textural properties of menu items. Examples of improving the nutritional qualities of menu items are given. Regulatory precautions for maintaining food safety are referenced. Although the need is great, food biotechnology will fail if the public does not trust its developments. When children are informed about food biotechnology, they will grow up accepting its advantages. An example of an action project for school cafeterias is given. CNPs can benefit dramatically from this involvement.

127 **NAL Call No.: 389.8-F7398**
The sciences of nutrition.
Thier, S. O. *Food-Technol* v.44(8): p.26, 28, 30, 32, 34. (1990 Aug.)
Descriptors: nutrition-; history-; health-protection; biotechnology-; nutrition-knowledge; nutrition-education; innovations-; food-sciences

Abstract: Abstract: This article discusses the history and the future of nutrition as a scientific discipline. Topics include the role of nutrition in

medicine, biotechnology, food technology, nutrition education programs for health professionals, and global nutrition.

128 **NAL Call No.: aQK981.4.P76**
Scientists as teachers/communicators: the importance of biotechnology education.
Dobert, R.; Zinnen, T. *Probe* v.5(2): p.1-5. (1995 Apr.-1995 June)
Includes references.
Descriptors: biotechnology-; genetic-engineering; agriculture-; education-; scientists-; science-education; research-workers; educational-policy; educational-methods

129 **NAL Call No.: SB1.H6**
Semiportable laminar flow hood for tissue culture and microscope use for research and teaching.
Meyer, M. M. Jr. *Hortscience* v.21(4): p.1064-1065. ill. (1986 Aug.)
Includes references.
Descriptors: experimental-equipment; portable-instruments; plants-; tissue-culture; research-; teaching-; microscopes-

130 **NAL Call No.: 275.8-AG8**
Shift your gears--to high technology.
Raymond, G.; Nowels, K. E. *Agric-Educ-Mag* v.59(3): p.5-6. ill. (1986 Sept.)
Descriptors: agricultural-education; technology-; telecommunications-; genetic-engineering; vocational-training

131 **NAL Call No.: S530.J6**
Should public funds support biotechnology development? A case about herbicide-resistant cotton.
Vietor, D. M.; Chandler, J. M.; Thompson, P. B.; Ketchersid, M. L. *J-nat-resour-life-sci-educ* v.24(2): p.173-178. (1995 Fall)
Includes references.
Descriptors: agricultural-education; herbicide-resistance; biotechnology-; research-support; public-finance; agricultural-financial-policy; ethics-; teaching-methods; case-studies; higher-education; gossypium-hirsutum; genetic-engineering; induced-resistance; bromoxynil-; weed-control; policy-analysis; agricultural-controversies

132 **NAL Call No.: TP248.22.S67--1990**
A sourcebook of biotechnology activities.
Rasmussen, A. M.; Matheson, R. R. H. 1.; North Carolina Biotechnology Center. Reston, Va. : National Association of Biology Teachers : North Carolina Biotechnology Center, 1990. 1 v. (loose-leaf) : ill., Includes bibliographical references (p. 227-230).
Descriptors: Biotechnology-Study-and-teaching

133 **NAL Call No.: QH1 A43**
Species identity of commercial stocks of paramecium in the u.s.
Cole, T. A.; And Others *American Biology Teacher* v.54(5): p.299-302 (1992 May)
Descriptors: Biology; DNA; Elementary Secondary Education; Higher Education; Laboratory Procedures; Microbiology; Science Education; Biotechnology; Laboratory Techniques; Paramecia

Abstract: Describes how paramecium can be identified through the use of DNA-binding fluorescent compounds. The authors used these techniques to test the paramecium stocks from 12 commercial sources. The details of the staining procedures and the results of the commercial tests are presented in this article.

134 **NAL Call No.: QH1 A43**
Staining for ribonuclease activity in polyacrylamide gels.
Harley, S. M.; Rasmussen, C. G. *American Biology Teacher* v.55(6): p.366-68 (1993 Sept.)
Descriptors: Biology; Biotechnology; College Science; Higher Education; Laboratory Procedures; Learning Activities; Plants (Botany); Science Activities; Science Instruction; Teaching Methods; Electrophoresis; Proteins

Abstract: Describes procedures for identifying the protein ribonuclease from plant tissue extracts using mini-gel electrophoresis.

135 **NAL Call No.: 275.8-AG8**
Teachers making a difference: Miller and McNutt--a case study.
Bruening, T. H.; Hoover, T. *Agric-Educ-Mag* v.64(4): p.17-19. (1991 Oct.)
Includes references.
Descriptors: teachers-; agricultural-education; biotechnology-; curriculum-; food-sciences; pennsylvania-

136 **NAL Call No.: N/A**
Teaching a biotechnology unit in high school general biology.
Hays, L. *Teaching and Change* v.1(4): p.333-48 (1994 Summer)
Descriptors: Biology; Biotechnology; DNA; Genetic Engineering; Heterogeneous Grouping; High Schools; Portfolios (Background Materials); Science Instruction; Secondary School Students; Student Projects; Teaching Methods; Technology Education

Abstract: Describes a unit in biotechnology for average and below average high school students. Students developed productive team membership, used math and communication skills to solve problems, and used the scientific method to learn about biotechnology. Students separated DNA, transformed bacterial cells, interpreted DNA fingerprints, completed creative writing assignments, and produced portfolios of their work.

137 **NAL Call No.: N/A**
Teaching biotechnology in schools. Science and technology education document series no. 39.
McInerney, J. D. Ed. France, 1990)
291p.; Based on the results of a round-table conference on biotechnology education held in Sendorf, Federal Republic of Germany, August 27-30, 1989. International Union of Biological Sciences. Commission for Biological Education. United Nations Educational, Scientific, and Cultural Organization, Paris (France). Div. of Science, Technical and Environmental Education.
Descriptors: Bioethics; Biology; Biotechnology; Elementary Secondary Education; Science Activities; Science and Society; Science Curriculum; Science Education; Science Experiments; Science History; Science Instruction; Scientific and Technical Information

Abstract: This document series has been established as part of UNESCO's Science and Technology Programme to encourage an international exchange of ideas and information in science education. This volume addresses the improvement of biotechnology education in school up to year 10 and aims at improving the quantity and quality of biotechnology taught in schools worldwide. The five chapters deal with the following subjects: an overview of biotechnology; the principles and applications of biotechnology; the social implications of biotechnology; and considerations for implementation. In addition to discussing the history and basic principles of biotechnology, the book provides detailed classroom lessons that can be incorporated into many general science and biology programs. The lessons on the science of biotechnology are complemented by discussions of ethical and policy issues related to biotechnology, and these discussions are developed further in the chapter on the social implications of biotechnology and the educational context in which they should be considered. The book concludes with an overview of common barriers to the introduction of biotechnology into the curriculum and with suggestions for overcoming those barriers.

138 **NAL Call No.: HD1755.A39-1988**
Technological innovations with implications for agricultural economists: a discussion.
Knutson, R. D. *Agriculture and rural areas approaching the twenty-first century : challenges for agricultural economics / edited by R.J. Hildreth ... [et al.]. 1st ed. Ames : Iowa State University Press* p.115-120 (1988)
Paper presented at a conference on "Agriculture

and Rural Areas Approaching the Twenty-first Century : Challenges for Agricultural Economics," August 7-9, Ames, Iowa.
Descriptors: agricultural-economics; technical-progress; innovations-; research-; extension-activities; agricultural-structure; biotechnology-; information-dissemination; structural-change; educational-programs; usa-

139 **NAL Call No.: 275.8 AG8**
Theme--agriculture education: 2025.
Riesenberg, L. E.; And Others *Agricultural Education Magazine* v.63(12): p.4-19 (1991 June)
Descriptors: Admission Criteria; Agricultural Education; Change Strategies; Educational Trends; Futures (of Society); Higher Education; Leadership; Secondary Education; Teacher Education; Teacher Role; Vocational Education; Biotechnology

Abstract: Seven theme articles address predictions for change in the field of vocational agriculture, strategies for effective change, Idaho's revised admission standards, professionalism and leadership development, and the development of skills for the future.

140 **NAL Call No.: Z7914.B33T66--1994**
Tools for teaching biotechnology : a bibliography of resources. Biotechnology bibliography of resources 1994.
Biotechnology Industry Organization. Education Committee. Washington, DC : Available from Biotechnology Industry Organization, 1994. iv, 52 p., Cover title.
Descriptors: Biotechnology-Study-and-teaching-Bibliography

141 **NAL Call No.: 275.8-AG8**
Toto, I don't think we're in Kansas anymore--agricultural education in a land of biotechnology.
Smith, D. *Agric-Educ-Mag* v.61(8): p.8-10. ill. (1989 Feb.)
Descriptors: agricultural-education; biotechnology-; technology-transfers; educational-planning; north-carolina; usa-

142 **NAL Call No.: 80-Ac82**
The training and role of the pomologist in Europe's fruit research and industry.
Sansavini, S. *Acta-hortic* (400): p.31-41. (1995 May)
Paper presented at the XXIVth International Horticultural Congress held August 21-27, 1994, Kyoto, Japan.
Descriptors: scientists-; training-; horticulture-; higher-education; college-curriculum; organic-farming; agricultural-research; biotechnology-; trends-; europe-; horticulturists-; specialized-curriculum; generalized-curriculum

143 **NAL Call No.: S530.J6**
Training expected for future private breeders.
Thorne, J. C. *J-Agron-Educ* v.19(2): p.203-205. (1990 Fall)
Includes references.
Descriptors: plant-breeding; training-; biotechnology-; plant-pathology; private-farms

144 **NAL Call No.: S530.J6**
Training expected for future public plant breeders.
Forsberg, R. A. *J-Agron-Educ* v.19(2): p.200-202. (1990 Fall)
Includes references.
Descriptors: plant-breeding; training-; molecular-genetics; biotechnology-

145 **NAL Call No.: N/A**
Twelfth-grade biology pupils' opinions of interventions of man in nature: agreement, indifference, and ambivalence.
Dreyfus, A.; Roth, Z. *Journal of Research in Science Teaching* v.28(1): p.81-95 (1991 Jan.)
Descriptors: Biology; Educational Research; Foreign Countries; Research Reports; Science and Society; Science Education; Science Instruction; Secondary Education; Biotechnology; Israel;

Science Education Research

146 **NAL Call No.: N/A**
Update. Biotechnologists aim to shoot plants.
Sheerman, S. *Journal of Biological Education* v.24(1): p.4-6 (1990 Spring)
Descriptors: Biological Sciences; Botany; College Science; Culturing Techniques; Ethics; Genetic Engineering; Genetics; Higher Education; Laboratory Procedures; Plants (Botany); Science and Society; Science Education; Science Instruction; Technological Advancement

Abstract: Reviewed are some of the techniques being used in plant biotechnology laboratories. Described are tissue culture and genetic manipulation. Advantages and disadvantages of this approach and ethics and public concern issues are discussed.

147 **NAL Call No.: SB379.A9A9**
The urban connection: farm advisor's role takes on new direction.
Mellano, V. J. *Calif-Grow* v.17(1): p.39-40. (1993 Jan.)
Descriptors: environmental-education; cooperative-extension-service; pesticides-; waste-disposal; endangered-species; wetlands-; urban-areas; agriculture-; safety-; biotechnology-; california-

148 **NAL Call No.: Q320.A4**
USDA official says biotech vital to ag future.
AgBiotechnol-News v.7(1): p.4. (1990 Jan.-1990 Feb.)
Descriptors: biotechnology-; food-costs; regulations-; science-education; usda-; national-research-council's-board-on-agriculture

149 **NAL Call No.: QH1 A43**
A user-friendly method for teaching restriction enzyme mapping.
Ehrman, P. *American Biology Teacher* v.52(7): p.429-35 (1990 Oct.)
Descriptors: Bacteria; Biochemistry; Biology; College Science; DNA; Enzymes; Genetic Engineering; Genetics; Higher Education; Laboratory Procedures; Maps; Nucleic Acids; Science Activities; Science Education; Structural Analysis (Science); Biotechnology

Abstract: Presented is a teaching progression that enhances learning through low-cost, manipulative transparencies. Discussed is instruction about restriction enzymes, plasmids, cutting plasmids, plasmid maps, recording data, and mapping restriction sites. Mapping wheels for student use is included.

150 **NAL Call No.: Q1 A3S3**
UW team reaches out to grade- and high-school students.
Hood, L. *Science* v.264(5156): p.208 (1994 Apr.)
Descriptors: College Faculty; DNA; Genetic Engineering; High Schools; Molecular Biology; Outreach Programs; Science Activities; Science Education; Science Instruction; Science Programs; Scientific Concepts; Hands on Science; Human Genome Project

Abstract: Describes an outreach program designed to expose high school students to cutting-edge science. High school students are provided with hands-on experience in molecular biology (polymerase chain reaction, restriction mapping, chromatography, gel electrophoresis, human DNA sequencing, etc.) and may have an opportunity to participate in the Human Genome Project.

151 **NAL Call No.: 241.5 IM7**
What are genetic resources and why should they be conserved?
Hawkes, J. G. *Impact of Science on Society* v.40(2): p.97-106 (1990)
Descriptors: Agricultural Production; College Science; Endangered Species; Farm Management; Food; Genetic Engineering; Genetics; Higher Education; Land Use; Overpopulation; Plant Propagation; Population Growth; Science Education

Abstract: Discussed is the need for producing

varieties of plants that can withstand the depredations of pests and diseases and are more adapted to stress conditions. Genes for better resistance and adaption are being found in conserved ancient farmers' varieties and related wild species. The importance of conserving these strains is emphasized.

152 **NAL Call No.: QH1 A43**
What's a nice biology teacher like you doing teaching humanities?
Biermann, C. A. *American Biology Teacher* v.52(8): p.487-90 (1990 Nov.-1990 Dec.)
Descriptors: Biological Sciences; College Science; Community Colleges; Controversial Issues (Course Content); Course Descriptions; Ethics; Higher Education; Humanities; Reading Skills; Science Education; Writing Skills; Biotechnology

Abstract: Described is the College Success Program designed to enhance retention of at-risk individuals. The goals, bioethics course offerings at various colleges, course outline for a bioethics course taught in the humanities, and evaluation of the course are discussed.

153 **NAL Call No.: 61.8-SE52**
World's friendlist biotechnology lab.
Seed-World v.128(7): p.20-21. (1990 June)
Descriptors: tissue-culture; biotechnology-; science-education; usda-; agricultural-research-service

Biotechnology: Education and Training

PRINT INFORMATION SOURCES

Subject Headings

The following Library of Congress subject headings can be used to locate books on biotechnology:

Agricultural Biotechnology
Agricultural Engineering
Animal Biotechnology
Bioengineering
Bioethics
Biotechnology
Biotechnology Industries
Cell Nuclei -- Transplantation
Cloning
DNA
Fertilization in vitro
Gene Libraries
Gene Mapping
Genetic Engineering
Genetic Recombination
Marine Biotechnology
Microbial Genetic Engineering
Molecular Cloning
Pharmaceutical Biotechnology
Plant Biotechnology
Protein Engineering
Recombinant DNA

The subdivision Biotechnology is also listed under individual and groups of chemicals, such as Insulin--Biotechnology

Indexes and Abstracts:

Following are some of the indexing and abstracting services that index journal and magazine articles. For some of the indexes, suggested search terms are also included.

Applied Science and Technology Index (1913-)
see: bioengineering, biotechnology, deoxyribonucleic acid, fermentation, gene therapy, genetic engineering

Bibliography of Agriculture (1942-)
see: biotechnology, clone, genetics, recombinant
Online database: AGRICOLA

Biological Abstracts (1926-)
see the subject index which uses keywords taken from the article titles.
Examples: biotechnology, cell fusion, clone, DNA, gene regulation
Online database: Biosis

Biological and Agricultural Index (1916-)
see: agricultural biotechnology, biotechnology, genetic engineering.

Chemical Abstracts (1907-)
see: biotechnology, deoxyribonucleic acids-- recombinant, genetic engineering
Online database: CA search

Special Reference Brief

ERIC
see: biotechnology, bioengineering, genetic engineering

Index Medicus (1960-)
see: antibodies, monoclonal, biotechnology, cloning(molecular), DNA recombinant, recombinant proteins
Online database: Medline

Reader's Guide to Periodical Literature(1990-)
see: clones (biology), DNA, genetic research

Science Citation Index (1955-)]
see the permuterm subject index which uses keywords from the article titles.
Examples: biotechnology, DNA, genetic(s), recombinant
Online database: Scisearch

Social Sciences Index (1974-)
see: bioethics, biological research, genetic engineering,
microbial genetics, recombinant DNA
Online database: Social Scisearch

DICTIONARIES

Bains, William *Biotechnology from A to Z.* New York, New York: Oxford University Press, 1993.

Coombs, J.M. *Dictionary of Biotechnology*, 2nd Edition. New York; Stockton Press, 1992.

Fleschar, M. H. and K. R. Nill. *Glossary of biotechnology terms*. Lancaster, PA; Technomic Pub. Co., 1993.

Glick, David M. *Glossary of Biochemistry and Molecular Biology*. New York; Raven Press, 1990.

Reiger, R. and M.M. Green. *Glossary of Genetics; Classical and Molecular, 5th Edition*. New York; Springer Verlag, 1991.

Scrip. *Biotechnology made simple, 4th ed.* Richmond, Surrey : PJB Publications, 1991.

Steinberg, Mark L. and Sharon D. Cosloy. *The Facts on File dictionary of biotechnology and genetic engineering*. New York ; Facts on File, 1994.

Walker, John M. and Michael Cox. *The Language of Biotechnology: A Dictionary of Terms. 2nd Edition.* Washington, D.C; American Chemical Society, 1995.

Biotechnology: Education and Training

BOOKS

In addition to those books found in the bibliography section, these publications provide valuable information for educators.

Becker, Jeffrey M.; Caldwell, Guy A.; and Zachgo, Eve Ann. Biotechnology: A Laboratory Course, San Diego: Academic Press, 1990

Massachusetts Biotechnology Research Institute. Biotechnology Resources for Teachers Worcester, MA, 1993 ($25.00, call 508 797-4200)

Micklos, David A. and Greg A. Freyer. DNA Science: A First Course in Recombinant DNA Technology, Cold Spring Harbor, NY: Cold Spring Harbor Laboratory, 1990.

Kriegler, Michael. Gene Transfer and Expression: A Laboratory Manual, New York: Stockton Press, 1990.

Systemwide Biotechnology Research and Education Program, University of California. Biotechnology : Agriculture, Food : A Guide for California Food and Farm Professionals, Berkeley, CA, 1994

Witt, Steven C. Biotechnology, Microbes, and the Environment. San Francisco, CA: Center for Science Information, 1990.

JOURNALS/NEWSLETTERS

Biotechnology Education
Pergamon Press, Inc.
660 White Plains Road
Tarrytown, NY 10591
Tel: (914)524-9200

Carolina Genes
North Carolina Biotechnology Center
Box 13547
Research Triangle Park, NC 27709-3547
Tel: (919)541-9366

GENErations - A science education newsletter
Genetics Society of America
c/o Dr. Gail Simmons, Editor
Department of Biology
City College of New York
Convent Avenue at 138th Street
New York, New York 10031
E-MAIL: simmons@scisun.sci.ccny.cuny.edu

Your World/Our World
Pennsylvania Biotechnology Association
1524 W. College Avenue, Suite 206
State College, PA 16801
Tel:(814)238-4080

The American Biology Teacher
National Association of Biology Teachers
11250 Roger Bacon Drive #19
Reston, Virginia 22090
Tel: (703)471-1134

EQUIPMENT RESOURCES

Carolina Biological Supply Co. (Cabisco)
2700 York Road
Burlington, NC 27215
Tel: (800)227-1150
(800)334-5551
FAX: (800)222-7112
caroscipub@aol.com
http://www.carosci.com/

Connecticut Valley Biological
82 Valley Road, P. O. Box 326
Southampton, MA 01073
Tel: (800)628-7748
FAX (413)527-8286

EDVOTEK
P. O. Box 1232
West Bethesda, Maryland 20827-1232
Tel: (800)338-6835

Fotodyne Inc.
Brian Walsh
Educational Products Division
950 Walnut Ridge Drive
Hartland, WI 53029-9399
Tel:(414)369-7000
(800)362-4657

"EPD Digest," published by the Educational Products Division of Fotodyne, Inc.,phone 1-800-DNA-FOTO or 800-362-3686

Life Technologies (GIBCO/BRL)
Dr. Ray Hadley
Senior Scientist
Tel: (301) 670-7730
(800) 828-6686 tech services

Modern Biology
P.O. Box 97
Dayton, IN 47941
Tel: (800)733-6544

Nasco
P.O Box 901
Fort Atkinson, WI 53538-0901
Tel: (800)558-9595

Pharmacia Biotech Inc.
800 Centennial Avenue
Piscataway, NJ 08855
Tel: (800)526-3593

Promega Corp.
Woods Hollow Road
Madison, WI 53713
Tel: (800)356-9526

Stratagene, Inc.
Randy Carver
11011 North Torrey Pines Road
LaJolla, CA 92037
Tel: 1-800-424-5444 ex5569
FAX (619) 535-0045
email: randy_carver@Stratagene.com

Wards' Natural Science Establishment, Inc.
5100 W. Henrietta Rd.
P.O. Box 92912
Rochester, NY 14692
Tel: (716)359-2502
FAX (716)334-6174
Toll-free: (800)962-2660

Biotechnology: Education and Training

INTERNET MATERIAL

LISTSERV's

BCEPP - Biotech Education Public Policy Network
Enables people working in biotechnology education and public policy to exchange ideas and documents.
Send mail to: **BCEPP@relay.adp.wisc.edu**
Subscribe to: **listserver@relay.adp.wisc.edu**

GENTALK
Discussions on genetic engineering and bioethical issues.
Send mail to: **Gentalk@usa.net**
Subscribe to: **Listserv@usa.net**

OTHER INTERNET RESOURCES

Biotechnology Information Center - Educational Resources
http://www.nal.usda.gov/bic/Education_res/
An extensive collection of education documents and links to other biotechnology education sites. Includes sections on General Education materials, Career Information and Training Opportunities.
For more information contact: biotech@nal.usda.gov

Access Excellence
http://www.gene.com/ae/
Access Excellence is a national educational program designed to enhance high school biology education by linking teachers and scientists through an interactive online network that provides peer support as well as access to critical sources of new information about leading-edge research and developments in the biological sciences.
For more information contact: aeperiodic@gene.com

Iowa State University Biotechnology Education Home Page
http://biotech.zool.iastate.edu/Biotech_Public_Ed.html
A collection of education materials from ISU's Office of Biotechnology and numerous other sources. Includes the Biotechnology Information Series, a series of plain language brochures covering the basics of biotechnology and specific applications.

The Biotechnology Education Program for the Public
http://www.biotech.wisc.edu/Education/education.html
A joint program of the UW Biotechnology Center and UW-Extension, this site contains a range of excellent teaching resources including "leader guides", classroom activities and several biotechnology posters.

National Center for Biotechnology Education (NCBE)
http://www.reading.ac.uk:80/NCBE/
Program based at the University of Reading (U.K.), providing access to the lab guide, Practical Biotechnology and other education resources.

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