DOCUMENT RESUME

ED 427 826 JC 990 129

AUTHOR	Kabat, Ellen J.; Friedel, Janice Nahra; Senew, Mike
TITLE	Partnering To Build a Quality Workforce: Critical Issues in Environmental Technology Education at Two-Year Colleges. A Report of the National Forum on Critical Issues in Environmental Technology Education at Two-Year Colleges (Washington, D.C., March 2-4, 1995).
INSTITUTION	Advanced Tech. Environmental Education Center, Bettendorf, IA.
SPONS AGENCY	National Science Foundation, Arlington, VA.
PUB DATE	1995-03-00
NOTE	56p.
CONTRACT	DUE-9453181
PUB TYPE	Collected Works - Proceedings (021)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	*Community Colleges; Curriculum Development; *Environmental Education; Environmental Technicians; *Job Skills; *Partnerships in Education; Program Implementation; *Strategic Planning; Two Year Colleges
IDENTIFIERS	National Science Foundation

ABSTRACT

The National Forum on Critical Issues in Environmental Technology Education at Two-Year Colleges addressed critical issues relevant to environmental technology education in the United States. Forty-three participants from across the country who attended the 1995 Forum represented business and industry, two-year colleges, four-year colleges and universities, secondary schools, professional societies and federal agencies with an interest in the education of environmental technicians. This publication reports on the Forum's activities and identifies critical issues in environmental technology programs. It aims to assist academia, industry, and government in implementing a number of recommendations, which include: (1) creating clear definitions of terms; (2) respecting environmental technicians as professionals; (3) developing a national strategy for marketing environmental technology programs; (4) standardizing competencies in environmental technology programs; (5) stressing critical thinking in students via application of skills to real-life situations; (6) facilitating communication; (7) integrating environmental issues into all educational levels; and (8) establishing alliances. More detailed recommendations fall under the topics of professionalism, curriculum and program development, environmental equity and human resources, employment needs, and transferability of credits. (AS)

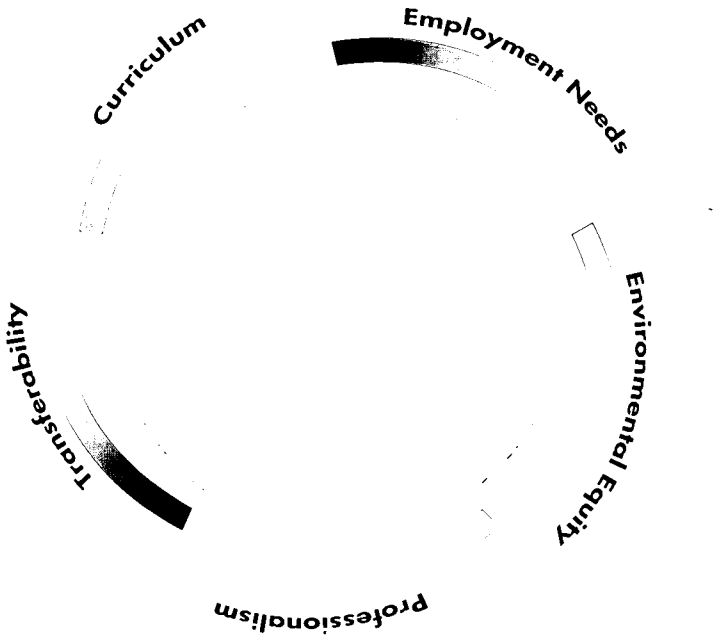
****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 427 826

PARTNERING TO BUILD A QUALITY WORKFORCE:

Critical Issues In Environmental Technology Education at Two-Year Colleges

This project was supported, in part,
by the
National Science Foundation
Opinions expressed are those of the authors
and not necessarily those of the Foundation



U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☒ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY
E. Kabat
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
1

BEST COPY AVAILABLE

Hazardous Materials Training & Research Institute • Kirkwood Community College
Advanced Technology Environmental Education

This material is based upon work supported by the National Science Foundation under Grant No. DUE-9453181

A report from a forum sponsored by the Advanced Technological Education Program of the National Science Foundation and by the Advanced Technology Environmental Education Center

Hazardous Materials Training & Research Institute
Eastern Iowa Community College District • Kirkwood Community College
Partnership for Environmental Technology Education
University of Northern Iowa • National Science Foundation

This project was supported, in part,
by the
National Science Foundation
Opinions expressed are those of the authors
and not necessarily those of the Foundation

Principal Investigator: Ellen J. Kabat • Co-Principal Investigators: Janice Nahra Friedel • Mike Senew • March 2-4, 1995

Cover design by The Creative Department, Davenport, Iowa

Published by the Advanced Technology Environmental Education Center (ATEEC)
500 Belmont Road
Bettendorf, Iowa 52722
(319) 344-0354

REFLECTIONS ON LEADERSHIP IN ENVIRONMENTAL TECHNOLOGY EDUCATION

Margaret Cozzens
Division Director
Elementary, Secondary, and Informal Education
National Science Foundation

Elizabeth J. Teles
Program Director, Division of
Undergraduate Education
National Science Foundation

Robert F. Watson
Division Director
Undergraduate Education
National Science Foundation

This report reflects the excellent leadership in environmental education being provided by the Advanced Technology Environmental Education Center (ATEEC), one of the National Science Foundation (NSF) Centers supported through the Advanced Technological Education (ATE) program.

Just as the world is changing, so must the nation's approach to the education of the technological workforce. First, there must be a community which values excellence in teaching and scholarship and is committed to the reform of technological education at both the secondary school and undergraduate levels. NSF is working hard to stimulate and encourage this community because it is from here that new ideas must emerge and experimentation be done. Second, only with a blend of core mathematics and science competencies which complement technical skills can we hope to have a technological workforce prepared to deal with not only today's challenges, but also those of tomorrow.

In addition, the community must be ready to commit to changes that constitute systemic reform in environmental technology education. More than ever before, individuals, colleges, and other institutions must cooperate if these objectives are to be achieved. Many walls exist between disciplines, academic institutions, governmental agencies, and business and industry. These walls are ill-suited to educating the many different individuals seeking preparation to help protect our environment and make our country a more competitive, safer, and a nicer place in which to live and work. For these reasons, there must be systemic changes in technical education and to accomplish this, there must be collaboration.

Our task for the community is a daunting one. We must have leaders who are ready to suggest, explore, and implement new approaches to the tasks at hand and to do this with some speed, so that we can achieve the reform of the system that we must have to serve national and global needs.

NSF is committed to supporting both productive experimentation and systemic changes. The communities brought together by this national forum represent the diverse groups that must be involved in improving technical education in the United States. People worked hard at the conference, as well as before they came and after they left, to prepare this report. We welcome these ideas and expect that many of the recommendations of the working groups will be turned into actions. The individual elements of reform must be joined and a collaborative community built. This is required if our nation is to become better able to address the many complex problems in environmental education. This resolution will further increase the quality of life for its citizens while serving to make the United States more globally competitive and simultaneously environmentally concerned.

LETTER TO THE COMMUNITY

July 17, 1995

Letter to the Community:

Our nation's focus on environmental concerns has shifted over the last few decades. In the seventies we saw a concentrated effort on the "end-of-the-pipe" issues. The eighties were devoted to embarking on the physical cleanup of waste sites. Today the emphasis has evolved into changing the way we manufacture products—that is, reducing or stopping pollution at its source. This recent philosophy of pollution prevention is having a positive impact on all sectors of our economy.

The challenge before us is much greater than reducing our output of waste or slowing the earth's deforestation. Our challenge is to find a way to prosper as a nation without impairing future generations. As Thomas Jefferson said, ". . . No generation can contract debts greater than may be paid during the course of its own existence."

How do we achieve an environmentally sustainable economy? The National Science and Technology Council's document, *Bridge to a Sustainable Future*, states, "Our nation's future strength will in large part be built on the viability of our nation's communities. We must make choices today that increase the sustainability and desirability of our cities, towns, and rural areas if we are to preserve our natural environment and build a strong domestic economy."

To succeed nationally we must begin to act locally—in communities. We must begin with education and retraining, and there is no better source for this than two-year colleges. The two-year college system is the fastest growing sector of educational institutions in the United States. The nation's two-year colleges currently collaborate with local businesses, making them ideally positioned to advance environmental technology programs and to build a quality workforce.

But the collaboration must not be limited to businesses. To achieve sustainability requires the building and melding of partnerships among educational institutions, industry, labor, communities, nongovernmental organizations, and state and federal government. These groups must move forward together with a common vision, building on the strengths of each to achieve the goals of all.

What does the future hold? As Alan Kay of Apple Computer Inc. said, "The best way to predict the future is to invent it." Our challenge is to come together as a community of concerned individuals to define our destiny and fulfill our dreams and the dreams of the generations who follow after us.

Sincerely,

Ellen J. Kabat, PhD
Director, ATEEC

FOREWORD

The *National Forum on Critical Issues in Environmental Technology Education at Two-Year Colleges* was a natural extension of recent workshops, studies, and reports supported by the National Science Foundation (NSF) to help improve science, technology, engineering, and mathematics education in the United States. The 1986 National Science Board report, *Undergraduate Science, Mathematics, and Engineering Education* (NSB 86-100), identified serious problems in undergraduate education and included recommendations for improving the quality of science, mathematics, and engineering problems in two-year colleges. NSF then convened a workshop that resulted in the report *NSF Workshop on Science, Engineering, and Mathematics Education in Two-Year Colleges* (NSF 89-50). A variety of groups then undertook studies that served as resources for a subsequent NSF workshop that produced the report *Matching Actions and Challenges* (NSF 91-111). This report contained specific recommendations for two-year college faculty, professional organizations, and college administrators to foster improved interactions among organizations, faculty, and federal funding agencies.

provide a base for future activities and projects designed to improve science, technology, engineering, and mathematics education in two-year colleges, NSF convened a workshop, *Partners in Progress*, on October 29-30, 1992. The report from this workshop, *Partners in Progress* (NSF 93-64), stressed the importance of using the resources and networking available from professional societies to help the educational community improve the quality and effectiveness of science, technology, engineering, and mathematics education at all levels.

The workshop *Gaining the Competitive Edge: Critical Issues in Science and Engineering Technician Education* (NSF 94-32) was in response to a nationally recognized need for a well-educated technical workforce in the high performance work place of advanced technologies. Both Congress and the White House emphasized the technical workforce in their 1992 and 1993 initiatives. Congress passed and the Administration supported the *Scientific and Advanced Technology Act of 1992*. This Act called for the National Science Foundation to establish a national program to improve the education for technicians in advanced technology fields using the resources of the nation's two-year colleges. In August 1993, NSF announced the *Advanced Technological Education* (ATE) program as a cooperative effort between NSF's Division of Undergraduate Education and the Division of Elementary, Secondary, and Informal Education. These efforts have created a sound foundation for cultivating innovative programs to advance technician education in the United States.

With the experience of several workshops that addressed science, mathematics, and engineering education in institutions that traditionally educate technicians, NSF supported the proposal of the Advanced Technology Environmental Education Center (ATEEC) and the Hazardous Materials Training & Research Institute (HMTRI) for an invitational forum to address environmental technology education in depth. The 43 participants from across the country who attended the forum represented business and industry, two-year colleges, four-year colleges and universities, secondary schools, professional societies, and federal agencies with an interest in the education of environmental technicians. Over the two-day period, participants worked to develop recommendations that provided a basis for future activities, initiatives, and projects designed to improve environmental technology education.

The American Association of Community Colleges (AACC) joined ATEEC, HMTRI, and NSF as co-sponsors of the forum. The recommendations developed at the forum are being used to provide direction for ATEEC, which is funded through a grant from NSF. The grant, which is admininstered by HMTRI, brings together institutions from throughout the

nation to promote and assist environmental technology credit programs. The ATEEC partners are HMTRI, the Partnership for Environmental Technology Education (PETE), the University of Northern Iowa, and NSF.

This project was supported, in part, by the Advanced Technological Education program at the National Science Foundation. The opinions expressed in this report are those of the forum participants and do not necessarily represent NSF policy. The recommendations are under review at NSF.

EXECUTIVE SUMMARY

The *National Forum on Critical Issues in Environmental Technology Education at Two-Year Colleges,* held March 2-4, 1995, in Washington, D.C., addressed critical issues relevant to environmental technology education in the United States. The purpose of the NSF-sponsored forum was to identify critical issues in environmental technology programs; to develop recommendations for academia, industry, and government; and to assist these communities in implementing the recommendations. These recommendations are timely because there is broad agreement that if the United States is to maintain a position of economic and political leadership in the world, there must be fundamental changes in the workplace and the educational programs which support the workplace.

The 43 participants from across the country who attended the forum represented business and industry, two-year colleges, four-year colleges and universities, secondary schools, professional societies, and federal agencies with an interest in the education of environmental technicians. Deliberations during the forum focused on ways to create a ional, world-class network two-year colleges supported through public-private partnerships to produce and maintain an environmental technology workforce that addresses the diversified needs of industry and promotes the transition of transfer students to higher education.

Planning and implementation of the forum was a cooperative effort involving the Advanced Technology Environmental Education Center (ATEEC), the Hazardous Materials Training & Research Institute (HMTRI), the American Association of Community Colleges (AACC), with participation, funding, and guidance from the National Science Foundation (NSF).

PRINCIPAL RECOMMENDATIONS

The participants were divided into five working groups to examine the following issues:

- Professionalization of environmental technician education as well as preparation, credentials, professional advancement, and continuing education of faculty;
- Curriculum and program development and implementation in environmental technician education;
- Environmental equity and human resources;
- Current and future employment needs; and
- Transferability of credits (2+2+2).

The forum report presents issues and recommendations relevant to the education of environmental technicians. The audience for this report includes: (1) administrators and faculty of academic institutions at all levels, but particularly in two-year colleges; (2) employers of technicians, such as companies and government agencies; (3) leaders of professional societies; and (4) federal, state, and local government officials who have responsibilities for the quality and quantity of the nation's technical workforce.

The recommendations in the final report are also being used to provide direction for the Advanced Technology Environmental Education Center (ATEEC). Funded by the National Science Foundation (NSF), ATEEC has three primary goals: first, to nationally validate environmental curriculum models and advanced instructional materials; second, to establish comprehensive programs of professional development for educators; third, to build an electronic clearinghouse to serve as a national center of environmental education information and as a hub for networking environmental educators, business and industry, federal agencies, and professional societies.

The recommendations in the report are clustered under the charges of the five working groups. Because there are

many cross-cutting themes, a few highlights of the recommendations are given in this summary.

Educators, employers, professional societies, and government working together must:

- Define the "environmental technology" field and the occupations it encompasses;
- Establish job classifications based on voluntary skills standards;
- Recognize and promote environmental technicians as professionals that contribute valuable skills and expertise in the workplace;
- Develop a national strategy for marketing environmental technology programs as well as the profession to business and industry, government, parents, teachers, counselors, and students;
- Identify and standardize the core competencies required in environmental technology programs: (1) establish the general education component, encompassing mathematics, science, oral and written communication, employability skills, and computer skills; (2) establish the technical component, encompassing knowledge and skills that are common across all environmental technology occupations; and (3) establish occupation-specific components which cover specialized knowledge and skills;
- Ensure that environmental technology programs/ curricula are competency based;
- Incorporate critical thinking skills into curricula by having students apply knowledge and skills to real-life situations;
- Incorporate the concepts of "environmental justice and equity" into environmental technology programs;
- Establish formal mechanisms to facilitate communication and coordinate curricula across institutions and educational levels;
- Require experiential learning/internships as a program completion requirement;
- Develop a national accreditation program for two-year environmental technology programs;
- Integrate environmental issues into traditional elementary, secondary, and post-secondary curricula;
- Establish alliances that will provide paid professional development opportunities for faculty such as summer internships, sabbaticals, conferences, and workshops;
- Develop and maintain partnerships with business and industry, labor, government, professional organizations, and other academic institutions in order to improve environmental technology programs and better serve students, employers, and the community as a whole; and
- Recruit and train non-traditional students, recognizing that many persons entering the field will be returning for new or additional skills.

THE FUTURE

It is paramount that a major national effort be launched to assist two-year community and technical colleges in meeting the increasing need for environmental technicians. This field is continually subjected to the impact of technological advances, new information and regulations, and mounting community activism. Global environmental issues and competitiveness require the development of a quality American workforce in the environmental technologies. The institutions best suited to meet these demands are two-year community and technical colleges.

Implementation of the recommendations in this report requires that all groups involved in technical education, regulatory and compliance oversight, and employment work

collaboratively. Increased accountability and the movement toward skills standards necessitate competency-based programs emphasizing a solid foundation in the basic math, sciences, and technical specialties. Technical education is a priority for the NSF as well as other governmental agencies. Federal support for technical education is evidenced by legislation which authorized NSF to create the Advanced Technological Education (ATE) program. The ATE program is supporting projects in curriculum and laboratory development, faculty preparation and enhancement, and a selected few Centers of Excellence, one of which is ATEEC.

The requirements to develop and maintain a highly qualified workforce in environmental technologies requires that all stakeholders work cooperatively and become agents of change. Two-year colleges must enhance their working relationships with employers in government, business and industry, as well as professional societies to ensure high quality educational programs. These environmental technology programs must address faculty enhancement, student recruitment and retention, and a comprehensive curriculum which incorporates the concept of environmental equity and which meets the needs of the existing and future workforce.

Moreover, articulation agreements with secondary schools and four-year colleges and universities must be developed to ensure the smooth transition of students from one level to the next.

The recommendations in this report provide the framework by which the nation's two-year colleges can move forward in meeting the diverse needs of the expanding environmental workforce. This must be a deliberate and cooperative effort; two-year colleges cannot work in isolation. Collaboration is essential to respond to the multitude of challenges confronting this vision for a world-class workforce striving to provide a safe and clean environment.

TABLE OF CONTENTS

Reflections on Leadership in Environmental Technology Education iii

Letter to the Community iv

Foreword v

Executive Summary vii

Introduction 2

- Background 3
- The Forum 4
- Closing 5

Personal Reflections on Critical Issues 6

Work Group Reports 11

- Curriculum and Program Development 11
- Employment Needs 17
- Environmental Equity and Human Resources 23
- Professionalism 29
- Transferability of Credits 34

Bibliography 39

Forum Participants 40

Forum Presenters 42

Acknowledgments 43

ERIC

Introduction

On March 2-4, 1995, the Advanced Technology Environmental Education Center (ATEEC), the Hazardous Materials Training & Research Institute (HMTRI), the American Association of Community Colleges (AACC), and the National Science Foundation (NSF) co-sponsored the *National Forum on Critical Issues in Environmental Technology Education at Two-Year Colleges*, to address issues relevant to producing a quality environmental technology workforce in the United States. This forum was timely because there is broad agreement that if the United States is to maintain a position of economic and political leadership in the world, fundamental changes must occur in the workplace and in the educational programs that support the workplace. A consensus has been built that the key to maintaining or increasing the economic productivity of the country lies in the creation of high performance work organizations which are supported by high performance educational programs.

The purpose of the NSF-funded forum was to identify critical issues in environmental technology programs; to develop recommendations for academia, industry, and government; and to assist these communities in implementing the recommendations. Deliberations during the forum focused on ways to create a national, world-class network of two-year college environmental technology programs supported through public-private partnerships to produce and maintain an environmental technology workforce that addresses the diversified needs of industry and promotes the transition of transfer students to higher education.

The 43 participants from across the country who attended the forum represented business and industry, two-year colleges, four-year colleges and universities, secondary schools, professional societies, and federal agencies with an interest in the education of environmental technicians. The participants were divided into five working groups to examine the following issues:

- Professionalization of environmental technician education as well as preparation, credentials, professional advancement, and continuing education of faculty;
- Curriculum and program development and implementation in environmental technician education;
- Environmental equity and human resources;
- Current and future employment needs; and
- Transferability of credits (2+2+2).

The forum report presents issues and recommendations relevant to the education of environmental technicians. The audience for this report includes: (1) administrators and faculty of academic institutions at all levels, but particularly in two-year colleges; (2) employers of technicians, such as companies and government agencies; (3) leaders of professional societies; and (4) federal, state, and local government officials who have responsibilities for the quality and quantity of the nation's technical workforce.

The recommendations in the final report are also being used to provide direction for ATEEC, which is one of a selected few Centers of Excellence funded by the NSF to improve the quality of advanced technological education in science and engineering technology fields, as well as the basic mathematics and science core underlying such programs. The Center has three primary goals: first, to nationally validate environmental curriculum models and advanced instructional materials; second, to establish comprehensive programs of professional development for educators; and third, to build an electronic clearinghouse to serve as a national center of environmental education information and as a

hub for networking environmental educators, business and industry, federal agencies, and professional societies.

BACKGROUND

"Today, it is estimated that as many as 3 million Americans are employed in environmental work, many jobs that were unimaginable even 15 years ago" according to *The New Complete Guide to Environmental Careers*. In almost every area of environmental service, technicians are part of the workforce (Green, 1994). Technician-level positions are not limited to the environmental field; they are a "large and rapidly growing population— a new worker elite who are transforming the American labor force and potentially every organization that employs them" (Richman, 1994). Due, in part, to the growing environmental industry and the proliferation of technician positions, many of the "environmental technician" occupations have not been clearly defined.

Along with the rapid growth of the environmental field and technician positions, the world is undergoing a period of technological revolution which many believe will be as widespread in its effects as was the industrial "mass production" revolution of nearly a century ago. The National Center on Education and the Economy, in its report, *America's Choice: High Skills or Low Wages*, labels these changes "the third industrial revolution," while the Hudson Institute publication, *Workforce 2000, Work and Workers for the 21st Century*, labels this the "post industrial information era." Whatever the label, there is broad agreement that if the United States is to maintain a position of economic and political leadership in the world, fundamental changes must occur in the workplace and in the educational programs that support the workplace.

In recent years broad political consensus has indicated the need for change. In 1989 President Bush and the nation's governors, in an attempt to provide a framework for action, established the National Education Goals. The link between education and the economy was clearly stated by the chair of the National Education Goals Panel, who wrote, "Education is as important to our global economy in its implications for a competent workforce as availability of capital or any other business condition." President Clinton, on the occasion of the establishment of the President's committee of Advisors on Science and Technology stated, "Science and technology are essential tools for achieving this administration's goals for strengthening the economy, creating high quality jobs, protecting the environment, improving our health care and education systems, and maintaining our national security. This country must sustain world leadership in science, mathematics and engineering if we are to meet the challenges of today . . . and of tomorrow." Representative Lee Hamilton, Vice Chairman of the Joint Congressional Economic Committee states, "For an advanced country such as ours, the only sustainable advantage is a talented and adaptive workforce capable of using the latest technologies and reaching ever higher levels of productivity."

A consensus has been built that the key to maintaining or increasing the economic productivity of the country lies in the creation of high performance work organizations which are supported by high performance educational programs. Such organizations are characterized by a willingness to adopt new technology, flexibility in organizational structures, accountability, and the empowerment of employees.

Both Congress and the White House emphasized the technical workforce in their 1992 and 1993 initiatives. Congress passed and the Administration supported the *Scientific and Advanced Technology Act of 1992*, which called for the National Science Foundation (NSF) to establish a national program to improve the education for technicians in advanced technology fields using the resources of the nation's two-year colleges. Thus, the Advanced Technological Education (ATE) program was established to address this need. As quoted in

the NSF publication, *The Advanced Technological Education Program: 1994 Awards and Activities* (NSF 95-6), Dr. Luther Williams, NSF Assistant Director for Education and Human Resources (EHR), says "It has become increasingly apparent that for the United States to be competitive in the world market, the technical component of the workforce in the United States must be better prepared than the corresponding workforce in other industrialized countries. The Advanced Technological Education (ATE) program is a major new NSF initiative in response to this challenge." The ATE program is managed jointly by the Division of Undergraduate Education (DUE) and the Division of Elementary, Secondary, and Informal Education (ESIE).

The aforementioned NSF publication also states that the goal of the new ATE program is to promote exemplary improvement in advanced technological education at the national and regional level through support of curriculum development and program improvement for technicians. Central to the ATE program is the development of strategies to strengthen two-year college technician education and to strengthen the mathematics, science, and technology education base in secondary schools. Expanded opportunities for technicians at four-year colleges and universities and for those employed are also included. Collaboration of two-year colleges with secondary schools and four-year institutions, as well as partnerships with business, industry, and government are encouraged/ expected. According to Margaret Cozzens, Division Director for ESIE, "Mounting a major national effort to improve the education of technicians requires that all groups involved in technician education become proactive. With support from the National Science Foundation and others who share the vision, it will be possible to make a difference in how science and engineering technicians are educated at all levels in this country." (NSF 95-6)

THE FORUM

Educators in the fields of math, science, and environmental technology education were invited to participate in the forum. These secondary and postsecondary educators were joined by employer, government, and professional society representatives who were leaders in their fields.

Prior to the actual forum event, participants received a list of issues and relevant background materials designed to stimulate their thinking in the particular critical issue category to which they were assigned. The participants were asked to review the list of critical issues and identify, or add to the list, those they considered most important.

To kick off the forum, a reception was held on Thursday evening, March 2 at the Holiday Inn - Capital in Washington, DC. Ellen Kabat, Director of ATEEC, welcomed the participants and discussed the objectives of the forum. Robert Watson, NSF's Director of the Division of Undergraduate Education (DUE), which co-administers the ATE program, spoke on the role of DUE. Watson stated that two-year colleges should place priority on partnerships with other institutions and with industry when applying for ATE grants. Following Watson's presentation, the participants met informally in their working groups.

On Friday morning the forum participants listened to presentations related to the five critical issues categories. Since one of the categories dealt with "Current and Future Employment Needs," Ken Chapman, Head Technician of Resources and Education for the American Chemical Society, spoke about planning for future workforce needs within the environmental technology field. This workforce will be enhanced by the movement toward voluntary skills standards in such occupations as chemical laboratory technician and process technical operator.

Margaret Cozzens, NSF's Division Director for Elementary, Secondary and Informal Education gave a presentation on the function of secondary education within the ATE program. Cozzens said it is estimated that in the future people will have seven different careers over the span of a

lifetime. "Tracking" students into preparation for a specific career field is unwise. By strengthening technological education at the secondary level through the ATE program, educators can make sure students are prepared when they leave high school. When they change career fields later in life, the door will be left open for individuals with a solid foundation in math and science.

R. Thomas Parker, Jr., Executive Director of the Clinton Administration's Interagency Environmental Technologies Office (IETO), told the participants that he predicts the ever-increasing speed of technological advancement will create a need for people trained to assess technology applications. This technology assessor would be trained to determine ways technology could be useful to business, communities, government, and other entities early in the development of the technology. But before community colleges can lead the way in technology transfer, they must address the issue of leadership. "When I think of the community colleges, I have a hard time defining their context in this arena," said Parker. However, he added that he is not criticizing community colleges but is setting out the challenge before them. "It is essential that community colleges establish a context in which to address change in terms of their communities." He told the two-year college participants that they have an obligation to redefine their leadership.

"Two-year colleges are uniquely equipped to make decisions in a rapid, mobile environment and they are usually well connected to the rest of the world," said Parker. Therefore, two-year colleges are poised to act as the "information utility" for their communities. Like the local service station or the power company, the successful technology transfer college can supply information to citizen consumers.

Other speakers included Bob Knox, Deputy Director of the Office of Environmental Justice within the U.S. Environmental Protection Agency; Elizabeth Teles, Program Director for Mathematics and Advanced Technological Education; James McKenney, Director of Economic Development for the American Association of Community Colleges (AACC); and Marjorie Buckholtz, Director of the Brownfields Group, U.S. Environmental Protection Agency Office of Solid Waste & Emergency Response.

Following the presentations, the participants broke into their assigned working groups and began to identify and prioritize what they believed were the most critical issues, using nominal group technique. Once the critical issues were identified, the working groups spent the afternoon and the following morning brainstorming and refining recommendations to address the issues. The technical chair for each group developed a rough draft of his or her group's recommendations. The draft reports were later sent to the working groups for their review and comments. After the group reports were compiled, each participant had the opportunity to submit revisions and write alternate recommendations to any part of the final report.

The next section of this document provides a participant's personal reflection on the issues and ideas presented at the Forum followed by detailed recommendations from the five working groups.

CLOSING

Two-year colleges must work cooperatively with business and industry, government, four-year institutions, secondary schools, and professional societies on ways to improve the quality of undergraduate education in order to meet the demands of the work place. No one group can do it alone; all must cooperate. Working together, academia and employers can improve the quality and effectiveness of mathematics, science, and environmental technology education at all levels. With continued support from the National Science Foundation and other organizations that share this vision, our nation will remain a leader in the world marketplace and meet the challenges of the future.

PERSONAL REFLECTIONS ON CRITICAL ISSUES

S. Merris Sinha, CET, CHMM
Consultant
Unlimited Learning

May 15, 1995

Let me start by saying that I am writing these comments as personal reflections on the issues and ideas presented at the Forum by the speakers and the participants. (Please pardon me for not crediting the specific individuals.) Below I have presented some of the main recurring ideas, issues and topics introduced during the Forum, and my own concerns and thoughts.

GROWTH OF ENVIRONMENTAL CONCERN

In the past, people did not see their environment as an asset to be protected, nor did they see health and safety of workers as an indisputable right of all employees.

Our planet and all of our natural resources have a quantifiable and finite economic value, approximately $360 quadrillion. It has been estimated that this value has eroded to about 80% or less since the dawn of industrial revolution. In the past, people did not see their environment as an asset to be protected, nor did they see health and safety of workers as an indisputable right of all employees. Today, notable increases in concern for these issues have occurred in all factions of our society, including industry and educational organizations. Citizen and not-for-profit organizations are inducing business to become better corporate citizens. Business for Social Responsibility, an alliance of over 750 member and affiliate organizations, helps member companies promote environmental causes through workplace donation to environmental groups and researches policies and programs affecting corporate responsibility. Citizen groups are having unprecedented clout over industry affairs and they have begun to tap the wellspring of corporate statesmanship as a valuable new funding source.

We continue to face environmental challenges, such as:
(a) proliferation of environmental regulations nationally and internationally, (b) stricter enforcement, (c) increased liabilities, (d) increased accountability, and (e) escalating environmental costs. Furthermore, many companies are confronted with other non-environmental issues such as varying cost structures, rapid technological changes, a fluctuating workforce, a demand for quality, and continued growth in global competition. Consequently, industries in the 1990's have to balance environmental concerns against these other issues, and the competition for limited dollars to address all these issues will be extremely keen. Therefore, to remain viable, management will be more focused to carry out cost-effective programs, education and training, and strategies.

Companies are realizing that they must create cleaner processes and products that contribute to profitability, rather than concentrate solely on pollution control.

A SHIFT TO "BEYOND COMPLIANCE"

Companies are realizing that they must create cleaner processes and products that contribute to profitability, rather than concentrate solely on pollution control. Reducing toxic chemical releases is increasingly considered good business and prudent environmental management. Many environmental, health and safety (EH&S) managers are seeking a competitive edge among environmentally conscious public and cost-minded competitors. Managers are looking beyond just compliance with EH&S regulations toward pollution prevention and waste minimization. The United States Environmental Protection Agency (USEPA) is promoting source reduction in the reauthorization efforts for the Resource Conservation and Recovery Act (a hazardous waste management regulation) and the Clean Water Act. EPA recently released a progress report for its "33/50" emissions reduction program which reported that 1,100 companies have pledged to reduce emissions of 17 target chemicals by a total of nearly 354 million pounds by 1995. The 33/50 Industrial Toxics Project has enticed large companies to pledge to significantly reduce chemical releases. In addition, EPA is encouraging the inclusion of pollution prevention projects for achieving compliance and of correcting violations when negotiating enforcement settlements.

A future trend will be toward regulation by industry rather than the historical approach of regulation by each specific medium (water, air, land).

The USEPA's New Chemicals Program is reviewing pre-manufacture notices to help identify pollution prevention options. The National Science Foundation recently founded the Emission Reduction Research Center as a resource for industry and government agencies interested in promoting pollution prevention in manufacturing. A future trend in EH&S regulations will be toward regulation by industry rather than the historical approach of regulation by each specific medium (water, air, land). A multimedia approach to preventing and reducing pollution with specific industries will be launched by the EPA in 1995.

Furthermore, the nature of the relationship between regulators and generators is shifting from adversarial to cooperative. Governments are looking beyond just environmental issues to include economics and are allowing for the business concerns of the private sector such as cost/benefit and risk analysis. In 1993, EPA unveiled its Environmental Leadership Program, which is intended to encourage and publicly recognize environmental leadership and promote pollution prevention in the manufacturing sector.

GREEN ECONOMICS AND ECO-JUSTICE

The "green" movement is forcing companies to design their products so the least amount of damage to the environment is accomplished. Therefore, companies are starting to look at the cycle of product development, from raw materials to disposal; this is in response to EPA changing how it looks at environmental problems,

not as problems in isolation, but as whole ecosystem problems. In addition, units formed under ISO 9000 standard (international quality standards, not regulations) have been created to develop standards for environmental management systems, audits, performance evaluation, product labeling and life-cycle assessment. ISO hopes to approve the final documentation in 1996.

Sustainable development and sustainable consumption—the idea of successfully integrating economic development, environmental protection and social equity—are being spearheaded by President Clinton and Vice President Gore.

Sustainable development and sustainable consumption—the idea of successfully integrating economic development, environmental protection and social equity—are being spearheaded by President Clinton and Vice President Gore. EPA also started moving towards environmental justice to promote equitable use of land for waste management so as not to unduly impact the economically disadvantaged in our society. The EPA Brownfields Economic Redevelopment Initiative—that is, revitalization of industrial and commercial properties in the inner cities where redevelopment is hindered by potential environmental contamination—is a burgeoning issue. There is a compelling trend toward involvement of the diverse cultures of our population and increased sensitivity to and support of their needs. For example, the EPA is working with the Hazardous Materials Training and Research Institute to expand training and curriculum development to at least twenty community colleges located near Brownfields pilots. EPA Brownfields staff, local contacts, and community colleges such as Cuyahoga Community College in Cleveland, Ohio, have already established a partnership, where the College is developing long-term plans for fostering workforce equity through environmental education, vigorous recruitment of students of color, and high quality worker training. Furthermore, EPA is working closely with states, municipalities, business and environmental communities to develop plans that further economic redevelopment goals.

SKILLS GAP

The flourishing of environmental awareness affords increased opportunity to the environmental market innovator, and increased responsibility and burden on established businesses. New approaches to solving old problems offer great potential for creating sizeable, profitable business niches. So, it is no surprise that this growth of the EH&S industry has necessitated the growth of demand for competent and skilled workers.

The need to integrate EH&S technical skills with workforce basic skills is also essential. It is estimated that 75 percent of American workers will need retraining by the year 2000 to meet the demands of the changing workplace. Fierce foreign competition has spurred many American companies to improve quality and boost productivity. However, when companies undertook a transformation, there was a holdup—longtime employees lacked the basic reading, writing and math skills to carry out the quality measures on the shop floor. Problem solving skills and other

employability skills such as writing, creative thinking, decision making, team building, and learning how to learn are regarded as abilities needed to be an effective performer. If we do not cultivate workers competent in basic skills, and also specific technical skills, then we will become a dinosaur in the global marketplace.

PROCESS NEEDED

The United States remains the only industrialized nation without standards to define skills required for industrial occupations. Therefore, schools and colleges are preparing learners for occupations without any effective, clear-cut guidance.

The United States remains the only industrialized nation without standards to define skills required for industrial occupations. Therefore, schools and colleges are preparing learners for occupations without any effective, clear-cut guidance. This Forum was designed to address this crucial need. It was apparent during the Forum that the terms "environmental technician" and "environmental technology" need to be clearly defined. In the future, a distinct definition will help to identify the difference between engineers, scientists and other specialists in the EH&S industry. The "technician" can then be marketed effectively to the end user two-year colleges; otherwise, the relationship between a technician and other EH&S specialists will be muddled and unnecessarily complicated. As two-year colleges develop and set up environmental technician programs, they must also become the "hub" for distribution, interpretation and "brokering" of EH&S technological innovations. This movement will also improve the perception of two-year colleges by the educational and professional community.

Two-year colleges must broaden their scholarly responsibilities to form partnerships with small, medium and large companies to ensure that theory is also being put into practice. Similarly, two-year colleges need to accept the responsibility of connecting knowledge and professional education with community goals and ethical standards. Faculty must expand their roles from just disseminators of usable knowledge, to also interpreters of knowledge; this can be accomplished through use of education-to-work cooperatives, internships, sabbaticals, conferences and workshops. Faculty must use various learning and delivery styles, including distance learning and multimedia technology, to enable learners from diverse cultural backgrounds to become actively involved in the process. Instructor involvement with EH&S practitioners must be increased to improve their competence and relate new knowledge to current issues and problems. Additionally, the curriculum developed for any EH&S technician must be flexible and quickly alterable to fit the needs of the community and employers and to adapt to new workforce trends, regulations and EH&S information.

The development of the two-year environmental technician program must be nationally usable, in that the program should be fairly uniform across the nation, but still be adaptable to the needs of the employers in the community.

Any tools that need to be developed to assist the development of the two-year environmental technician program must be nationally usable, in that the program should be fairly uniform across the nation, but still be adaptable to the needs of the employers in the

community. The curriculum must also be designed to allow for ease of transfer of credits from high schools to two-year colleges and from two-year colleges to four-year colleges (2+2+2.) Portions of the core program can come from an already nationally validated curriculum model (such as science or engineering technology) with supplemental EH&S specialty courses. Program developers should collaborate with existing accreditation boards and should design a peer review system to ensure a high quality, competency-based curriculum.

Regulators, community leaders, industry representatives, academic administrators and faculty, labor, and other stakeholders must be genuinely involved in developing competency-driven curricula.

It is vital that program design allow for flexibility in a learner's career path in this highly volatile and changeable industry. Since the EPA is heading toward regulating by industry rather than media, it will be critical for learners to know how to acquire technological and regulatory information and be able to apply it to a variety of industries. Consequently, regulators, community leaders, industry representatives, academic administrators and faculty, labor, and other stakeholders must be genuinely involved in developing competency-driven curricula. These partnerships will enhance the employability, acceptance and promotability of environmental technicians. The program can also offer a guarantee to the employers, with the aim of re-educating the learners who do not meet the agreed upon standards.

WORK GROUP REPORTS

CURRICULUM AND PROGRAM DEVELOPMENT

To develop and maintain a highly qualified workforce in the environmental technology field will require that all stakeholders work cooperatively.

As discussed in the introduction of this report, there is broad agreement throughout the nation that if the United States is to maintain a position of economic and political leadership in the world, fundamental changes must take place in the educational programs that support the workplace. To develop and maintain a highly qualified workforce in the environmental technology field will require that all stakeholders work cooperatively. Two-year colleges must enhance their working relationships with employers as well as professional societies to ensure the relevance of the curriculum. In addition, two-year colleges must work closely with secondary schools and four-year institutions to ensure a smooth transition for students from one level to the next.

Following are critical issues and recommendations that address curricula and program development for the environmental technology field.

ISSUE: As environmental technology and workplace demands rapidly change, two-year college environmental technology programs must be kept current and competency-based.

Design a comprehensive educational program for environmental technology.

RECOMMENDATIONS: The environmental technology program must assure that its curricula meet the career skills standards of the employment opportunities for which the program is designed. The environmental technology program may include all or specific traditional environmental disciplines (water, wastewater, hazardous materials, land and air) and the employer needs of a region. The program must implement national employer-recommended base skills that include oral and written communications, math, science, troubleshooting, critical thinking, and teambuilding.

Program design must merge workplace demands and society's needs and must implement the recommendations from a variety of state, regional and national skills standards projects.

It is imperative that curricula be continually reviewed and validated to meet the employment needs of the environmental technician workforce.

Thus a successful environmental technology program must:

- Incorporate environmental justice issues into environmental curricula;
- Ensure that curricula interrelate air, land, and water issues, regulations, and environmental technologies;
- Integrate business, environmental ethics, and critical thinking skills into curricula;
- Ensure that programs are competency-based;
- Ensure that programs emphasize life-long learning;
- Incorporate into the curricula concepts from the quality movement to ensure that technicians have the ability to work in groups and to do basic statistical process control;
- Coordinate across institutional boundaries to ensure program continuity;
- Coordinate across academic disciplines to ensure appropriate course offerings;
- Use nationally validated skills standards adapted to include local employment needs; and
- Integrate technical, related academic, and employability skills (i.e., SCANS Report) into a comprehensive educational program.

Seek ways to make the transition from school to work more efficient.

ISSUE: With the diversity of students currently in environmental technology programs, we must seek ways to make the transition from school to work more efficient. Further, articulation between secondary school programs and postsecondary technical programs is being advocated and supported by government, business, industry, labor and education leaders.

Strive for seamless educational offerings.

RECOMMENDATIONS: Two-year colleges, in collaboration with employers, must assess and define the career paths associated with environmental occupations and align their curricula accordingly. The following recommendations will assist in achieving this goal:

- Define career paths associated with environmental occupations;
- Determine the entry-level knowledge, skills, and abilities that should be taught in a two-year degree program, compared to diploma, certificate, or 4-year degree programs;
- Plan for flexibility across career paths;
- Strive for seamless educational offerings between secondary and

Develop institutional partnerships/alliances with academia, business and industry, government, and labor.

postsecondary programs and inform students of potential additional program requirements for transferability; encourage the development of 2+2+2 articulation agreements; and

- Coordinate across disciplines to encourage the integration of environmental issues into the general education curricula.

ISSUE: To develop the education and careers of environmental technicians, two-year colleges should be partners with employers, environmental professional societies, and certification and accreditation institutions.

RECOMMENDATIONS: Two-year colleges must establish partnerships to address the professionalism of technicians. Employers who demand top quality technicians must ensure that two-year colleges have appropriate resources and should encourage their own employees to utilize these resources. Better partnerships must be leveraged and new creative opportunities tried.

These partners may be business; industry; local, state and federal government agencies; professional societies/organizations; labor; and academic institutions. Two-year colleges, with their partners, should:

- Strive for a seamless transition between education and employment;
- Build school-to-work strategies such as internships and co-op programs;
- Encourage awareness of environmental careers in elementary and secondary schools; for example, support job shadowing programs;
- Explore apprenticeships with local labor organizations;
- Recruit educational resources from government, business and industry, and labor;
- Develop articulation agreements with industry training programs;
- Develop relationships among industry training providers and educational institutions to facilitate cost-effective education; and
- Promote involvement of faculty and students in professional organizations.

ISSUE: The demands of an ever-changing environmental work place and societal needs will require two-year colleges to implement

recommendations from a variety of skills standards projects to ensure that students successfully enter an environmental career path.

RECOMMENDATIONS: Several professional societies/ organizations, state agencies, and labor groups have implemented various certification programs to promote quality assurance standards for the environmental workforce. To ensure that faculty and environmental technology programs are held to high quality assurance standards, the recommendations of accreditation organizations should be addressed.

To assure top quality graduates, faculty, and programs, two-year and four-year colleges should:

- Establish an internal quality assurance program for students, faculty and curricula to ensure competency-based programs;
- Utilize available model accreditation programs;
- Establish pre- and post-assessments to ensure achievement of competencies;
- Develop a peer review accreditation program (collaboration with existing accreditation agencies should be explored); and
- Conduct local, regional, and/or national validations of competency-based programs.

Implement financial, facility, human and information resource development.

ISSUE: In order to offer successful, high quality graduates, environmental technology programs require support in many ways, including financial security for the program, up-to-date skilled and educated faculty, and the availability of state-of-the-art information services.

RECOMMENDATIONS: To attain financial, facility, human, and information resource development, two-year colleges should:

- Implement instructional methodologies that meet the needs of a diverse population; requiring that faculty be well-versed in these methodologies; and providing training to those faculty who need increased experience in various instructional methodologies;
- Encourage advanced education for instructional staff;
- Establish minimum faculty standards;
- Utilize students for environmental jobs at the institution;
- Incorporate access to electronic information systems for students and faculty;

- Develop matching grant or in-kind cooperative agreements with business and industry;
- Become a technical resource for government and for business and industry;
- Develop partnerships with business, industry, labor, and government institutions for access to sites, facilities, equipment, and supplies; and
- Promote instructor internships with government, business and industry, and other academic institutions.

A variety of instructional delivery systems are needed to meet the needs of a diverse student body.

ISSUE: A variety of instructional delivery systems are needed to meet the needs of a diverse student body; however, program budgets are limited.

RECOMMENDATIONS: To meet the needs of a diverse student body and to optimize program budgets, two-year colleges must access fully and improve upon their instructional delivery systems. These instructional delivery systems may involve classroom, shop, laboratory, simulations, pilot systems, correspondence courses, computer-aided instruction, satellite/broadcast delivery, and virtual reality. Programs may be offered during the day and evening and for credit and noncredit, to meet the needs of students and employers. The delivery system utilized must be appropriate to the needs of the student population.

Two-year colleges must access fully and improve upon their instructional delivery systems.

To improve and fully access their instructional delivery systems, two-year colleges should:

- Investigate uniform standards for alternative delivery systems;
- Ensure quality of alternative delivery systems;
- Utilize the full capabilities of available learning technologies;
- Adapt delivery systems to target populations and populations with special needs; and
- Ensure adequate faculty training and awareness of instructional delivery systems and facilities (i.e., multimedia equipment and distance learning technology).

Allow credit for relevant short-term training and work experience towards formalized certificate, diploma, or degree-granting environmental programs.

ISSUE: The nation's continually changing workplace demands ongoing training and retraining of its workforce. As a result, it has become evident that we need to facilitate the pathway for individuals to obtain certification, diplomas, and degrees by accepting credit for prior relevant training and work experience.

RECOMMENDATIONS: Two-year colleges should consider a

procedure to allow credit for relevant short-term training and work experience towards formalized certificate, diploma, or degree-granting environmental programs. Two-year colleges should:

- Incorporate mechanisms to assess and grant credit for prior learning and work experience;
- Provide a bridge programs to meet minimum competency requirements;
- Develop alliances between noncredit and credit programs; and
- Explore joint use of faculty and facilities between short-term, noncredit, and credit programs.

Citizens should have the opportunity to receive environmental awareness education.

ISSUE: The environmental movement towards a "green community" and environmental compliance can only be achieved with overall environmental awareness by the citizens of this country.

RECOMMENDATIONS: Citizens should have the opportunity to receive environmental awareness education. One way to achieve this is to integrate environmental awareness issues into the traditional secondary and postsecondary curricula. Two-year colleges should:

- Strive to be an institutional model of environmental health and safety compliance;
- Promote environmental enrichment activities on campus;
- Promote the development of student involvement in environmental clubs/organizations; and
- Encourage integration of environmental issues into traditional curricula at elementary, secondary, and postsecondary institutions.

EMPLOYMENT NEEDS

The environmental technology field lacks a clear definition of what constitutes the environmental workforce.

One of the most critical issues facing both employers and educators at the postsecondary level is creating a balance between the supply and demand in the myriad career fields that support our national economy. Forecasting future workforce numbers in these career fields or clusters has traditionally been an elusive and difficult task. In the environmental technology field this is even more problematic, because we lack a clear definition of what constitutes the environmental workforce.

In 1993, Environmental Business International (EBI) Inc. identified a need for over one million jobs in more than a dozen different environmental industry segments, nearly one out of every twelve jobs for the economy as a whole. But even that number does not account for everyone employed in the environmental technology field. "EBI estimates that another one-half million environmental workers are employed in the public sector." (Green, p. 3)

Until recently, public support for environmental issues drove the creation and implementation of legislation and regulations that ultimately resulted in the funding allocated to the environmental field. Thus, environmental jobs were created primarily as a result of enforcement to protect public health, workers' health, and the overall environment. Now, however, there is a new growth in environmental jobs because many environmental practices such as pollution prevention strategies increase business profits. Almost all experts in the industry believe continued economic growth will result in additional job creation.

Kevin Doyle, Director of Research and Publication for the Environmental Careers Organization in Boston, predicts that both the kinds of workers needed and the education required of them will change. Doyle says "Workforce training needs are changing all the time. The trend is going in both directions, toward the person with a master's and the person with a two-year degree. The one who's going to get left out is the person with a general bachelor's degree." (Green, p. 3).

Frequently, two-year colleges fill the void between a high school diploma and a bachelor's degree as well as meet the retraining needs of the displaced workforce. Many believe these schools will provide most of the career-oriented education and training for the next century. That forecast is most realistic in the environmental technology field.

An in-depth examination of the public and private sector marketplace is essential for the development and implementation of environmental education programs that will provide graduates with the knowledge, skills, and abilities to obtain jobs, perform

successfully, and advance in their career fields. Following are issues and recommendations that address current and future employment needs.

ISSUE: Because there is no common, agreed-upon definition for the terms "environmental technician" and "environmental technology," two-year colleges are lacking clear-cut parameters for preparing learners for occupations in this field.

Define/clarify what is meant by the "environmental technology" field.

RECOMMENDATIONS: Define/clarify what is meant by the "environmental technology" field. In order to define this field, two-year colleges should work collaboratively with business and industry, government, and professional organizations to:

- Develop common language and terms to be used in the environmental technology field;
- Define "environmental technician" and the job categories and/or skills it would include; and
- Identify specialty areas for environmental technicians (e.g., hazardous waste management, pollution prevention, air quality, soil, water quality, water supply, solid waste, bioremediation, biohazardous wastes, and radiation).

ISSUE: Forecasting workforce needs has been an elusive and difficult task because of, in part, the lack of a clear definition of what constitutes the "environmental technology" career field.

RECOMMENDATIONS: To identify existing and emerging jobs within the environmental technology career field, two-year colleges should:

Identify existing and emerging jobs within the environmental technology career field.

- Conduct ongoing needs assessments of the private and public sector both prior to and during the development and implementation of a program;
- Seek input from federal and state environmental agencies on potential needs as a result of proposed regulations;
- Seek input from senior executive/strategic planners regarding their view of future employment trends (including number of future jobs as well as knowledge, skills, and abilities required); and
- Identify career ladders within the environmental career field.

ISSUE: Academia, business and industry, professional societies, and government have often worked in isolation from each other.

To develop and maintain a qualified workforce in environmental technologies requires that all stakeholders work cooperatively.

RECOMMENDATIONS: To develop and maintain a qualified workforce in environmental technologies requires that all stakeholders work cooperatively; therefore, two-year colleges should:

- Become customer-driven and respond to employers' needs. This includes providing for continuing education and/or retraining of current employees;
- Include small, medium, and large employers through organizations such as the Chamber of Commerce; for example, form an environmental roundtable sub-workgroup;
- Determine local employers who are at risk environmentally and who need the two-year college to help them with problem solving;
- Seek to become brokers who bring two cultures (employer and educator) together, serving as translators of terminology, and creating a sense of common ownership among all players;
- Foster win-win situations among the partners;
- Promote colleges and universities as resource centers for employers and community;
- Develop modular and portable curricula to meet and exceed employer and community needs;
- Share resources with other schools, including secondary, two-year, and four-year institutions; and
- Ensure commitment to employers by guaranteeing results and performance after placement of graduates. This may be achieved by developing learning contracts with partners and offering assurances on meeting established performance objectives. Student internships, mentorships, and co-ops with employers should be created as well as memoranda of understanding (M.O.U.) and/or contracting mechanisms to "partner" with employers.

ISSUE: The United States remains the only industrialized nation without standards to define skills required for industrial occupations. Therefore, schools and colleges are preparing learners for occupations without any clear-cut guidelines.

Identify and standardize core proficiencies in environmental technology curricula.

RECOMMENDATIONS: To identify and standardize core proficiencies in environmental technology curricula, two-year colleges, in cooperation with industry and professional societies, should:

- Provide a basic environmental technology curriculum that creates a long-term educational foundation, while satisfying the immediate needs of the rapidly changing workforce. Such a curriculum should:

  - Establish a general education component, including mathematics and science, written and oral communication, computer skills, as well as prerequisites to technical and discipline-specific courses;

  - Develop a core technical component encompassing discipline-specific courses and training skills that are fundamental to the field of environmental science technology, including instruction in values and business ethics for the environmental technician; and

  - Create a job-specific component to include standard job skills developed for a specific environmental science technology (i.e., hazardous waste technician, air quality technician) as well as retraining skills for local needs and technology changes.

- Determine the knowledge, skills, and abilities that should be taught at each educational level;

- Identify current certifications;

- Explore and define future certifications;

- Design/adapt curricula and teaching methodology for training and retraining of existing workforce;

- Establish subject matter expert teams;

- Establish dissemination methodologies;

- Ensure continuous improvement of curricula; and

- Review the above-listed products and processes on a regular basis to validate that curricula are meeting employment needs.

"Environmental technicians" have not been clearly defined and differentiated from engineers, scientists, and other professionals in the environmental field.

ISSUE: "Environmental technicians" have not been clearly defined and differentiated from engineers, scientists, and other professionals in the environmental field.

RECOMMENDATIONS: Market "environmental technicians" to business and industry, government, and the community. Two-year colleges should:

Market "environmental technicians" to business and industry, government, and the community.

- Develop a consensus view of what environmental technician means locally, regionally, and nationally;
- Develop an awareness of the value of the associate degree and establish the two-year degree as the criterion for the "environmental technician" title;
- Seek accreditation from appropriate agencies;
- Identify client base such as local, state, and federal governments and business and industry;
- Develop and implement a formal marketing plan that includes goals, measurable objectives, concrete tasks, and specifications that define responsibilities;
- Develop marketing pieces (e.g., brochures, pamphlets, and other advertisements);
- Develop the ability to meet short-term environmental training needs in the workforce; and
- Articulate short-term training programs with associate degree programs.

ISSUE: Until recently, employers often believed that environmental practices and staff cut into profits. Now, however, employers are beginning to see the benefits of environmental efforts.

Promote the improved quality of life and economic benefit to the employer and the community as a result of environmental technology efforts.

RECOMMENDATIONS: Promote the improved quality of life and economic benefit to the employer and the community as a result of environmental technology efforts. To promote benefits, two-year colleges should:

- Educate the public on global "green" economics/workforce and the international quality standards for environmental issues;
- Educate employees about the global and cultural context in which they work;
- Educate employees on the Total Environmental Quality Management (TEQM) process: that environmental compliance/ performance can have a positive economic effect on business;
- Market environmental services as a front-end component of business (rather than back-end compliance) emphasizing pollution prevention and cost savings;

- Establish a public speaking bureau in which environmental technicians become spokespersons/advocates for the nonscience community; and

- Track graduates' employment histories to demonstrate sustained value of investment for education.

ISSUE: Legislation has an impact upon the workplace as well as the community.

Review current and proposed legislation and determine its impact on the workplace and the community as a whole.

RECOMMENDATIONS: Review current and proposed legislation and determine its impact on the workplace and the community as a whole. Two-year colleges should:

- Provide a methodology to review current and proposed legislation;

- Determine the impact on current and future workforce needs;

- Seek opportunities to influence proposed legislation;

- Educate employers and students on legislation and regulations; and

- Position themselves as clearinghouses of information on existing legislation and regulations; for example, disseminating "user friendly" interpretations of legislation and regulations to the community.

ENVIRONMENTAL EQUITY AND HUMAN RESOURCES

The concept of environmental equity implies that some populations, particularly minorities and those of low income, are disproportionately exposed to environmental injustices.

The concept of environmental equity implies that some populations, particularly minorities and those of low income, are disproportionately exposed to environmental injustices. The major concern of environmental equity is expressed in the idea that minority and low-income residential neighborhoods are most proximate to elevated concentrations of environmental hazards such as waste treatment facilities, waste dumps, incinerators, landfills, and other industrial and commercial toxic release sites.

According to the United States Environmental Protection Agency (EPA), environmental justice is defined as "the fair treatment of people of all races, cultures and income with respect to the development, implementation and enforcement of environmental laws, regulations, and programs and policies. Fair treatment means that no racial, ethnic or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from the operation of industrial, municipal and commercial enterprises and from the execution of federal, state and local, and tribal programs and policies."

In 1990, the EPA Science Advisory Board issued a report entitled *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*. This report recommended that EPA "target its environmental protection efforts on the basis of opportunities for the greatest risk reduction." In July of 1990, EPA Administrator William K. Reilly formed the EPA Environmental Equity Workgroup. The charge to the Workgroup was to assess evidence that racial minority and low-income communities bear higher risk burden than the general population. In February 1992, the Workgroup issued a draft of its report, entitled *Environmental Equity: Reducing Risk for All Communities*.

The Report defined "environmental equity" as embracing three main concerns: (1) the environmental policy-making process; (2) the administration of environmental protection programs; and (3) the distribution and effects of environmental problems. Environmental policy-making, according to the Report, raises issues about the access of racial minority and low-income communities to the process. This, in turn, requires the need for hiring more minorities in policy and decision-making positions and managing programs.

The connection between economic distress and the location of toxic waste facilities has been clearly established and widely accepted in the fields of environmental technology and education. In response to these concerns, a number of federal agencies have turned their collective attention to the problems of environmental justice and

equity. A recent collaborative report from the EPA, the Food and Drug Administration (FDA), and the Occupational Safety and Health Administration (OSHA) strongly encourages the transfer of knowledge from the research institutions and federal laboratories to the general public via two-year colleges (EMCT3I Final Report, p. ES-2). Because of two-year colleges' geographic locations and relatively low tuition rates, these institutions can play a pivotal role in assuming major responsibility for initiating an acceptable remediation process. Through leverage of resources and cooperative efforts, funded in large part by federal grants, important community college activities are already underway in this critical area.

Providing accessible, quality education and training that meets the needs of learners with diverse backgrounds and learning styles is the mission of all two-year colleges. Two-year college leadership and commitment are essential for developing an effective environmental technology education program. This effort must incorporate environmental equity to ensure equal participation and representation of a diverse population.

The concepts of "environmental justice and equity" are not usually addressed in environmental technology programs.

ISSUE: The concepts of "environmental justice and equity" are not usually addressed in environmental technology programs.

RECOMMENDATIONS: To create an environmental technology program that incorporates the concepts of "justice and equity," two-year colleges should provide environmental enlightenment and enrichment activities for the general public, and most importantly, for communities of diversity. These environmental activities require the involvement of other community organizations, agencies, and institutions who are stakeholders in resolving environmental inequity. It requires that two-year colleges lead in community and individual renewal. To accomplish this goal of enlightenment about environmental justice and equity, two-year colleges should:

Two-year colleges should provide environmental enlightenment and enrichment activities for the general public, and most importantly, for communities of diversity.

- Collaborate with local grass roots/community groups to identify environmental issues in their own communities;
- Provide communities of diversity with greater opportunities to understand the principles of environmentalism, community rights, and the needed training to help reduce environmental risks in their communities;
- Integrate environmental and social/economic issues into curricula;
- Provide education and training, so that communities of diversity can be better informed and involved in decisions affecting their communities;
- Create forums where communities engage in enlightening environmental awareness dialogues with leaders of color who

are recognized and accepted by diverse groups;

- Provide for youth environmental awareness experiences that promote sustainable development and environmental citizenship;
- Identify formal and informal leaders of affected communities of diversity;
- Seek funding to support community outreach/education initiatives; and
- Evaluate impact of environmental awareness activities and initiatives.

ISSUE: Generally, the environmental field has done a poor job of attracting and retaining people of color (African Americans, Asian Americans, Latino Americans, and Native Americans). However, in recent years, this has begun to change because employers are aware that the United States is becoming more multicultural and that people of color represent the fastest growing sector of people entering the labor force.

To create a diverse workforce, environmental technology programs must be designed to attract and prepare students of color for environmental jobs.

RECOMMENDATIONS: To create a diverse workforce, environmental technology programs must be designed to attract and prepare students of color for environmental jobs. Colleges must develop, implement, and regularly evaluate a "student success" action plan that will:

- Create a broad-based awareness that student success, satisfaction, and retention rates are the responsibility of faculty, staff, and support personnel college-wide;
- Outline specific steps that faculty, staff, and support personnel must do to help students succeed at their college;
- Provide support services and academic enrichment programs to increase retention and graduation rates;
- Develop marketing strategies that reflect the diversity of environmental technology careers as well as the opportunities for advancement; utilize persons of color as mentors and role models;
- Provide internship/co-op opportunities that actively involve students in environmental issues;
- Encourage industry participation, parental involvement, and student/faculty interaction;

- Create student support/study groups and student organizations;
- Make developmental courses relevant, contextual, and interesting;
- Provide scholarship opportunities and recognition awards to attract and encourage gifted and talented students of color; and
- Evaluate student and program outcomes regularly.

The number of nontraditional students with diverse backgrounds and needs is growing.

ISSUE: The number of nontraditional students with diverse backgrounds and needs is growing.

RECOMMENDATIONS: Environmental technology programs must develop initiatives to meet the needs of a diverse student population and to provide a learning environment that fosters student persistence and success. This can be accomplished if colleges:

Environmental technology programs must develop initiatives to meet the needs of a diverse student population and to provide a learning environment that fosters student persistence and success.

- Recognize diverse experiences, backgrounds and learning styles, and exercise sensitivity towards nontraditional students;
- Encourage cross-cultural communication, in which differences in background, life experience, and values are acknowledged to foster mutual understanding;
- Provide remedial courses and services, life skills and career exploration coursework, and work experience opportunities;
- Provide flexible training schedules, such as education at the workplace, distance learning opportunities, and college credit for work/life experiences;
- Provide alternative teaching/learning methodologies;
- Collaborate with community-based organizations to prepare high school students for college work;
- Provide proactive guidance counseling and developmental academic advising;
- Assess how well students' needs are being met on an ongoing basis; and
- Adequately assess student needs prior to entering an environmental technology program to determine appropriate support services. Providing appropriate support will help ensure student success in the program.

ISSUE: More students will be enrolling in community colleges in need of increased and better support and structure than ever before. Consequently, the role of support services is crucial in fostering student persistence and achievement.

Two-year colleges should provide support services designed to promote academic achievement among a diverse student population.

RECOMMENDATIONS: The nation's schools must develop and implement programs that are educationally sound and provide the best opportunities to improve student success. Thus, two-year colleges should provide support services designed to promote academic achievement among a diverse student population. These support services should:

- Identify specific deficiencies in the educational preparation of prospective student populations with diverse backgrounds;
- Establish a pre-environmental technology learning center to assist academically disadvantaged students in overcoming deficiencies prior to enrolling in an environmental technology program;
- Assist students in the enrollment process to ensure a smooth transition;
- Provide assistance in obtaining financial support;
- Assist students in finding solutions to personal problems that are hindering their academic success by connecting them with appropriate social services;
- Enlist the aid of the community in fulfilling student needs;
- Provide orientation programs which help students develop an awareness of educational or career goals; and
- Document the positive impact that student support services can have on student persistence and success.

Research suggests that a diverse faculty can serve as positive role models and influence motivation and persistence in students of color.

ISSUE: Research suggests that a diverse faculty can serve as positive role models and influence motivation and persistence in students of color. Faculty diversity is a critical part of any environmental technology program addressing equity.

RECOMMENDATIONS: To achieve faculty diversity, the following steps must be taken:

- Acquire a "top-down" commitment from the president, administrators, and faculty to hire a multicultural staff;
- Foster faculty, staff, and community acceptance and respect for student diversity;

People of color represent a significant and ever-increasing number of the United States' future workforce. The investment private industry devotes to this segment of our society could reap enormous profits in the long run.

- Provide faculty/staff development regarding the needs of diverse student populations and their preferred modes of learning;
- Appoint individuals of diverse backgrounds to the college's board of trustees; and
- Utilize diverse industry personnel as adjunct faculty.

ISSUE: Clearly the private sector has a stake in environmental education and equitable training of diverse groups. People of color represent a significant and ever-increasing number of the United States' future workforce. The investment private industry devotes to this segment of our society could reap enormous profits in the long run.

RECOMMENDATIONS: Private industry can promote environmental education and the career opportunities available by doing the following:

- Sponsor apprenticeship, internship, and training programs in communities of diversity;
- Help coordinate and fund scholarship programs for students of color;
- Specify current and future occupational skill requirements;
- Provide diverse representation on advisory/planning and curriculum committees;
- Provide and maintain accurate labor market information;
- Establish independent study projects for credit;
- Evaluate relevance and applicability of an environmental technician program and how it meets the needs of industry; and
- Provide "on-loan" technical professionals who will work with high school students, motivating them to explore environmental careers. For example, create a public speaking bureau for schools and civic organizations.

PROFESSIONALISM

Environmental technicians are increasingly performing the front-line work of environmental remediation, pollution control, and pollution prevention and should be recognized as professionals for their important contribution.

Environmental technicians are increasingly performing the front-line work of environmental remediation, pollution control, and pollution prevention and should be recognized as professionals for their important contribution. In conducting their work, environmental technicians utilize a wide array of processes, techniques, and technologies, which are generally not well known or understood outside of very specific technical disciplines. Academic institutions, scientific professional societies, accrediting bodies, and employers need to understand the professionalism associated with environmental technicians.

The critical issues in professionalism were divided into three major areas: students, faculty, and programs. Unique concerns were identified for each of the three areas and a number of issues were highlighted that were common to all three.

STUDENT ISSUES

ISSUE: Most students are not aware of the variety of environmental careers available, especially at the technician level.

Technicians are not "junior engineers" but valued professionals with their own set of skills and expertise.

RECOMMENDATIONS: The student should understand the role of environmental technicians in the workplace—that technicians are not "junior engineers" but valued professionals with their own set of skills and expertise. Two-year colleges should:

- Encourage prospective environmental students to visit industries to see firsthand what a possible environmental career may entail; and
- Obtain or develop environmental career resource materials, such as books and videotapes, to provide to students.

The underlying communication, math, and science knowledge and skills required of environmental technicians have not been identified.

ISSUE: The underlying communication, math, and science knowledge and skills required of environmental technicians have not been identified.

RECOMMENDATIONS: Define basic communication, math, and science (including an understanding of the earth's basic physical and ecological processes) knowledge and skills needed by environmental technicians. Two-year colleges should:

- Initiate the definition through ATEEC/NSF Fellows Institute;
- Involve technicians and employers in the definition process;
- Define and categorize the types of environmental technician positions and developing voluntary standards for communication, math, and science course content; and

- Establish local private/public committees (alliances) to customize voluntary guidelines.

Develop an appropriate nationally recognized technician/operator certification process as an entrance to employment.

ISSUE: Environmental technician certification would assure employers that workers are qualified.

RECOMMENDATIONS: Develop an appropriate nationally recognized technician/operator certification process as an entrance to employment. Certification components should include:

- Written test on knowledge;
- Hands-on testing of skills (based on specific programs, if available);
- Work experience (may need to establish a minimal experience level);
- Recommendations of industry/peers (develop a local consortium of local employers, peers, faculty, etc.); and
- Required course work.

Communication skills are essential in many tasks performed by environmental technicians.

ISSUE: Communication skills are essential in many tasks performed by environmental technicians.

RECOMMENDATIONS: Since communication skills are as important to employers as technical skills, two-year colleges should:

- Incorporate communication skills across the curriculum; and
- Incorporate SCANS skills, which include competencies and personal qualities that are essential preparation for all students. These skills are listed in the report from the Secretary of Labor and the Secretary's Commission on Achieving Necessary Skills (SCANS).

Continuing professional development will be critical throughout environmental careers.

ISSUE: Because environmental technologies and regulations change rapidly, students and graduates must recognize that continuing professional development will be critical throughout their careers.

RECOMMENDATIONS: Two-year colleges should:

- Encourage professional societies and associations to promote affiliations, programming, publications, and local chapters;
- Encourage employer support through work/study programs;
- Encourage colleges to establish relationships with local chapters to promote and enhance networking; and

Educational institutions need to heighten the awareness of life-long learning.

- Heighten the awareness of life-long learning.

ISSUE: Experiential learning activities and internship programs would better prepare students for the workplace.

RECOMMENDATIONS: Two-year colleges should:

- Promote a nationwide program placing students in internships that are locally implemented to meet employers needs; an organization such as PETE and ATEEC could implement a national environmental internship clearinghouse;
- Investigate issues of liability and blanket insurance coverage for students participating in an internship program;
- Develop state/local clearinghouses that interact regularly with a national clearinghouse established to promote work experience/ internship opportunities and full-time employment upon graduation; and

Require experiential learning/internship for program completion.

- Require experiential learning/internship for program completion. The workplace activity could occur part-time during the semester or full-time during the summer. Experiential learning/ internships must have commitment from the top administrative level.

FACULTY ISSUES

A system of assessing technical experience and teaching skills should ensure that full-time and adjunct faculty members are qualified.

ISSUE: A system of assessing technical experience and teaching skills should ensure that full-time and adjunct faculty members are qualified.

RECOMMENDATIONS: Two-year colleges, in cooperation with industry and professional societies, should:

Faculty should be encouraged to possess certification in adult learning.

- Set base standards including technical content and instructional technology excellence with reference to national voluntary industry standards and/or accreditation programs. Faculty should be encouraged to possess certification in adult learning such as the Certified Environmental Trainer (CET) established by the National Environmental Training Association. The CET program measures the instructional competency and confirms the technical expertise of the environmental professional. The program advisory board, alliance, or administrators should establish local guidelines. The guidelines should include evaluation of previous employment, reference checks, educational background, professional affiliations, and community involvement.

Faculty should participate in continuing education and professional development experiences.

ISSUE: Because environmental technologies and regulations change rapidly, faculty should participate in continuing education and professional development experiences.

RECOMMENDATIONS: Two-year colleges, in cooperation with industry and professional societies, should:

- Develop a national program to facilitate faculty professional development in the public/private sectors such as summer internships, sabbaticals, or other opportunities;
- Support the national professional development program through information networks (electronic and print); and
- Enable faculty to participate in professional society and organization opportunities (conferences and short courses).

ISSUE: The recruitment and retention of faculty can be challenging for two-year colleges since industry tends to pay higher wages.

RECOMMENDATIONS: Two-year colleges should:

- Utilize private industry and professional society connections to recruit adjuncts; increase adjunct faculty pay in order to attract and retain industry professionals;
- Support overload opportunities to supplement full-time salaries (e.g., co-op teaching, tenure, paid professional development opportunities); and
- Encourage the recruitment of minority faculty.

PROGRAM ISSUES

ISSUE: Programs that are backed by an accrediting body, provide an indication that they are credible and consistent.

RECOMMENDATIONS: Two-year colleges should:

Encourage strong national accreditation and certification processes that provide a consistency of outcomes with flexibility for local customization.

- Encourage strong national accreditation and certification processes that provide a consistency of outcomes with flexibility for local customization; and
- Develop or team up with an existing national accreditation program for two-year environmental technology programs. Focus initial efforts on identifying communication, math, science (including an understanding of the earth's basic physical and ecological processes), and technical skills required for a broad-based environmental problem-solver. Supplement transferable credit core with short-term training for specific

needs and supplemental certification identified by a local alliance of employers, regulators, and educators.

Employers are often unaware of the competencies of environmental technicians.

ISSUE: Since employers are often unaware of the competencies of environmental technicians, two-year colleges must better market the associate's degree.

RECOMMENDATIONS: Two-year colleges, in cooperation with industry and professional societies, should:

- Identify by title the technical career fields and develop clusters on which to base the educational programs and certifications required for employment or to enhance employment opportunity success;
- Develop a national strategy for marketing two-year environmental technology programs and technician job placement; and
- Clarify the perception of technicians (both how technicians are perceived by the world and how technicians perceive themselves).

A basic core curriculum has not been established for environmental technology programs.

ISSUE: Because environmental technology programs are relatively new offerings in two-year colleges and because the programs are usually occupation-specific, a basic core curriculum has not been established.

RECOMMENDATIONS: Two-year colleges, in cooperation with industry and professional societies, should:

- Reach consensus on a recommended core curriculum, which would include general education requirements and introductory, prerequisite environmental technology courses;
- Develop an offering of occupation-specific emphases that accommodate local workforce needs; and
- Develop a system that requires periodic acquisition of continuing education units (CEUs).

TRANSFERABILITY OF CREDITS

A plan to facilitate communication and curriculum coordination among educational institutions would improve programs and better serve students, employers, and the community.

Although environmental technology programs have grown significantly at the postsecondary education level, curriculum coordination between secondary and postsecondary has been minimal. A plan to facilitate communication and curriculum coordination among educational institutions would improve programs and better serve students, employers, and the community.

A prerequisite for curriculum coordination and articulation is having courses and programs that are competency-based. At the two-year college level, these program outcomes need to match with the entry-level competencies required for new employees. At the secondary level, the program outcomes need to be matched with specific employment opportunities and must allow for transition into two-year college course work. Currently, many high school graduates seeking to enroll in an environmental technology program at a two-year or four-year institution find themselves inadequately prepared, especially in science and mathematics. Therefore, many students are required to begin their college education with "remedial" courses, thus increasing the financial burden on both students and colleges. Others may have to repeat course work at the post-secondary level that they have already mastered at the secondary level. Developing and maintaining a formal articulation process throughout an educational system would help provide students with a smooth transition from one level of instruction to another without experiencing unnecessary delays or duplication of learning.

Articulation should not be limited to the transferability of credit from high school to two-year colleges and from two-year colleges to four-year institutions; it must also include assessment of knowledge, skills, abilities, and competencies of interest to potential employers.

Furthermore, two-year college missions have an effect on the overall philosophy of transferability within the college system. College missions may vary from state to state and region to region within a state. If the primary mission of a two-year college is to prepare graduates for the workforce, then less emphasis will be placed on articulating their programs with a four-year institution. When two-year colleges have the dual role of workforce development and preparation for further education, these colleges will have a parallel track of transfer programs available and the college mission will dictate the amount of effort dedicated to each track. It is critical that the college's mission is made clear before beginning a 2+2+2 articulation effort.

In addition to the lack of communication and curriculum coordination among educational institutions, there is also a lack of knowledge about the career opportunities and the preparation

required to work in the environmental technology field. This includes the general public and, more importantly, educational institutions at all levels.

All transferability issues identified share a common need for funding. Financial support would allow faculty and staff the release time needed to share information, to coordinate their efforts in curriculum development, and to develop state and regional plans.

Following are issues and recommendations that address transferability of credit.

Communication among educational institutions and with the community is inadequate.

ISSUE: Communication is inadequate among high schools, postsecondary educational institutions, businesses, industries, and the community. Mechanisms to facilitate communication among representatives from high schools, community colleges, universities, and industries are lacking.

Two-year colleges should foster open, clear, and frequent communication among all parties.

RECOMMENDATIONS: To foster open, clear, and frequent communication, two-year colleges should:

- Establish formal mechanisms for networking among all parties such as:
  - Regular meetings among faculty and staff from high schools, community colleges, and four-year institutions;
  - Electronic bulletin boards;
  - An advisory board with representation from educational institutions, local community, relevant industries, and governmental agencies; and
  - Other formal and informal activities designed to build working relationships. These activities may include:
    - Site visits at schools, businesses, etc.
    - Curriculum and other program information exchange
    - Guest lecturers/faculty exchange from participating institutions.
- Provide release time to faculty and staff for meetings; and
- Create partnerships among academic, business, industry, government, and professional organizations.

If articulation is part of an institution's mission, articulation activities must be an integral part of the system.

ISSUE: Although articulation activities are occurring among different levels of educational institutions, the degree of activity and commitment varies from one community to another, from one educational institution to another, and even among departments within institutions. Articulation decreases when funding is not available to support the staff involved. If articulation is part of an

Articulation should be a part of every educational institution, with strong leadership and commitment at the top administrative level.

institution's mission, then articulation activities must be an integral part of the system.

RECOMMENDATIONS: Articulation should be a part of every educational institution, with strong leadership and commitment at the top administrative level. Secondary and postsecondary schools should:

- Provide release time to instructors for curriculum development and revision; before a school can begin articulation activities, its curriculum must be competency-based for faculty to be able to compare courses;
- Involve faculty and staff in the development of articulation procedures;
- Identify the math and science core competencies for each educational level;
- Compare, assess, and revise course content based on the identified math and science core for each educational level;
- Encourage revision of traditional math and science courses to incorporate critical and creative thinking skills, reduce memorization of facts, and increase the application of knowledge to real-life situations;
- Encourage high school and college instructors to work together to develop a recommended sequence of high school courses that will prepare students for college courses in an environmental program;
- Establish and maintain an electronic bulletin board directory of successfully articulated programs;
- Publish and distribute semester-by-semester curriculum materials of model programs;
- Develop and distribute an articulation guidebook that provides step-by-step instructions for effective articulation;
- Provide joint professional/staff development opportunities for faculty and staff at all educational levels;
- Hold local forums to enhance networking opportunities among community leaders and faculty and staff from all levels of educational institutions;
- Disseminate information and promote articulation agreements to students, teachers, counselors, parents, and employers; and

- Develop and implement a system to ensure that curricula are reviewed annually and articulation agreements are revised as necessary.

The majority of students are insufficiently prepared for technical programs.

ISSUE: The majority of students are insufficiently prepared for technical programs.

RECOMMENDATIONS: To help prepare students for technical programs, schools should:

- Expose elementary and high school students to the value of technical programs and career opportunities available;
- Use small-group discussion techniques to improve students' analytical skills;
- Provide continuing education on both technical topics and instructional methods for faculty at all levels of educational institutions;
- Obtain or develop valid techniques for the assessment of students' understanding of the process of science and their ability to use appropriate mathematics skills;
- Establish internship/co-op positions with local businesses; and
- Provide exchange opportunities for faculty with business and industry.

A poor perception of environmental studies and earth science courses is common among educators, parents, students, and the public.

ISSUE: A poor perception of environmental studies and earth science courses is common among educators, parents, students, and the public. Such courses are often viewed as inferior and are populated with students who are not preparing for a technician/ technologist career.

RECOMMENDATIONS: To create a positive perception of environmental studies and earth science courses as well as the environmental field, secondary and postsecondary schools should:

- Publicize and promote exceptional courses that already exist;
- Host career days and distribute information on environmental employment opportunities, job responsibilities, and salary ranges;
- Establish active outreach programs to increase community awareness regarding the environmental field;
- Establish long-term relationships with local regulatory agencies and request that technician-level positions be created or accepted for entry-level duties within the organization;

- Establish and maintain an electronic bulletin board listing environmental jobs and typical salaries;
- Develop/obtain and distribute environmental career resources (e.g., videotapes) that provide role models for students; and
- Encourage the development of high quality environmental studies courses at all educational levels.

There is a need to break down institutional bureaucratic barriers that inhibit or discourage articulation efforts.

ISSUE: There is a need to break down institutional bureaucratic barriers that inhibit or discourage articulation efforts.

RECOMMENDATIONS: Two-year colleges should take the initiative to:

- Increase inter-institutional and intra-institutional communication among administrators, faculty, and staff by creating a mechanism to bring all parties together; and
- Host regional and state-wide conferences on nationally recommended articulation standards and initiatives.

BIBLIOGRAPHY

The Environmental Careers Organization, *The New Complete Guide to Environmental Careers*, Island Press, Washington, D.C., 1993.

Green, Kathleen, "We've Got the Whole World in Our Hands," *Occupational Outlook Quarterly*, Winter 1994-95, pp. 2-15.

Johnston, William B. and Arnold Packer, *Workforce 2000: Work and Workers for the 21st Century*, Hudson Institute, Indianapolis, Indiana, 1987.

National Science and Technology Council, *Bridge to a Sustainable Future*, April 1995.

National Science Foundation, *Advanced Technological Education Program: 1994 Awards and Activities*, The Science & Technology Information System at the National Science Foundation, January 1995.

Richman, Louis S., "The New Worker Elite," *Fortune*, August 22, 1994.

The Secretary's Commission on Achieving Necessary Skills, *"What Work Requires of Schools: A SCANS Report for America 2000,"* U.S. Department of Labor, Washington, D.C., 1991.

(NSF publications referenced in this report are not repeated here.)

FORUM PARTICIPANTS

CURRICULUM AND PROGRAM DEVELOPMENT

Gary Abbas
Biology Instructor
West High school
3505 West Locust Street
Davenport, IA 52804

Ashok Agrawal, PE
Program Officer for Engineering and ATE
National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

John Bonte, PhD
Chemistry & HazMat Instructor
Clinton Community College
1000 Lincoln Blvd.
Clinton, IA 52732-6299

Ann Boyce
Coordinator & Instructor HazMat Program
Bakersfield Community College
1801 Panorama Drive
Bakersville, CA 93305

Doug Feil
Associate Director, Hazardous Materials Training & Research Institute (HMTRI)
Kirkwood Community College
Environmental Training Center
6301 Kirkwood Blvd. S.W.
P.O. Box 2068
Cedar Rapids, IA 52406

James Johnson
Senior Research Associate
Center for Occupational Research and Development (CORD)
601 Lake Air Drive
P.O. Box 21689
Waco, TX 76702-1689

☆ Kirk Laflin, CET
Director
New England Interstate Environmental Training Center/NE PETE
2 Fort Road
South Portland, ME 04106

Dan Knapik
Trainer
Aulson Company
191 S. Main Street
Middleton, MA 01949

Trish Pollick
Technical Writing Teacher
Oak Hills High School
3200 Ebenezer Road
Cincinnati, OH 45248

Mike Senew
Staff Assistant, Hazardous Materials Training & Research Institute (HMTRI)
President, Martini Print Media
6320 - 116 Capital Blvd.
Raleigh, NC 26704

EMPLOYMENT NEEDS

Judy Becker, CHMM
Division Environmental Manager
Dana Corporation-Victor Products Division
1945 Ohio Street
Lisle, IL 60532

Clark Brink
Public Education & Outreach Officer
Cal/EPA, Air Resources Board
2020 L Street, P.O. Box 2815
Sacramento, CA 95812

Nolan Curtis
Development Officer
Workforce Restructuring
Fernald Environmental Restoration Management Corp. (FERMCO)
Mailstop 18
P.O. Box 538704
Cincinnati, OH 45253-8704

Molly Frisbie
Assistant Professor of Biology
Lexington Community College
Cooper Dr.-Oswald Bldg.-Room 303
Lexington, KY 40506-0235

Bettye Lawrence, PhD
Program Consultant
Advanced Technological Education
National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

☆ Joe Richey
Retired, former CEO of Pacific Bell
3117 Saddleback Court
Thousand Oaks, CA 91360

S. Merris Sinha, CET, CHMM
Consultant
Unlimited Learning
42 Onendago Trail
Medford Lake, NJ 08055

Robert (Bob) Welch
Program Director
Geographic Res. & Envir. Technology
Lansing Community College
422 N. Washington Square Dept. #31
Lansing, MI 48901

ENVIRONMENTAL EQUITY AND HUMAN RESOURCES

Myra Blakely
Office of Solid Waste & Emergency Response
U.S. Environmental Protection Agency
Washington, DC 20460

☆ Sandie Crawford
Director
Cuyahoga Community College
Environmental Equity Institute
2900 Community College Avenue
Cleveland, OH 44115-3196

Carol Kefford Eshelman, CET
President
CK Eshelman Assoc.
30 E. Montgomery St.
Baltimore, MD 21230

Steven Fenton
Associate Director
Hazardous Materials Training & Research Institute (HMTRI)
Eastern Iowa Community College District
500 Belmont Road
Bettendorf, IA 52722

KEY
- Principal Investigator
- Co-Principal Investigator
- ☆ Technical Working Group Chair
- Group Recorder/Writer
- Forum Report Editor

Ellen J. Kabat, PhD
Director
Advanced Technology Environmental Education Center (ATEEC)
500 Belmont Road
Bettendorf, IA 52722

Larry Lucas, PhD
Sandia Lab Visiting Professor in Mathematics, Sandia National Labs
Haskell Indian Nation's University
155 Indian Avenue
Lawrence, KS 66046

Elizabeth J. Teles, PhD
Program Director, Mathematics and Advanced Technological Education
Division of Undergraduate Education
National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

☆ Adrianne White, CHMM
President
White Inc. Associates
Environmental Services
1316 S. Baylis Street
Baltimore, MD 21224

PROFESSIONALISM

Pat Berntsen
Director, Hazardous Materials Training & Research Institute (HMTRI)
Kirkwood Community College
Environmental Training Center
6301 Kirkwood Blvd. S.W.
P.O. Box 2068
Cedar Rapids, IA 52406

Chris Biellier
Manager, Environmental Services Division
Enviromark Corporation
7301 Vine Street Ct.
Davenport, IA 52806

Ken Chapman
Head, Technician Resources/Education
American Chemical Society
1155 16th Street, N.W.
Washington, DC 20036

Paul Dickinson
Executive Director
National PETE
6601 Owens Drive, #235
Pleasanton, CA 94588

Chris Fox
Instructor
Technical Studies Division
Catonsville Community College
800 S. Rolling Road
Catonsville, MD 21228

Duncan McBride, PhD
Head, Laboratory and Technology Development Section
Division of Undergraduate Education
National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

☆ Mike Steinmaus
President
Steinmaus Environmental Services, Inc.
319 East 2nd Street
Muscatine, IA 52761

TRANSFERABILITY OF CREDITS

☆ Chulee Grove
Instructor, Occupational Safety & Health
Honolulu Community College
874 Dillingham Blvd.
Honolulu, HI 96817-4598

William T. Engel, Jr., CET, PhD
Director
Center for Training, Res. & Educ. for Environmental Occupations (TREEO)
University of Florida
3900 S.W. 63rd Blvd.
Gainsville, FL 32608-3848

Eldon Enger
Professor of Biology
Delta College
University Center, MI 48710

Jim Gager
Science Teacher
Moline High School
3600 23rd Avenue
Moline, IL 61265

Dennis Graham
Training & Development Dept.
Safety-Kleen Corp.
777 Big Timber Road
Elgin, IL 60123

Cindy Lake
Instructional Designer
Advanced Technology Environmental Education Center (ATEEC)
500 Belmont Road
Bettendorf, IA 52722

B. Michael Momany
Assistant to the Director
Hazardous Materials Programs
The University of Findlay
1000 North Main Street
Findlay, OH 45840-3695

Herbert Richtol, PhD
Program Director
Division of Undergraduate Education
National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

Gerhard Salinger, PhD
Program Director
Division of Elementary, Secondary, and Informal Education
National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

Cathy Wilson
Science Teacher
City High School
1900 Morningside Drive
Iowa City, IA 52245

Also, the contributions to this project by the other Co-Principal Investigator, who was unable to participate in person in a Forum Group, are gratefully acknowledged:

Janice Nahra Friedel, PhD
President
Lexington Community College
Cooper Dr., Oswald Bldg., Room 209
Lexington, KY 40506-0235

KEY
- Principal Investigator
- Co-Principal Investigator
- ☆ Technical Working Group Chair
- Group Recorder/Writer
- Forum Report Editor

FORUM PRESENTERS

Presenters:	*Presentations:*
Marjorie Buckholtz, PhD Director, Brownfields Group, Office of Solid Waste & Emergency Response, U.S. Environmental Protection Agency Washington, DC 20460	*The Link Between the Community College Workforce Training Program and EPA's Economic Redevelopment Initiative*
Ken Chapman Head, Technician Resources/Education, American Chemical Society, 1155 16th Street, N.W., Washington, DC 20036	*Planning for Future Workforce Needs*
Margaret Cozzens, PhD Division Director, Elementary, Secondary, and Informal Education, Advanced Technological Education Program, National Science Foundation, 4201 Wilson Blvd., Arlington, VA 22230	*Secondary Education Function Within the ATE Program*
Bob Knox Deputy Director, Office of Environmental Justice, U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460	*Environmental Justice*
James F. McKenney, PhD Director of Economic Development, American Association of Community Colleges (AACC), 1 Dupont Circle, N.W., Suite 410, Washington, D.C. 20036	*The Role of Community Colleges in Technician Education*
R. Thomas Parker, Jr. Executive Director, Interagency Environmental Technologies 955 L'Enfant, Suite 5322 Washington, DC 20024	*The Role of Community Colleges in Technology Transfer*
Elizabeth J. Teles, PhD Program Director, Mathematics and Advanced Technological Education, Division of Undergraduate Education, National Science Foundation, 4201 Wilson Blvd., Arlington, VA 22230	*Expectations of Forum Outcomes*
Robert Watson, PhD Division Director, Division of Undergraduate Education, Advanced Technological Education Program, National Science Foundation, 4201 Wilson Blvd., Arlington, VA 22230	*The Role of the Division of Undergraduate Education (DUE) Within the Advanced Technological Education (ATE) Program*

ACKNOWLEDGMENTS

For all of the details and arrangements which ensured the success of this event and its resulting report, those involved with the Forum wish to express acknowledgment and thanks to

Forum Coordination

Lori L. Maher
Forum Coordinator
ATEEC Project Coordination Specialist, Advanced Technology Environmental Education Center, 500 Belmont Road, Bettendorf, IA 52722

Forum Report Production

Diane Gere
Forum Report Editing Assistant
Instructional Designer, Advanced Technology Environmental Education Center (ATEEC), 500 Belmont Road, Bettendorf, IA 52722

Ellen J. Kabat, PhD
Forum Principal Investigator
Director, Advanced Technology Environmental Education Center (ATEEC), 500 Belmont Road, Bettendorf, IA 52722

Cindy Lake
Forum Report Editor
Instructional Designer, Advanced Technology Environmental Education Center (ATEEC), 500 Belmont Road, Bettendorf, IA 52722

Susan K. Massick
Forum Report Production Assistant
Senior Secretary, Eastern Iowa Community College District, 306 West River Drive, Davenport, IA 52801

Technical Working Group Report Production

Sandie Crawford
Technical Working Group Chair, Environmental Equity and Human Resources
Director, Cuyahoga Community College, Environmental Equity Institute, 2900 Community College Avenue, Cleveland, OH 44115-3196

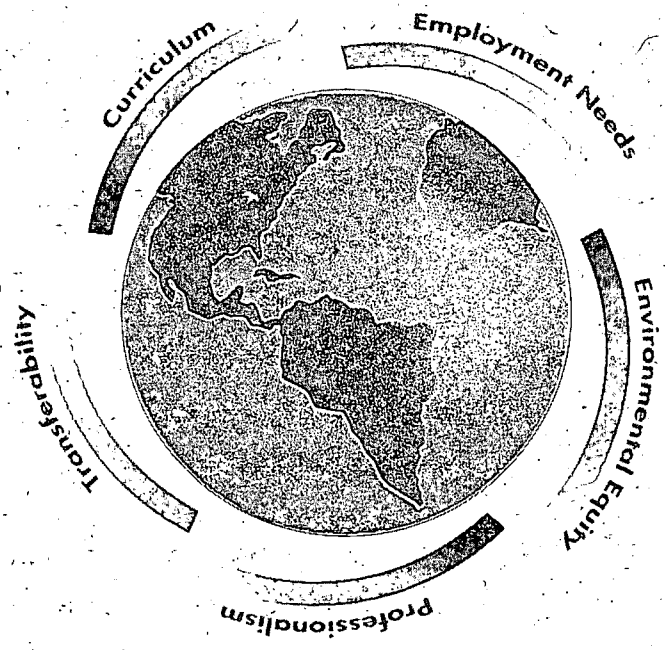
Chulee Grove
Technical Working Group Chair, Transferability of Credits
Instructor, Occupational Safety & Health, Honolulu Community College, 874 Dillingham Blvd., Honolulu, HI 96817-4598

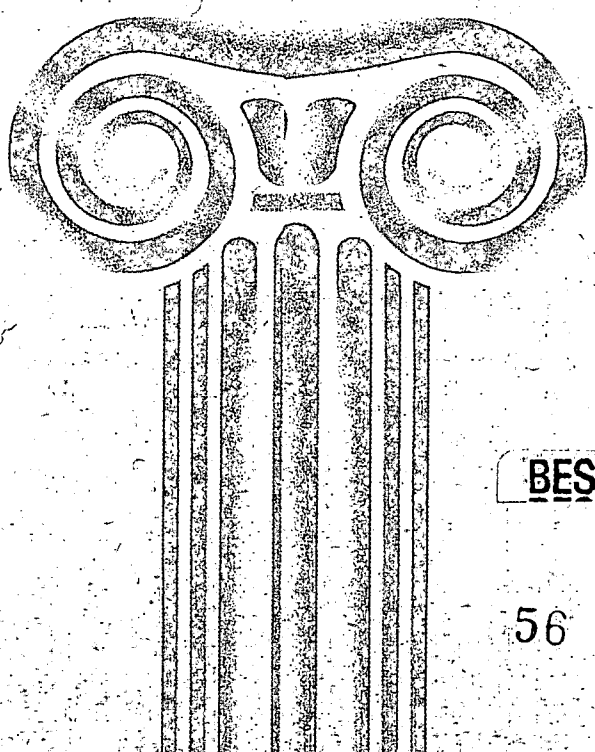
Kirk Laflin, CET
Technical Working Group Chair, Curriculum and Program Development
Director, New England Interstate Environmental Training Center/NE PETE, 2 Fort Road, South Portland, ME 04106

Joe Richey
Technical Working Group Chair, Employment Needs
Retired, former CEO of Pacific Bell, 3117 Saddleback Court, Thousand Oaks, CA 91360

Molly Frisbie
Technical Working Group Co-Writer, Employment Needs
Assistant Professor of Biology, Lexington Community College, Cooper Dr.-Oswald Bldg.-Room 303, Lexington, KY 40506-0235

Mike Steinmaus
Technical Working Group Chair, Professionalism
President, Steinmaus Environmental Services, Inc., 319 E. 2nd St., Muscatine, IA 52761





BEST COPY AVAILABLE

U.S. Department of Education
Office of Educational Research and Improvement
(OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

JC 990129

Reproduction Release

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: **Partnering to Build a Quality Workforce: Criticasl Issues in Environmental Technology Education at Two-Year Colleges**	
Author(s): **Advanced Technology Environmental Education Center**	
Corporate Source: **Hazardous Materials Training & Research Institute**	Publication Date: **March 1995**

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, Resources in Education (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign in the indicated space following.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY SAMPLE TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY SAMPLE TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY SAMPLE TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
Level 1	Level 2A	Level 2B
↑ XX	↑ ☐	↑ ☐
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g. electronic) *and* paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche onl
Documents will be processed as indicated provided reproduction quality permits. If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.		