Best Practices in Environmental and Energy Technology Education at Tribal Colleges

A Guide for Improving Programs

PETE

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NSF

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Section A: Introduction and Rationale

Introduction

The Advanced Technology Environmental and Energy Center (ATEEC) and the Partnership for Environmental Technology Education (PETE) work collaboratively with Tribal colleges through a National Science Foundation (NSF) grant awarded to PETE, *A National Collaboration to Strengthen the Advanced Environmental Technology Education Programs at Tribal Colleges*. This project strives to improve, enhance, or create environmental science programs in recognition of the critical cultural component Native Americans present to the study of environmental science**.**

ATEEC was established in 1994 as an NSF Advanced Technology Education (ATE) Center of Excellence. Our mission is to advance environmental and energy technology education through curriculum, professional, and program development and improvement in the nation's community colleges and secondary schools. ATEEC provides professional development, guides program improvement, designs and develops curriculum and instructional materials, and much more. Our vision is to foster a network of educational communities, supported through public and private partnerships, which ensure human health, safety, and global sustainability. (See diagram on the inside of the back cover of this book.)

PETE is a nonprofit 501(c)3 organization that helps facilitate, partnerships with educational institutions, industry, and government. Serving the 50 states, Tribal Nations, U.S. territories, and insular areas, the PETE network includes more than 400 community, tribal, and technical colleges, representing one-third of America's two year institutions. Business, industry, and governmental agency partnerships are integral to this network.

ATEEC's original *Best Practices in Environmental Technology Education: A Guidebook for Improving Programs* was published in 2000. PETE's *Bring Energy to Your Campus: Start an Energy Services and Technology Program at Your College* was published in 2002. These reports presented best practices for administration, curriculum and instruction, student support, alliances, professional development, learning resources, facilities, equipment, and supplies, as well as program development and assessment. This guide attempts to cover the essential components of those two previous publications in a more up-to-date and efficient format and is presented in the following sections:

Best practices for **program management** include understanding the environmental field, program possibilities, labor market analyses, and workforce needs of the nation. ATEEC works with new and existing programs to stay abreast of current research and practice. Instructional designers develop curriculum models, perform occupational task analyses, and advise programs on budget planning processes. The first guidebook stressed the importance of full-time instructional staff and management practices based on continuous quality improvement.

Best practices in **professional development** are modeled in ATEEC's and PETE's annual Fellows Institutes and workshops. Opportunities encourage use of online libraries and databases to expand the technical knowledge and skills of students and instructional staff. Utilization of Tribal community and work experiences keep students connected to the larger community while they learn. ATEEC encourages and

supports the enhancement of teaching methodologies and strategies. Maintaining up-to-date credentials and certifications is essential for both part- and full-time instructors.

Curriculum and instruction best practices are based on national and state standards, seamless articulation agreements (see Section F: Alliances), and internship opportunities. Performance-based learning objectives and authentic assessment keep instruction relevant to student experience and workforce options. Contextual teaching and learning methods create a simulated work environment in which to develop essential skills. Individualized accommodation and integration of knowledge and skills is vital to a successful program. Industry competency models are available to guide curriculum development in a wide range of technical fields (Career One Stop, 2010).

Program evaluation/assessment includes an annual program review in order to determine goals for the following year. A comprehensive program assessment should be conducted every three to five years. Best practices for **student assessment** include fostering higher order thinking skills, stating objectives in measurable terms, using objectives to evaluate progress, measuring student achievement regularly, and utilizing contextual teaching and learning strategies.

Best practices in **student support services** emphasize flexible programs that address individual and Tribal community needs through personal and social support venues. Internship and job placement assistance are integral to the success of community, technical and Tribal college programs.

Best practices in **facilities, equipment, and supplies** dictate sound financial and administrative management. ATEEC provides information to administrators on funding needs and opportunities through private, state, and federal programs. ATEEC advocates adequate facilities for scientific and technical skill development. Regular application of procedures

Credit: jelaga (2008, Dec. 21) stock.xchng

for inspection, maintenance, and security keep a college operational. Essential equipment and supplies for technology education may be expensive but are vital to the success of the program.

Strategic **alliances** are defined by the American Chemical Society (ACS) with helpful ideas from successful national programs. Formation of active advisory committees align curriculum and job placement with existing local and regional business opportunities. Partnership networks share best practice models for new and emerging institutions. Clearly defined articulation programs are the key to student transition from high school to community college and four-year institutions.

Environmental learning **resources** are technical by nature and should therefore utilize modern media (i.e., print, video, and computer applications). Real-life problem solving develops practical skills and increases motivation when aligned with engagement, interaction through hands-on teaching and learning experiences, and Tribal employment opportunities. Best practices dictate appropriate accommodations for students and staff with disabilities. Universal acceptance and support create an atmosphere

of confidence that increases **retention** and enhances **recruitment**.

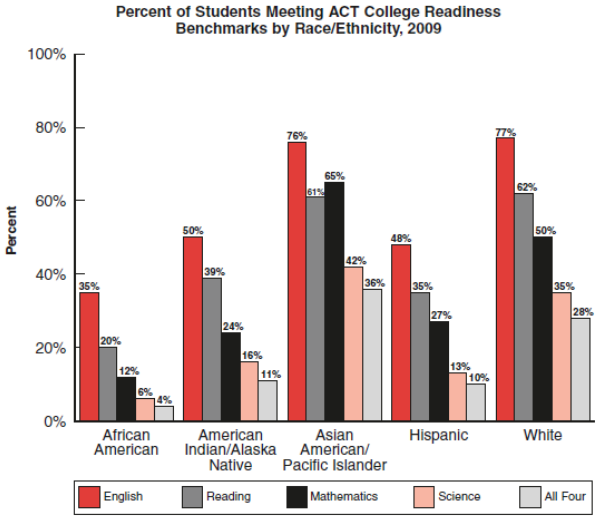
The original Best Practices Guidebook (2000) offered teaching and learning tools (i.e., surveys, checklists, and assessments), information on the Developing A Curriculum (DACUM) process, and sample wording from national standards. Health, Safety, and Environmental Technology (HSET) certification requirements, case studies, and technical documents were included. A bibliography of available media and a list of prospective partnership networks concluded the compilation. Links to these resources are listed throughout this guide and are at http://www.ateec.org/ateec-downloads/latest.

Rationale for Revision

In a field that is changing as rapidly as the environmental and energy technology fields are today, it is important to keep current on policies and issues that arise. PETE and ATEEC are funded in part by the National Science Foundation (NSF). According to the NSF, STEM skills are vital to U.S. competition in an increasingly global economy. Most jobs—not just jobs in STEM fields—require a technologically literate workforce. U.S. students rank well behind students in other industrialized countries in STEM critical thinking skills. NSF programming:

- Works to increase interest in STEM fields among the public and students at ll grade levels; and builds bridges between K-12 schools, higher education institutions, and the workforce;
- Supports STEM teaching and learning preparation, and research programs for instructors;
- Supports efforts to improve articulation agreements among institutions of higher education; and
- Encourages partnering with stakeholders to strengthen the technical workforce.

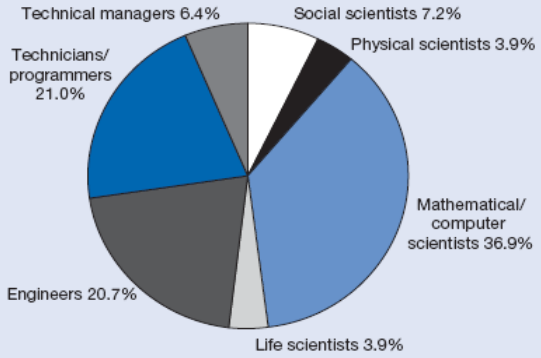
Many Tribal colleges have developed state-wide articulation agreements with four-year colleges and universities.



The U.S. Department of Labor (DOL) reports the current kindergarten through twelfth grade (K-12) system provides inadequate preparation in STEM skills. Native American students are one of the most underrepresented groups in STEM-related college programs. According to *American College Testing* (ACT, 2009), less than 50 percent of Native American high school students entering college meet the minimum requirements in all four basic skill areas. Less than 25 percent meet the benchmarks in science and mathematics. Only two percent of the population of the United States works in the science and engineering fields (CPST, 2007).

The DOL also reports college graduates in non-STEM fields far outnumber graduates in STEM-related fields, particularly in minority groups such as members of Tribal Nations.

Figure 3-15
Employment distribution across science and technology or STEM occupations: May 2006



STEM = science, technology, engineering, and mathematics

NOTE: As generally used in policy discussions and as used in this chapter, STEM and science and technology have identical meaning.

SOURCE: Bureau of Labor Statistics, Occupational and Employment Statistics Survey, May 2006.

Science and Engineering Indicators 2008

Section B: Program Management

Program management is THE essential component of developing a new program, making significant revisions to an existing program, or simply adding a new course. All educational institutions have their own formal procedures for program management, required in part by their accrediting organizations. There are usually very specific forms that must be used and submitted through established channels to administration.

This Best Practices Guide offers some practical suggestions for supplementing and enhancing a school's requirements for program management. Before beginning any new or revised curricula, check with the applicable department chair or administrative office for proper procedures, and approval. (For an example of a Tribal college strategic plan, see the Northwest Indian College Web site.)

Starting Your Program

The most successful environmental and energy programs, many of which are referenced throughout this guide, have one major feature in common—administrative "buy-in". The success or failure of any new or updated program rests on up-front support from the college president, deans, directors, etc. Creating or revising a program is a difficult and time-consuming challenge; without a strong commitment from top administrators, the program may not be allowed the time and resources necessary to achieve its full potential. One of the surest ways to achieve administrative buy-in is to create a solid program management plan. Background research and analysis should align with and reinforce the program goals.

A written plan, shared with faculty and staff, is a critical tool for effective program management. It should list steps, personnel, and a timeline for plan implementation.

As a minimum, the plan should encompass the following areas:

- Analysis
- Design
- Development
- Implementation
- Evaluation/assessment

These steps should follow a natural progression and can be repeated as necessary. There must be a continuous loop of formative (ongoing) evaluation throughout the program management effort to re-evaluate and revisit the different functions, and to adapt as necessary.

"It is important to have support from the college administration on any new program development, including the president. When the president is representing the college in the community, they will be the champion of the new program." (Colleen Jorgensen; Vice President of Instruction; Red Rocks Community College; Lakewood, CO.)

Analysis

With the rise in popularity of environmental and energy programs, many schools want to join this movement to enhance their enrollment and the variety of programs they can offer to their students. With respect to Tribal colleges, environment and energy programs have and

continue to be important subjects since they are deeply connected to traditional culture.

However, the motive can backfire on a school's good intentions and can potentially do a huge disservice to the students if the proper analysis isn't performed for the program's occupational focus. For example, wind energy has recently become an extremely popular program. Without the proper research, specifically a Labor Market Assessment (LMA), the program may fail.

Some questions to consider are:

- Who are the companies connected to the industry, and what is the status of the applicable industry in the region? Are they hiring? Are they stable companies?
- Will there be Tribal community or regional jobs for program graduates?
- If not, are potential graduates of the program willing to travel or relocate? If applicable, are students willing to leave the reservation after graduation?
- Does the school have the resources to develop a program of this type? Where does the money come from, and what are the expectations of the funders?
- Who is the target student audience, and do they have the proper personal learning environment and resources to complete the program? What are the prerequisite skills? Are the students adequately prepared?

A Labor Market Assessment (LMA) is also a good vehicle for establishing industry contacts that may join your program's advisory committee, or be willing to partner in training or donate equipment.
Your institutional research office is a good place to check for existing information or assistance with labor market assessments in the Tribal community

Design and Development

Don't reinvent the wheel. Your school or other schools may already have similar programs. Build on what already exists.

The **target audience** and **program occupation** should always be the most important elements. Components of program development include:

- Performing occupational analysis with heavy industry involvement. [See Section C: Curriculum and Instruction.]
- Organizing an advisory committee of industry representatives, Tribal leaders, and other stakeholders to provide guidance and assess progress in all phases of program development and implementation.
- Forming alliances and partnerships with other schools and industries to strengthen recruitment, retention, and motivation.
- Listing the program resources that will be needed, including faculty/staff, physical space, equipment, materials, etc. to enhance program cohesiveness and align facilities with specific programmatic needs.
- Using the information gathered in the above items to select a delivery method (e.g., online, face-to-face, hands-on activities) to begin developing the

curriculum. (See Section C: Curriculum and Instruction.)

- Performing continual formative (ongoing) evaluation checks to measure program effectiveness.
- Providing support services to enable the largest number of potential students to participate.
- Providing support services in balance with Tribal cultural and historic traditions.

"The program management process MUST be organic; educators have to be OK with a certain amount of risk associated with REALLY listening and engaging industry partners through every step. We figured out how to work with our own, sometimes outdated, higher education barriers to create programs that industry has not only endorsed but supported with funding and high utilization of the education provided for their incumbent workforce." (Joan W. Smith; Rocky Mountain Education Center Dean and Executive Director; Red Rocks Community College, Lakewood, CO.)

Implementation

Allow for greater flexibility in the first year to evaluate, fine-tune, and adapt the program structure to meet the needs of participating students.

The implementation process includes:

- Starting the program with existing courses to allow for additional time for the development of new courses and/or to hire the best possible faculty;
- Pilot-testing new courses during the first semester with a controlled focus group of current students or nonstudents;
- Interpreting results to determine revisions; and
- Obtaining a complete assessment of individual courses and of the overall program from students, faculty, industry, and the program advisory committee.

Evaluation and Assessment

Most educational institutions have formal, ongoing evaluation mechanisms in place. The program management plan should include:

- Internal and external evaluations,
- Formal and informal evaluations,
- Formative and summative assessments, (Strickland, 2001)
- Reporting procedures, and
- Consistent intervals between evaluations.

Who?

You. The guidance at the beginning of this section is critical enough to bear repeating here. It is important to keep in mind throughout your program management efforts that the above steps follow a natural progression for planning. The steps need not be followed in order and can be repeated. There must be a continuous loop of formative (ongoing) evaluation throughout the program management effort to re-evaluate and revisit the different functions, and to adapt as necessary.

- Analyze the program
- Design the program
- Develop the program
- Implement the program
- Evaluate/assess the program

What?

Program assessment is a systematic process for the collection, analysis, and interpretation of data concerning a program and its curriculum. The purpose of the program assessment process is to improve quality and relevance, and to ensure the effective and efficient use of resources. Program assessment is a cooperative process that relies on the knowledge and

expertise of instructors, administrators, students, graduates, advisory committee members, employers, and Tribal leaders. Program quality is built by seeking and acting on feedback from all stakeholders.

Program assessment ensures that both the needs of the students and employers are met. The process examines the viability of the occupational field, as well as the degree to which the program outcomes meet the needs of the labor market. The process promotes self-examination by administrators, faculty, and staff, and assists in the formulation and clarification of program goals and objectives.

An internal program assessment enables the institution to make informed decisions regarding program development, maintenance, modification, elimination, and the allocation of resources. It provides information regarding the job market for program graduates and their success, and indicates a direction for curriculum improvement and the essential equipment and materials needed for program delivery.

An external program assessment assures that the institution provides quality education to enable individuals to become academically, occupationally, and socially competent. It communicates to the Tribal community a commitment to excellence and continuous quality improvement.

When?

Program assessment should be conducted **annually** with a **comprehensive review** every three to five years.

An **annual program assessment** obtains and analyzes statistical data. The types of data that typically comprise the annual assessment are:

- Enrollment (i.e., a headcount of students enrolled),
- Contact hours generated,
- Full-Time Equivalent Enrollments (FTEEs) generated,
- Costs,
- Program completion rates, and
- Success of leavers and completers (e.g., job placement and employment status of graduates as well as transfers to higher degree granting institutions).

All institutions/schools annually collect and report statistical data to their state departments of education. If you are not already receiving data on your program, contact the appropriate office at your school to obtain a copy of the annual program assessment.

The annual collection and analysis of this data serves multiple purposes.

- Assessment of the well-being of the program;
- Gauge for indicating the need for program revisions;
- Measurement of the success of the program;
- Calculation of program/department costs, and the factors affecting these costs;

- A "snapshot" view of the viability of the program;
- Determination of success (completion of the entire certification program/degree program, attainment of a job, skill enhancement, etc.)

The "snapshot" obtained as a result of the program assessment process may indicate a need for further examination of the program, or provides reasons for celebration.

A **comprehensive review** of the program is designed to verify and improve the quality and relevance of a program's offerings. The process provides the faculty and administrators with information and perceptions regarding the program from a variety of audiences in order to identify strengths and areas for improvement.

Why?

The primary purpose of program assessment is to improve quality and to ensure the effective and efficient use of resources. Program assessment provides the opportunity to:

- Identify the strengths and areas for improvement of the program,
- Identify areas for curriculum improvements and revisions, and
- Provide data for valid program and staff development activities, equipment acquisition, and facilities utilization.

The secondary purpose for program assessment is to enable the institution to:

- Compare business and industry standards with institutional occupational program standards;
- Inform business and industry about the institution and program;
- Involve and use the expertise of representatives from business and industry;
- Improve job placement opportunities for students;
- Inform former students of the institution's commitment to self-improvement and excellence;
- Identify necessary modifications or additions to physical facilities;
- Determine instructional equipment needs;
- Determine needs for learning resources;
- Provide data relative to decisions for expenditure of funds;
- Track future occupational trends;
- Discover any bias based on gender, ethnic background, or social/economic level;
- Identify unmet needs of disadvantaged and handicapped students;
- Identify barriers of student success that may not be evident; and
- Recognize opportunities for collaboration with other educational institutions.

How?

The program assessment process typically consists of the following components:

- Statistical data,
- Program descriptive information (i.e., official documentation),
- Perception/satisfaction surveys,
- Labor Market Assessment (LMA), and
- Internal review team.

Each component is described in more detail in the sections that follow.

Statistical Data

Statistical data is collected annually for the program. Data is compiled by the institution and provided to the internal review team for use in assessing the program. Examples of statistical data include enrollment, contact hours, full-time equivalency (FTEEs), costs, graduation rates, and success rates.

For example, Little Priest Tribal College of the Winnebago Nation, NE, offers an Environmental Studies Associate Degree Program. Data collected when they began the assessment process included:

- 150 students (full- and part- time),
- 5 faculty and 10 adjunct faculty,
- 67 required credits with STEM assistance provided,
- Articulation agreements with 5 colleges, and
- 3 local businesses that typically employ graduates.

Descriptive Information

Program descriptive information includes all supporting documents of a program, such as program goals, performance-based learning objectives (often listed in the syllabi), and equipment lists. Descriptive information helps identify the program's strengths and areas for improvement. It facilitates the formulation of recommendations pertinent to the curriculum, facilities, equipment, and faculty development. Remember that documentation may not support existing perceptions. One may believe that the courses have performance-based learning objectives, but several of the objectives may begin with vague verbs such as "know" or "understand" rather than action verbs stated in measurable terms.

For example:
***Vague**: Understand cultural and socioeconomic influences on implementation of renewable energy options.*

***Measurable**: Students will be able to list at least 20 cultural and socioeconomic influences on the construction of an electric dam near their town.*

***Vague**: Understand how an electric dam works.*

***Measurable**: Students will be able to explain orally and in writing the parts, functions, and process involved in the production of energy by a 25-foot high dam across a 60-foot wide river.*

For more information on how to write measureable objectives, download the Stanford University *Creating Learning Outcomes* guide.

Program descriptive information is provided to an Internal Review Team (IRT), if applicable, for use in the completion of its report. (See example from the University of New Mexico.)

Credit: Instructor, Sitting Bull College, SD (2009) NSF Tribal Fellows Institute

Perception/Satisfaction Surveys

Perception/satisfaction surveys are designed to gather evaluative information on the program by measuring the respondents' perceptions of and satisfaction with the program. The following six groups should be surveyed:

1. Graduates over the past three years,
2. Employers of graduates,
3. Advisory committee members,
4. Students currently enrolled in the program,
5. Administrators, and
6. Full-time and part-time faculty.

Download a sample *Perception/Satisfaction Survey*. The survey has been divided into the following four sections:

Section A. **Profile**

This section collects information that enables the analyst to categorize and compare groups of respondents. For example, graduates of a program were asked, "What was your primary purpose when you enrolled in the program?" and "Are you employed in the field for which you were trained?" These questions are designed to identify students who did or did not find the program directly applicable to employment after graduation.

Section B. **Employment Skills**

Respondents rate the program on preparing students for specific academic, employability, and technical skills necessary for technicians employed in the environmental technology field. The survey instrument lists more than 30 employment skills that have been developed and revised by several groups (listed in the Acknowledgement section of this guide.) The skills may be adapted to reflect the objectives as specified for different programs.

Section C. **Program Characteristics and Support Services**

Respondents rate the program's characteristics including course objectives, instructional resources, facilities, equipment, supplies, and support services. Support services include academic skills assessment, tutoring, guidance and counseling, academic advising, and job placement.

Section D. **Suggestions for Improving the Program**

Through open-ended questions, the respondents are asked to describe what they feel are the program's strengths and weaknesses. They are encouraged to offer suggestions for improving the program.

This survey instrument was designed to compare the perceptions of each group on a number of variables. For example, comparing student perceptions with faculty perceptions makes it easy to identify areas of agreement and areas of discrepancy.

The survey may be adapted for specific programs and copied for distribution. Please note that some of the surveys provided on the ATEEC Web site do not include all of the four sections outlined above. A given section may not be applicable to a particular group. For example, an employer of program graduates would probably not be able to answer questions about program characteristics and support services (Section C).

Labor Market Assessment

The purposes of a **Labor Market Assessment** (LMA) are to:

1. Assess the need for a program in a specific community.

2. Assess the types of education and training needed.

A labor market assessment helps an institution to sense if future students will be likely to find employment opportunities after graduation. Using the *business model* for reference, graduates and employers are the "customers" who need to be "satisfied". A "customer" is a person or company who interacts with others in matters of business.

A labor market assessment provides information for program start-up, as well as data on programs that have been around for several years. If students are not being placed as readily as they once were, or if employers' needs have shifted, a periodic market study will help keep student and industry needs aligned.

A LMA may target the labor needs of the immediate community, or it may range further to fill a regional need. For example, if an environmental technician program is not available anywhere in the Tribal community, consider sending surveys to a sampling of potential employers statewide.

An LMA may be conducted in one of two ways:

1. Distribute a survey instrument to potential employers, either the entire population or a representative sample; or
2. Convene a focus group to collect information.

The information payback of a survey is valuable because of the number of employers included. It is necessary to be realistic, however, about the effort and cost that goes into such a survey. Depending on the size of the market, a survey might be mailed to several hundred potential employers. Identifying who should receive the survey and collecting their addresses is time-consuming.

Focus groups may provide a smaller picture of the Tribal community market but are easier to plan. Arrange a meeting with ten or twelve industry leaders whose reputations indicate they are knowledgeable about the field as well as the community.

The survey questions are the focus of discussion. The main cost of the focus group consists of refreshments, which can range from dessert to lunch depending on your resources. Some of those attending may become advisory committee members, who eventually would help in the development of curricular goals and objectives.
Regardless of the strategy for collecting data, the following types of information should be requested:

- Type and size of the organization as well as its products and/or services,
- Type and number of personnel employed by the organization,
- Wage for entry-level personnel,
- Minimum level of education required and preferred for full-time employment,
- Required work experience for employment,
- Degree of difficulty finding qualified personnel,
- Projected number of full-time and part-time job openings, and
- Types of training the organization would like to offer to its employees.

A sample *Labor Market Assessment (LMA) Survey for Energy Services Careers* is available at http://ateec.org/ateec-downloads/latest. The survey instrument may be customized to suit individual needs.

Internal Review Team

Check with administration before beginning the internal review process. Many institutions already have established instruments and protocols. A formal process typically pulls together annual statistical data, program descriptive information, and the results of labor market assessment and perception/satisfaction surveys. This information is used by the internal review team to write its report.

A report usually provides narrative descriptions regarding the program's history, philosophy, curriculum, professional development of faculty, equipment and facility, and employment projections for related occupations. The team identifies a program's strengths and areas for improvement. Then they make recommendations for program improvements, such as curricular revisions, facility and equipment needs, and professional development activities.

If a practice is marked as needing improvement, briefly state a plan for remediation including those responsible, suggested timeline, and recommended strategies. Documentation pertaining to each item may be needed. For example, survey results may be cited for the item, "Assess your Tribal community labor market to determine current and future workforce demands."

Most colleges have an Internal Review Team (IRT) that validates the data, provides consultation on the program, and formulates recommendations regarding program improvement. An IRT, which is appointed, comprises vocational/technical and academic faculty as well as administrators. The team analyzes data and reports associated with the program, conduct an onsite visit to evaluate the program, and makes recommendations based on its findings.

Section C: Curriculum and Instruction

Curriculum Development

Our goal is to prepare students for work in the environmental and energy technology fields. This section provides an answer to the question, "How do we get from not knowing to knowing to doing?" Wiggins and McTighe provide an excellent framework and curriculum creation system in their book, *Understanding By Design* (revised 2005).

Credit: Sustainable Energy Education & Training Technology Workshop (2007) Golden, CO

Suppose you have completed the steps outlined in the Program Management section. Now you are ready to turn a program into a curriculum of courses specifically designed for the needs of regional employers and prospective students.

1. Analyze labor market (i.e., results of LMA) needs by creating a Developing a Curriculum (DACUM) chart—similar to the example provided on page 19 of this report—that fits your quality expectations.
2. Meet with a panel of regional employers to determine knowledge and skills as indicated on the DACUM chart using a task analysis approach—similar to the example provided on page 22 of this report. The panel identifies tasks that:
   a) are usually performed by entry-level employees, and
   b) are essential to the job.
3. Chose contextual teaching and learning as the best method for producing a graduate who has a strong preparation in core environmental and energy technology knowledge, and critical-thinking and problem-solving skills.
4. Study similar college programs and courses. **Design your curriculum** to best suit the needs of regional employers and prospective students. Use measurable outcomes stated as learning objectives.

For example, United Tribes Technical College, ND, conducted a labor market analysis in 2008. They determined the following jobs are in demand and growing in North Dakota and the surrounding regions.

- *Mineral Specialist/Technician*
- *Wind Technician*
- *Soil Conservation Technician*
- *Air Monitoring Technician*
- *Hydro Technician*
- *Range Technician*
- *Physical Science Technician*
- *Biology Technician (wildlife and fishery)*
- *Engineering Technician*
- *Environmental Protection Technician (compliance)*
- *Lead Firefighter (entry level)*

Jobs that are in low demand in the region, and therefore should not be included in the curriculum, consist of the following.

- *Environmental Management Systems Specialist*
- *Recreation Technician*
- *Geology Technician (both energy and environment reports)*
- *Forestry Technician*
- *Archeological Technician*

Sample DACUM Chart

Strategic Group Interview (SGI) Chart: Residential Energy Technician

The Residential Energy Technician applies the "house as a system" energy efficiency technology to new and retrofit construction.

GENERAL AREAS OF COMPETENCE

A. ACQUIRE GENERAL BUILDING TRADE KNOWLEDGE	A-1 Demonstrate Knowledge of basic construction prac-	A-2 Follow OSHA/state/local safety regulations.	A-3 Incorporate applicable general building codes.	A-4 Employ trade terminology.	A-5 Demonstrate knowledge of tools (hand & power).	A-6 Read & interpret building plans.
	A-7 Stay current with product knowledge.					
B. ACQUIRE KNOWLEDGE OF BASIC MATH & PHYSICS	B-1 Solve equations.	B-2 Calculate area & volume.	B-3 Create & understand graphs.	B-4 Calculate metric system conversions.	B-5 Control relative humidity.	B-6 Calculate heat transfer.
	B-7 Calculate & analyze fluid flows & pressure flows (fluid	B-8 Apply energy dynamics theory.				
C. PRACTICE GREEN BUILDING PRINCIPLES	C-1 Incorporate tight construction techniques.	C-2 Implement Energy Star choices.	C-3 Select Energy Star appliances.	C-4 Incorporate blower door technology (energy di-	C-5 Size/install high efficiency systems (e.g., HVAC, lighting,	C-6 Install energy efficient materials (e.g., win-
	C-7 Plug & seal.					
D. INTEGRATE ENERGY EFFICIENCY INTO BUILDING TRADES	D-1 Integrate "house as a system" concepts.	D-2 Promote & encourage appropriate site management (relationship of	D-3 Incorporate construction waste management.	D-4 Incorporate occupant waste management options.	D-5 Perform & incorporate environmental life cycle cost analysis	D-6 Utilize renewable energies (e.g., building orientation)
	D-7 Minimize embodied energy.	D-8 Incorporate tight construction techniques	D-9 Select materials with low environmental costs	D-10 Identify & select water conservation options	D-11 Practice optimum value engineering (e.g., less	
E. EVALUATE INDOOR AIR QUALITY	E-1 Educate consumers on indoor air quality.	E-2 Test & mitigate (e.g., for radon, lead, CO, asbestos, moisture, VOC off-	E-3 Incorporate indoor air quality source reduction techniques			
F. PRACTICE EFFECTIVE COMMUNICATION SKILLS	F-1 Perform minimum drafting skills.	F-2 Present & explain pertinent oral	F-3 Research, organize, analyze, &	F-4 Summarize & document technical	F-5 Learn & apply active listening &	F-6 Demonstrate basic computer lit-
	F-7 Lean & apply team-building (collaborative) skills.					

December 14, 1998

PANEL MEMBERS

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DACUM Needs Analysis

How do you use the DACUM chart for curriculum development?

1. Analyze each task on the chart to determine what knowledge and skills are necessary for performing the task. One example identifies a task as "sample surface waters." Select only entry-level tasks; for example, "sample surface waters" is an entry-level task.
2. Write the performance standard, which is a measurable, specific criterion of acceptable performance. For example, "The technician must avoid cross contamination while handling all samples."
3. Identify and sequence the steps a worker follows to complete the task. Include cues, decisions, warnings, or errors that may occur during these steps.

   For example:

   - Make field observations and take measurements to accompany water sample.
   - Log field observations, measurements, and procedures.
   - Determine sampling target.
   - Use a technique appropriate to the sampler.
   - Fill sample container.
   - Decontaminate sampler.
   - Label and document the sample container.
   - Prepare the sample for transport.

Attitudes and traits preferred include safety and organization. Safety standards and factors identified include wearing personal protection equipment, and using the buddy system.

Equipment and materials needed include:

- Samplers: subsurface grab sampler, Kemmerer bottle, bailer, dipper, and pump;
- Meters: dissolved oxygen meter, thermometer, flow meter, conductivity, and depth;
- Sample containers for water: vials, jars, and caps;
- Written sampling plan;
- Transport/storage containers, cooler, and ice packs;
- Documentation materials: logs, labels, seals, chain of custody forms, and waterproof pen; and
- Decontamination supplies: solvent, (organic-free water), de-ionized rinse water, scrub brushes, plastic wrap, and paper towels.

After staff and industry advisors analyze the entry-level tasks on the DACUM chart, the information is developed into student performance objectives and units or courses. Performance objectives are sometimes referred to as learning outcomes—similar to the example provided on page 22 of this report.

Learning outcomes are statements of knowledge, skills, and abilities that the students possess and can demonstrate upon completion. Learning outcomes are expressed as though the student has mastered the concept and can effectively apply it to real situations.

Performance objectives are statements that identify the specific knowledge, skill, or attitude that the learner should gain or demonstrate as a result of training or instruction. Performance objectives must be stated in measurable terms.

For example, United Tribes Technical College, ND, conducted a job analysis and found that the occupation of Wind Technician was in demand and growing in the North Dakota region. Their program, Construction Technology could add certification in Generation and Utility-Scale Construction teaching the following knowledge and skills .

- *Functionally test electrical circuits working with 24 to 600 V DC/AC.*
- *Troubleshoot and repair integrated systems.*
- *Troubleshoot complicated mechanical and hydraulic problems on turbines.*
- *Perform all mechanical, hydraulic, and electrical component maintenance, repair, or replacement of parts to correct malfunctions.*
- *Perform start-up procedures and equipment function tests.*
- *Perform maintenance on turbine equipment per the commissioning manual.*
- *Collect turbine data for research and/or analysis.*
- *Report turbine conditions and complete reports and paperwork as required.*
- *Provide technical assistance to other technicians.*
- *Responsible for adherence to OSHA-compliant health and safety programs.*
- *Coordinate with engineering on technical issues and documentation.*
- *Prepare wind turbine generators for commercial operation.*
- *Travel and work overtime as required.*
- *Evaluate product conditions and quality to verify that systems have been assembled and wired correctly to meet product standards.*
- *Ensure that less experienced colleagues and subcontractors adhere to all best practices and work instructions, and provide quality workmanship combined with good housekeeping practices.*
- *Document all work performed using computer-based service reporting procedures.*
- *Possess a valid driver's license.*

DACUM Task and Skills Analysis

Courses should have simply stated measureable learning objectives that guide student actions and aid the instructor in evaluating student performance.

A best teaching practice is to provide students with the performance-based learning objectives at the beginning of a course. A performance objective should consist of a(n):

- **Action** verb that describes the learning required by the student,
- Content reference that describes the content being treated,
- Level of achievement stated in measurable terms, and
- Conditions under which the evaluation will take place.

A successfully developed objective allows the instructor to determine, in a concrete way, whether or not a student has acquired the knowledge or skill; therefore, the selection of an appropriate verb is important. Verbs, such as describe, model, debate, illustrate, develop, critique, compare and contrast, argue, select or design permit the student to demonstrate knowledge or skills to the instructor through a physical or written performance.

> *For example, "Using OSHA's Bloodborne Pathogens standard in 29 CPR 1910.1030, write an Exposure Control Plan that complies with all the requirements in paragraph c(ii) of that standard."*

Outcomes: Foster Higher Order Thinking Skills

Another best practice is to plan objectives that foster the development of high cognitive abilities, which are referred to in education as Higher Order Thinking Skills.

Sample Task Analysis

6. Installing Subsystems and Components a the Site			
Task/Skill:		***Skill Type:***	***Priority/ Importance:***
As part of a small wind energy system installation process, the installer shall be able to:			
6.1	Utilize drawings, schematics, instructions mathematics and recommended procedures in in-	Cognitive	Critical
6.2	Implement all applicable personnel safety, environmental protection, and public safety pro-	Cognitive	Critical
6.3	Utilize appropriate math skills to lay out the tower	Cognitive,	Important
6.4	Excavate, properly form, pour, and properly backfill the tower foundation per the tower supplier's specifications, or be able to oversee such activities as carried out by a concrete contrac-	Psychomotor	Very Important
6.5	Visually inspect the tower and components, wind turbine, wiring, lighting protection, disconnect and over-current protection devices, inverters, batteries, and balance of system components for readily identifiable problems before installation	Psychomotor	Very Important
6.6	Test the wind turbine for voltage and current output	Psychomotor	Critical
6.7	Assemble the tower and wind turbine as specified by the appropriate equipment manufacturer or suppliers	Psychomotor	Critical
6.8	For crane installations, understand crane operator signals and protocol, and be able to communicate with the crane operator during the tower and turbine lift	Cognitive, Psychomotor	Critical
6.9	For tilt-up tower installations, understand the installation process and safety consideration unique to the equipment and situation	Cognitive, Psychomotor	Very Important
6.10	Install the turbine, tower, and underground wiring, disconnect switches, and over-current protection devices	Psychomotor	Critical
6.11	Complete the final assembly and installation of all electrical components, inverters, controllers, disconnects and over-current devices, surge and lightning arrestors, grounding equipment, junction boxes, batteries and enclosures, conduit and other electrical hardware, anemometers, and energy and wind monitoring equipment	Psychomotor	Critical
6.12	Label, install, and terminate electrical wiring, verify pooper connections, voltages, and phase/polarity relationships	Psychomotor	Critical

Credit: NABCEP – Small Wind Energy System Installer Task Analysis (Approved 12/7/06: Version 1.0)

Thanks to psychologist Benjamin Bloom's taxonomy of thinking skills (see following page), educators today recognize the ability to:

- Apply knowledge and skill (e.g., use learned skill in new situations);
- Analyze a situation or information (e.g., breakdown material to determine structure);
- Evaluate a situation or information (e.g., judge the value of material for a given purpose); and
- Synthesize or create a new product or point of view (e.g., construct, design, or write).

Bloom's taxonomy also lists two lower order thinking skills: remembering and understanding. An example of **remembering is recalling** previously learned material, and an example of **understanding is comprehending** enough to explain the meaning of new material. When developing objectives for courses, choose from all cognitive levels but especially include higher order thinking skills such as analyze, synthesize and evaluate during the progression of the course.

The following performance objectives would require students to use higher order thinking:

- **Application**
  Students will be able to *apply* a seven-step process for testing weather variables and reporting data to the local television station. Data must be within five degrees of accuracy when compared with data provided by the nearest official weather station.

- **Analysis**
  Students will be able to *prioritize* the steps in a decontamination procedure for benzene with 90 percent accuracy.

- **Evaluation**
  Given wind direction, amount of release and local climate, topography and demographics, students will be able to *calculate* the area and people impacted in a chlorine release of one tanker truck and *recommend* a course of action.

- **Creativity**
  Students will be able to *compose* a press release which informs the community about the potential hazards of a toluene spill from the local chemical plant in 500 words or less.

Objectives: State in Measurable Terms

Measureable objectives provide the student with a concrete framework for completion of a learning objective. Often these are stated using qualifying numbers, time, or conditions, for example:

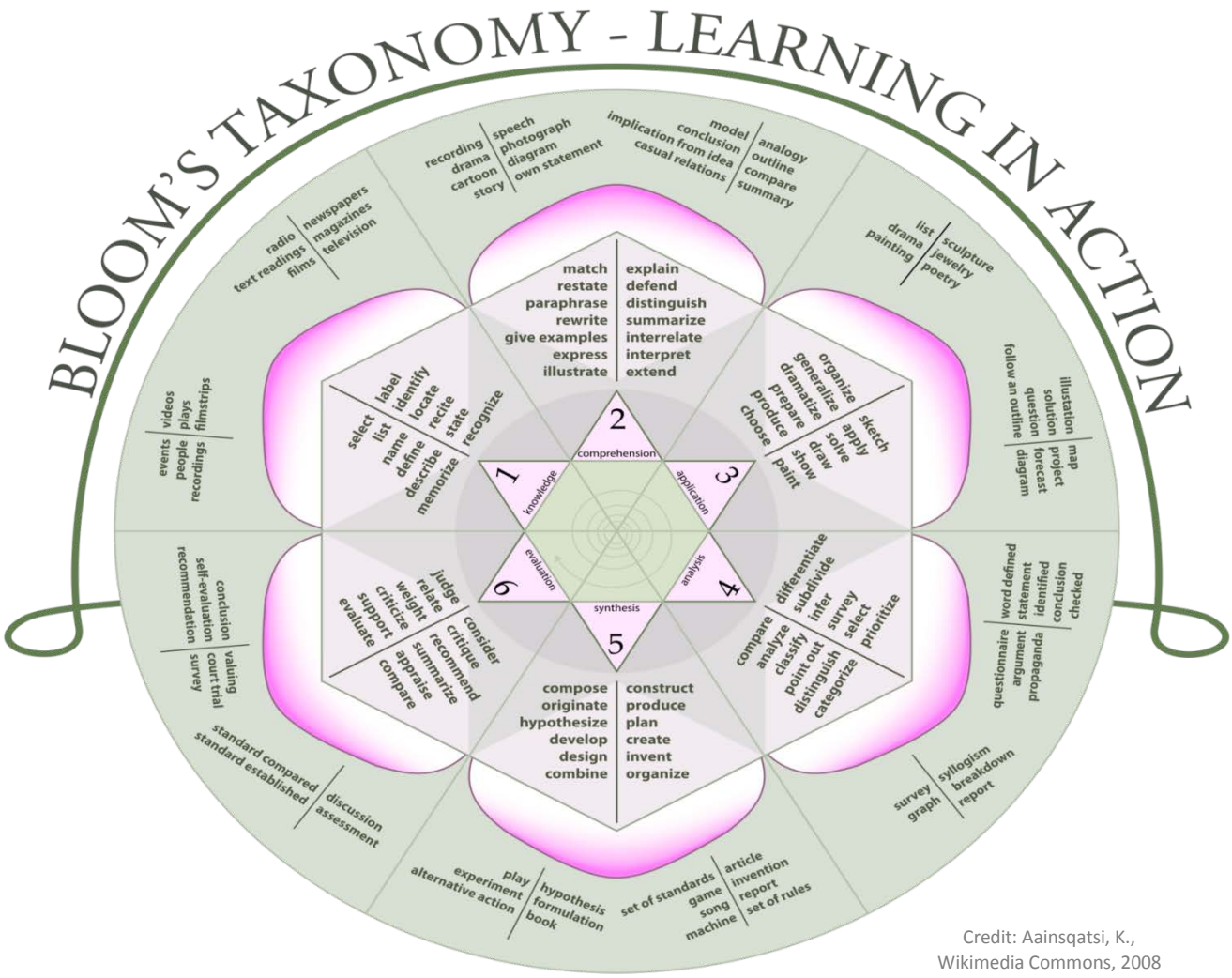
- The student will choose the correct Personal Protective Equipment (PPE) for use in four out of four scenarios during the semester.
- The student will patch/plug a leaking container in a simulated hot zone within fifteen minutes.
- The student will take off a Level A suit, **remaining free of contact with contaminates.**

Assessment: Measure Student Achievement

Performance objectives lend themselves to measurement of student achievement. Common measurement techniques include:

- Pencil and paper tests,
- Performance checklists, and

  Authentic assessments measured with rubrics such as portfolios and presentations.



Credit: Aainsqatsi, K., Wikimedia Commons, 2008

Pencil and paper tests include traditional essays, quizzes, and midterm and final exams. Teachers who are not trained to write test items should refer to one of the many books about educational measurement and test construction, such as Linn, Miller, and Gronlund's *Measurement and Assessment in Teaching* (2009).

Checklists use the course objectives, stated in measureable terms, to create a list of skills. The teacher simply turns the objectives into checklists of skills attained. As the teacher observes the student's successful performance of the skill, the objective is checked off. Evaluations may be completed at regular intervals during the semester.

Authentic assessments require the learning experience to be based on a real-life activity or problem. For example, if an objective is to be able to write an evaluation plan that complies with OSHA's general industry standards, then the authentic assessment is based on the product of the student's activity, which is the written plan itself.

A **portfolio** is a record of achievements based on the performance objectives. A student can create a portfolio of class work such as plans, procedures, reports, and notes. The student may also keep a journal of reflections. The process of being reflective and analytical about achieving the objectives is part of one's growth in "learning to learn."

An effective way to authentically assess a student's product or performance is with a grading **rubric**. The rubric is often set up as a table. One direction on the table indicates the points to be earned for various levels of performance. The other direction on the table lists the objectives to be met. The cells of the table define criteria for evaluating the student's product or performance. (See sample provided on page 26 of this report.)

Instruction

Contextual Teaching and Learning

> *Contextual Teaching and Learning (CTL) are defined as strategies that focus on students as active learners and provide a wide range of learning opportunities, leading students to solve complex, real-world problems. (Ohio Resource Center for Mathematics, Science, and Reading)*

Two of the best methods for contextual teaching and learning are problem- and project-based learning.

Problem-Based Learning

Picture a classroom of students actively engaged in solving a real-life community problem, for which a town meeting has been scheduled. Teachers have students gather data as they prepare to address the issue of an abandoned, environmentally contaminated property acquired by the Tribal Nation. The problem statement reads, *"How can we determine the most economically advantageous and environmentally safest use of this parcel of land, so that the people and the Tribal government are happy with the result?"*

Time is provided in applied math, science, communications, economics, psychology, fine arts, and technology classes to get ready for a simulated town meeting activity. Each student assumes a role of one community stakeholder. Each stakeholder participates in the "town meeting" about the future of the site. The goal is to achieve consensus among stakeholders regarding the proper use of contaminated land. Then the entire class attends the actual town meeting, with the most logical and persuasive group presenting.

The teaching and learning strategies described in this guide are among those referred to as contextual practices. Meaning classroom concepts are applied to a community and business context to maximize authentic learning. When students find academic and technical concepts to be relevant to their lives, they are more able to learn the concepts and apply them properly.

Project-Based Learning

Project-based learning involves actual production of a product. For example, Adam Sigler uses graduate students to create low-cost, high-quality, environmental science videos for Montana State University.

Credit: Tohono O'odham Community College (Fall 2009) Sells, AZ

This experience helps students appreciate the environment while actively engaged in conservation methods, and will share those methods with other interested parties.

Sample Rubric

Scientific Report Rubric

Authors' names: _____

_____

_____

Title of Report: _____

	Beginning 1	Developing 2	Accomplished 3	Exemplary 4	Score
Introduction	Does not give any information about what to expect in the report.	Gives very little information.	Gives too much information—more like a summary.	Presents a concise lead-in to the report	
Research	Does not answer any questions suggested in the template.	Answers some questions.	Answers some questions and includes a few other interesting facts.	Addresses a real issue directly related to research findings.	
Purpose/ Problem	Does not address an issue related to tide pools.	Addresses a tide pool issue which is unrelated to research.	Addresses an issue somewhat related to research.	Addresses a real issue directly related to research findings.	
Procedure	Not sequential, most steps are missing or are confusing.	Some of the steps are understandable; most are confusing and lack detail.	Most of the steps are understandable; some lack detail or are confusing.	Presents easy-to-follow steps which are logical and adequately detailed.	
Data & Results	Data table an/or graph missing information and are inaccurate.	Both complete, minor inaccuracies and/or illegible characters.	Both accurate, some ill-formed characters.	Data table and graph neatly completed and totally accurate.	
Conclusion	Presents an illogical explanation for findings and does not address any of the questions suggested in the template.	Presents an illogical explanation for findings and address few questions.	Presents a logical explanation for findings and addresses some of the questions.	Presents a logical explanation for findings and addresses most of the questions.	
Grammar & Spelling	Vey frequent grammar and/or spelling errors.	More than two errors.	Only one or two errors.	All grammar and spelling are correct.	
Appearance	Illegible writing, loose pages.	Legible writing, some ill-formed letters, print too small or too large, papers stapled together.	Legible writing, well-formed characters, clean and neatly bound in a report cover, illustrations provided.	Word processed or typed, clean and neatly bound in a report cover, illustrations provided.	
Timeliness	Report handed in more than one week late.	Up to one week late.	Up to two days late.	Report handed in on time.	
				Total	

Credit: Kathy Schrock's Guide for Educators, Subject-Specific Rubrics (2010)

Contextual Teaching

> *Students learn best–and retain what they have learned–when (1) they are interested in the subject matter and (2) concepts are applied to the context of the students' own lives. (ATEEC Fellows, 2000)*

Consider Cultural Differences

Build into the curriculum an attitude of acceptance and admiration for students' cultural diversity. Draw upon that diversity as a resource for instructional storytelling. Few Tribal Nations are large enough to cater to a single Tribe. Most reservations—and certainly most communities outside the reservations—serve students with a variety of cultural backgrounds.

The Confederated Tribes of the Chehalis and the local school district used a community-based curriculum to capture the history and culture through oral narration by Chehalis Elders. These perspectives were then supported by historical documents to create academic integrity and developed into course plans. Project managers found the development of essential and guiding questions, assessments, and lesson plans easier when a protocol for working with Tribal Elders and the Tribal community was established first. Multiple community-based discussions about the intended learning outcomes and chronology of histories increased stakeholder buy-in and community support for the project. (The *Evergreen State College Magazine*, 2007)

The North Central Regional Educational Laboratory (NCREL), in collaboration with the nation's leading scholars and practitioners in multicultural education, developed the following principles for multicultural integration.

1. School policies and practices demonstrate respect for and acceptance of culturally and linguistically diverse students.
2. Curriculum, instruction, and assessment build on students' culture, language, and prior experiences.
3. Educators set high expectations for all students and provide opportunities to reach them.
4. Students gain knowledge about a variety of cultures and languages.
5. Schools construct culturally responsive and high-achieving learning environments through active partnerships with parents, families, and community leaders.
6. Professional development helps educators examine their own beliefs and fosters understanding of culturally and linguistically diverse groups. (NCREL, 2009)

Multicultural education applies to members of different Nations as well as those of different races and countries. Most Tribal colleges serve students from more than one cultural heritage. American Indian and Alaska Native; Navajo and Ute; Dakota and Lakota; and many other Nations live and learn together. They need instructors who understand the way they learn and the history of their Tribal interactions.

Credit: Tohono O'odham Community College (2009) Sells, AZ

Accommodate Students' Individual Differences

Contextual teaching is rooted in real-life applications and student-centered activities.

Six of the most popular and effective techniques include:

1. Formulating **problem-based learning** experiences that are relevant to students' lives makes instruction practical and creates memories that increase application of problem-solving skills to future issues.
2. Using **multiple contexts—**such as work, home, school, and the community—to apply skills and solve real problems allows students to observe and reflect upon concrete, familiar situations.
3. Drawing upon **student diversity** encourages reflection by students as they bring their own perspectives and experiences into the learning process. By drawing on diversity, the teacher sets up a climate of mutual respect among students, encouragement for broadening each other's perspectives, and development of students' interpersonal skills.
4. Supporting **self-regulated learning** allows the teacher to encourage students to come up with ideas, try them out, and analyze or test them to see if they work. The teacher who continually fosters students' self-regulated learning builds capacity for critical-thinking skills.
5. Using **interdependent learning groups** allows students to teach and to learn from each other. Such groups are compatible with and enhanced by an atmosphere that draws upon student diversity and facilitates students' self-regulated learning.
6. Employing **authentic assessment** gives students the opportunity to apply their skills in a practical way.

Cultural Relevance

According to the *Tribal College Journal of American Indian Higher Education* (1997), 85 percent of students feel American Indian values are reflected in their classes. Making coursework relevant to student interests and experience helps them retain their cultural values and spiritual beliefs, and strengthens students' self-esteem and cultural esteem. They become better workers and citizens within their own culture.

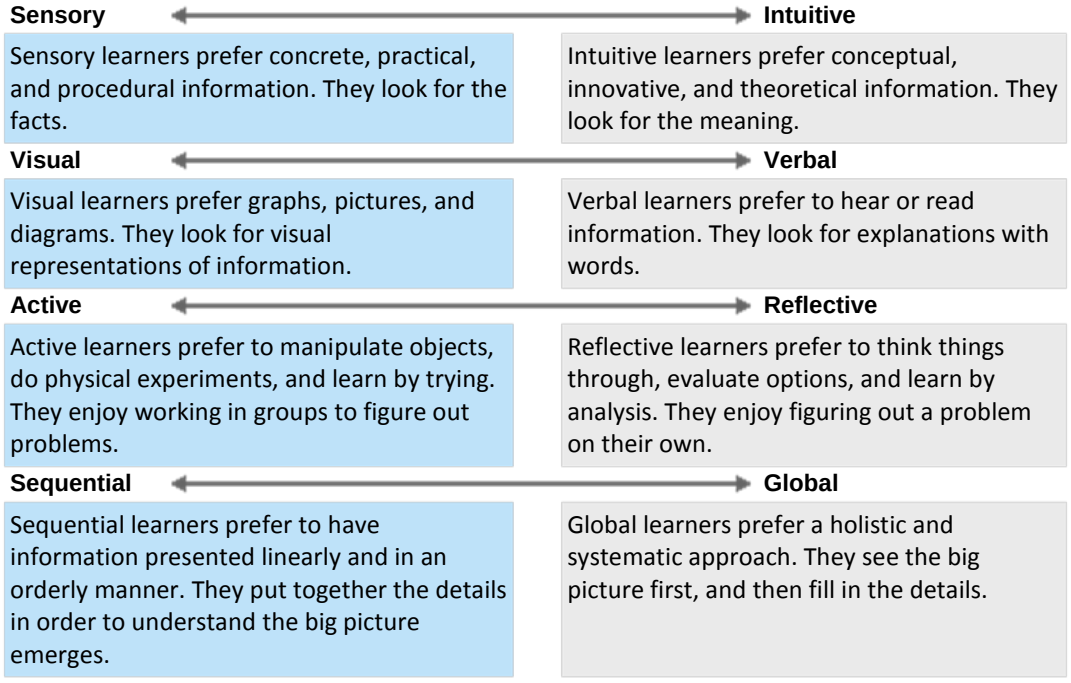
All of the Tribal colleges that participated in the NSF Tribal College Technical Assistance program emphasized the importance of cultural relevance and Native language in their curriculums. Curriculum elements included information on how to navigate federal government programs and blend into national conference settings.

Telecommunications technology enables Tribal colleges to establish communication networks with respected scientists and research facilities, and to stretch beyond the geographic boundaries of the reservation and rural areas that are home to so many of their students.

United Tribes Technical College, ND, offers an associate's degree in Tribal Environmental Science. Curriculum outcomes state that Graduates of the Tribal Environmental Science program will be able to:

1. Apply concepts and facts from various disciplines to analyze environmental issues from a scientific viewpoint.
2. Conduct introductory environmental scientific research through example, mentoring, and personal experience.
3. Understand and be sensitive to the economic, cultural, and political factors that impact environmental issues.
4. Understand the importance of environmental stewardship in appreciating and caring for the natural resources on earth.

Figure 1: Learning Styles Index



Rubrics

A rubric is a scoring guide used to objectively assess what would otherwise be a subjective exercise. By placing criteria for success on a graduated rating scale, students who follow the rubric are assured of success as defined by the instructor. There is no guesswork involved on the part of students regarding what it takes to be competent in a skill or to fully understand a concept. (See the sample rubric on page 26 of this report.)

Contextual Learning

Characteristics of Adult Learners

Adults tend to:

- Bring their own experiences to the setting and appreciate being considered a learning resource;
- Prefer life-based or problem-based learning activities;
- Learn best when they actively practice, perform, and work with new knowledge, skills, and attitudes;
- Appreciate teaching that connects new concepts with something familiar; and
- Like to have opportunities for self-regulated learning.

Accommodating Learning Styles

According to Felder and Silverman, there are four dimensions of learning styles that range across a continuum of cognitive preferences (1980, revised 2002).

Learners benefit from using all styles, not just those they prefer. Incorporate as many styles as possible to achieve a balanced learning experience.

Sensory - Intuitive: *Provide both hard facts and general concepts.*

Visual - Verbal: *Incorporate both visual and verbal cues.*

Active - Reflective: *Allow both experiential learning and time for evaluation and analysis.*

Sequential - Global: *Provide detail in a structured way, as well as the big picture.*

Intelligences

Another popular explanation of individual differences comes from Howard Gardner's theory of multiple intelligences (MI Theory). Gardner, a Harvard University researcher, is a proponent of the theory that we share eight sets of human abilities: logical, spatial, musical, kinesthetic, linguistic, naturalistic, interpersonal, and intrapersonal abilities—in his words, "intelligences."

According to Gardner, we do not have the same strength in each intelligence area. He says in an interview for *Educational Leadership:*

> *"Just as we look different from one another and have different kinds of personalities, we also have different kinds of minds... What I argue against is the notion that there's only one way to learn how to read…to compute…to learn about biology. I think that such contentions are nonsense. It's equally nonsensical to say that everything should be taught seven or eight ways. That's not the point of the MI theory. The point is to realize that any topic of importance, from any discipline, can be taught in more than one way." (Gardner, 1997)*

Gardner asks us to consider the things that people do in the world and the abilities they need to succeed in a career. He feels intelligence is not the same as a learning style.

> *"You can say that a child is a visual learner, but that's not a multiple intelligences way of talking about things. What I should say is 'Here is a child who very easily represents things spatially, and we can draw upon that strength if need be when we want to teach the child something new.' (Gardner, 1997)*

Gardner's theory emerged from studying people with brain damage resulting from a stroke.

> *"When a person [has] had a stroke, a certain part of the brain gets injured, and that injury can tell you what that part of the brain does… That understanding not only brought me into the whole world of brain study, but it was really the seed that led ultimately to the theory of multiple intelligences. As long as you can lose one ability while others are spared, you cannot just have a simple intelligence. You have to have several intelligences." (Gardner, 1997)*

Curriculum Design

There are many ways to design curriculum. The most effective methods are described below.

Traditional teaching and learning takes place in a classroom. Lessons are conducted face-to-face. Assignments are typically written or performed in a laboratory setting.

Distance learning occurs when the instructor and student are physically in different places, whether in another room; off campus; or out of town, city, or even country. Original distance learning involved **correspondence courses** that consisted of course materials and grades relayed via the postal service. **Video teleconferencing** revolutionized distance learning by using televisions, video cameras, microphones, and projectors located in high-tech classrooms to relay information between remotely located teachers and students.

Today distance learning usually takes place in a **virtual learning** environment: over the Internet on the World Wide Web or via Web 2.0 services also referred to as "online learning". The **World Wide Web** is an open **Internet** that can connect anyone anywhere as long as they have a

computer and an Internet service provider (ISP). **Web 2.0** services are confined to **Intranets** which are restricted to students enrolled in the course through a particular college or registered for a particular Web site. They may require use of a particular type of **software application**, such as Blackboard or eCollege. Proprietary **platforms**, **portals**, and **virtual communities** are Web 2.0 services.

There are two **primary types of distance or online learning courses** that use the Internet synchronous and asynchronous.

1. **Synchronous** distance learning occurs when the teacher and the students interact in different places at the same time. Students enrolled in synchronous courses are required to log on to their computer during a set time(s) each week. Synchronous distance learning may include multimedia components such as group chats, Web seminars (also called webinars), video conferencing, and phone conferencing. The instructor sets the pace and is able to answer questions when they arise.
2. **Asynchronous** distance learning occurs when the teacher and pupils interact in different places at different times. Students enrolled in asynchronous courses are able to complete work in their own time within a timeframe. Asynchronous distance learning is preferred by students with complicated schedules. It works well for self-motivated learners who do not need direct guidance to complete assignments.

There are four **levels of Internet-based, online learning**:

1. An **enhanced** course posts some but not all of the course materials online. Often an enhanced course consists of the course syllabus, instructor information, presentations or other multimedia, assignments, and/or an online discussion board. Students are still required to attend traditional classes.
2. A **hybrid** course combines face-to-face classroom instruction with computer-based learning. In a hybrid course there may be online class activities, project collaboration, and other tools for learning provided only online. Some class meetings may be conducted entirely online while others may be of a more traditional nature. Hybrid courses move a significant part of course learning online and, as a result, reduce the amount of classroom seat time. Hybrid courses often make greater use of technology and alternative learning environments, such as service learning and electronic tutoring or mentoring.
3. **Blended** classes offer all of the same information online as in the classroom. Students may choose either method of learning at any time during the semester. Blended courses provide students with a way to study class materials both in and out of the classroom.
4. A **fully online** course has no face-to-face class meetings and all class activities are conducted using the Internet or Web 2.0 service.

Universal Design

The Office of Vocational and Adult Education (OVAE) advocates the use of "Universal Design" at the community, technical and Tribal college

levels. Universal Design approaches education with the intent of making learning environments useful and accessible to people of all ages and abilities. Universal Design for Learning (UDL) offers flexible approaches that can be easily adapted to individual needs.

The founder of the Universal Design Institute, Ron Mace, formulated seven principles to govern the concept:

1. **Equitable Use** — The design is useful and marketable to people with diverse abilities.
2. **Flexibility in Use** — The design accommodates a wide range of individual preferences and abilities.
3. **Simple and Intuitive** — Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. **Perceptible Information** — The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. **Tolerance for Error** — The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. **Low Physical Effort** — The design can be used efficiently and comfortably and with a minimum of fatigue.
7. **Size and Space for Approach and Use** — Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Educators can use these seven principles of Universal Design as a **checklist** for assessing *educational products*: the curriculum and courses that make up a program. Ensure your design includes:

1. **Interactive** learning approaches such as cooperative and collaborative learning with genuine language input from the "real-world" for meaningful communication;
2. **Learner-centered** assessment which allows for creativity from the students and accommodates their learning needs and objectives;
3. **Cooperative** learning exercises that require teamwork. Group consensus is stressed in the classroom with an emphasis on cooperation within a group to master a concept;
4. **Content-based** learning to emphasize scientific, engineering, and mathematical language in specific content or subject matter activities; and
5. **Task-based** activities to develop personal techniques and career-applicable skills. Provide structure through procedures and step-by-step checklists.

Tracking/Multiple Pathways

School tracking (i.e., the separation of students into hierarchical learning groups based on perceived or measured ability) has evolved into a new system of "multiple pathways." These pathways "provide both the academic and real-world foundations that students need for advanced learning, training, and preparation for responsible civic participation."

In their book, *Beyond Tracking*, (2008) Oakes and Saunders describe four main components of multiple pathway programs for K-12 schools to improve student readiness for college:

1. A college-preparatory core,
2. A professional/technical core,
3. Field-based learning and realistic workplace simulations, and
4. Support services that meet the needs of individual students and specific communities.

"In this conception of multiple pathways, students and their families choose from among a variety of options, all of which lead students to the same destination: preparation to succeed in both college and career, not one or the other." (Harvard Education Press, 2010)

Colleges that participate in multiple pathway programming increase enrollment by offering advanced courses, improve retention by knowing more about the students' educational preparation, and expand outreach to students who may never have considered college as an option.

Professional Development

Nothing is more effective at increasing teachers' use of specific instructional practices and increasing active learning strategies than quality professional development and teacher training. (Desimone, et al., 2002) Unfortunately, training is often the first thing cut when budgets get tight. Lately, travel bans have practically eliminated professional development opportunities for community, technical, and Tribal college instructors. To recruit and retain quality teachers, institutions must provide a wide range of professional development opportunities on a regular basis.

According to the *Tribal College Journal* (1993), there is "an unquestioned need for well-trained teachers to teach Native students." Teachers of Native students need to understand the findings of anthropology, sociology, and history. Teachers should be systematically trained to understand the sociocultural processes and cultural influences operating within the community.

Some of the best resources for professional development services are the:

- Association for Supervision and Curriculum Development (ASCD).
- Staff Development for Educators (SDE), and
- U.S. Department of Education

Partnership for Environmental Technology Education (PETE) works to strengthen Science, Technology, Engineering, and Mathematics (STEM) education through a project funded by the National Science Foundation (NSF) and organized in conjunction with Native American and Tribal College faculty representatives. Technical assistance is provided to Tribal Colleges for:

- Program assessment,
- Job/labor market assessment,
- Development of regional environmental technology jobs charts,
- Construction of effective advisory committees, and
- Student recruitment and retention planning.

Credit: Professional Development, NSF Tribal Fellows Institute (2009)

PETE's Tribal *Fellows Institutes* are offered for Tribal college instructors. The Institutes focus on environmental and energy issues to educate a workforce capable of creating a sustainable future. Funds are typically provided for travel and accommodations, as well as a stipend for applying new skills in the classroom.

Section D: Student Support Services

One of the biggest problems for colleges today is student s' lack of preparedness in math and science. Face it - you will need to provide remedial/developmental support services to bring many students up to a level where they can learn college skills. Whether you have a complete program or provide individualized care, instructors will need more time to teach prerequisites.

Individualized Academic Advising

Individualized academic advising for each student is essential for maximum retention and ultimate student success. Course schedules should allow for individual student needs, both academic and personal. Consider alternative delivery systems and scheduling to help students make the most of their time. Ask students what they think! Many students are never asked to form an opinion or support opinions with logical reasoning.

Many students are new to higher education. Some received inadequate preparation for the science and math necessary to understand environmental and energy concepts. Many are already full- or part-time workers, displaced workers, single parents, and experiencing pressures external to college programming. Individualized service is the only way to guarantee each student receives the best a college has to offer. Consider the following options.

Alternative **delivery** systems:

- Independent study
- Self-paced study
- Interactive television courses
- Distance learning/correspondence courses
- Internet classes
- Credit for prior learning
- Credit for courses taken at other colleges

Alternative **scheduling** options:

- Evening courses
- Weekend courses
- Workshops
- Seminars
- Webinars

If you do not already have a diversity committee that promotes multicultural education, start one now. Diversity within an organization encourages mutual respect between students with different life experiences. School policies set the principles and model the practices that not only accommodate student differences, but value and embrace the unique nature of each individual. (Gorski, 2010)

Accommodate individual differences in the classroom. Contextualize teaching and learning for real-life application in a student-centered environment. Methods for contextualizing instruction include problem-based learning, worksite instruction and practice, critical thinking exercises (e.g., reflection, perspectives, and journals), self-regulated or self-paced learning, cooperative learning groups, and authentic assessment.

Credit: NSF Tribal Fellows Institute (2009)

Adult Learners

Harvard University offers a comprehensive model of adult learner engagement in environmental and energy science. Visit the Sustainability at Harvard Web site to see how they encourage everyone on campus to learn about and build a greener future. Additional information on sustainability is available at the following Internet locations:

- Association for the Advancement of Sustainability in Higher Education (AASHE);
- Campus Green Builder;
- Eastern Iowa Community College District (EICCD);
- National Wildlife Federation, Campus Ecology;
- The Nature Conservancy;
- TreeHugger.com; and
- UGA Green Way.

Information on greening the future is available from the following Web sites:

- American Chemical Society, Green Chemistry Educational Resources;
- American Chemical Society, Green Chemistry Institute;
- California Department of Toxic Substances Control, Green Chemistry;
- EnvironmentalChemistry.com;
- Green Chemistry Resource Exchange;
- Journal of Chemical Education;
- The Right-to-Know Network;
- Scorecard: The Pollution Information Site;
- University of Oregon, Department of Chemistry, Greener Education Materials for Chemists ; and
- U.S. Environmental Protection Agency, Green Chemistry.

Credit: NSF Tribal Fellows Institute (2009)

Mentoring and Tutoring

Tutorial services in large universities are usually provided by graduate students. Some community and technical colleges do not have that advantage. Instructors must be willing to offer tutoring in addition to class instruction.

Many students may be capable of understanding a concept without the ability to read the textbook in English (e.g.; English as a second language students or students with

dyslexia). Other students may be capable of understanding a concept without the ability to write papers in English, calculate mathematical equations, or use a computer software application (e.g.; English as a second language students or students with physical disabilities).

Confidence building is more important than any other student service. Many students come to college expecting to fail. They need soft skills training (e.g., critical thinking, problem solving, reliability, time management, accountability, and communication skills). Some students come to college never having read an entire book. Some may earn all A's, but when they get a single F feel like a total failure. Plagiarism has become a major problem in higher education. Teach students to avoid problems before they occur.

Instructors should ask each other for help when faced with a student who needs tutoring or mentoring. An individual learning plan can be drafted when instructors know the student, and the teaching and learning methods that prove most effective. A meeting with the student and one or more of his/her instructors should be held to design a plan of action and obtain commitment from all parties.

Mentoring services are exceptionally fruitful when students are paired with support personnel who have similar cultural affiliations and backgrounds. Mentored students often excel beyond the expectations of family, peers, and even themselves.

Internship Programs

Internship programs can provide valuable real-life experiences for students, especially when faculty works with the employer to set worksite performance objectives for the intern. Service-learning "enhances what is taught in school by extending student learning beyond the classroom and into the community and helps to foster the development of a sense of caring for others" (National and Community Service Act of 1990 definition). Send a faculty member or experienced mentor with each student when the internship begins to provide moral support and ensure the student is comfortable working in the environment.

Service Learning

Before implementing a service learning or internship agreement:

- Review child labor laws, Fair Labor Standards, and workmen's compensation regulations;
- Delineate work hours and type of work to be performed;
- Use risk assessment checklists to define placement opportunities;
- Address health and safety issues before placing a student on-site;
- Coordinate with the work site supervisor, placement officer, department chair, counselor, advisor, instructor, and student;
- Identify responsibilities of college, community, and Tribal members;
- Specify participant roles and expectations;

- Define reporting and assessment procedures; and
- Perform entrance interviews. (Conduct exit interviews when the agreement term expires.)

Successful mentors model dedication to academics, demonstrate refined skills, share knowledge, and provide progress reports on a regular basis. They guide learning in school and external learning environments. They take a personal interest in the student and have a real stake in their success. They communicate with instructors and counselors to head-off problems and create mutually beneficial solutions. They encourage leadership, responsibility, ethics, and dedication.

The best programs include individual and group sessions on a weekly basis. Youth outreach programs are especially good at capturing the scientific inquisitiveness of young people before they decide on a career to pursue.

Risk Management Counseling

The best way to help students who may be at risk for failure is to prevent failure before it happens. Early outreach programs require students to attend orientation programs that provide extensive instruction on financial aid, registration procedures, support services, and graduation requirements. Orientation can be provided online but is more effective on-site.

Orientation

If students are required to take placement tests, offer testing at Tribal community high schools along with mini orientation sessions. It is advisable for first-time students to take an introductory course in strategies for academic success. This course should teach stress management, test-taking, time management, note-taking, and study skills as well as school procedures and policies.

Financial Assistance

Financial assistance is crucial to the success of all students but especially those with low incomes and first generation students. Counselors must have the latest information on student job programs, financial aid, scholarships, and grants. They should be able to advise students of workshops and seminars that can be taken instead of full-time college classes.

Libraries can provide textbooks for those who cannot afford to buy them. Books can be placed on reserve and checked out for specific lengths of time to use in the library. Students in study groups who read the textbook and participate in group discussions build comprehension more effectively than those who do not.

Students with Disabilities

Students with learning disorders and deficits enroll in ever increasing numbers. Educational institutions are required by law to provide reasonable accommodation for disabled persons (Americans with Disabilities Act of 1990, updated in 2008). Disability services provided in curriculum learning centers or other common areas allow all students to benefit from learning strategies taught by support specialists.

Students who require assistance should feel free to ask staff to walk them through difficult processes such as registration, completing admissions forms, and filling out applications for financial aid. Students in need of academic support should feel free to ask for a tutor or mentor. Remove disability barriers within the classroom setting. Provide assistive technologies and instructor accommodations as needed (LDA, 2005-2010)

Reasonable accommodations include:

- Untimed and/or private testing;

- American Sign Language and oral interpretation;
- Alternative print format (e.g., large print or Braille textbooks and closed-captioned videos);
- Reading services and permission to audio tape lectures;

- Note-taking services and copies of lecture notes;
- Portable equipment (e.g., listening devices, books on tape, personal scanners, and speaking systems);
- Laboratory assistants and specialized lab equipment; and
- Tutors, preferential seating, and partnered labs.

Private Counseling

High school and college counselors need to work together to help students navigate the emotional and personal hurdles they face when furthering their education. The counseling office must be prepared to offer emotional support and refer students to professional services if necessary. College students are often ill prepared for the stress they face in their personal lives and the academic demands of higher education.

Advising

Academic advising helps match student interests and abilities with a rewarding career. Non-departmental academic advisors need to be familiar with and committed to environmental and energy technology programs. It is not enough to locate courses in the catalog and complete registration forms; advisors must be committed to the college and knowledgeable about its programs.

Monitor student attendance and academic performance. Establish a system to warn counselors of problems before they become too big to overcome.

Science and math instructors can hold office hours in the student support area. Students should be encouraged to approach any teacher in the area for help. Asking a teacher of a different subject often provides a new perspective on the problem. Expand student opportunity for help when and where it is needed most.

Offer a "Fresh Start" type of program for students on probation. Limit the number of registration days and notify students who have dropped classes or left program of study that they are welcome to return. Tell them the school will do everything it can to make this time successful. Allow department chairs to remove poor grades from the transcript after completion of specific steps to improve academic standing and proof

EPA Tribal Grant Guidance (2008)

of intent to graduate. If all else fails, seek out and pursue appropriate transfer opportunities.

Internal and External Community Networking

Internal

The services we automatically think of in reference to student support are more important now than ever before. Investment in support services increases community visibility, alumni support, and student identification with a college. Integrated support systems help students to bond with and support each other in times of need. Internal support services encourage students to study together and develop teamwork skills.

Student support groups are often affiliated with a particular cultural event or organization. Social clubs and peer support groups provide the stability that is missing during those first few years when students start making their own way in the world. Staff and instructor involvement increases student contact time. Support groups increase self-awareness and confidence.

Internal community networks are very good at marketing school and Tribal community events. Students volunteer to create Web pages, host workshops, write newsletters, tutor, and more. Internal community networks provide avenues for stress management through recreation. Recognition for academic achievement and exceptional instruction solidifies collegial bonds when disseminated internally.

Consider starting a student organization in conjunction with one of the following professional associations.

- ACS – American Chemical Society
- AISES – American Indian Science and Engineering Society
- ASES – American Solar Energy Society
- ASPRS – American Society for Photogrammetry & Remote Sensing
- AWEA – American Wind Energy Association
- Botanical Society of America
- IEEE – Institute of Electrical & Electronics Engineers
- NAAEE – North American Association for Environmental Education
- NACA – National Association for Campus Activities
- NAEP – National Association of Environmental Professionals
- NAHB – National Association of Home Builders
- NCSE – National Council for Science and the Environment
- NESEA – Northeast Sustainable Energy Association
- NWF – National Wildlife Federation
- SAF – Society of American Foresters
- SEEDS – Sustainable Energy for Economic Development (Northwest)
- UNESCO – United Nations Educational, Scientific and Cultural Organization
- USGBC – U.S. Green Building Council

Try brown bag lunch meetings to increase attendance.

External

Reach out to young students and their families. Build a community that values college education and lifelong learning. Youth summer camps and classes encourage young people to come to the campus and participate in fun activities. Hosting community activities on campus can alleviate much of the discomfort associated with attending college for the first time. During the school year, host science fairs, workshops, and seminars for primary, intermediate, and high school students.

> *Navajo Technical College, NM, examined their outreach strategies and found that the local rodeo event and horse ranch provided public venues for teaching animal husbandry and agriculture prerequisite skills to middle school students and arranged internship experiences for college students.*

Offer similar venues to senior citizens and other adults to build comfort around the idea of continuing education. Teach them how to use a computer through science, technology, engineering, and mathematics topics. In the southwest, colleges sponsor rodeos; along rivers, colleges sponsor river clean-ups; and on the coasts, people gather data on sea-level rise, topographical temperature differences, and the use of renewable energy technologies.

Find a topic that suits your region of the country and use it to teach basic science concepts and experimentation skills. Adults will encourage students to pursue higher education when they have experienced its benefits for themselves. Children will be more likely to explore careers in science after they have had a taste of what it is like to be a scientist.

Articulation programs with area high schools and four-year institutions create a seamless progression through the educational system, making it easier for students to see progress as they work toward their goals. Hard work in prerequisite courses is preserved, not lost, during transfer. Students who know where they have been, where they are now, and where they can be are more likely to follow the path than those who only have a vague perception of what they need and where they are going.

Provide opportunities for student travel and participation in multicultural activities. Fear of being "different" is a powerful deterrent to acceptance and understanding, career exploration, and life skills. Support student travel; it is the only way to understand the real world. Many organizations offer field trip and student travel opportunities such as competitions, conferences, and student exchange programs. Government programs, private foundations, and international organizations often grant funds to worthy projects. Sources include NASA, NOAA, NSF, Packard Foundation, AHEC, and AISES.

Tribal and public business and industry alliances help instructors to create relevant, real-world learning experiences. For example, reading about wind energy systems is good; simulating wind energy systems is better; helping a local wind energy company solve real problems is the best way to understand the whole system and how it interacts with other systems and company policies. Knowing where the jobs are located and how to prepare for the career of choice gives learning purpose and direction.

Job Placement Services

We can train people for any career, but if the jobs are not available in the area where the student lives or wants to live, then colleges are wasting their time as well as the students' time. To adequately meet student needs, the department should identify jobs in the field, analyze those jobs for essential skills, conduct a task analysis of each skill, formulate learning objectives, and monitor results. Jobs that have been around for a while should already have

been analyzed. If a job is new or emerging (e.g., bio mimicry and myco-remediation), be the first to define it.

The best way to match college training with job requirements is to conduct a job market analysis before developing a new program of study to be sure the jobs will be available when students graduate. Conduct periodic follow-up assessments to keep programs aligned as the job market shifts over time. There is general consensus in the field that technician level jobs are decreasing. Most environmental and energy science jobs now require a bachelor's degree to start. Two-plus-two programs work best in hydrology, geographic information systems, and field work.

Survey Tribal community businesses that typically hire your graduates. If a survey is too expensive or time consuming to implement, gather a focus group of key business and industry practitioners.

Types of survey information to be requested include:

- Type and size of the organization as well as its products and/or services;
- Type and number of technicians employed by the organization;
- Wage for entry-level technicians;
- Minimum level of education required and preferred for full-time employment as a technician;
- Required work experience for employment as an entry-level technician;
- Degree of difficulty finding qualified technicians;
- Projected number of full-time and part-time openings for technicians; and
- Types of training the organization would like to offer to its employees.

DACUMs

Conduct a professionally facilitated DACUM (Developing a Curriculum) job analysis. The DACUM process is a quick, cost-effective way to identify the necessary worker competencies for an occupation.

Formulate a list of the largest environmental and energy employers in the area. For example, in the northwest, the most common employers are the U.S. Department of Agriculture (USDA), specifically the Natural Resources Conservation Service (NRCS), and Farm Service Agency (FSA).

Hire a professional facilitator to organize the meeting. Select 8-12 people currently employed in the field, and invite supervisors.

In the meeting, develop a list of skills that address the worker competencies needed for an occupation. For example, if the college offers a program in energy services careers, list the skills to be taught in that program. Break each skill into measureable objectives.

The advantages of the DACUM process include:

- Increased focus on the problem-solving process,

- Encouragement of divergent thinking (a wide range of ideas),
- Validation of charted competencies describing the occupation,
- Production of a concise document useful to all stakeholders,
- Shared ownership and recognition of curriculum components, and
- A task analysis for each required skill.

Advisory Boards

Organize meetings of the Advisory Board on at least an annual basis. Include technology-related business representatives in board meetings. Specialize in technical areas not adequately supplied by other colleges—find your niche. Become expert in a regionally high-need area such as wind energy in North Dakota or solar energy in Arizona. Provide the greatest number of highly skilled technicians to meet an increasingly demanding and technically complicated field. For example, consider expanding research and technician training to new forms of energy collection and distribution.

Capitalize on strong programs by pairing them with new programs. For example, coal is one of the dirtiest types of fuel; convert coal mines to geothermal energy production sites. Target and market the program to businesses that typically hire graduates. Capitalize on college, community, and Tribal strengths. Share success stories with media and marketing departments. Show new and prospective students what can be accomplished with your help. Encourage staff to try innovative strategies and to "think outside the box." Service learning is not the only way to involve community, Tribal, and business, and industry leaders in the educational process.

Outreach

Visit K-12 classrooms and support summer youth programs. Individualize your approach to job fairs and career days. Use college students as mentors. Provide career exploration activities; many prospective students believe education, medicine, and business are their only career options.

Each student should have his or her own individualized career plan and job hunting strategy. Plan job placement strategies long before students graduate. Actively seek out and promote students you feel are best suited for a specific job within the community. Create opportunities for Tribal community business and industry personnel to interact with those students, learn the strengths, identify program weaknesses, and choose the most qualified applicants. They may even append their business plans and create new jobs based on skills they see in your students as ways to expand their organizations.

Track student plans from the time they first visit or show interest in the college; this may be as early as third grade. Note career interests as they change over time. There are a number of aptitude, personality, motivational, and occupational interest assessment devices to help students channel strengths and interests into a successful career. Many of them are provided free online, such as:

- Analyze My Career
- Career Explorer: Career Aptitude Test
- CareerScope®
- Free Career Assessment Test
- Live Career Interest Inventory
- Motivational Appraisal of Personal Potential (MAPP) Assessment
- Vocational Research Interest Inventory
- WorkPlace Mentor™

careeronestop
PATHWAYS TO CAREER SUCCESS

The U.S. Department of Labor (DOL) regularly announces initiatives to prepare the workforce for jobs in the future. Watch for new program opportunities in green jobs as these initiatives begin to impact your area of the country.

Section E: Facilities, Supplies, and Equipment

Establish an emergency management plan and stick to it. Train all students, faculty, and staff. Adopt an existing safety manual or write your own. Either way, plan for the worst that can happen and enjoy success when it doesn't. Offer prerequisite classes in health and safety. Ensure students are fully informed on and able to comply with laboratory safety and security policies, practices, and procedures.

Funding

Traditional classrooms, multimedia, laboratories, and outdoor facilities are essential to running an environmental or energy program. With so many environmental laws, regulations, and cases online, access to a computer lab and the Internet is a must. Even a basic science facility can be very expensive to design, build, and maintain.

If you are lucky enough to be able to create your own lab, work directly with architects and talk to science teachers about design, layout, equipment, storage, vents, fans, and eyewash stations. Contact state health and fire departments for current regulations and building codes.

Credit: aazevedo (Feb 13, 2005) stock.xchng

If you must make do with an existing facility, the proper equipment and supplies can be acquired by asking science instructors and Tribal community businesses for suggestions on funding and procurement for your programs.

Funding is acquired through endowments to the college, student tuition and fees, industry support, and often grants offered by any number of agencies, organizations, and the U.S. government. Applying for grants (e.g., Tribal Grant Guidance, applicable to most government grant programs) takes considerable time and networking skills. The applicant needs to know the providers well enough to discern exactly what they are looking for and how to word the application to suit their requirements as well as the applicant's needs. Unfortunately, this process tends to widen the gap between wealthy and struggling institutions, as the wealthy can afford to set aside time for their most capable personnel to monitor grant possibilities and apply for those most suited to their needs.

Other options for management of funding issues include:

- Sharing facilities with other departments, high schools, or colleges;
- Offering short-term training programs to create income;
- Partnering with industries that hire graduates of your programs; and
- Soliciting for used equipment and supplies.

Beware of old equipment in need of repair or for which parts are unavailable. Old appliances such as refrigerators can cost more than they are worth to maintain. Make sure all chemicals are still within their active shelf life, and properly packaged, labeled, and stored.

Prioritization

Acquire equipment and supplies that cover core training necessities first. A basic environmental technology program requires equipment for:

- Decontamination,
- Monitoring,
- Personal protection,
- Respiration,
- Safety (e.g., hazardous materials, hygiene, storage, safety, lockout/tagout of electrical and mechanical hazards, walkway and egress plans),
- Sampling,
- Site and spill control (laboratory hygiene), and
- Tools for working with the equipment.

Checklists for the above equipment categories are provided at http://ateec.org/ateec-downloads/equipment-checklists.

Pace of technological advancements

The pace of technological advancements is staggering. It increases exponentially over time. Keeping up with the newest developments is not easy, but it may make the difference in quality that your students need to obtain good jobs in their fields.

How to determine what is essential

Only purchase what you really need. Be creative; make your own equipment when possible. Collaborate with engineering, electrical, mechanical, and construction departments or businesses. Buy for existing programs first and then start looking at additional equipment and/or expanding into new programs. Specialize in programs with stable or growing employment opportunities in your immediate area. Include Tribal community experts in program design and development as well as teaching and learning activities. They know what is new and which equipment provides the highest quality and greatest durability. Build strong ties with those companies that best match the needs of your program.

Acquisitions

If your institution does not have an established procurement and purchasing process, set one up immediately. Vendors thrive on predictability and consistency. You will always know what you have, what you need, and when to reorder supplies. The budget will be easier to balance and invoices paid faster. If you cannot afford to purchase all of the equipment needed, consider leasing or renting from vendors.

Procedures

Standard operating procedures (SOPs) should be developed for handling facility functions, such as locking cabinets and doors for security and in emergencies. Department facilities should be in compliance with Occupational Safety and Health Administration (OSHA) standards to ensure the health and safety of employees and students. Following regulations reduces school liability and sets an example for students who are learning to apply these rules in their future workplaces.

Allow students to assist in auditing departmental facilities for meaningful life experience. Students can design facility checklists for compliance.

Typical compliance procedures include:

- Hazard communication (signage, labeling, and data sheets);
- Proper storage of chemicals;
- Lockout/tagout of electrical and mechanical hazards;

- Walkway design and layout;
- Egress plans;
- Respiratory protection; and
- Laboratory hygiene.

Reduce injury by keeping facilities clean and well maintained. Comply with all local building, electrical, and fire codes. Take a walk-through with an industrial hygienist and the local fire chief.

Credit: HAZMAT, HMTRI (May 16, 2008) ATEEC

Inventory

Inspection

To ensure that equipment and facilities are available and in good condition when needed, align procedures for periodic inspection, and routine and preventative maintenance. Follow all requirements set by the Occupational Safety and Health Administration (OSHA), Department of Transportation (DOT), and Environmental Protection Agency (EPA). Follow professional standards such as those outlined by the National Fire Protection Association (NFPA) and manufacturers' documentation.

When inventorying supplies, create a checklist or spreadsheet. For each item, describe the supply, unit price, source of supply, expiration date (if applicable), and number of units. Date and initial the checklist each time inventory is conducted. Store supplies in proper facilities. Keep chemicals locked in cabinets marked poisonous, flammable, and so on. Keep flammable materials in fire-resistant containers. Inventory can be conducted on a weekly, monthly, or quarterly basis depending on how often items are used and replaced.

Maintenance

Facilities

Department facilities should be in compliance with OSHA standards to ensure the health and safety of employees and students. Check OSHA general industry standards in the Code of Federal Regulations (29 CFR 1910). The facility should comply with all applicable local building, electrical, and fire codes. Ask administration if the insurance company has a loss prevention specialist or industrial hygienist who could walk through the facility and make recommendations on how to keep the facilities clean and well maintained. Local fire chiefs will also walk through the facility and make recommendations on how to reduce hazards, such as those that could cause falls or fires.

Equipment

The OSHA regulations in 29 CFR 1910 contain standards for respirators, ladders, power tools, and other equipment. Equipment standards are also published by several national organizations such as the American National Standards Institute (ANSI), American Conference of Governmental Industrial Hygienists (ACGIH), and Underwriters Laboratory (UL) for electrical equipment standards. However, OSHA standards are aligned with other organization's standards and should be the primary source of information for processes, procedures, and policies.

Credit: ninci (Sep 23, 2007) stock.xchng

Equipment manufacturers supply documentation about their products that spell out procedures for calibration, inspection, maintenance, cleaning, hazardous materials decontamination, and battery charging. They explain procedures for parts replacement for monitor sensors and lamps. A maintenance timetable can be added to remind staff of recommended factory inspection and cleaning dates, warranty deadlines, and parts replacement guidelines.

Handling and wearing of personal protective equipment (PPE) can pass germs between users. After each use of especially vulnerable equipment such as face masks, follow manufacturer instructions for disinfection.

If equipment is needed for only a short time, consider renting or leasing it instead of purchasing. Establish partnerships with Tribal community industries; they may be willing to loan equipment as an investment in quality preparation and training of future employees. Discuss partnerships fully to determine who maintains this equipment and how to handle any problems that may arise (e.g., replacement of broken and worn parts, accidental damage, and so on). Consider who owns the equipment and what is covered by the user's insurance.

Safety first! Equipment must be functioning properly to protect the safety and health of students and staff. Ensure that machine guards are in place, personal protective equipment is worn, and medical surveillance is conducted for those who wear respiratory protective equipment. Medical surveillance includes a baseline physical examination by a physician and monitoring of any difficulty with respiratory equipment, especially in hot weather.

Supplies

A simple recordkeeping system helps to maintain adequate stores of supplies. Don't wait for inventory time; some materials have a limited shelf life. Determine how often you will need to purchase these materials so that you use them before they pass their expiration date and new supplies arrive before the old stock runs out. Chemical materials should arrive with a Material Safety Data Sheet (MSDS). If not, contact the manufacturer, since OSHA requires MSDS to be accessible to all staff and students.

Develop written procedures for handling chemicals that include but are not limited to:

- Proper storage (flammables in storage cabinets),
- Prevention of hazardous exposures,
- Disposal of waste materials, and
- Response to emergencies.

Train staff and students to follow established procedures. Label materials and post National Fire Protection Association (NFPA) hazard warning signs on doors of each area where hazardous materials are used or stored.

Security

Plans for security maintenance should also be developed. All equipment should be assigned to responsible individuals who are properly instructed in maintenance and operational

procedures. Control access by unauthorized persons to hazardous or potentially dangerous situations, install fire detection and suppression equipment, and plan response procedures for emergency situations.

Staff training

Ensure that each teacher's credentials meet the needs of the program and state certification requirements. Entice instructors to earn additional certifications and levels of expertise by offsetting the cost of professional development and licensing fees. Encourage them to increase status, credibility, salary, and marketability in their respective fields.

State requirements for licensing vary across the country or may be based on federal requirements. A state license may be required to teach asbestos abatement, soil sampling, water and wastewater operations, radon inspection, groundwater, geology, and engineering—just to name a few.

Sample Guidelines for Staff

All teachers, technicians, and support staff

1. Teachers and technicians have a general duty to take reasonable care for the health and safety of themselves, other members, staff, and students. They need to be familiar with the health and safety policy, its updates, the texts to which it refers, and appendices. They must cooperate with the employer's instructions, observe the requirements of the policy, and fulfil special responsibilities when applicable. They must cooperate with colleagues in their specific health and safety duties. They have a duty to report to Tribal management any failure of equipment that has a health and safety function.
2. Staff must set a good example to students and follow laboratory rules (e.g., wearing eye protection).

Credit: sadsac (Sep 4, 2004) stock.xchng

3. Staff must be familiar with emergency drill procedures and with the locations of escape routes; fire-fighting equipment, eye wash stations, the main gas cock, the main electricity switch, and the nearest spill kit.
4. Laboratories must remain safe. Special arrangements must be made for equipment left running overnight, and hazardous equipment left out. In general, all gas taps should be completely turned off, and all apparatus operated from a main terminal or power source switched off. At the end of the day, if practical, gas should also be turned off at the laboratory main gas cock and electricity at the laboratory main switch.
5. Eating, drinking, and the application of cosmetics should not take place in laboratories, storage areas, or preparation rooms unless an area in which it is safe to do so has been created. Students should not be allowed to drink from water bottles.
6. When a staff member is alone in the science department, nothing should be done which could lead to an accident requiring remedial measures. A teacher or technician must assess risks very carefully before conducting any practical operation in such circumstances.
7. In general, students must not be left unsupervised in a laboratory. Staff needing to leave a class briefly must assess the risks of doing so, perhaps arranging for temporary supervision by a neighbouring staff member. Special arrangements may be needed for senior students doing project

work depending on the hazards involved (e.g., an experienced staff member in an adjacent room).

8. Science laboratories, preparation rooms, and storage areas must be locked by staff when not in use. Special arrangements must be made if access is required to a fire escape route. Students must never be allowed into preparation rooms unless 100% supervision can be guaranteed. Laboratories must be cleared before being used by teachers who are not scientists. If clearing the laboratory is not possible, these teachers must receive special training. Teacher-supervised club activities in laboratories should only be possible by special arrangement.

Teachers

1. At the beginning of each school year, teachers must ensure their students understand the rules for working in a laboratory. Place copies in places like an exercise book or work folder.

2. Teachers must enforce the student laboratory rules, reminding students of them often enough for them to become familiar. With new students, time should be spent explaining the rules with appropriate demonstrations.

3. Lesson preparation should include risk assessments and a list of the health and safety precautions required to work with the materials. Requisitions must be handled in time to obtain materials for testing before use in the classroom. Technicians must be given adequate time to prepare the work space and materials for use in a safe manner.

   Time should be allowed for consulting colleagues where there is any doubt and to try out experiments, particularly those involving significant hazards. Teachers must only deviate from the scheme of work—for which the activities have been checked against model risk assessments—after making a further risk assessment. This includes checking with a subject specialist, and possibly obtaining a special risk assessment from CLEAPSS. Teachers should explain precautions to students as part of their health and safety education, (using the CLEAPSS *Student Safety Sheets*, where appropriate).

4. Open-ended investigations must be organized to allow teachers to assess risks and identify precautions before any hazards are met or practical work begins.

5. If a large class size or indiscipline prevents health and safety from being maintained during certain practical work, the work should be modified or abandoned. This decision should be reported to the head of the department or other appropriate person.

6. The teacher is responsible for the health and safety of students in his/her classes that are taught by a trainee teacher. If the normal class teacher is absent, another science teacher must be given this responsibility by the head of department.

7. Teachers in charge of courses are responsible for ensuring that technicians are familiar with the appropriate precautions needed to control hazards that could be encountered during preparation of and clearing away equipment. Class teachers may need to remind technicians of such warnings. (CLEAPSS®, 2007)

Both Tohono O'odham Community College, AZ, and Keweenaw Boy Ojibwa Community College, MI, have reserved plots of land for use by environmental science programs. These private lands enable students and teachers to work with native plants, many central to the students' cultural heritage and community practice. Agriculture, biology, botany, ecology, genetics, foods, and environmental science

programs can merge cultural ideals with the science necessary for their graduates' careers.

Little Priest Tribal College (LPTC), NE, recognized a cultural need in the death of Winnebago elders. They knew where to find food and how to use medicinal plants native to the region. In response, the college developed an ethno botany research program. Students and instructors catalog native plants and their uses based on oral tradition and published resources. Al Martyn, ethno botany instructor, teaches "from the big picture down" from ecology down to cells. The class spends a great deal of time outdoors. It has become an extremely popular course, facilitating an alliance with other Nebraska colleges and universities to "enhance the competitiveness of biomedical research in Nebraska." (NSF, 2008)

Section F: Alliances

The need for strong alliances and partnerships cannot be over-stated. For example, the Advanced Technology Environmental and Energy Center (ATEEC) is supported in part by the Eastern Iowa Community College District. It would not exist without its many funding and collaborating partners.

ATEEC's federal funding partners have included:

- National Science Foundation (NSF),
- Environmental Protection Agency (EPA),
- Department of Energy (DOE),
- Department of Defense (DOD),
- National Institute for Occupational Safety and Health (NIOSH), and
- Occupational Safety and Health Administration (OSHA).

Credit: teaksato (Jun 13, 2004) stock.xchng

ATEEC has worked with the University of Northern Iowa (UNI), Kirkwood Community College, and the Massachusetts Institute of Technology (MIT). ATEEC's community and technical college partners are mapped on their Web site at http://ateec.org/core-partners High school and K-8 programs prepare students in developmental skills for early college entrance; dual-credit programming; and basic science, technology, engineering, and math (STEM) skills necessary for a successful career.

Tribal business and industry relationships provide internship possibilities for students and training revenue for community projects. ATEEC provides certification training of the workforce in health, safety, and hazardous materials management.

Community networking is essential to communication and the development of fruitful partnerships. ATEEC is a national Advanced Technological Education (ATE) Center. Along with 35 other ATE Centers across the country, ATEEC "…endeavors to strengthen the skills of technicians, whose work is vitally important to the nation's prosperity and security." (*ATE Centers Impact*, 2011.

For example, SpaceTEC (National Resource Center for Aerospace Technical Education) is an ATE Center allied with the National Aeronautics and Space Administration (NASA). Based on input from members of the aerospace industry, SpaceTEC plans to add additional certifications. The plan calls for a DACUM (Developing A CurriculUM) "conducted with representatives from industry who are subject matter experts (SME). The DACUM identifies duties and tasks; knowledge and skills; tools and equipment; and traits and attitudes for inclusion in new certifications. Competencies are then developed and SMEs are identified who can help develop the test bank. After a beta test of the bank is completed and analyzed, the new certification examination is approved for use and released, opening a new credentialing opportunity for technicians. In today's work environment, certifications are an indispensable element for qualifying employees, and Questionmark plays a key role

> in that effort." (SpaceTEC Newsletter, 2011, May)

In addition to other ATE Centers, ATEEC works closely with a number of professional organizations, such as the Partnership for Environmental Technology Education (PETE) and the National Renewable Energy Laboratory (NREL).

These partnerships and alliances help to make ATEEC a contributing member of Tribal, state, and national networks. These networks support community, Tribal, and technical colleges in their efforts to educate quality technicians and keep them up-to-date on the latest regulations and advances in their fields of interest.

Possible partners include:

- K-12 schools,
- Two-year colleges,
- Four-year colleges and universities,
- Businesses,
- Industries,
- Tribal governments,
- State governments,
- Federal government programs, and
- Federal government agencies.

Success then depends on the school's ability to partner with the best resources available. According to Lame Deer of the Northern Cheyenne Reservation in south-central Montana, "MAP [Midwest Assistance Program] staff understands the tribal political climate, knows how to motivate Tribal managers and operators, and holds a deep appreciation for Native cultures. MAP has developed a sound reputation in Indian Country as a reliable source of training and technical assistance for a wide variety of issues affecting the health and safety of its members."

The ACS Model

An excellent model for the initiation and continuation of successful alliances is offered by the American Chemical Society (ACS), reprinted here with their permission.

A partnership can be defined as a system by which there is a shared responsibility between education, industry, labor, Tribal government, and community to develop the human resources required for high-performance workplaces. Alliance activities must yield benefits to all participating members.

A successful alliance:

- Continuously updates, improves, and customizes industry-based competencies;
- Develops curricula, course content, and programs;
- Uses instructional materials that support a customized set of industry-based competencies;
- Provides workplace experiences for students;
- Provides professional development activities for faculty;
- Links intermediate, secondary, and postsecondary institutions;
- Shares financial, capital, and human resources;
- Monitors employment, occupational trends, and other regional trends;
- Provides public relations, outreach, and career guidance; and
- Communicates about events, activities, and findings.

For a Tribal community alliance to be successful, it is critical that all stakeholders do the following:

- Share a common vision, recognizing that skilled workers create high-performance workplaces and benefit the community as a whole.
- Share financial, capital, and human resources so that benefits outweigh the costs.
- Exhibit a willingness to change some existing values, recognizing that the process for identifying and developing industry-based competencies is a collaborative effort. It is from this basis that the skills of incumbent workers can be upgraded, and entry-level workers can be better prepared for entering the workplace.
- Respect one another's self-interests. In today's competitive environment, stakeholders set high expectations. It is understandable that in order to meet these objectives, it is likely that stakeholders will:
    - support activities that can be shown to effect the bottom line,
    - competitively recruit top students and workers, and
    - require programs that meet narrowly defined needs.
- Provide flexibility to accommodate differences, ensuring that:
    - the needs of small and large companies are met;
    - private and public educational institutions are accommodated;
    - a single stakeholder, or group of stakeholders, does not dominate alliance activities; and
    - alliance activities are managed by an unbiased group of participants aimed at benefitting the community as a whole.
- Support initiatives at the regional and state levels, including the incorporation of state frameworks aimed at workforce development and skill standards implementation.
- Conduct an annual program review, obtaining and analyzing data on…
    - enrollment,
    - contact hours, and
    - full-time equivalent enrollment;

  …generated by…
    - program,
    - graduate completion rate,
    - job placement,
    - transfer, and
    - certification/licensure

  …in order to determine goals for the following year.

Advisory Committee

An advisory committee is composed of community and Tribal leaders; knowledgeable persons from government, business, and industry; as well as area high school and higher education staff, faculty, and students. Their charge is to advise and consult with administrators and faculty on educational programs for the community or technical college. Establishing an active advisory committee is a necessary part of a team effort to provide quality education for students in technical fields.

The institution needs close cooperation with the Tribal community if it is to provide relevant occupational education. The evaluation and advice of experienced employers and employees ensure that the knowledge and skills being taught are applicable to the needs of the Tribal and public businesses and industries that will most likely hire them after completion of their degree program.

An advisory committee provides guidance on the following functions:

- Assist in assessing the need for education and training in an occupational area.
- Assist in determining an appropriate program of study to meet the needs of students and the Tribal community.
- Assist in analyzing and/or validating the tasks as well as the knowledge and skills required in that occupation.
- Provide insight into the educational program relative to expected student outcomes/job skills.
- Recommend instructional equipment and assist in obtaining it (e.g., soliciting donations).
- Make recommendations in planning and/or modifying facilities.
- Assist in recruiting and placing students.
- Identify people in the field who can advise and make presentations to students and instructors.

- Create public awareness of the program by promoting good public relations between the school and the Tribal community.

Other Partnerships

Alliances with other community and technical colleges expand the institutions' ability to provide high quality educational opportunities at reasonable costs. Partners might arrange for each college to choose a program to specialize in, and offer articulation agreements with partner colleges. Each college need only equip one or two labs instead of building separate labs for each subject. Supplies can be purchased in bulk and are easier to categorize. Partnered schools share faculty and staff as well as services not otherwise available through institutions operating alone.

For example, in 1987 two Iowa community colleges, Kirkwood Community College in Cedar Rapids and Eastern Iowa Community College in Davenport, established the Hazardous Materials Training and Research Institute (HMTRI). Together they provided eastern Iowa with environmental health, safety, security, hazardous materials, emergency management, and OSHA education for credit and certification purposes.

Partnership Roles

The American Chemical Society further describes the **roles** of partners as follows:

Education	Government	Community	Business and Industry	Labor
Build courses, curricula, and programs.	Endorse processes to identify and validate industry-based competencies.	Coordinate public outreach activities such as career days.	Identify competency requirements for the workplace.	Participate in the process of identifying and validating industry-based competencies.
Articulate with other educational institutions.	Establish portfolio, certification, and credentialing frameworks.	Participate in state academic and skill standards initiatives.	Identify business and employment trends.	Promote continuing education for workers.
Encourage faculty and students to take advantage of workplace experiences, co-ops, and internships.	Establish and monitor safety, health, and environmental data.	Encourage participation in faculty development and opportunities.	Provide financial, capital, and human resources.	Ensure that current workers have access to education and development opportunities.
Provide financial, capital, and human resources.	Provide a seamless link between secondary and post-secondary education.		Provide workplace experiences for faculty and students.	Participate in state certification and portfolio initiatives.
Ensure well-rounded educational experience to support technical skills and knowledge.			Encourage employees to participate in alliance activities.	
Provide flexible schedules for current workers.			Provide public awareness programs.	
			Participate in career guidance activities	
			Provide scholarships.	

Credit: American Chemical Society

Sample List of Alliances

Eastern Iowa Community College District
Alliances with Environmental and Energy Technology Programs of Study

Funders

- Advanced Technology Environmental and Energy Center, Bettendorf, IA
- Friends of Nahant Marsh, Davenport, IA
- State of Iowa, Des Moines, IA

Advisory Board Members

- Bergey Wind, Norman, OK
- BP Wind, Midwest Representative
- Iowa Wind Energy Association, Estherville, IA
- Mariah Power Company, Reno, NV
- Power Film, Ames, IA
- Sagrillo Power and Light, Forestville, WI
- The Weidt Group, Minnetonka, MN
- University of Northern Iowa, Cedar Falls, IA

Business and Industry

- Med Force, Colona, IL

Community Leaders

- Albany Fire Protection District, Emergency Medical Service Division, Albany, IL
- Davenport Fire Department, Davenport, IA
- Iowa Renewable Energy Association, Dubuque, IA
- Mississippi Bend Area Education Agency, Bettendorf, IA
- Project Lead The Way, Inc., Clifton Park, NY
- River Action, Davenport, IA
- Scott County Conservation Department, Davenport, IA
- Trinity Health System, Bettendorf, IA

Government Agencies

- City of Davenport, Davenport, IA
- City of Muscatine, Muscatine, IA
- Division of Vocational Rehabilitation Services, Department of Education, Des Moines, IA
- Iowa Department for the Blind, Des Moines, IA
- Iowa Office of Energy Independence, Des Moines, IA
- U.S. Army, Armament Research, Development and Engineering, Rock Island, IL
- U.S. Green Building Council

Educational Institutions

Two-Year Community and Technical Colleges

- Black Hawk College, Moline/Kewanee, IL
- Mineral Area College, Park Hills, MO

Educational Institutions (continued)

Four-Year Colleges and Universities

- Ashford University, Clinton, IA
- Capella University, Online Program Articulation
- Columbia Southern University, Orange Beach, AL
- Defense Acquisition University, Kettering, OH
- Fort Hays State University, Hays, KS
- Iowa State University, Ames, IA
- Kaplan, Online Program Articulation
- Loras College, Dubuque, IA
- Missouri University of Science and Technology, Rolla, MO
- North Carolina Agricultural and Technical State University, Greensboro, NC
- Southeastern Community College, West Burlington, IA
- Southwestern Community College, Creston, IA
- St. Ambrose University, Davenport, IA
- The University of Iowa, Iowa City, IA
- University of Northern Iowa, Cedar Falls, IA
- University of Phoenix, Phoenix, AZ
- Western Illinois University, Macomb, IL
- Western Iowa Technical Community, College Sioux City, IA

High Schools and Community School Districts

- Andrew Community School District, Andrew, IA
- Assumption High School, Davenport, IA
- Bellevue Community School District, Bellevue, IA
- Bettendorf Community School District, Bettendorf, IA
- Calamus-Wheatland Community School District, Calamus/Wheatland, IA
- Clinton Community School District, Clinton, IA
- Columbus Community School District, Columbus Junction, IA
- Camanche Community School District, Camanche, IA
- Davenport Community School District, Davenport, IA
- Delwood Community School District, Delwood, IA
- DeWitt Central Community School District, DeWitt, IA
- Durant Community School District, Durant, IA
- East Central Community School District, Sabula, IA
- Geneseo Community School District, Geneseo, IL
- Louisa-Muscatine Community School District, Muscatine, IA
- Maquoketa Community School District, Maquoketa, IA
- Muscatine Community School District, Muscatine, IA
- North Scott Community School District, Eldridge, IA
- Northeast Community School District, Goose Lake, IA
- Pleasant Valley Community School District, Bettendorf, IA
- Preston Community School District, Preston, IA
- Prince of Peace College Preparatory, Clinton, IA
- West Liberty Community School District, West Liberty, IA
- Wilton Community School District, Wilton, IA

Articulation Agreements

Tribal planning facilitates communication and curriculum coordination among educational institutions providing an essential service to students, employers, and the community. Two-year colleges provide a natural bridge for articulation programs between secondary schools and four-year colleges. Articulation agreements are often initiated by two-year colleges and reviewed annually by the Advisory Committee. Tribal colleges are particularly good at developing smooth articulation paths.

It is critical to establish a college mission before beginning articulation efforts. Is the goal of the community or technical college to prepare students for employment, four-year degree programs, or both?

Start by establishing a set of core knowledge and skills for a comprehensive program. Divide those into three categories: prerequisite, essential, and advanced knowledge and skills.

- Prerequisite knowledge and skills constitute content for secondary students and remedial or developmental courses.
- Essential knowledge and skills are taught in community and technical colleges.
- Advanced knowledge and skills make up the program offered at four-year colleges and universities.

Articulated courses facilitate a smooth transition through the subject matter. Students move from one level of instruction to another, decreasing the amount of time and money required to complete a program of study.

Use partner expertise to address relevant academic and occupational standards. Encourage partners to market information about the articulation program and career opportunities to students, teachers, counselors, parents, employers, and the Tribal community. Develop a system to ensure the articulation partners annually review their agreements and revise if necessary. Encourage universities to offer satellite classes on community, Tribal, and technical college campuses so that students unable to attend the university can still earn higher degrees.

DACUMS

As mentioned in previous sections, an effective way to determine job knowledge and skills for integration in a curriculum is through the DACUM (Developing A CurriculUM) process. Traditionally used more often by community colleges, the process can actually define both basic and higher levels of knowledge and skills, which in turn can be used to transition a program from a community college to a four-year institution.

For example, the following chart for Small Wind Energy System Installers was created during a DACUM workshop conducted by the North American Board of Certified Energy Practitioners. Charts can be prioritized to show the pathway transitions from basic to advanced knowledge and skills. For a list of the essential knowledge and skills for many technical careers, download a copy of ATEEC's Defining Environmental Technology and/or Defining Energy Technologies and Services reports.

Environmental Compliance & Technology Technician

The Environmental Compliance and Technology Technician interprets and applies applicable regulations, identifies, understands and maintains regulatory compliance and monitors and reports health and physical hazards in the workplace and the environment with the utilization of applicable technology.

←General Areas of Competence→	←Specific Tasks→						
Field Operations	Perform sampling & monitoring	Perform site investigation	Perform environmental remediation	Perform spill containment	Monitor shelf life of hazardous materials	Ensure proper labeling/cataloguing of hazardous materials	Ensure proper storage & inventory protocols are being followed for hazardous materials (e.g. aisle spacing)
	Develop and interpret Standard Operating Procedures (SOPs)	Understand research methodologies					
Safety	Understand hazard assessment resources (MSDS, NIOSH, etc.)	Identify product & its hazards	Conduct site/risk assessment	Understand all levels of PPE and use	Maintain and inspecting safety equipment	Certified in first aid & CPR	Proficiency in monitoring & sampling equipment
Regulatory Compliance	Ability to locate essential regulations specific to the job	General knowledge of which regulatory authority applies to specific situations	Assist employers or organizations in following applicable regulations	Review updates for applicable regulations	Working knowledge of NIMS (National Incident Management System) protocol	Understand community 'right to know' protocols	

←General Areas of Competence→	←Specific Tasks→						
Technology & Equipment	Understand how and when to calibrate/maintain equipment	Ability to operate specific equipment for a task	Assist in selection of equipment	Stay abreast with evolving & current technology, equipment, & methodologies	Provide hands-on training with equipment	Ensure proper storage of equipment	Familiar with utilizing social media when appropriate
	Familiarity with and ability to use GIS/GPS						
Public Relations and Outreach	Ability to communicate with the public	Recognize cultural differences	Understand chain of command	Establish and effectively utilizing partnerships	Assist with risk management training to the public	Assist with workshops for public information (eg. safety awareness)	
Internal Training and Education	Assess training needs	Create presentation materials for training	Provide training to coworkers	Assessment of training delivered			
Record Keeping	Provide oral or written reports, as required	Maintain appropriate disposal documentation (i.e. disposal					
Professional Development	Acquire/maintain proper certifications	Stay abreast of current and emerging research methodologies	Participate in appropriate continuing education opportunities	Network with other professionals in the field			

PANEL MEMBERS

Michelle Isle, Great Northern Development Corp.
Dennis Four Bear, EHT, Environmental Health Department
Lars Mikkelsen, Fort Peck Tech Services
Steve Harada, Montana Fire Services Training School
Chris Martinez, Agricultural Department – PD Jeff Berger, FPT-OEP, UST-LUST
OBSERVER: Zara Berg, Instructor

DACUM LOCATION

Fort Peck Community College
605 Indian Street
Poplar, Montana

FACILITATOR

Steven Fenton, Consultant

RECORDER:
Sarah Gross, Environmental Analyst, PETE

DACUM Dates:
July 14 & 15, 2011

Additional Skills and Knowledge (Flip Side)

◦ **Other Knowledge Required** ◦ Understand grant management and budgeting ◦ Understand company policies and procedures ◦ Minimum statistics/math ◦ Computer Skills (need to be proficient in these skills) ▪ Word ▪ Excel ▪ Access ▪ PowerPoint ◦ General chemistry ▪ Understand basic chemistry (how to do titrations, etc.) ◦ More certifications ▪ Lead Abatement ▪ Asbestos abatement	◦ **Recommended Classroom/Field Activities** ◦ Field trips (going to abandoned sites, going to court house to do a phase 1 site history) ◦ Job search skills ▪ Resume building ▪ Interview training ◦ Can send students on OEP (office of environmental protection) sampling – they'll teach the students & need the help. ◦ Visit Superfund sites ▪ Columbus saw mill ▪ Airport is a CERCLA site (Brownfield) ◦ Go online to EPA to research Superfund sites ◦ Tour Industrial Park (Lars would be happy to conduct a tour for students)
◦ **Important Regulations** ◦ Clean water act ▪ Water Standards (what's allowable, if they test the water, etc.) ◦ Safe Drinking Water Act ◦ RCRA ◦ SARA	◦ **Soft (Durable) Skills** ◦ General work ethic ◦ Timeliness/punctuality ◦ General writing skills ◦ Technical writing skills ◦ Analyze and write reports ◦ Ability to work in teams ◦ Critical thinking skills

SPONSOR: National Partnership for Environmental Technology Education (PETE)

Additional Skills and Knowledge

o **Other Knowledge Required** o Understand grant management and budgeting o Understand company policies and procedures o Minimum statistics/math o Computer Skills (need to be proficient in these skills) ▪ Word ▪ Excel ▪ Access ▪ PowerPoint o General chemistry ▪ Understand basic chemistry (how to do titrations, etc.) o More certifications ▪ Lead abatement ▪ Asbestos abatement	o **Recommended Classroom/Field Activities** o Field trips (going to abandoned sites, going to court house to do a phase 1 site history) o Job search skills ▪ Resume building ▪ Interview training o Can send students on OEP (office of environmental protection) sampling – they'll teach the students & need the help. o Visit Superfund sites ▪ Columbus saw mill ▪ Airport is a CERCLA site (Brownfield) o Go online to EPA to research Superfund sites o Tour Industrial Park (Lars would be happy to conduct a tour for students)
o **Important Regulations** o Clean water act ▪ Water Standards (what's allowable, if they test the water, etc.) o Safe Drinking Water Act o RCRA o SARA	o **Soft (Durable) Skills** o General work ethic o Timeliness/punctuality o General writing skills o Technical writing skills o Analyze and write reports o Ability to work in teams o Critical thinking skills

SPONSOR: National Partnership for Environmental Technology Education (PETE)

Business and Industry Partnerships

Networking with professional organizations, business and industry, labor unions, the Chamber of Commerce, Tribal government, community groups, professional colleagues, and international alliances are examples of ways to partner with:

- Community environmental forums that include citizens, government, business and industry, and education;
- Community environmental and energy decision-making partnerships with leaders of the community, business, government, and education;
- Tribal government, educators, business and industry, and community leaders for internship, training, and hiring programs;
- Professional and state affiliate organizations, such as the North American Association for Environmental Education and the American Indian Higher Education Consortium;
- Tribal and national conference associations to provide support for students to present at community and national conferences, and maintain an up-to-date list of partners;
- Local and regional newspapers, science and education magazines, and radio and television stations; and
- Annual event holders in the community.

When partnering with business and industry, take note of lessons learned by experience.

- Contact the company's corporate headquarters rather than a local or regional office.
- Small businesses may not be able to afford the staff required for compliance and keeping current with regulations. Find those companies, gain their confidence, and determine what the program can do for them.
- A college must be ready to justify its value for a business's profits.
- Corporate relationships require persistent communications and active involvement.
- Teamwork is essential to the continued benefit for all partners.
- Students are motivated by a real-world project with hands-on career experience.
- Faculty are motivated to pursue multi-disciplinary projects based on a working model.
- Ensure that internship work is directly related to and/or credited to the student's academic degree.
- Make sure interns are paid a fair hourly wage.
- Document the ground rules and expectations of all partners. Insist that all partners sign the agreement.
- Contact all area businesses, not just those that you are sure will say yes.
- Explain how the college can assist the company in obtaining qualified employees while saving money on initial and continued training.
- Ensure all participants are committed to the partnership yet willing to be flexible.
- Schedule a three- to four-month period to recruit participants.
- Real-world experiences teach students much more than video, lecture, or simulated labs.

- Consider all viewpoints before making decisions; attitudes take time to change.
- Don't reinvent the wheel. Determine and utilize existing resources.
- Time spent developing a partnership is worth the effort.
- Education doesn't exist in a vacuum; Tribal business and community needs are the reason schools exist.

Example of a Successful Partnership		
Educational Institution	Texas State Technical College (TSTC)	
Location	Breckenridge, TX	
Business / Industry	• City of Breckenridge • Veale Ranch • Texas Agricultural Extension Service at Texas A&M University • College Station • Stephens County Agricultural Extension Agency	
Partnership Description	The above entities have agreed to partner to work on the project, entitled "Soil Reclamation by Landfarming With Water-Treatment Plant Sludge." The project is located on a 43-acre test site on Veale Ranch. The basic premise is to reduce the salt content by leaching and diluting through the addition of water treatment plant sludge (for moisture) and wood chips (for nutrients) from the city brush collection. The city hired an environmental consulting firm (whose employees include adjunct faculty at TSTC) to develop a plan to recycle resources and help recover soil damaged by salt contamination. The test site is a salt scald, which resulted from oil production and overflow of saltwater holding tanks operating some 50 years ago. The site is currently devoid of vegetation.	
Advantages for Educational Institution	• Provides science students with an opportunity to participate in real-world activities. • Students learn about soil and water sampling, land surveying, mapping, permit application processes, and more. • Students learn about the regulatory, technical, engineering, and scientific aspects of the field. • TSTC benefits from the goodwill generated by a project that helps the citizens of the city and county.	
Advantages for Business and Industry	• The city is able to reduce distant disposal transport costs for water treatment plant sludge. • The city benefits from local utilization of brush and tree wood chips. • Soil reclaimed in the near future may be used for growing crops, livestock grazing, or maintained with grasses to prevent erosion. • Real estate values may increase.	
Maintenance	The recycling of water sludge and wood chips is a year-round activity. The soil reclamation may take several years to show significant recovery.	
Improvements	Seek additional funding through private foundations for help in maintaining a continuous program of field soil and water testing as well as laboratory analysis. Extend the project to other sites. (There are over 1,700 acres of salt scalds in Stephens County.)	

Credit: Arrows, svilen001 (Mar 23, 2010) stock.xchng

Community Networks

One of the best ways to increase enrollment, placement, and visibility within the community is to establish relationships within the institution. Students are more willing to attend a community or technical college where staff and faculty work together to support that individual's career. Internal partnerships should include staff working as:

- Secretaries and clerks
- Computer technicians and recruiters
- Academic advisors and counselors
- Financial aid and placement officers
- Registrar and admissions personnel
- Administrators and librarians
- Tribal community liaisons
- Activities directors and coaches
- Physical plant and maintenance technicians
- Faculty in liberal arts as well as science, technology, engineering, and mathematics

Natural disasters and loss of major industries provide unique opportunities to connect the college community with the Tribal community. According to Workforce3 One:

> *Effective partnerships between community colleges and National Emergency grantees can aid in the efficient design of educational programs that are relevant for the laid off workers. Large layoff events pose distinct challenges when planning for the effected workforce to receive retraining that may be necessary for re-employment success. Collaboration with community colleges can help to meet the unique training needs of dislocated worker populations.*

Professional Organizations

Professional organizations such as the U.S. Department of Labor's Employment and Training Administration (ETA); National Association of Safety Professionals (NASP); American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE); American Chemical Society (ACS); and many others can be critical partners on ambitious projects.

Professional organizations may offer:

- Funding opportunities,
- Access to a larger network of partners,
- Certification and recertification services, and
- Expert advice on standards and regulations.

Nurture these relationships by keeping the lines of communication open and dialogue flowing. Consider including one of their members on the advisory committee. When professional organizations know what is needed in the field, they are more likely to offer financial assistance.

Credit: Microsoft Office, Clip Art

Section G: Recruitment and Retention

1. Effective recruitment and retention begins with the program management plan. Plan to succeed or the only option left is failure.
2. Universal acceptance of students from a variety of backgrounds and experiences maximizes recruitment and produces the best retention rates when:
   - combined with personalized instruction, and
   - supported with individualized student services in a fully equipped facility.
3. Provide outreach to the entire population (all ages) through as many venues as possible. Spread the word that you provide a quality education.
4. Form alliances. Partner with other schools and industries to strengthen:
   - recruitment marketing potential,
   - program motivation, and
   - long-term retention rates.
5. Keep staff and students up-to-date on the latest developments in their respective fields, including new technologies.
6. Track baseline and achievement data every year to measure the success of the plan and make informed changes when necessary.

Case Study of
Tohono O'odham Community College,
Sells, AZ

The Tohono O'odham Agriculture and Natural Resources (TOANR) program is a key offering at Tohono O'odham Community College (TOCC). The Nation used to consist entirely of farmers and ranchers; the study of science enables students to reconnect with who they are. TOANR produces flyers and posters, which they distribute throughout the larger community. They sponsor the Junior Rodeo Series, the Tohono Land Connections program (a two-week residential program for youth ages 14-17), attend district meetings, present at the high schools, participate in advisory committee meetings, and offer student scholarships.

Summer bridge programs provide developmental skills in math, reading, physics, study, and computer skills. They prepare high school students for entry into the community college. Radio stations run ads, but community events provide the best venue for spreading the word. TOCC sponsors lunch-time promotions with Student Services, job fairs, round tables, community nights, student scholarships, and the Nation's rodeo. Barbeques and a recent corn roasting exhibition have successfully demonstrated to the community the value of college through the connection between science and culture. Scientific experiments and activities are conducted on site and involve public participation. They motivate community members to find out more about science and how it relates to their personal lives and the future of the Nation. Word of mouth has been the most effective method of recruitment.

Credit: Tohono O'odham Community College, Annual Report (2008)

Recruitment

The key to measuring success in recruitment strategies is to gather data. Include not only enrollment data, but also how the student learned about the college and environmental or energy science program, and what convinced them to enroll. Collect data on why students chose other institutions and compare. Something as simple as judging projects at the annual middle school science fair may be all it takes to turn a program around.

Consider comparing data such as:

- Tuition rates and average income rates;
- Primary and secondary languages spoken;
- Size of the recruitment area and public transportation issues;
- Types of media used and time on air or in print;
- Costs for production and distribution of recruitment materials and staff time;
- Number of elementary, middle, and secondary schools visited each year and time spent onsite with students and counselors;
- Number of Tribal and regional activities attended by recruitment personnel;
- Number of students who attend outreach activities and number of new students enrolled; and
- Web site visits and length of time on the site.

Watch recruitment pay off. Display a regional map with a pin for the home of each student in the program. Chart and graph data comparisons. Talk to people. Word-of-mouth (personal recommendation) is still the most effective method of recruitment. Keep your image positive.

Credit: Certificate, Microsoft Office, clip art; Meeting house, Salish Kootenai College, NSF Tribal Fellows Institute (2010)

Retention

The ability to persuade students to try a two-year college is only part of the job of student services personnel. Best practices in student support services tend to include a number of common features; however, an institution-wide strategic retention plan is crucial.

According to the USA Group Noel-Levitz, Inc., – who has studied recruitment and retention for 37 years—the development of a successful retention plan requires six steps:

1. Set the stage by obtaining a three-year commitment from the board and administrators.
2. Establish retention priorities and formulate goals.
3. Integrate retention goals with existing programs and services.
4. Evaluate retention outcomes with data, exit interviews, and program reviews.
5. Prepare realistic retention timelines and action plans.
6. Recognize, reward, and celebrate student success.

Common components of a strategic retention plan include individualized academic advising, mentoring and tutoring, risk management counseling, internal and external community

networking, and job placement services. If your school does not have a retention plan, form a team or committee to study what works in your college with your students, and recommend initiatives. Invite all stakeholders (e.g., Tribal and public business and industry representatives from the region, board members, staff, instructors, and students) to participate in the decision to adopt a Student Success Plan (see example on page 66).

Strategic Retention Plan

It takes a solid plan to build a successful program. The purpose of providing student support services is to help students succeed in higher education. One of the many definitions of the word "retention" is the ability to remember or the capacity to retain something. When using the word "retention" in reference to higher education institutions, *retention is the ability to keep students "retained" or actively engaged in learning through completion of certificate or degree programs*.

Offer incremental incentives to stay in school, such as weekly or monthly financial aid payments rather than one check per semester, with an advance for books. Feature a student of the month in the local paper. Encourage students to apply to present at national conferences or participate in national competitions and attend with them. Find what works to motivate your students and make it happen.

The following factors have been found to significantly affect retention rates:

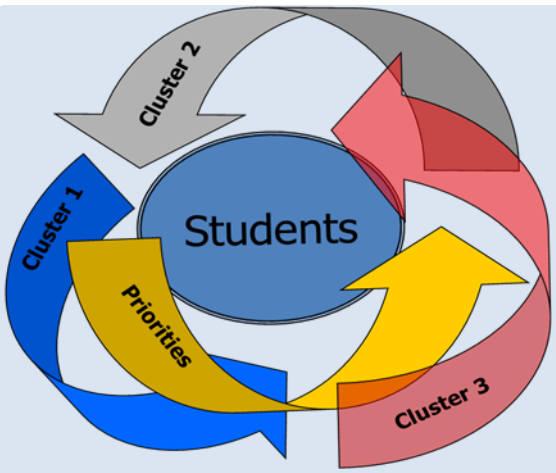
- **Preparation** (e.g., academic success in high school, standardized test scores, and socioeconomic status);
- **Environment** (e.g., housing, advising, orientation, extra-curricular activities, and support services); and
- **Academic Standards** (e.g., required courses, developmental progression through courses, grading practices, and instructor differences) (Gonzalez, 2005).

We know that student support services positively affect retention rates. Peer tutoring, developmental courses, workshops, and cultural events are services that prove most effective at addressing deficits in preparation, especially when a wide range of services are provided out of a single location. The level of student motivation affects the degree of success, and higher levels of student contact are most likely to enhance student motivation. (Muraskin, 1997)

Small two-year colleges face huge challenges in the struggle to keep students beyond the first one or two trial courses. Students attend courses for a number of reasons such as social expectations, personal ambitions, peer or parental pressure, career changes, certification issues, and so on. Students tend to span a wider range of age and economic groups than traditional four-year college students. Therefore, two-year institutions serve an extremely heterogeneous population. They are expected to provide a wide range of opportunities to a very diverse group of students. Offering multiple ways to bond within the college environment addresses motivation and identification issues.
Economic conditions tend to affect two-year colleges differently than other institutions of higher learning. During recessions, enrollment in two-year colleges increases. Students realize they require higher wages to meet their personal needs. Members of the workforce who are laid off or underemployed view college as an opportunity to switch careers or move up on the pay scale. Quick-fix curriculums, like technician certification programs, increase in popularity at a time when funds for technology supplies and equipment are low. Keeping academic standards high, while providing multiple venues for assistance, is the best way to retain students when things get tough.

Retaining students requires strategic planning and consistent implementation of a student retention plan. Successful student retention programs are highly structured, interlock with other programs and services, rely on extended and intensive student contact, place special emphasis on staff and faculty quality, and focus on attentive and cognitive needs while tracking and monitoring student satisfaction. (Sims, 2006)

Conduct an assessment of student needs. What would make learning easier for your students? Maybe they need onsite, drop-in child care services, smaller classes (more instructors), or free or discounted transportation services. Take inventory of resources that are rarely used and re-appropriate them to serve existing needs.



PRIORITIES for 2003-04

1. **Assessment**
2. **Communication**
3. **Diversity**
4. **Entrepreneurship**
5. **Expansion of Thematic Learning Communities**
6. **Graduate/Professional Students**
7. **Help Desk**
8. **Recruitment**
9. **Retention**
10. **Staff Development**
11. **Wellness**

Student Success Plan

CLUSTER 1

- **Counseling & Psychological Services**
- **Freshman-Sophomore Advising Center**
- **Hilltop Child Development Center**
- **KU Writing Center**
- **Services for Students with Disabilities**
- **Student Development Center**
- **Student Health Services**
- **University Career Center**

CLUSTER 2

- **Center for Campus Life**
- **Dean of Students Office**
- **Department of Student Housing**
- **KU Recreation Services**
- **Legal Services for Students**
- **Office of Multicultural Affairs**

CLUSTER 3

- **KU Memorial Unions**
- **New Student Orientation**
- **Office of Admissions & Scholarships**
- **Office of Student Financial Aid**
- **Office of the University Registrar**

Credit: University of Kansas strategic Student Success plan, Academic Technology Services, Office of the Vice Provost for Student Success, (McCluskey-Fawcett, K., 2004)

Individualized academic advising for each student is essential for maximum retention and ultimate student success.

Resources

To stay informed, subscribe to Really Simple Syndication (RSS) feeds through informational Web sites like Twitter ( ). We recommend the *Journal of STEM Education* (JSTEM) for the latest environmental and energy technology education news and research.

Teaching and Learning

U.S. Department of Labor, Workforce One: Communities, *Green Jobs*. "Education & Training Programs." http://greenjobs.workforce3one.org/page/resources/1000916955604530872.

U.S. Department of Energy, Energy Efficiency and Renewable Energy, *Solar Energy Technologies Program*, Program Areas, "Solar Instructors Training Network ." http://www1.eere.energy.gov/solar/instructor_training_network.html

Model Programs

Degree, Certificate, and Workforce Development Training Programs in the United States. http://www.ateec.org/programs-database/about

Bring Energy to Your Campus: Start an Energy Services and Technology Program at Your College http://ateec.org/ateec-downloads/bring-energy-to-your-campus

Case Studies

ATEEC and the Partnership for Environmental Technology Education (PETE) with support from the National Science Foundation (NSF) provide technical assistance to Tribal Colleges across the country. Tribal Technical Assistance reports are available at: http://ateec.org/ateec-downloads

Leech Lake Tribal College

Leech Lake Tribal College (LLTC) program assessment was conducted and published online in 2009 at http://ateec.org/images/cprojects/tribalcolleges/reports/lltc_workshop_report.pdf.

Below is a brief summary of the results.

- *Many students have a limited awareness of the workforce, jobs, and the business world.*
- *STEM awareness efforts are limited to experimental programs, and career and science fairs offered by area high schools.*
- *Twenty percent of college students enter college with a GED rather than a high school diploma.*
- *Many students have not taken a science class since 7th or 8th grade.*
- *Many students have not taken algebra.*
- *Many have not attended school for several years.*
- *Testing reveals that 85 percent of students do not have college level STEM skills.*

In response to gaps in STEM skills, LLTC plans to:

- *Evaluate STEM course offerings.*
- *Refine career and life skills programs.*
- *Examine the articulation process with area high schools.*
- *Review articulation agreements with four-year colleges.*
- *Document student matriculation and job success rates.*
- *Consider providing internships, STEM clubs, and physics requirements.*
- *Emphasize the importance of library and computer skills.*
- *Expand career planning and job placement services.*

Materials

ATEEC offers environmental and energy print and multimedia resources in the products section of the ATEEC Web site. Users can register to download items free of charge or pay five dollars for a hard copy. Many publications are also available on CD-ROM. Among the many excellent materials are those featured here. All are available at http://ateec.org/ateec-downloads/latest.

Print

Best Practices: A Guidebook for Environmental Technology Credit Programs

In 2000 ATEEC wrote *Best Practices: A Guidebook for Environmental Technology Credit Programs*. This publication provides the reader with best practice strategies in administration, curriculum and instruction, student support, alliances, professional development, learning resources, facilities and equipment, and program assessment. (It was updated in 2011 as *Best Practices in Environmental and Energy Technology Education: A Guide for Improving Programs.*)

Best Practices for Job Training Programs

The EPA's Brownfields Economic Redevelopment Initiative is intended to empower economic redevelopment stakeholders to prevent, assess, safely clean up, and sustainably reuse brownfields areas. The *Best Practices for Job Training Programs in Brownfields Redevelopment Initiatives* report provides past, present, and future brownfields project stakeholders with a blueprint of strategies for successfully administering brownfields initiatives.

Bring Energy to Your Campus!

In 2002 PETE and ATEEC created *Bring Energy to Your Campus: Start an Energy Services and Technology Program at Your College.* This publication provides a model curriculum and program planning guide based on best practices identified by experienced energy services practitioners and educators. The model curriculum and program planning guide may be used to establish two-year associate degree and one-year certificate programs in community, technical, and junior colleges.

Critical Issues in Environmental Technology

The report, *Critical Issues in Environmental Technology: Creating Dynamic Links between Research, Education, and Business and Industry* is the result of a forum sponsored by ATEEC and the Massachusetts Institute of Technology Laboratory for Energy and the Environment to outline current trends and barriers in the environmental technology field.

Defining Environmental Technology
The *Defining Environmental Technology* report validates and updates occupational information with input from educators, technicians, researchers, and business and industry. It defines the environmental technology field and identifies occupational categories and job functions.

Defining Energy Technologies and Services
The *Defining Energy Technologies and Services* report validates and updates occupational information with input from educators, technicians, researchers, and business and industry. It defines the energy technologies and services field and identifies occupational categories and job functions.

Multimedia

Best Practices – A Guidebook for Environmental Technology Credit Programs
Best Practices: A Guidebook for Environmental Technology Credit Programs was developed by successful environmental technology educators and includes the curriculum development experience of the ATEEC instructional design group. [Updated 2011 as *Best Practices in Environmental and Energy Technology Education*.)

Essential Web Sites

Advanced Technology Environmental and Energy Center

The Advanced Technology Environmental and Energy Center (ATEEC) is a national center that promotes and supports environmental and energy technology education to address the needs of the national and global workforce. http://www.ateec.org/

Electronic Environmental Resources Library

eERL, ATEEC's Resource Library, is a multi-faceted clearing house of valuable electronic resources. This digital library collects STEM (Science, Technology, Engineering, and Math) resources. These resources are tied to environmental science, technology resource information (from classroom-ready materials), regulatory information, and global environmental issues. http://www.eerl.org/index.php

Brownfields Toolbox

The online *Brownfields Toolbox* provides communities and stakeholders with information and tools to assist them in the development, enhancement, and maintenance of environmental education, training, and job development programs. http://www.brownfields-toolbox.org/

National Partnership for Environmental Technology Education (PETE)

PETE provides leadership in environmental education and training through community and technical college (two-year college) partnerships with business, industry, government, and other educational providers. http://nationalpete.org/

Tribal Grant Guidance

The National Partnership for Environmental Technology Education (PETE), with the U.S. Environmental Protection Agency (EPA), developed a nationwide Tribal training program for the Office of Grants and

Debarment (OGD) and the Office of Small Business Programs (OSBP). National PETE provides instruction and technical assistance through interactive training workshops, Webinars, and an asynchronous Web course. http://petetribal.org/

Contacts

Environmental and Energy Programs (U.S.)

One of ATEEC's goals is to identify and maintain an updated, online listing of environmental and energy technology programs in the nation's two-year colleges. This list will eventually tie to four-year institutions through the National Council for Science and the Environment's programs database. An interactive map enables users to locate environmental and energy technology programs across the country. http://ateec.org/programs-database/about

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Acronyms

ACGIH	American Conference of Government Industrial Hygienists
ACS	American Chemical Society
ACT	American College Testing
AISES	American Indian Science and Engineering Society
ANSI	American National Standards Institute
ASES	American Solar Energy Society
ASHRAE	American Society Heating, Refrigerating, and Air-Conditioning Engineers, Inc.
ASPRS	American Society for Photogrammetry and Remote Sensing
ATE	Advanced Technological Education
ATEEC	Advanced Technology Environmental and Energy Center
AWEA	American Wind Energy Association
CLEAPSS	Consortium of Local Education Authorities for the Provision of Science Services
CPST	Commission on Professionals in Science and Technology
CTL	Contextual Teaching and Learning
DACUM	Developing a Curriculum
DOD	Department of Defense
DOE	Department of Energy
DOL	Department of Labor
DOT	Department of Transportation
EPA	Environmental Protection Agency
ETA	Employment and Training Administration (U.S. Department of Labor)
HSET	Health, Safety, and Environmental Technology
IEEE	Institute of Electrical and Electronics Engineers
LDA	Learning Disabilities Association of America
LFEE	Laboratory for Energy and the Environment
LLTC	Leech Lake Tribal College
LMA	Labor Market Assessment
LPTC	Little Priest Tribal College
MAPP	Motivational Appraisal of Personal Potential Assessment
MSDS	Material Safety Data Sheet
MSP	Math and Science Partnership Program
NAAEE	North American Association for Environmental Education
NACA	National Association for Campus Activities
NAEP	National Association of Environmental Professionals
NAHB	National Association of Home Builders
NASP	National Association of Safety Professionals
NCSE	National Council for Science and the Environment
NESEA	Northeast Sustainable Energy Association
NFPA	National Fire Protection Association
NSF	National Science Foundation
NWF	National Wildlife Federation
OSHA	Occupational Safety and Health Administration
PETE	Partnership for Environmental Technology Education
PPE	Personal Protective Equipment
SAF	Society of American Foresters
SEEDS	Sustainable Energy for Economic Development (Northwest)
SMP	Science Masters Program
STEM	Science, Technology, Engineering, and Mathematics
UL	Underwriters Laboratory for Electrical Equipment Standards
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USGBC	U.S. Green Building Council

Sustainability consists of social and environmental practices that protect and enhance the human and natural resources needed by future generations to enjoy a quality of life equal to or greater than our own. (U.S. Environmental Protection Agency, 2010)

Viable and equitable sustainable behaviors require responsible social, environmental, and economical practices. Thank you for leading the way to a future where sustainability *is* the bottom line.